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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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JULY/AUGUST 1995
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- 2 Editorial
Wrong-Sizing Technology-Based Companies
Ken Werner
- 4 The Display Continuum
The Wonderful World of Color . . .
Aris Silzars
- 10 Projecting with LCDs
LCD panels and projectors account for a modest but rapidly growing number of liquid-crystal displays.
William L. Cogshall
- 14 Touch Technology Grows Up
The need for simpler human interfaces to ever more complicated technological systems is making touch a growth industry.
Wayne Wehrer
- 20 CeBIT '95
Under sunny skies, the last seven-day-long CeBIT drew record crowds, while monitor manufacturers muttered darkly of tube shortages.
Bryan Norris
- 28 Industry Directory
ID's ninth annual directory of the display industry.
Editorial Staff
- 61 New Products
- 73 Calendar
- 76 SID News
- 84 Index to Advertisers



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. Cogshall

ALTHOUGH 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 1280×1024 images. Actually, there are only 1024×768 pixels. It "compresses" 1280×1024 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.

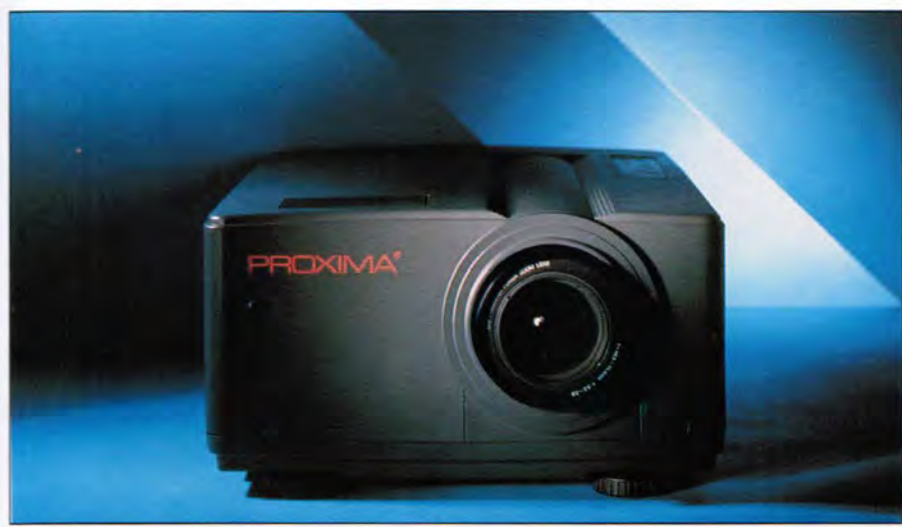
Projector Forecasts

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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Touch Technology Grows Up

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

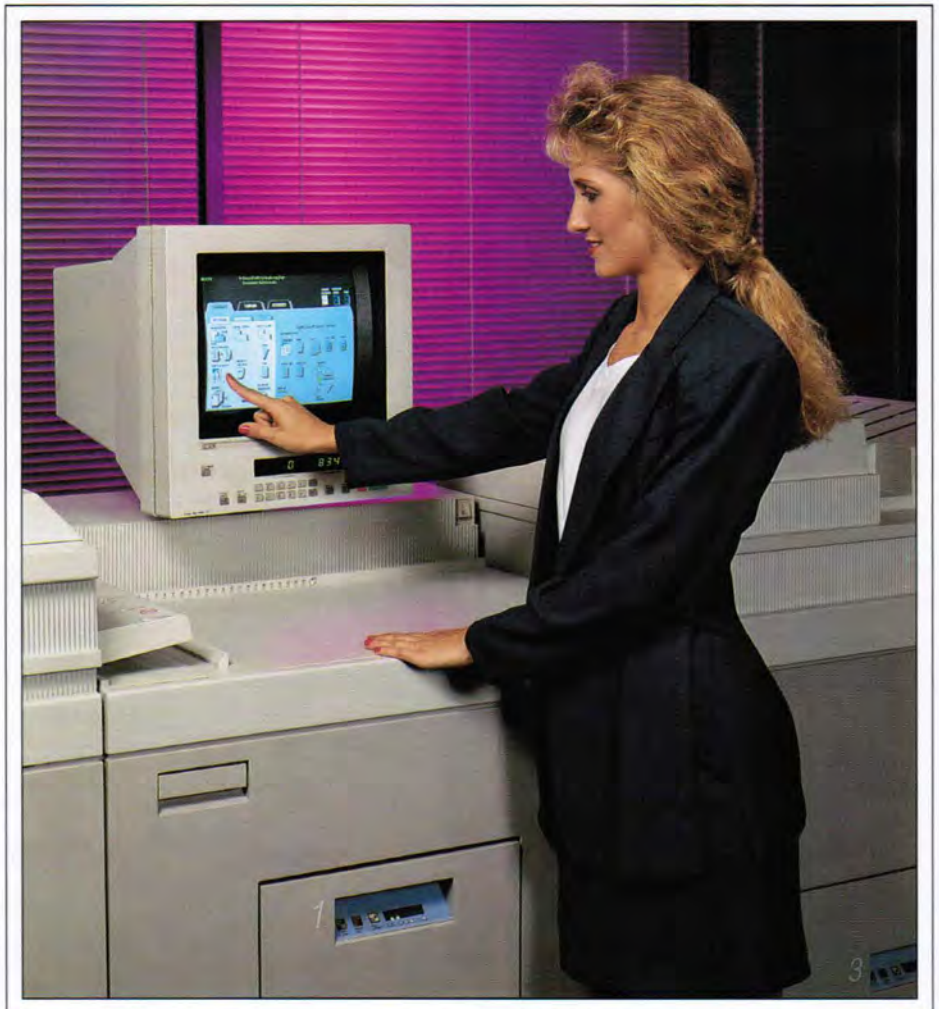
by Wayne Wehrer

TOUCH 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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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.

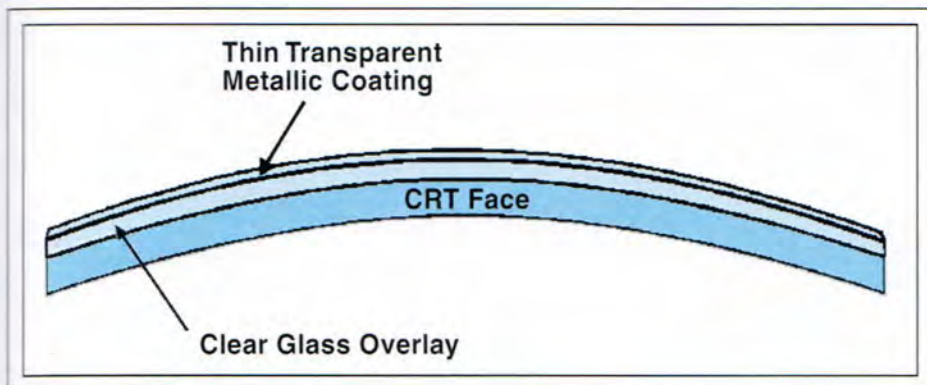


Fig. 2: Capacitive-overlay touch screens have a glass overlay with a thin metallic coating on the surface of the display. Touching the surface with a conductive stylus produces a capacitive coupling with the voltage field that draws a minute amount of current to the point of contact.

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 menus 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

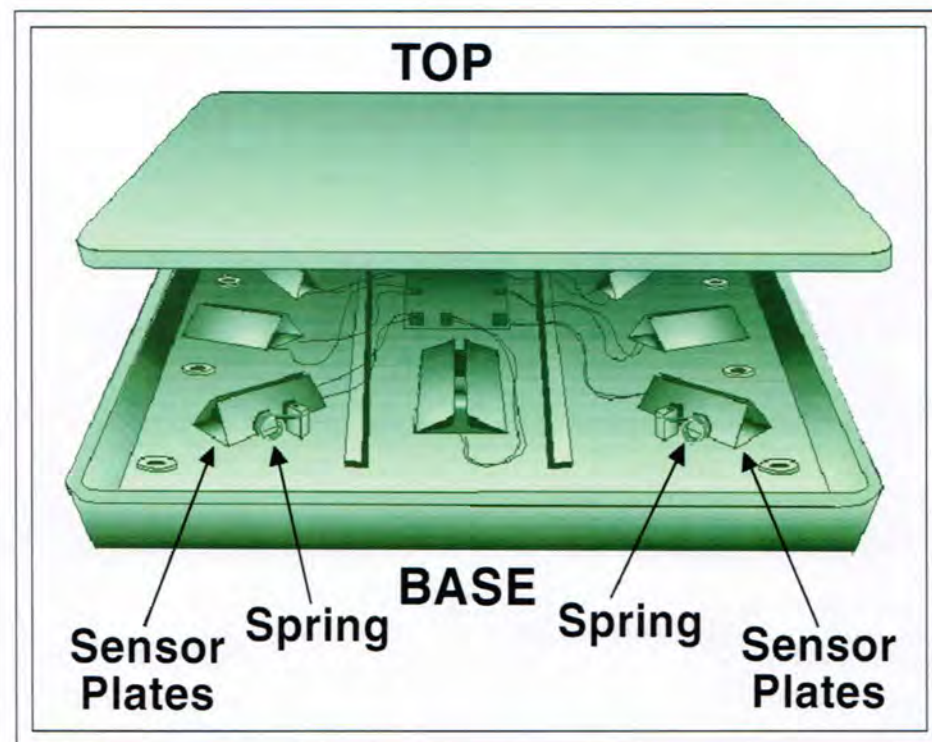


Fig. 3: With force-vector touch technology, the monitor is placed on a top plate that rests on springs. The springs, in turn, sit on a base. Capacitive sensors measure the distance between the top plate and the base. When the display is touched, the force displaces and rotates the top plate slightly,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

data input

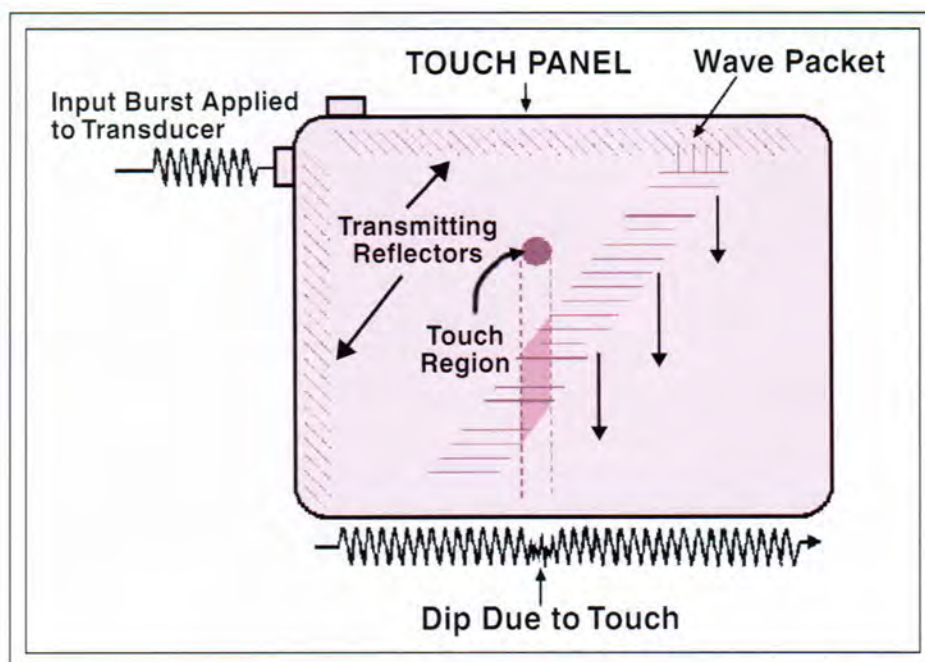


Fig. 4: In guided-acoustic-wave technology, a transducer mounted on the edge of the glass emits an acoustic wave, which travels through the overlay and is reflected across the overlay by an array of reflectors. When a finger contacts the overlay, it absorbs part of the wave.

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.

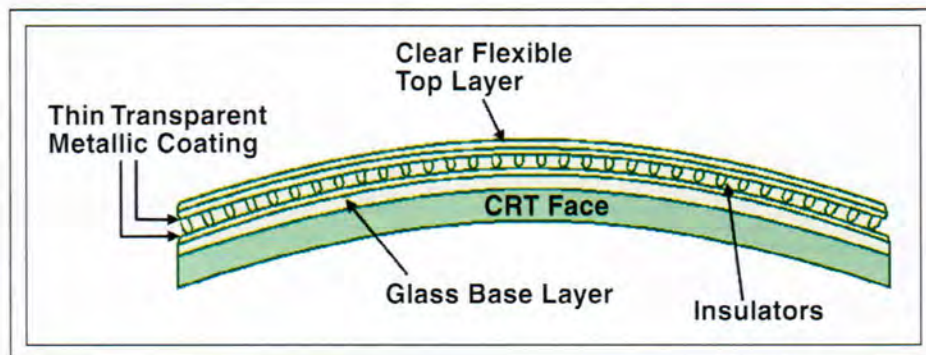


Fig. 5: Resistive-overlay technology involves a glass overlay with a thin metallic coating, over which a layer of polyester is placed. The polyester layer has a similar metallic coating on its interior surface, and tiny spacer dots of non-coated polyester prevent the two surfaces from contacting each 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.

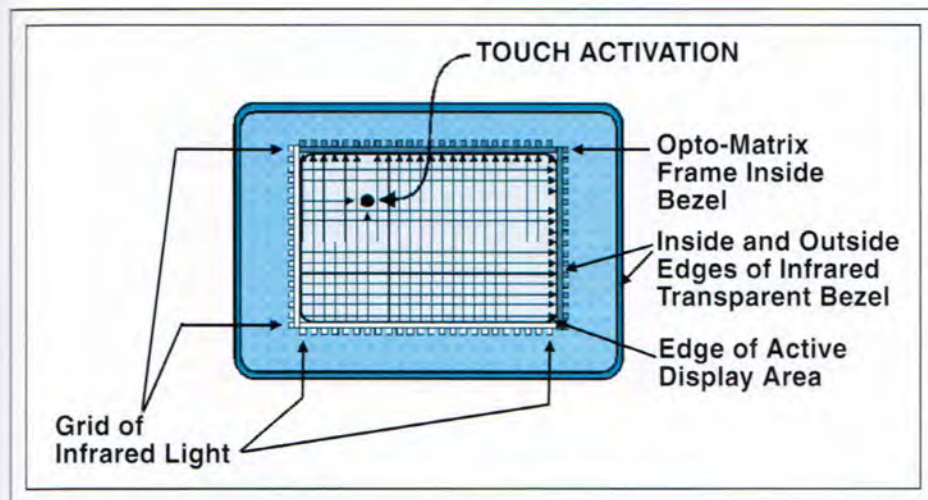


Fig. 6: Scanning-infrared technology relies on the interruption of infrared light beams in front of the display screen. The touch frame contains a row of LEDs and phototransistors mounted on opposite sides to create a grid of invisible infrared light beams. When a stylus enters the grid and breaks one 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 4096×4096 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 4096×4096 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

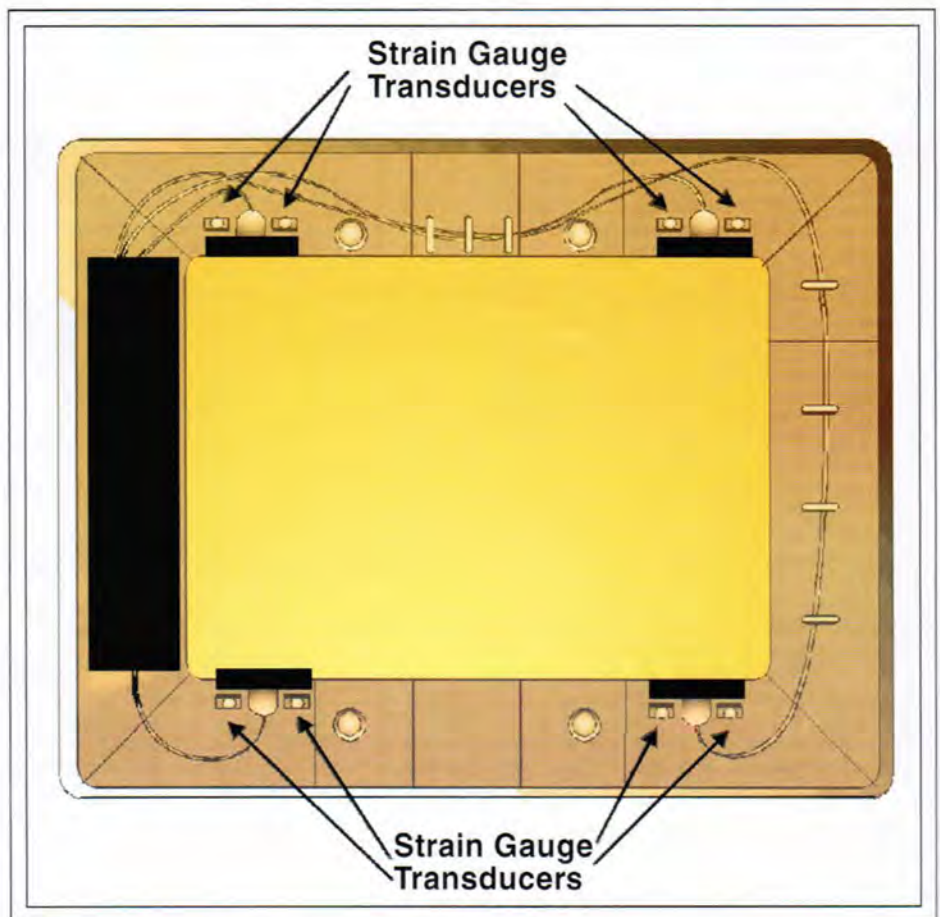


Fig. 7: A strain-gauge touch system consists of a CRT mounting shield, a clear glass overlay, and four strain-gauge transducers mounted at the corners of the overlay. Touching the overlay produces different strains at each transducer. A comparison of these strains can determine the touch location.

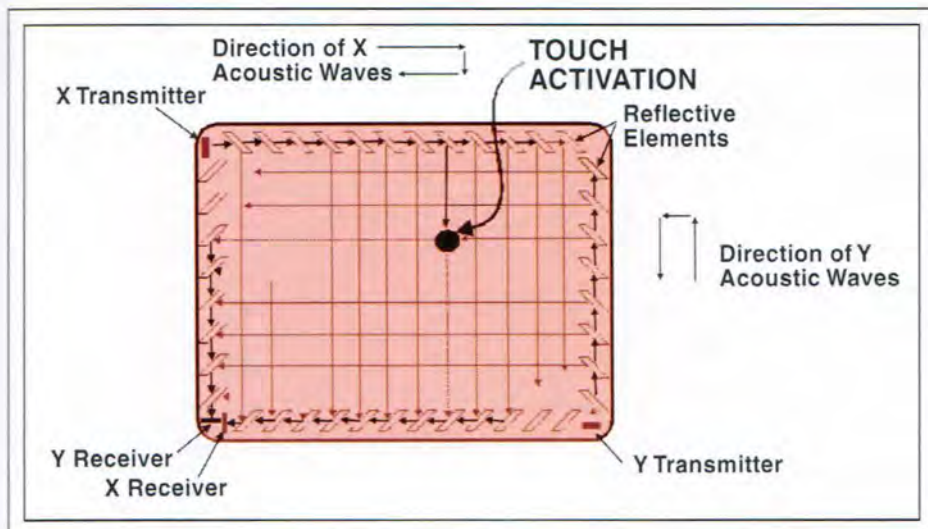


Fig. 8: In a surface-acoustic-wave touch system, a transducer mounted on an acrylic wedge attached near the edge of a glass overlay emits an acoustic wave that travels across the overlay surface and is reflected across the overlay by an array of reflectors. When a soft stylus contacts the wave, it absorbs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

LIKE 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 m² (306,557 m² 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

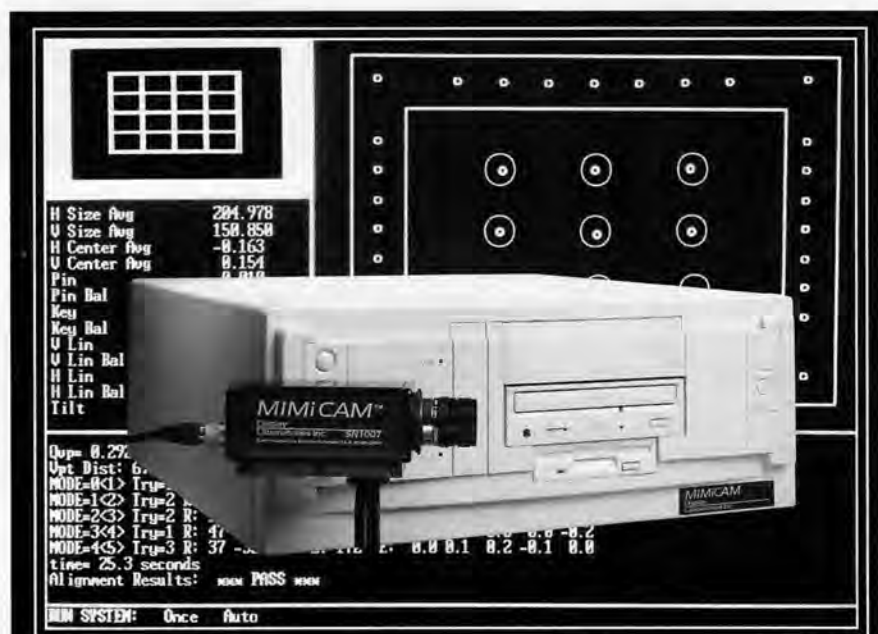
A visit to TCO's booth in Hall 7 made it obvious that the organization has worked hard over the last few months to produce copies of the TCO '95 document and specifications, which were available to all interested parties. The document defines the criteria a product must meet to qualify for a TCO '95 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 DEKIZT (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



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"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/Staticide □ Donteck □ 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 Engrg.
□ Display Systems □ Durel □ Earth
Computer □ Elform □ ELtech □
Eurecran □ Flat Candle □ Flat Panel
Display □ Futaba America □ General
Electric □ Hamlin LCD □ Hewlett-Packard
□ Hitachi America □ Hoffman Engrg. □
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 □ Pacifico
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 Teknologies □ 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 Engrg. □ 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 Engrg. □ 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 □ CSERAC □ Display
Engrg. □ 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. □ Kamstra Communications □
Kenix Industries □ Bernard J. Lechner □
Lighting Sciences □ Machine Vision and
Control Intl. □ MIRC □ Monterey
Technologies □ Mushfield □ 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 □ Stereomedia □
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 Engrg. □ 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 □ Zytronic

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 □ Manirion Displays □
MicroTouch Systems □ Milgray Electronics
□ Mitsubishi Electronics America □
Monitron □ MTL Systems □ Nippon
Electric Glass □ Opto-Cal □ Orwin □
Panasonic Industrial □ Pegasis □ 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 Tak □ 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 □ Monitron □ 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 □ Monitron □ 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 □ Monitron □ 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 □ Metheus □ MicroTouch Systems □ Milgray Electronics □ Monitron □ 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 □ LCSP-Deeco □ Milgray Electronics □ Plessey Naval Systems □ Racal 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 □ Eurescan □ 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 Engrg. □ 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 □ Donteck □ E for M □ Flex Products □ Fosta-Tek □ Ginsbury □ Glaverbel □ Hoffman Engrg. □ 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 Engrg. □ 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 □ Liton Electron Devices □ Philips Components □ Sony Display Device Group □ Teltron 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 & Commun. □ Capetronic □ Comfuture □ Convac-APT □ Cornerstone Technology □ Craft Data Ltd. □ Crystop Display □ Davies □ Densitron □ Digitran □ Display Tech □ EDL Displays □ EEV Ltd. □ Electronic Image Systems □ Eurescan □ 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 □ Infocorp Corp. □ Intecolor □ Iristal □ Micron □

MicroTouch Systems □ Milgray Electronics
 □ Mito Fine Glass □ **Mitsubishi Electric Sales America** □ **Mitsubishi Electronics America** □ Monitorm □ Norsk LCD □ nView □ Omega Electronics □ Optical Radiation □ Optical Solutions □ **Panelight** □ Planar Advance □ Plasmarc □ 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 □ Tatum □ 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

□ Acculex □ 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 □ Infolex Corp. □ Interface Products □ ISCAN □ JKL Components □ Litton Systems Canada □ Mark IV Industries □ MicroTouch Systems □ Milgray Electronics □ Modutech □ 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

□ Acculex □ ASM America □ Astronautics □ Robert Busch □ 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 □ Modutech □ 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. □ Eucran □ GEC Hirst Research Centre □ Ginsbury □ BF Goodrich □ Horrell Elektropolik □ 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 Busch □ Casio LCD □ Craft Data, Inc. □ Craft Data Ltd. □ CRT Intl. □ Crystaloid Electronics □ Crystop Display □ CTX □ Dale Electronics □ Davies □ Densitron □ Dycrystal Images □ Digitran □ Display Systems □ **Earth Computer** □ Eaton □ EEV Ltd. □ EM Microelectronic □ Eucran □ Excel Technology □ GEC Hirst Research Centre □ General Electric □ Ginsbury □ Hamlin LCD □ Hantronix □ Hitachi America □ Horrell Elektropolik □ **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 □ Rascal 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 □ Transicoll □ 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 □ Dotech □ 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 □ Mushfield □ Raytheon □ Romag Glass □ Siemens Components □ Vacuumschmelze □ Viratec

MANUFACTURING EQUIPMENT

□ Accudyne □ Advanced Display □ ASM America □ **autronic** □ Aydin Computer/Monitor □ AZ LCD □ Best Power Technology □ Bilco Mfg. □ Brewer Science □ Brooks Automation □ CFM Technologies □ Convac-APT □ CRT Intl. □ Donnelly Applied Films □ Eaton IDT □ Fairchild Convac □ **Florod** □ Glen Technologies □ Holtronic □ Horrell 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 Helt & 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 □ Eucran □ Hoya Electronics □ Balzers □ Holtronic □ Microphase Labs □ MRS Technology □ Pacific Technologies □ PPM Photomask □ Terapixel □ U.S. Precision Glass

MATERIALS

electrochromic displays

□ Brewer Science □ Courtauld's □ 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's □ 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-Allen □ 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 □ Plasmatronics □ 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 □ Infolex Corp. □ **Physical Optics** □ Plasmarc □ Plasmatronics □ Quantum Electronics □ Stanley Electric □ Target Materials □ Teledyne Electronic Technologies □ Vacuum Engineering □ James Wilson

light pens/pointing systems

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

liquid-crystal displays

□ Advanced Display □ ALCOM □ AlliedSignal □ Arconium-Plasmarc □ AZ LCD □ BDH □ Brewer Science □ Courtauld's □ 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 □ **Korrey Electronics** □ Mark IV Industries □ Merck □ Nagase California □ National Research Resources □ Nippon Electric Glass □ Optotek □ Optrex/Satori □ Pacific Technologies □ **Physical Optics** □ Planar Advance □ Plasmarc □ Plasmatronics □ 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

□ Courtauld

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 □ Courtauld □ Denglas □ Denton Vacuum □ Diagnostic/Retrieval Systems □ Donnelly Applied Films □ Donteck □ E for M □ Exxene □ Flex Products □ Fosta-Tek □ Ginsbury □ Hoffman Engr. □ Homalite □ Hoya Electronics □ Hoya Optics □ IBM Canada □ Kollmorgen □ Kurdex □ Liberty Mirror □ LMT □ Merck □ Melovac □ 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 □ Unigrat □ Veeco/Sloan Technology □ Video Instruments

PHOSPHORS

□ CRT Intl. □ EEV Ltd. □ General Atronic □ 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 Engr. 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 □ Discorn □ Display Components □ EEV Ltd. □ Eldec □ Endicott □ John Fluke Mfg. □ Ginsbury □ HC Power □ Honeywell □ ILC Technology □ Innotec □ K and M Electronics □ K & R Engr. □ 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 □ QMS □ Raytheon □ Seiko Instruments □ Syntest □ Team Systems □ Toyo Spectrum □ Versatec □ Xerox Engr. 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 □ Eurescan □ 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 □ Paneflight □ Polytronix □ PPM Photomask □ Proxima □ Regisbrook □ Retroscon □ 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 Atronic □ 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 □ Techniglas □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electroniques □ Video Display □ Vidiwall □ 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 Technologies □ SEOS Displays □ Summagraphics □ Telesensory □ Versatec

SCANNERS, DOCUMENT (TEXT)

Eastman Kodak □ Gordon Instruments □ IBM □ **Mitsubishi Electronics America** □ Pentax Technologies □ 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 □ Ralac 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 & Commun. □ 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 □ **Florod** □ John Fluke Mfg. □ GenRad □ Hoffman Engr. □ Hughes Aircraft □ Kenix Industries □ **Image Processing Systems** □ Inter-Logic □ KLA Acrotec □ KLA Instruments □ Kontop 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 Optonics** □ **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

Inspec, 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 Optonics** □ 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 Optonics** □ 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 □ Courtaulds □ Donteck □ Dynapro □ E for M □ Innatec □ **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 □ Innatec □ Kontop 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

AMUNEL 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 ± 0.00002 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 02908

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-Measuring 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.
David Smith, V.P. Sls.
215/542-7800 Toll Free: 1-800/366-8889
Fax: 215/542-8447

AZ LCD, Inc., 7411 W. Boston St., Ste. 1,
Chandler, AZ 85226

Equipment suppliers with in-depth knowledge of LCD technologies. Consulting, program management, and facilities set-up services available. Suppliers of custom and refurbished equipment for the FPD industry. Design and prototyping services for display and drive electronics also available.
Dr. Wing Li, Pres.
602/940-8598 Fax: 602/345-9338

BABCOCK DISPLAY PRODUCTS, INC.,
14930 E. Alondra Blvd., La Mirada, CA 90638-5752

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.
Carl Doria, Natl. Sls. Mgr.
714/994-6500 Fax: 714/994-3013

DAVID BALDAUF, 15 S. Hinterland Dr.,
Rhinebeck, NY 12572

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.
David Baldauf
914/876-2153

BALL AEROSPACE & COMMUNICATIONS
GROUP, 9675 W. 108th Circle, Broomfield,
CO 80021

Manufacturers of militarized CRT displays, ruggedized and militarized CCDs, and intensified CCD cameras.
Robert M. Baker, Mktg. Mgr.
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-

reflection and contrast-enhancement coatings.

Philip Krueger
510/651-1232 Fax: 510/651-1669

BALZERS, 8 Sagamore Park Rd.
Hudson, NH 03051

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.
Todd Plaisted, Sls. Engr.
603/889-6888, Fax: 603/889-8573

BANGS LABORATORIES, INC., 979
Keystone Way, Carmel, IN 46032

Distributors of microparticles of different sizes, colors, and surface chemistries. Now providing polymeric and silica microspheres for use as spacers in FPDs.
Thomas Petro, Sls. Mgr.
317/844-7176 Fax: 317/575-8801

BARCO CHROMATICS, Inc., 2558
Mountain Industrial Blvd., Tucker, GA 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. Sevenlaan 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.
Guy Putman, Prod. Mgr.
32-56-233-282 Fax: 32-56-233-462

BARCO nv, PROJECTION SYSTEMS,
Noordlaan 5, B-8520 Kuurne, Belgium

Designers/manufacturers of front and rear projectors for video, data, graphics, and HDTV projection. LCD light-valve projector using three active-matrix LCD panels (5.8-in. diagonal) and offering an overall resolution of more than 1.2 million pixels with an equivalent CRT peak white of over 5000 lumens.
Sjoerd De Clerck, Mktg. Mgr.
32-56-368-378 Fax: 32-56-368-354

BARCO nv, VIDEO & COMMUNICATIONS,
Th. Sevenlaan 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.
32-56-233-242 Fax: 32-56-233-374

BATRON GmbH, Landsberger Str. 320,
Munich, 8000, Germany

Large-character alphanumeric and graphic LCD modules in STN technology with extended temperature range. Control boards for graphic LCD modules.
Axel Schaefer
89-560-17-292 Fax: 89-560-17-295

BDH, LTD., Advanced Materials Div.,
Broom Rd., Poole, Dorset, U.K. BH12 4NN

Manufacturers of LCDs for electro-optic displays; thermochromic LCDs; single crystals for UV and IR optics; scintillators; fluoride glass components for fiber optics; precursors for high T_c superconductors.
M.G. Pellatt, Bus. Mgr., Adv. Mat. Div.
44-202-745-520 Fax: 44-202-738-299

LEO BEISER, INC., 151-77 28 Ave.,
Flushing, NY 11354-1548

Consultancy specializing in design of image and data laser scanning and recording subsystems. Advancing speeds and resolutions for printing, graphic arts, quality and defect inspection, microscopy, triangulation, and display. Expert witness and litigation research and guidance.
Leo Beiser, Pres.
718/353-7298 Fax: 718/353-7098

BEST POWER TECHNOLOGY, INC.,
P.O. Box 280, Necadah, WI 54646

Manufacturers of uninterruptible power supplies ranging from 500 VA to 18 kVA. Trade names are FERRUPS and MICRO-FERRUPS. Protects sensitive electronic equipment from power problems.
Don Soe
608/565-7200 Toll Free: 1-800/356-5794
Fax: 608/565-2221

Beta Products, Inc., P.O. Box 38, Millwood,
VA 22646

Consultant and manufacturer's representative for flat-panel color displays and monitors.
Norman M. Fine, Pres.
703/837-1436 Fax: 703/837-3063

BILLCO MANUFACTURING,
100 Grandview Blvd., Zellenople, PA 16063

Manufacturers of glass cleaning equipment for critically clean applications. Machines may be chosen from a standard line or engineered for specific requirements.
Bob Long, Sls. Mgr.
412/452-7390 Fax: 412/452-0217

BKL, INC., 421 Feheley Dr., King of
Prussia, PA 19406

Manufacturers of EL panels for use in LCDs, membrane switches, and other display devices. KARD-O-Lite, a patented EL material, is thin, flexible, energy efficient, moisture-resistant, and inexpensive.
Douglas Breskin, Tech. Sls.
215/277-2910 Fax: 215/277-2956

BORER CHEMIE AG, Gewerbestrasse 13,
Zuchwil, Solothurn, CH-4528, Switzerland

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

CAMBRIDGE RESEARCH SYSTEMS, LTD., 80 Riverside Estate, Sir Thomas Longley Rd., Rochester, Kent, U.K. ME2 4BH

Manufacturers of graphics systems for vision research, Precision color control (36 bit), photometric linearization, optional 36-MB framestore, and 42-bit grating generator. Configurable for many displays.

Custom-software library for C, PASCAL, and BASIC. Carol Luscombe, Mktg. Mgr. 44-1634-720-707 Fax: 44-1634-720-719

CANADIAN MARCONI, Avionics Div., 415 Leggett Dr., P.O. Box 13330, Kanata, Ontario, Canada K2K 2B2

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

CAPETRONIC COMPUTER USA, 140 Knowles Dr., Los Gatos, CA 95030

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

CARDION ELECTRONICS, Long Island Expwy., Woodbury, NY 11797

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

CARROLL CONSULTING CO., 20930 Panorama Dr., Los Gatos, CA 95030

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

CARROLL TOUCH, INC., 811 Paloma Dr., Box 1309, Round Rock, TX 78664

Designers, developers, and manufacturers of scanning infrared touch systems for monitors, terminals, and FPDs; industrial terminals and single-board computers; and

touch systems based on the newest touch technology, guided acoustic wave. 512/244-3500 Toll Free: 1-800/386-8241 Fax: 512/244-7040

CASIO LCD SALES, Div. of Kanematsu USA, Inc., 543 W. Algonquin Rd., Arlington Hts., IL 60005

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

CATON CONNECTOR CORP., 20 Wapping Rd., Kingston, MA 02364

Manufacturers of high-voltage (1-60 kV) connectors and cable assemblies. Single- and multi-conductor configurations. Standard and custom designs. Silicone wire up to 100 kVdc. Daniel Galambos, Pres. 617/585-4315 Toll Free: 1-800/221-8438 Fax: 617/585-2973

CELCO, 70 Constantine Dr., Mahwah, NJ 07430

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

CFM TECHNOLOGIES, INC., 1381 Enterprise Dr., West Chester, PA 19380

Manufacturers of the Vapor-Flow™ FPD wet-processing system, consisting of a processing station and IPA drying system. This equipment performs cleaning, etching, and stripping processes in a single chamber for plates up to 360 x 500 mm. Alan Walter, V.P. 610/696-8300 Fax: 610/696-8309

CHERRY ELECTRICAL PRODUCTS, 3600 Sunset Ave., Waukegan, IL 60087

Manufacturers of segmented bargraphs and dot-matrix dc plasma displays and display systems. PLASMA DOT™ 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

CHIPS & TECHNOLOGIES, INC., 2950 Zanker Rd., San Jose, CA 95134

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

CID Technologies, Inc., 101 Commerce Blvd., Liverpool, NY 13088

Manufacturers/marketers of a full line of high-resolution solid-state monochrome video cameras incorporating patented charge injection device (CID) sensors. In-house design and fabrication of custom or application-specific sensors and cameras. Tony Chapman, Tech. Mktg. Mgr. 315/451-9410 Fax: 315/451-9421

CIRCON ACMI CORP., 460 Ward Dr., Santa Barbara, CA 93111

Manufacturers of the Endo Video-V™ CCD camera. Featuring over 400 lines of horizontal resolution, this camera is ideal for all endoscopy applications. David Calvin, Mktg. Mgr. 805/967-0404

CIRRUS LOGIC, INC., 1463 Centre Pointe Dr., Milpitas, CA 95035

Manufacturers of graphics controller semiconductors for CRT and LCD displays, providing full VGA (including mode 13), EGA, CGA, MDA and HGC computability. William Caparelli 408/945-8300 Fax: 408/263-5682

CITRONIX, INC., 5342 Halsted Ave., Carmichael, CA 95608

Manufacturers of CRT deflection amplifiers (magnetic) for calligraphic and linear HDTV raster applications. Integrated CRT test station and ruggedized color CRT monitors. Al Pletz, V.P. Sls. 916/489-9858 Fax: 916/481-3246

CLINTON ELECTRONICS CORP., CRT Div., 6701 Clinton Rd., Rockford, IL 61111

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

CLINTON ELECTRONICS CORP., Electron Gun Div., 6701 Clinton Rd., Rockford, IL 61111

Designers/manufacturers of monochrome display-grade electron guns in 20-, 29-, and 36-mm neck sizes. Custom gun assembly quoted on case-by-case basis. Ed Newkirk, Div. Mgr. 815/633-1444 Fax: 815/633-8712

CLINTON ELECTRONICS CORP., Monitor Div., 6701 Clinton Rd., Rockford, IL 61111

Designers/manufacturers of high-resolution monochrome displays with embedded microprocessor control. Multi-frequency range up to 1600 x 1280 on standard configurations. Contract manufacturing available for color and

monochrome displays with engineering support.

Ken Compton, Dir. Mktg.
815/633-1444 Fax: 815/633-9340

COLORADO VIDEO, INC., 6235 Lookout Rd., Ste. G, Boulder, CO 80301

Manufacturers of a line of specialized video instruments, including test and measurement, image analysis, unique frame stores, and slow-scan TV communications equipment.

Larry McClelland, Pres.
303/530-9580 Fax: 303/530-9569

COLOR TECHNOLOGY SOLUTIONS, 17890 N.W. Deercreek Ct., Portland, OR 97229-3060

Consulting services in color technology and applications for electronic imaging systems, color displays, television/video, multimedia, printing, instrumentation, and color-management systems. Technology/product evaluations, benchmarking, application of color standards, and color quality assurance.

Joann M. Taylor, Pres.
503/645-5129 Fax: 503/645-5129

COMFUTURE LTD., 7 Habonim St., Ramat Gan, Israel 25251

Manufacturers of alphanumeric or graphic displays and sunlight-visible color graphic displays, with animation of 24 frames/second. All products driven by PC compatibles.

Eilon Ginsburg, CEO
972-3-751-0940 Fax: 972-3-752-2935

COMPUTER DYNAMICS, 7640 Pelham Rd., Greenville, SC 29615

Manufacturers of a variety of FPD-based computer systems and operator interfaces. Display technologies include EL and monochrome and color LCDs. Touch screens and single-board computers are integrated with displays to create compact workstations.

Sue Priester, Mktg. Mgr.
803/627-8800 Fax: 803/675-0106

COMPUTER KEYBOARDS SYSTEMS, 1640 Fifth St., #224, Santa Monica, CA 90401

Manufacturers of standard and custom keyboards, with facilities to design and manufacture sealed and conventional keyboard systems. All CKS keyboards comply with FCC Class-B regulations.

Trevor Bray, Sls. Mgr.
310/395-4639 Fax: 310/393-6040

COMPUTER PERIPHERALS, INC., 667 Rancho Conejo Blvd., Newbury Park, CA 91320

Manufacturers of font cartridges and expandable memory for the HP LaserJet printer and enhancement board products for IBMs, PC/XT/AT/XT286/PS2, and true compatibles.

Susan Humpling, Mgr. Inside Sls.
805/499-5751 Toll Free: 1-800/854-7600
Fax: 805/498-8848

CONRAC DISPLAY PRODUCTS, INC., 1724 S. Mountain Ave., Duarte, CA 91010-2746

Manufacturers of color and monochrome monitors for computer graphics, process control, medical, broadcast, ruggedized products for hostile environments, simulator systems, and other custom applications. Monitor screen sizes range from 9 to 27 in.

Ali Hussein, Dir. Mktg. & Sls.
818/303-0095 Fax: 818/303-5484

CONSTELLATION, P.O. Box 117, West Olive, MI 49460

Consultancy specializing in the design, installation, and turn-on of high-volume LCD and FPD production lines, including TN, STN, active-matrix, and PBCT. Upgrading of existing production lines available. Specialist in ITO deposition.

Jerry Garies, Managing Dir.
616/786-9988 Fax: 616/786-9160

CONVAC-APT, 24 Third Ave., Burlington, MA 01803

Manufacturers of photolithographic process equipment for the automatic processing of large glass substrates 200 x 200 mm (8 x 8 in.) up to 400 x 400 mm (16 x 16 in.).

Mark Mason, Dir., Eastern Reg.
617/229-7772 Toll Free: 1-800/622-8060
Fax: 617/272-8079

CORECO, INC., 6969 Trans Canada Hwy., Ste. 113, St. Laurent, Quebec, Canada H4T 1V8

Designers/manufacturers of board level frame grabbers and digitizers compatible with the IBM PC bus taking any video input for vision-related applications, including machine vision, robotics, factory automation, scientific, medical, security and desktop publishing.

Patrick Urbain
514/333-1301 Toll Free: 1-800/361-4914
Fax: 514/333-1388

CORNERSTONE IMAGING, INC., 1990 Concourse Dr., San Jose, CA 95131

Designers/manufacturers of large-screen high-resolution (1600 x 1280) display controllers and subsystems for PC/AT and microchannel architecture, specifically for document image processing and publishing applications.

Ken Westrick, V.P. Sls.
408/435-8900 Fax: 408/435-8998

CORNING ASAHI VIDEO PRODUCTS, 2 East Denison Parkway, Corning, NY 14831

Manufacturers of a complete line of CRT panels, funnels, bulbs, and TV glass components.

Alan G. Herklotz,
607/974-7791 Fax: 607/974-7731

CORNING INCORPORATED, Advanced Display Products, MP VX-1-3, Corning, NY 14831

Manufacturers of 7059F and 1737F glass substrates for advanced technology flat-panel displays.

Ben J. Garbowski, Mgr./N.A. Sls.
607/974-4308 Fax: 607/974-7097

CORNING INCORPORATED, Corning Engineering, HP-ME01-003-C10, Corning, NY 14831

Provider of worldwide turnkey services for the design, supply of equipment, training, and on-site assistance concentrating in glass components for entertainment and display CRTs (b/w and color); lighting (ribbon machine, Vello tubing); pharmaceutical tubing; and consumer products.

Zia Haider, Sls. & Mktg. Mgr.
607/974-6023 Fax: 607/974-8354

CORYPHAEUS SOFTWARE, INC., 985 University Ave., Ste. 31, Los Gatos, CA 95030

Software developers of a comprehensive line of real-time visual-simulation products, including Designer's Workbench™ (DWB), a 3D modeling and editing environment;

Easy™, a terrain-creation system; and EasyScene™, a real-time scene-display system.

Bill Oliver, Dir. Sls./Mktg.
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COURTAULDS PERFORMANCE FILMS, 21034 Osborne St., Canoga Park, CA 91304

Manufacturers/specialty vacuum coaters of uniform and consistent sputtered coatings of metal and metal oxides on assorted flexible web substrates for use in touch panels, membrane switches, radiation shielding, and electroluminescent lamps and displays.

Bunny Buckley, Sls. Mgr.
818/882-5744 Fax: 818/882-6519

COVID, INC., 1725 W. 17th St., Tempe, AZ 85281

Manufacturers of high-resolution 100-MHz computer-video interfaces, distribution amplifiers, switches, and umbilical cables. Interfaces link PCs, terminals, and graphics workstations to RGB data projectors and monitors for viewing on large displays.

Suzanne Jones
602/966-2221 Toll Free: 1-800/638-6104
Fax: 602/966-6728

CRAFT DATA, INC., 27022 Cordero La., Mission Viejo, CA 92691

Value-added distributor for Planar and Panasonic. Distributor for Casio LCD. Manufacturer of CD650 controller for flat-panel displays. Modules assembled with/without touch panels to customer specifications.

Fred W. Holstein, Jr., Pres.
714/582-8284 Fax: 714/248-2390

CRAFT DATA LTD, 92 Broad St., Chesham, Bucks., HP5 3ED, U.K.

Franchised distributors in the U.K. and Ireland for Seiko Instruments' LCDs, Panasonic's dc plasma displays, and Photonics Systems' ac plasma displays. Also, Samsung's VFD products, Sekonic and ELCOM's EL material, and Carroll Touch's touch-screen displays.

F. G. Tagg, Dir. Sls./Mktg.
44-494-778-235 Fax: 44-494-773-645

CREW SYSTEM ERGONOMICS INFORMATION ANALYSIS CENTER, AL/CFH/CSEIAC, 2255 H Street, Bldg. 248, Wright-Patterson AFB, OH 45433-7022

Information and technology distributor of a variety of products and services to help incorporate ergonomic principles in the design and development of visual display systems. Provides technical summary and analysis support for human-factors-related inquiries.

Kathy Reineke, Sls. Mgr.
513/255-4842

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Manufacturers of advanced automated test and inspection systems based on machine vision and computer-controlled actuation/sensor networks, test/inspection systems for high-density flat-panel displays of all types; powerful low-cost machine vision/image analysis systems.

Rod Morris
714/448-0443 Fax: 714/859-3214

CRT INTERNATIONAL CORP., 429 N Street S.W., #S-106, Washington, DC 20024

Distributors of CRTs for photorecording, special-application CRTs, e-guns, and various flat-panel displays.

Boris L. Chervinsky, Pres.
202/863-0539 Fax: 202/863-0539

CRT SCIENTIFIC CORP., 14746 Raymer St., Van Nuys, CA 91405

Manufacturers of a wide range of monochrome CRTs from 0.5 in. to 25V.

Ken Keller, Pres.
818/989-4610 Fax: 818/989-4617

CRYSTALOID ELECTRONICS CO., 5282 Hudson Dr., Hudson, OH 44236

Manufacturers of LCDs for commercial and avionics applications. Specialized, custom-designed display engineering of twisted nematic, supertwist nematic, and dichroic display technology.

Ed Surjan, Jr., V.P. Sls./Mktg.
216/655-2429 Fax: 216/655-2176

CRYSTAL VISION, INC., P.O. Box 3960, Rolling Hills Est., CA 90274

Manufacturers of video LCD controller board that digitizes real-time "video-in-a-window" (NTSC, PAL, SECAM, or S-Video). Such a 32,768 color video is overlaid with VGA graphics and displayed on two AMTFT color LCD panels and a VGA CRT simultaneously.

Richard Hopkins, Engrg. Mgr.
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, Fujioka-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.
408/257-6886 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 I/O-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/INV, target acquisition, and radar.
David Neitberger, Sls. Mgr.
714/892-7631 Fax: 714/897-1948

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.
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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 Gavlas, Opns. 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 C³I 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

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Carmen Piucci, V.P. OEM Products Group
510/661-2220 Toll Free: 1-800/538-7506
Fax: 510/490-8345

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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 handheld, 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.² 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.
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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.
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714/448-9368, Fax: 714/448-9316

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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 Matz, 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 avionics 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 B11, 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 Arducci, 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
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.
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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.
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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.
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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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Manufacturers of a full line of S-MIM and poly-Si TFT active-matrix color LCDs designed to meet a wide range of applications, including medical instrumentation, in-flight personal video displays, and marine equipment.
Hubert Filmore, Product Mgr.
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ERGONOMICS, INC., P.O. Box 964, Southampton, PA 18966

Exclusive North American distributor for Combinova AB Sweden, manufacturer of precision magnetic- and electric-field meters for non-ionizing-radiation VDT test protocols, such as MPR2, TCE, and IEEE P1140.
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ERGOSYST ASSOCIATES, INC., 123 W. Eighth St., Ste. 210, Lawrence, KS 66044-2605

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.
John L. Burch
913/842-7334 Fax: 913/842-7348

ETC COMPUTER, INC., 2917 Bayview Dr., Fremont, CA 94538

Manufacturers of small-footprint specialty display monitors: 10-in. color (super VGA) and 9- and 10-in. monochrome monitors, designed for space-limited applications. Also, providers of turnkey integrated touch screens for 10-, 14-, 15-, and 17-in. monitors.
Kent Huang, Pres.
510/226-6250 Fax: 510/226-6252

EURECRAN SA, ZA Cap Alpha Lot No. 1, Rue Monnet, Clapiers 34830, France

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.
Stephen Black
801/582-5847 x6501 Fax: 801/582-5848

EXCEL TECHNOLOGY INTERNATIONAL CORP., 5-4 Stryker La., Belle Mead, NJ 08502

Manufacturers of custom and standard glass-panel LCDs and LCD modules.
Michiko Chen, Sls. Mgr.
908/874-4747 Fax: 908/874-3278

EXTRON ELECTRONICS, 1230 S. Lewis St., Anaheim, CA 92805

Manufacturers of computer-video interfaces, RGB switchers, distribution amplifiers, video test generators, and scan conversion equipment. Computer-video routing equipment is used to connect computers to large-screen displays and other presentation equipment.
Jim Costigan, Natl. Sls. Mgr.
714/491-1500 Toll Free: 1-800/633-9876 Fax: 714/491-1517

EXXENE CORP., 5939 Holly Rd., Corpus Christi, TX 78414

Manufacturers of thick-film polymer optical coatings for glass and plastic surfaces. Properties include low gloss, anti-static, and transmission control, as well as abrasion, weather, and chemical protection for plastics. Also, developers of proprietary coatings. Application services available.
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708/587-8787 Fax: 708/587-7373

ExZec, INC., 1840 Oak Ave., Evanston, IL 60201

Manufacture, research, and development of touch-input devices for computers and electronics using guided acoustic waves (bulk, shear mode). SureTouch touch screens respond to varying pressures and can be operated with gloves or in wet or dirty surroundings. Supplier of panels, controllers, and consulting services.
Terence J. Knowles, Pres.
708/866-1868 Toll Free: 1-800/523-5883 Fax: 708/866-1808

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Ralph Mason, Sr. V.P. Sls./Mktg.
510/659-8370 Fax: 510/659-9407

FAI TECHNOLOGY MARKETING, 82 Main St., Ste. 300, Huntington, NY 11743

Full-service market research organization focused on leading-edge electronics tech-

nologies. Significant experience in semiconductor, ATE, CIM, and AMLCD market research.

Debbora Ahlgren
516/351-2100 Fax: 516/351-2199

FIMI PHILIPS, via S. Banfi 1, Saronno 21047, Italy

Manufacturers of high-resolution 17-, 20-, and 21-in. color CRT monitors with line scan frequencies up to 115 kHz and digital autoscan monitors (models C2082-DAS and C2182-DAS) equipped with micro-processor-controlled features and RS-232 interface.
S. Bonfiglio
39-2-9618-237 Fax: 39-2-9618-305

FLACHGLAS AG, Technical Glass Div., Otto-Seeling Str. 7, P.O. Box 1309, 5810 Witten, Germany

Producers of a wide range of coated and uncoated soda-lime glasses for all display applications. With MICROWIT and MICRO-WIT PLUS, standard or specific customer requirements can be met.
Uwe Vogt
49-2302-582-256 Fax: 49-2302-582-353

FLAT CANDLE CO., 4725 B, Town Center Dr., Colorado Springs, CO 80916

Manufacturers of flat-form-factor fluorescent lamps and accessories for LCD backlighting. Sizes range from 0.8 to 10.4 in. on the diagonal.
Judd Lynn
719/573-1880 Fax: 719/573-2080

FLAT PANEL DISPLAY CO. (FPD) BV, 2099 Gateway Pl., Ste. 100, San Jose, CA 95110

Manufacturers of active-matrix monochrome and color LCD panels in many screen sizes and resolutions. Extended-temperature-range options and long-lifetime backlights. Suitable for direct-view projection and datagraphic applications. Special version for sunlight readability.
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408/453-7373 (direct 7007) Fax: 408/453-6444

FLATSCREEN TECHNOLOGIES CORP., 633 Michigan Ave., Evanston, IL 60202

Consultancy providing research, development, and engineering of flat-panel and other displays, components, and systems. Specializing in gas-discharge and gas-electron-phosphor technologies.
Alan Sobel, Pres.
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FLEX PRODUCTS, INC., 2793 Northpoint Pkwy., Santa Rosa, CA 95407-7350

Manufacturers of advanced sputtered and electron-beam deposition coatings on flexible LumiFlex™ transparent conductive films used in touch screens, EL displays, and LCD panels. Optional features include EMI/RFI shielding and anti-reflection filters.
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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 of color active-matrix LCDs, full-color ac-memory plasma displays, and color projection LCDs for a variety of personal computer, medical, industrial, financial, and instrumentation applications.
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81-475-24-1111 Fax: 81-475-23-1346

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Plymouth, MI 48170

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Manufacturers of high-brightness multicolor vacuum fluorescent display products, ranging from simple numeric and dot-matrix displays to large multifunction graphic panels, and offering design and marketing expertise.
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Fax: 703/532-0529

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Fax: 508/371-3039

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Fax: 916/478-3187

industry directory

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H. W. Grossbohl
805/581-1467

JOE HALLETT, Technical Marketing Consultant, 22370 SW Grahams Ferry Rd., Tualatin, OR 97062-8022
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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 placed 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 93085

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 HS1-I 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 Muray, 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, Woburn, MA 01801

Manufacturers of Crystal Clear™ capaci-

industry directory

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.

Ilana 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.

Kazuhiko 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: 408/456-8664

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.

Luhr 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 LCD 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 DeLucca 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

Manufacturers of a wide range of test equipment, including programmable RGB generators capable of driving advanced displays. Featured are dot-clock rates to 300 MHz, on-screen techniques for raster and test-pattern design, and memory control. Robert Sparks, Dir. Sls. 516/231-6900 Toll Free: 1-800/645-5104 Fax: 516/231-5295

BERNARD J. LECHNER, 98 Carson Rd., Princeton, NJ 08540

Consultancy in display devices and systems and all aspects of television, including HDTV systems and standards. Knowledgeable about patent matters: infringement, interference, etc. Experienced expert witness. 609/924-7545 Fax: 609/924-7547

LEICA, INC., 323D Vintage Park Dr., Foster City, CA 94404

Manufacturers of optical inspection and metrology systems for large-scale LCDs up to 600 x 400 mm. Systems are automatic and can be configured for high-resolution CD measurements on low-contrast patterns, film thickness, and filled and unfilled gap measurements. Richard D. Eandi, Product Mgr. 415/578-0488 Toll Free: 1-800/716-0900 Fax: 415/578-8116

LEVY HILL LABORATORIES LTD., 5 Sheffield House, Fieldings Rd., Cheshunt, Herts., U.K. EN8 9TJ

Manufacturers of scintillators, x-ray screens, and detectors for x-ray image displays. Also, x-ray image storage screens. Guy Hill, Managing Dir. 44-99-230-808 Fax: 44-99-221-909

LEYBOLD AG, Wilhelm-Rohn-Strasse 25, Postfach 15-55, D-6450 Hanau, Germany 6450

Suppliers of vacuum coating systems and vacuum processing technology (sputtering, PE-CVD, plasma-etching) for production of active-matrix LCD and color displays. Dr. Reineck 33-6181-34-0 Fax: 33-6181-34-1690

LEYBOLD TECHNOLOGIES, INC., 1860 Hartog Dr., San Jose, CA 95131

Manufacturers of high-throughput in-line sputtering systems, complete with ITO, silicon dioxide, and metal processes commonly used in LCD and other FPD manufacture. Substrate areas range from 350 x 400 mm to 830 x 1500 mm. Also, the Panel 450, a large-area plasma etching system. And the LC 350, a large-area LPCVD system for the deposition of a-Si and p-Si. Tony Sisca, Sls. Engr. 408/436-2822 Fax: 408/436-2847

LIBBEY-OWENS-FORD CO., 811 Madison Ave., P.O. Box 799, Toledo, OH 43697-0799

Manufacturers of float glass, including on-line pyrolytic coatings using atmospheric CVD technology. Industrial products include TEC-glass, on-line multilayer tin-oxide-coated float glass, and UltraFloat, a super-flat high-quality clear float glass. Peter F. Gerhardinger, Mgr. New Prod. Technology 419/247-3931 Fax: 419/247-4517

LIBERTY MIRROR, 851 Third Ave., Brackenridge, PA 15014

Custom design and engineering of optical thin films, specialty mirrors, and optical components. Capabilities cover a broad range from coating customer's material to supplying a complete optical product. Coatings range from highly reflective front-surface mirrors to low-reflection coatings to dichroic and beamsplitter coatings. Also, conductive coatings for EMI and RFI applications. Steve Zebert, Coatings Sls. Engr. 412/224-1800 Fax: 412/224-8754

LIGATURE SOFTWARE, INC., 25 Burlington Mall Rd., Ste. 300, Burlington, MA 01803

Developers of CharacterEyes, 32-bit OCR software that scans documents, analyzes page layout, and outputs directly to a word processor. CharacterEyes supports all major scanners and image file formats. It is available for Windows and Macintosh and is priced at \$695. Ed McGuigan, Dir. No. Amer. Oprns. 617/238-6734 Toll Free: 1-800/888-0060 Fax: 617/272-3085

LIGHTING SCIENCES, INC., 7830 E. Evans Rd., Scottsdale, AZ 85260

Manufacturers of custom photometric test equipment, including high-speed video-photometer systems (backlight and display technology), automated goniometer and photometer systems. Developers of Raymaster™. Also, consultants for many optical-design applications. Dana Hunton, Inside Sls. Mgr. 602/998-9252 Fax: 602/998-9498

LINDGREN RF ENCLOSURES, 3138 E. Segundo, Hawthorne, CA 90250

Manufacturers of rf-shielded enclosures, rf-shielded anechoic chambers, RFI/EMI power, signal, data and control line filters, rf-shielded honeycomb air vents. Janet O'Neill, Sls. Adm. 213/870-9383 Toll Free: 1-800/969-9383 Fax: 213/870-0828

LITTON ELECTRON DEVICES, 1215 S. 52 St., Tempe, AZ 85281

Manufacturers of high-resolution CRTs for a wide range of recording, scanning, and viewing applications, including typesetting, color graphics, medical imaging, and flying spot scanning. Byron Harding, Sls. Mgr. 602/968-4471 Fax: 602/966-9055

LITTON SYSTEMS CANADA LTD., 25 Cityview Dr., Etobicoke, Ontario, Canada M9W 5A7

Manufacturers of military and aerospace flat-panel display systems and products based on LED matrix and active-matrix liquid-crystal technologies. Custom designs to meet specific requirements. Van Angelo, Mgr. Displays Bus. Dev. 416/249-1231 x3905 Fax: 416/246-2955

LMT, P.O. Box 269046, MB 116, San Diego, CA 92196

Manufacturers of a complete line of photometers (both luminance and illuminance meters) and colorimeters for display measurements and high-accuracy lab use. Some are NiCd-battery operable for field use with lab accuracy. Margaret M. Watson 619/271-7474 Fax: 619/693-3670

LOCKHEED SANDERS, INC., P.O. Box 868, 95 Canal St., Nashua, NH 03061

Manufacturers of ruggedized and militarized cockpit display systems; intelligent graphic terminals, and display workstations using color liquid-crystal flat panels and CRTs for application in aircraft, ground vehicles, movable shelters, ships, submarines, and space. Robert Perutz, Prog. Devel. Mgr. 603/885-3524 Toll Free: 1-800/258-1573 Fax: 603/885-7264

LOCTITE LUMINESCENT SYSTEMS, INC., 101 Etna Rd., Lebanon, NH 03766-9004

Manufacturers of electroluminescent (EL) lamps and dc-ac inverters that are performance-matched to the lamps they drive. The thin, solid-state, low-power lamps are used to backlight LCDs, and come in a wide range of colors, including NVIS-compatible green. Michael R. Hartman, V.P. Sls/Mktg. 603/448-3444 Fax: 603/448-3452

LORAD POWER SYSTEMS, 36 Apple Ridge Rd., Danbury, CT 06810

Manufacturers of custom high-voltage power supplies. Dan Lyke, V.P. 203/790-1188 Fax: 203/743-3370

LORAL FAIRCHILD IMAGING SENSORS, INC., CCD Imaging, 1801 McCarthy Blvd., Milpitas, CA 95035

Manufacturers of line-scan and area sensors, line-scan development boards and modules, and line-scan and area cameras. Jim Johnson, Dir. Commer. Mktg. Toll Free: 1-800/325-6975 Fax: 408/433-2508

LORAL INFORMATION DISPLAY SYSTEMS, 6765 Peachtree Industrial Blvd., Atlanta, GA 30360

Manufacturers of ruggedized and militarized active-matrix LCDs, graphics processors, and system integration for aircraft platforms. John A. Dolan, Mgr. Bus. Dev. 404/448-1604 Fax: 404/448-9163

LUCAS CONTROL SYSTEMS PRODUCTS—DEECO™ SYSTEMS, 31047 Genstar Rd., Hayward, CA 94544-7831

Manufacturers of ruggedized industrial computers, serial graphics and text terminals, VGA monitors, and embedded modules for NEMA-4/12 (IP65) applications. Systems incorporate resistive or infrared touch electroluminescent or color LCDs. Sunlight-readable models are available. Frank Pensa, Natl. Sls. Mgr. 908/850-5889 Toll Free: 1-800/376-1154 Fax: 908/850-6009

LUMITEX, INC., 8443 Dow Circle, Strongsville, OH 44136

Manufacturers of woven fiber-optic backlighting for LCDs. Specific HID and halogen light sources. Bruce Baunach, V.P. Sls. Toll Free: 1-800/969-5483

industry directory

LXD, INC., 7650 First Place, Oakwood, OH 44146

Manufacturers of standard and custom LCDs. Specializing in long-life high-reliability products featuring wide temperature ranges, fast response times, and wide viewing angles. Innovators in large-area and sign displays. Colored polarizers also available. Chuck Oravec, Sls. Mgr. 216/786-8700 Fax: 216/786-8711

MACHINE VISION AND CONTROL INTERNATIONAL, INC., 1804 Johni Dr., Glenview, IL 60025

System design, integration, and installation in the application of infrared- and visible-image capture and analysis for measurement, process control, quality control, and troubleshooting; training in the use of these techniques; system maintenance also provided. Gary Shubinsky, Pres. 708/657-0200 Fax: 708/729-9120

MAGNETIC RADIATION LABORATORIES, 690 Hilltop Dr., Itasca, IL 60143

Manufacturers of precision shields of formed and fabricated construction, providing shielded products for commercial, medical, aerospace, and military applications. In-house painting and welding facilities are working to MIL-I-45208A. Jack White, Mktg. Sls. Mgr. 708/285-0800 Fax: 708/285-0807

MAGNETIC SHIELD CORP., 740 N. Thomas Dr., Bensenville, IL 60106

Manufacturers of ImageGuard enclosures to shield monitors from interference caused by magnetic fields. B. Friestedt, Sls. Mgr. 708/766-7800 Toll Free: 1-800/304-5665 Fax: 708/766-2813

MANAGEMENT GRAPHICS, INC., 1401 E. 79th St., Minneapolis, MN 55425

Manufacturers of Solitaire image recorders, offering up to 16K resolution on a variety of film formats from 16 mm to 8 x 10 in. and Mac, PC, and workstation compatible. Every Solitaire features patented Digital Geometry Control, an all-digital image-alignment system. All image characteristics are available from Solitaire's front panel. Bill Hansen, Mktg. Mgr. 612/854-1220 Fax: 612/851-6159

MAN AND MACHINE, INC., 3501 Hamilton St., Hyattsville, MD 20782

A third-party service company specializing in the service and repair of color active-matrix (TFT) and color dual-scan passive-matrix (STN) LCDs and gas-plasma displays. Repair and sales of portable, notebook, and laptop computers. Flat-panel-display repair yield is over 70%. One-year warranty on all display repairs, with a 5-7-day turnaround. Suppliers of retrofit polarizers for older displays. Jaime Hidalgo, Sls. Mgr. 301/277-3760 Fax: 301/779-1455

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MARKET INTELLIGENCE RESEARCH CORP. (MIRC), 2525 Charleston Rd., Mountain View, CA 94043

Market researcher/publisher of high-tech market research reports covering displays, graphics, and image processing. Mel Neri, Mktg. Mgr. 415/961-9000 Fax: 415/961-5042

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Manufacturers of electronic display products for passenger-information display systems for bus, rail, and airport terminals; highway-traffic information; bus-destination signs; scoreboards; fuel-pump displays; time/temperature; and advertising signs. Douglas Greenwood, Gen. Sls. Mgr. 905/624-3020 Toll Free USA: 1-800/265-7773 Fax: 905/238-3141

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Designers and manufacturers of video controllers targeted to several distinct markets: graphics, imaging, interactive videodisc, videographics, and financial information. Markets encompass a large variety of applications including CAD, 3D-display, medical electronics, and robotics. Bruce Seidel, Sls. Mgr. 514/685-2630 Toll Free: 800/361-4903 Fax: 514/685-2853

McMAHAN ELECTRO-OPTICS, INC., P.O. Box 14026, 79 T. W. Alexander Dr., Bldg. 4201, Ste. 101, Research Triangle Park, NC 27709

Manufacturers of the Model MRL-V1701 high-performance 40-MFLOP image-oriented workstation. Standard and custom software are available. Tracy Frantz, Office Mgr. 919/549-7575 Toll Free: 800/733-7575 Fax: 919/549-0421

McMAHAN RESEARCH LABORATORIES, P.O. Box 14026, 79 T. W. Alexander Ave., Research Triangle Park, NC 27709

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Manufacturers of image acquisition, display, processing, and analysis systems oriented toward engineering, and research and development. Ken Boydston, Pres. 805/964-1400 Fax: 805/683-6690

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Manufacturers of the M400 microfilm digitizer that scans 16 and 35mm roll microfilm for quick transfer to digital storage media; featuring unattended operation, selectable resolution, built-in sensors to detect start and end of each image, and PC controlled. Maurice Amesbury, Pres. 909/594-5158 Fax: 909/594-1216

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METAVAC, INC., 4000 Point Street, Holtsville, NY 11742

Manufacturers of high-efficiency reflection-reducing coatings and transparent conductive coatings; contrast-enhancement filters for P43 CRT and color displays. Clifford E. Sisler, Sls. Mgr. 516/447-7700 Fax: 516/447-7715

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Manufacturers of liquid-crystal-based spatial light modulators, shutters, polarization optics, and related light control

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Manufacturers of flat-tension-mask color monitors; 29-in. autosync color monitors; the Comprehensive Display Evaluation System (CODES); and video test-pattern generators. Ray Wabler, Dir. Products Div. 513/426-3111 Fax: 513/426-8301

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Steve Wilson, Mgr. Design Engrg. Svcs.
613/591-0336 Fax: 613/591-0584

OPTREX AMERICA, INC., 44160 Plymouth Oaks Blvd., Plymouth, MI 48324
Manufacturers of a complete line of standard and custom LCDs in both character and graphic type.
Rob Harrison
313/416-8500 Fax: 313/416-8520

OPTREX/SATORI, 3830 Del Amo Blvd., Torrance, CA 90503
Marketers of alphanumeric and graphic LCD panels and modules. Extended temperature, EL, LED and CCT back-lighting, NTN, black-and-white, high-contrast fluids, passive color, VGA, and XGA options available.
Ken Yoshikama, Pres.
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OPTRO-MECHANICS (USA) CORP., One Blue Hill Plaza, Pearl River, NY 10965-8667
Distributors of a line of microscopes and LCD inspection systems manufactured by Seiwa Optical Co., Ltd., Tokyo, Japan.
Sal Miwa, Pres.
914/620-1999 Toll Free: 1-800/890-3333
Fax: 914/620-1950

OPTRONICS ENGINEERING, 175 B Cremona Dr., Goleta, CA 93117
High-resolution high-sensitivity color video cameras for fluorescence and low-contrast surface inspection. The auto exposure system has a shutter range of 1/10,000-4 sec with light sensitivity as low as 0.0025 lux.
Doug Marker, Sls. Dir.
805/968-3568 Fax: 805/968-2046

ORWIN ASSOCIATES, INC., 88 Seabro Ave., Amityville, NY 11701
Designers/manufacturers of specific-purpose CRT monitors: high-bright color and monochrome for ATC towers, special large-screen high-resolution workstations, gray scale/high resolution for medical diagnosis and image analysis.
Ben Iannotta
516/842-7177 Fax: 516/842-7410

PACIFIC MEDIA ASSOCIATES, 1121 Clark Ave., Mountain View, CA 94040
Market researchers offering multi-client and custom studies on large-screen display markets. Publishers of the continuing Large-Screen Displays Industry Service (detailed market estimates) and conducts the annual North American Large-Screen Displays Reseller Survey.
William L. Cogshall, Pres.
415/948-3080 Fax: 415/948-3092

PACIFIC TECHNOLOGIES, INC., 123 N.W. 13th St., Ste. 308, Boca Raton, FL 33432
Distributors of Nippon Graphite Industries' FlexEL line of electroluminescent lamps, conductive graphite pastes, graphite dispersions, and related items. LCD-manufacturing equipment and materials, including TAB-attach, polarizer lamination, panel cleaning, polyimide print mattes, and spacer material.
Peter J. Opdahl, Managing Dir.
407/392-2555 Fax: 407/392-0807

PANASONIC INDUSTRIAL CO., 2 Panasonic Way, 7C-7, Secaucus, NJ 07094
Manufacturers of a complete line of electronic components, sub-assemblies, and industrial technologies.
Toll Free: 800/848-3979

PANASONIC INDUSTRIAL CO., Display Products Dept., 2 Panasonic Way, 7H-1, Secaucus, NJ 07094

Manufacturers of high-resolution monochrome and color CRTs, in sizes from 5 to 27 in.; high-resolution monochrome and color display monitors, open frame or cabinet style, in sizes from 9 to 21 in.; high-resolution dc plasma display panels, in formats from 200 x 640 to 1152 x 900; vidicon and newvicon camera tubes. Mario Bartalotta
201/392-4502 Fax: 201/392-4815

PANELGRAPHIC CORP., 10 Henderson Dr., West Caldwell, NJ 07006

Manufacturers of Chromafilter contrast-enhancing antistatic filter materials for all types of optoelectronic and CRT displays; antilog, antistatic Vneeguard™ coatings to protect display readout windows from scratching and harsh chemicals. Jane Ryan, V.P. Mktg.
201/227-1500 Toll Free: 800/222-0618 or 0617 (NJ only) Fax: 201/227-7750

PANELIGHT DISPLAY SYSTEMS, INC., 101 Embarcadero, #100A, San Francisco, CA 94105

Distributor of flat-panel display products for end-users. So-hail Malik
415/772-5800 FAX 415/986-3817

PARALLAX GRAPHICS, INC., 2500 Condensa St., Santa Clara, CA 95051

Manufacturers of high-resolution video and graphics display controllers for Qbus, VMEbus, and PC/AT PC/XTbus. Stu Taylor, V. P. Intl. Sls.
408/727-2220 Fax: 408/980-5139

PEARSON & ASSOCIATES, INC., 11811 N. Tatum Blvd., Ste. P. 129, Phoenix, AZ 85028

Consultancy specializing in LCD technology. Chuck Pearson, Pres.
602/953-9783 Fax: 602/996-1261

PEGASYS DISPLAYS, INC., P.O. Box 1795, Eau Claire, WI 54702

Designers/manufacturers of custom high-resolution monochrome/color monitors, with screen sizes from 9 to 25 in. and resolutions up to 1600 x 1280, designed for medical imaging, document processing, and other OEM markets. Custom ruggedized monitors also available. Portrait and landscape enclosures available. Oscar Martinez, Engr. Mgr.
715/832-5170 Toll Free: 1-800/666-5170 Fax: 715/832-5170

PEMM SERVICES, 1 Friars Tale Place, Staatsburg, NY 12580-5104

Consultancy specializing in display technologies, providing technology evaluation and comparisons, strategies, technology recommendations for a given application, and assessments of the viability, cost, and availability of various display technologies. Peter Pleshko, Consultant
914/889-4246 Fax: 914/889-4246

PENTAX TEKNOLOGIES CORP., 100 Technology Dr., Broomfield, CO 80021

Manufacturers of precision optical components and subassemblies for computer peripherals. Robert Ariniello, Mgr. Opt. Prod. Mktg.
303/460-1600 Fax: 303/460-1628

PERCON, INC., 1720 Willow Creek Circle, Suite 530, Eugene, OR 97402

Manufacturers and distributors of barcode reading equipment and accessories for many different computer/terminal systems, including IBM, Dec, Wyse, and Apple Macintosh. Five-year warranty on all decoders. One-year warranty on all input devices. Beth Daniels, Dir. Mktg.
503/344-1189 Toll Free: 800/873-7266 Fax: 503/344-1399

PHILIPS COMPONENTS, P.O. Box 218, 5600 MD Eindhoven, The Netherlands

Worldwide manufacturers of electronic components, including display components and electro-optical components. Jeannet Harpe, Press Off.
31-40-724-173 Fax: 31-40-724-825

PHILIPS COMPONENTS, 100 Providence Pike, Slatersville, RI 02876

Manufacturers of camera tubes, CCD chips, complete imaging modules, high-resolution and square pixel devices. Components for device manufacturing (glass guns, coatings) are also available. Jeff Brook-Stewart, Gen. Mgr.
401/762-3800 Fax: 401/767-4493

PHILIPS CONSUMER ELECTRONICS CO., 1 Philips Dr., Knoxville, TN 37922

Manufacturers of a broad range of CRT-based display products from 12-in. monochrome through 21-in. FSO color. Resolution levels up to 1600 x 1280 are supported by dedicated and multifrequency designs. John Neilson
719/593-4297

PHILIPS DISPLAY COMPONENTS CO., P.O. Box 963, 1600 Huron Pkwy., Ann Arbor, MI 48106-0963

Manufacturers of color display tubes for TV and monitor applications, monochrome tubes and deflection units for monitor applications, flyback transformers, degaussing coils, various wirewound components, tuners for TV and satellite receivers. Patrick Canavan, Sls. Mgr.
313/996-9400 Fax: 313/761-2776

PHOSPHOR PRODUCTS CO., LTD., 1 Factory Road, Upton, Poole, Dorset BH16 5SJ, England

Manufacturers of DCEL displays and phosphors. N. Bainton
44-202-632-116 Fax: 44-202-631-980

PHOSPHOR TECHNOLOGY LTD., Middle St., Nazeing, Essex EN9 2LP, England

Manufacturers of inorganic phosphors for CRTs, FEDs, PDPs, x-ray imaging screens, and IR detectors. Gerry Sorce, CEO
44-1992-89-3424 Fax: 44-1992-89-3729

PHOTOMETRICS, 3440 E. Britannia Dr., Tucson, AZ 85706

Manufacturers of digital imaging systems for research and industrial applications. CCD technology-based applications include life sciences, high-energy physics, astronomy, spectroscopy and deep-water imaging fields. Still-imaging cameras offer response linearity, geometric stability, and high dynamic range. John Allard, Sls. Mgr.
602/889-9933 Fax: 602/573-1944

PHOTON DYNAMICS, INC., 1504 McCarthy Blvd., Milpitas, CA 95035

Designers and manufacturers of a complete product line of advanced test, inspection, and repair systems for flat-panel displays. Alan Nolet, V.P., U.S. Sales
408/433-3922 Fax: 408/433-3925

PHOTONICS SPECTRA, Berkshire Common 2 South Street, Pittsfield, MA 01201

Publishers of Photonics Spectra, a magazine devoted to photonics technology: optics, lasers, fiber-optics, electro-optics, imaging, and optical computing. Also, the four-book set of The Photonics Directory: The Corporate Guide, Buyers Guide, Handbook, and Dictionary. Toni R. Ranson, Mktg./Sls. Coord.
413/499-0514 Fax: 413/442-3180

PHOTONICS SYSTEMS, INC., 6975 Wales Rd., Northwood, OH 43619

Manufacturers of ac plasma flat-panel display monitors, heads, and terminals (with 32-bit microprocessor), ranging in sizes up to 2048 x 2048 pixels and 1.5 Mpixels. Gray scale up to 8 bits (256 levels). Full-color ac plasma video monitors, including 19 in. 640 x 480 VGA and 30-in. 1024 x 768 XGA. IR touch for all flat panels and CRTs. RS-170, RS-343, and other standard serial and video interfaces. AC gas plasma flat-panel displays with display sizes up to 60 in. (1.5 m), resolutions up to 2048 x 2048, gray scale to 256 levels (8 bits), and full color. Standard sizes 640 x 480 and 1280 x 1024. Sharon M. Toth, Mktg. Mgr.
419/666-6325 Fax: 419/666-0785

PHOTON, INC., 1115 Space Park Drive, Santa Clara, CA 95054

Manufacturers of test instrumentation that records the energy distribution pattern of optical sources including imaged spot size. Jim Darchuk, Mktg./Sls. Mgr.
408/492-9449 Fax: 408/492-9659

PHOTO RESEARCH, 9330 DeSoto Ave., Chatsworth, CA 91311

Manufacturers of state-of-the-art electro-optical instrumentation and systems. Elaine Tito, Coord.
312/243-1111 Fax: 312/243-2424

PHYSICAL OPTICS CORP., 20600 Gramercy Pl., Torrance, CA 90501-1821

Manufacturers of surface-relief holographic diffusers for LCD backlights; high-resolution high-gain transmission and reflection screens for projection systems. Also, HOEs for barcode readers, projector-beam homogenization, and round-to-rectangular beam converters. Rick Shie, Dir. Sls./Mktg.
310/320-3088 Fax: 310/320-8067

PIXELINK CORP., 577 Main Street, Hudson, MA 01749

Importer/reseller of high-resolution monitors, color and monochrome, for Philips, IDEK and others. Authorized depot repair center with parts inventory for quick turnaround on repairs. Custom mechanical and electrical modifications and graphic display controllers. Bill Ingraham, Sls. Mgr.
508/562-4803 Fax: 508/568-0514

PLANAR ADVANCE, P.O. Box 4001, Beaverton, OR 97006

Manufacturers/distributors of high-performance CRT-based and flat-panel-

display products for the defense market, utilizing the following technologies: taut shadow mask, liquid-crystal color shutter, field-sequential and active-matrix liquid crystal.

Bob Johnson, Mktg. Mgr.
503/614-4110 Fax: 503/614-4101

PLANAR AMERICA, INC., 1400 N.W. Compton Dr., Beaverton, OR 97006

Manufacturers/distributors of high-performance flat panels using electroluminescence (EL) technology. Included are high-performance monochrome, multicolor, and full-color displays. Rick Phillips, Dir. Sls., EL Displays
503/690-1100 Fax: 503/690-1493

PLANAR INTERNATIONAL LTD., Olarinluoma 9, P.O. Box 46, Espoo SF-02201, Finland

Manufacturers and suppliers of electroluminescent flat-panel displays, providing crisp bright images of text and graphics viewable from wide angles and under most lighting conditions. Preferred for industrial applications. Jukka Eskelinen, Sls. Mgr.
358-0-420-01 Fax: 358-0-422-143

PLANAR SYSTEMS, INC., 1400 N.W. Compton Dr., Beaverton, OR 97006

Manufacturers of standard and custom electroluminescent displays for commercial use. Display resolutions range from 240 x 64 to 1024 x 768 in monochrome and 640 x 350 to 640 x 480 in multicolor. Gary Baughn, V.P., Sls.
503/690-1100 x7208 Fax: 503/690-1493

PLASMACO, INC., 180 South St., Highland, NY 12528

Manufacturers of color and monochrome ac plasma displays and monitors. Products include 21-in. full-color 640 x 480 plasma panel suitable for full-motion video, TV, or computer applications, and 21.3-in. monochrome 1280 x 1024 display compatible with PC, Sun, and Macintosh computers. Jane D. Birk, Appl. Engr.
914/883-6800 Fax: 914/883-6867

PLASMACO, Division of Arconium, 400 Harris Ave., Providence, RI 02909

Manufacturers of ITO and indium/tin metal sputtering targets, including planar, rotatable, and custom design. Fully integrated approach, from indium refining and oxide manufacturing capability to localized bonding in U.S., Belgium, and Hong Kong. David Sklariski, Gen. Mgr.
401/456-0800 Toll Free: 1-800/343-0282 Fax: 401/421-2419

PLASMATERIALS, 3223 Crow Canyon Rd. (#290), San Ramon, CA 94583

Manufacturers of high-purity materials for the thin-film industry. Specializing in sputtering targets, evaporation materials, bonding service, and backing plates. Specific materials for transparent conductive coatings include fully oxidized and reduced ITO as well as ZnO. Don Sarach, Pres.
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Manufacturers of plasma process equipment (deposition and etch) for the electronics display industry. Small systems are available for R&D. Fully automated multichamber production systems process

industry directory

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Command Systems Group, 241 Station
Rd., Addlestone, Weybridge, Surrey, U.K.
KT15 2PW

Manufacturers of naval command-and-control systems. NAUTIS (Naval Autonomous Information System) has color raster on cursive monochrome displays. Rugged monochrome raster monitors and 512 x 512 ac plasma terminals also available.
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Manufacturers of polarizers for emissive electronic displays that improve contrast and reduce glare on virtually any emissive electronic display and available in plastic acrylic or glass laminations with various EMI/RFI and abrasion resistant coatings in a variety of colors.
Terry Holmes, Mktg. Mgr.
617/446-4505 Fax: 617/446-4600

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Colchester, VT 05446

Manufacturers of 3D position/orientation tracking and digitizing systems used in CAD, virtual reality, animation, and biomedical and scientific applications. Product family includes the Digitizer, Tracker, and the IsoTrack.
Tom Jones, Sales Rep.
802/655-3159 Fax: 802-655-1439

POLYTRONIX, INC., 805 Alpha Dr.,
Richardson, TX 75081

Manufacturers of custom twisted-nematic displays, standard TN displays, dichroic displays, polymer-dispersed liquid-crystal film, PDLC displays, active-matrix displays, and special shutters.
Gordon Laurie, Mktg./Sls. Mgr.
214/238-7045 Fax: 214/644-0805

POSITIVE TECHNOLOGIES, 6640 Lusk
Blvd., Ste. A200, San Diego, CA 92121

Manufacturers of adaptive-scanning controllers for passive- and active-matrix displays. Adaptive scanning increases the contrast and gradations by employing selective multi-line control of both the rows and columns, depending on the image to be displayed.
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619/457-5151 Fax: 619/457-4646

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St-Laurent, Quebec, Canada H4T 1J6

Specializing in photomask fabrication and phototooling services for flat-panel displays including digitizing, drafting of Calma GDS II, and data conversion from various software; photomasks for optoelectronics, laser diodes, photodiodes, integrated guided-wave optics devices, surface-acoustic-wave devices, and VLSI.
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514/737-7030 Fax: 514/737-9893

PRECISION ELECTRONIC GLASS, INC.,
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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.
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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.
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707/792-0333 Fax: 707/792-2738

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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.
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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.,
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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

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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.
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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.
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714/964-7818 Toll Free: 800/872-7385
Fax: 714/968-7884

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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.
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PULSEVIEW, LTD., Units 1&2, Suffolk
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Manufacturers of display hardware and software. Optical design of display modules in all technologies, especially VFDs and LCDs. Conventional and surface-mount manufacturing.
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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, limitless 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.
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708/888-0450 Fax: 708/888-2802

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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.
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717/242-1132 Fax: 717/248-8680

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Middlesex HA1 4TR, U.K.

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

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5 Mandeville Ct., Ryan Ranch Business
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408/655-2772 Fax: 408/655-4858

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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,
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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.
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44-161-681-7072 Fax: 44-161-682-3818

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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).
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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.
408/562-4200 Toll Free: SAY COLOR
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.
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617/984-8570, Fax: 617/984-4196

RAYTHEON CO., Submarine Signal Div.,
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Manufacturers of the Thermal Display Unit with true gray shades at high speeds and high resolution, producing recordings of

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John Lorea, Sls. Mgr.
401/847-8000 x2054 Fax: 401/847-8002

RECOGNITION CONCEPTS, INC.,
5200 Convoir Dr., Carcara, NY 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).
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Suppliers of stereoscopic viewers for 3-D pairs, both slides and print, and polarized and anaglyphic 3-D viewing glasses. Also, stereoscopic books.
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310/837-2368 Fax: 310/558-1653

REFLECTION TECHNOLOGY,
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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.
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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.
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212/532-4647 Fax: 212/532-4725

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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
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RGB SPECTRUM, 950 Marina Village Pkwy., Alameda, CA 94501
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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.
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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

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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

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Takashi Kashiwagi
81-3-3710-2222 Fax: 81-3-3792-0007

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Designers and manufacturers of a line of monochrome and color military avionics displays, graphics symbol generators with aircraft navigation interfaces, and night-vision equipment.
Jack T. Dehail, Prod. Mgr.
513/427-7608 Fax: 513/427-0205

SYSTEMS RESEARCH LABORATORIES, INC., Information and Displays Visual & Training Systems Center, 2800 Indian Ripple Road, Dayton, OH 45440-3696
Designers and manufacturers of commercial, ruggedized, and high-resolution color monitors and projection display equipment for training and simulation, C3I, airborne and mobile systems. Raster and/or raster/calligraphic systems available; unique designs and application services a specialty; small quantity requirements welcomed.
Chuck Silcott, Mktg. Mgr.
513/427-7266 Fax: 513/426-1984

TAMARACK SCIENTIFIC CO., INC., 1040 N. Armando St., Anaheim, CA 92806
Manufacturers of lithographic exposure production systems, including new large-area scanning projection tools, large-area proximity equipment, and mask aligners. Also, high-precision UV-laser ablation production systems.
Ron Sheets, Pres.
714/632-5030 Fax: 714/632-1455

TANNAS ELECTRONICS, 1426 Dana Pl., Orange, CA 92666
Consulting services in electronic information displays; design of display

industry directory

components and products; evaluation of display companies and component sources; tours (Asia) and seminars; and marketing, human factors, and electro-optic studies. Lawrence E. Tannas, Jr., Pres. 714/633-7874 Fax: 714/633-4174

TARGET MATERIALS, INC., 1145 Chesapeake Ave., Columbus, OH 43212
Manufacturers of sputtering targets and evaporation materials for flat-panel displays and other thin-film applications. Materials provided include indium tin oxide, zinc oxide, zinc oxide w/alumina, and 195 other materials. Kevin Williams, Sls. Engr. 1-800/292-8639 Fax: 1-800/292-8654

TATUNG COMPANY OF AMERICA, INC., 2850 El Presidio Street, Long Beach, CA 90810
Manufacturers of a variety of monochrome and color monitors, ranging in screen size from 12 to 20 in. and designed for basic and sophisticated applications. Michael Lee 213/979-7055 Toll Free: 800/827-2850 Fax: 213/637-8484

TDSD CORP., 9005A Eton Ave., Canoga Park, CA 91304
Manufacturers of a family of single-lens CRT projectors from economy models to very-high-power models for simulators, sports arenas, etc. M. Akhavi 818/407-8991 Fax: 818/407-1050

TEAM SYSTEMS, INC., 2934 Corvin Dr., Santa Clara, CA 95051
Manufacturers/distributors of a complete line of fully programmable video generators, which can cover any display resolution up to a pixel frequency of 440 MHz. The newest entries are PC-based low-cost products which provide ideal tools to service and maintain any monitor/display system. Also distributes a high-resolution video printer with 256 gray-level capability and full compatibility with workstations. Bill Nicklin, Sls. Mgr. 408/720-8877 Toll Free: 1-800/338-1981 Fax: 408/720-9643

TECHNEGLAS, INC., 707 E. Jenkins Ave., Columbus, OH 43207
Manufacturers of a full line of glass for CRTs. Sizes range from 1 to 35 in. for use in industry, home, or projection CRTs. James E. Kyle, Sls./Mktg. Mgr. 614/445-4800 Fax: 614/445-4702

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

TECH SPRAY, INC., P.O. Box 949, Amarillo, TX 79105
Manufacturers of chemical products used to clean, coat, and protect components and finished products from grease, moisture, mildew, fungus, acid, and caustic contaminants. Static control products for carpets, glass, and plastics. Don Schrowangen 806/372-8523 Toll Free: 800/858-4043 Fax: 806/372-8750

TEKNEK ELECTRONICS LTD., Quarriers Village, Bridge of Weir, Renfrewshire PA11 3SA, U.K.

Manufacturers/designers of equipment for removal of particulate contamination from sheet and web substrates, especially prior to coating, laminating, and printing. Mark Sunderland, Commercial Mgr. 44-0505-690-707 Fax: 44-0505-614-708

TEKTRONIX, INC., P.O. Box 500, Beaverton, OR 97077
Manufacturers of portable handheld digital photometer/radiometer/colorimeter products capable of making a wide range of display measurements. Several pre-calibrated plug-in heads are available for high-accuracy display and ambient measurements. Chuck Price, Mktg. Mgr. 503/627-5077 Fax: 503/627-5622

TEKTRONIX, INC., Display Products Operation, P.O. Box 500, Beaverton, OR 97077

Manufacturers of display products, providing high-resolution color and monochrome displays as well as 3-D stereoscopic display systems based on its liquid-crystal technology developments. Richard Osborn, Prod. Mktg. Mgr. 503/627-5064 Toll Free: 800/TEK-WIDE x5000 Fax: 503/627-1070

TELEDYNE ELECTRONIC TECHNOLOGIES Electro-Optic Devices & Displays, 12964 Panama St., Los Angeles, CA 90066
Manufacturers of **TELERAY™** LED-based lighting, radiation, and display products: **DYNELAMP™** greater than 98% efficient lighting elements; **DYNELUX™** full NVIS-compatible matrix displays; and **DYNEVIEW™** dot-matrix indoor/outdoor tiles/screens. Bill Kennedy, Bus. Dev. Mgr. 310/574-2065 Fax: 310/574-2015

TELEDYNE KINETICS, 410 S. Cedros Ave., Solana Beach, CA 92075
Manufacturers of connectors for connecting flat-panel displays to printed-circuit boards. Doreen Deschamps, Mktg. Commun. 619/755-1181 Toll Free: 800/344-4334 800/991-9988 (CA only) Fax: 619/755-6163

TELESENSORY, 455 N. Bernardo, P.O. Box 7455, Mt. View, CA 94039-7455
Manufacturers of access devices for blind and low-vision people. Product line includes computer-screen enlargers, speech and braille output devices, OCR system, braille printers and video magnifying reading aids. Kathy Kinkaid 415/960-0920 Toll Free: 800/227-8418 Fax: 415/969-9064

TELEX COMMUNICATIONS, INC., 9600 Aldrich Ave. S., Minneapolis, MN 55420
Manufacturers of MagnaByte brand LCD computer projection panels compatible with IBM, IBM compatible, Apple II series, and Macintosh (required standard overhead projector to project image), and MagnaByte brand LCD video projectors. Pat George 612/884-4051 Fax: 612/884-0043

TELIC OPTICS, INC., 420 Maple St., Suite 25, Marlborough, MA 01752
Consultants in optical design and analysis including lens design, illumination systems analysis, and stray-light analysis.

Custom optical analysis software also provided. Jim Howard, V.P. 508/485-4088 Fax: 508/485-4618

TELTRON TECHNOLOGIES, INC., 2 Riga La., Birdsboro, PA 19508
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TEMPEST TECHNOLOGIES, INC., 460 Herndon Parkway, Herndon, VA 22070
Manufacturers and sellers of dot-matrix (200-400 cps), line (300-600 lpm), letter-quality (55 cps), and page (6 ppm) printers, and plotters (8 pen) for use when processing sensitive data in office and engineering activities. James L. Leatherman 703/471-0157

TENCOR INSTRUMENTS, 3231 Scott Blvd., Santa Clara, CA 95054
Manufacturers of the new FP-20, which measures surface topography on flat-panel displays up to 650 x 650 mm. Features include pattern recognition, a Windows-based operating environment, and SECSII (GEM 93) compatibility. An automatic substrate handler is also available. Janet Case, Mktg. Mgr. 408/654-2490 Toll Free: 1-800/358-6784 Fax: 408/982-9654

TENCOR INSTRUMENTS, 3231 Scott Blvd., Santa Clara, CA 95054
Manufacturers of the FLX-2350FP, a thin-film stress-measurement system designed for flat-panel-display applications. The system monitors stress at room temperatures, and features a 500-mm scanning capability to allow local stress analysis along the scan. Dov Hirsch, Sr. Prod. Mgr., Film Stress Prod. 408/654-2436 Toll Free: 1-800/358-6784 Fax: 408/982-9654

TERAPIXEL, Olarinluoma 9, Fin-02200 Espoo, Finland
Manufacturers of photomasks for displays up to 22 in. using laser pattern generation technology. Aro Salin 358-0-423-537 Fax: 358-0-423-813

TEXAS INSTRUMENTS, P.O. Box 655474, M/S 429, Dallas, TX 75265
TI's Digital Light Processing (DLP™) solutions deliver compelling all-digital images as further evidence of projection display and near-photographic printing quality. The DLP solutions will first appear in market-maker projection displays. Gary Feather, Digital Imaging Mktg. Mgr. 214/995-2426 Fax: 214/995-2217

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Manufacturers of color plasma display drivers/controllers for future A/V systems, including new chip process of high-voltage CMOS based on technology exchange agreement with Supertex. LCDs in slim TAB packages and chip-on-glass assembly covering all flat panels. Plasma: Hiro Kawai; LCD: Toshi Ikai 81-3-3769-8724 Fax: 81-3-3457-6777

TFD, INC., 1180 N. Tustin Ave., Anaheim, CA 92807

Manufacturers of high-quality vacuum sputter-deposited thin films in sample or volume quantities. "Diamond-like" coatings, LCDs, flat fluorescent lights, flexible PC, ITO, and thin-film heaters are also available. Richard Tremblay, Mktg. Mgr. 714/630-7127 Fax: 714/630-7119

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Manufacturers of a wide variety of thin-film coatings, and providers of services for the flat-panel display industry. Transparent conductor ITO black matrix with low defect $\leq 2 \mu\text{m}$ and etch-patterned without residuals. Antiglare screens, EMI shields, laminated filters, transparent heaters, and other unique custom products are available under MIL-I-45208A and ISO 9000 standards. Saleem Sheikh, Pres. 714/630-7127 Fax: 714/630-7119

THIN FILM TECHNOLOGY, INC., P.O. Box 1942, Buellton, CA 93427
Manufacturers of custom thin-film vacuum coatings: metals and dielectrics for electrical and optical usages. Also, patterning capabilities. Gary St. Amour, V.P. Mktg. 805/688-4949 Fax: 805/688-8487

THOMAS ELECTRONICS, INC., 100 Riverview Dr., Wayne, NJ 07470
Manufacturers of CRTs and CRT assemblies for the military, industrial, and commercial marketplace. Applications include air-traffic control, avionics, HMD, medical imaging, simulations, photo-recording, and C4I. New products include flat fluorescent lamps for use in backlighting LCDs. Bruce Paget, V.P. Sls. 201/696-5200 Fax: 201/696-8298

THOMSON COMPONENTS & TUBES CORP., 40G Commerce Way, Totowa, NJ 07512
Manufacturers of color VGA 64-dpi flat plasma displays, monochrome high-resolution plasma panels, ruggedized color CRT monitors, 9-in. RGB projection CRTs, color beam index and monochrome avionic displays, and 26-in. diagonal plasma displays. Jeffrey G. Ohlstrom, Sls. Mgr., Optoelec. Products 201/812-9000 Fax: 201/812-9050

THOMSON-CSF, 160 bd de Valmy, Colombes, 92704 France
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THOMSON TUBES ELECTRONIQUES, 38, rue Vauthier, B.P. 305, Boulogne-Billancourt F-92102 France
Manufacturers of professional CRTs: very-high-resolution, head-up, head-down, helmet-mounted, projection, beam index, and ruggedized shadow-mask monitors; ac plasma displays (military and civil), color and monochrome with gray scale and high

brightness. Models suitable for PC monitors.
P. Menes, Sls. & Mktg. Dir.
33-1-49-09-28-28 Fax: 33-1-46-04-52-09

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Specializing in the design and manufacture of three-dimensional optical products and systems including 3D video helmets, 3D monitors and display systems, as well as other commercial products.
Craig M. Crawford, CEO
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Manufacturers/distributors of a wide variety of hardware and software for making and displaying stereoscopic video and computer graphics, ranging from low-cost consumer kits to professional systems.
Michael Starks, Pres.
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THREE-FIVE SYSTEMS, INC., 1600 N. Desert Dr., Tempe, AZ 85281
Designers/manufacturers of custom display systems combining LCD panels, LED die, chip-on-board silicon drivers, and keyboard elements to customer specifications. Standard products include LC and LED displays with on-board drivers and visible and infrared LED components.
Paul Holman, Dir. Mktg.
602/389-8600 Fax: 602/389-8801

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Designers, manufacturers, and marketers of products for a variety of specialty electrical applications including control of static electricity, insulating tapes, resins and heat-shrink products.
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Toll Free: 800/328-1368 Fax: 512/984-2211

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Designers, manufacturers, and marketers of electronic packaging and interconnect products providing reliable and effective solutions to interconnect problems faced by electronic equipment manufacturers and assemblers.
Jim Mathews, Mktg. Commun. Mgr.
Toll Free: 800/225-5373 Fax: 512/984-6972

3M OPTICAL SYSTEMS, 3M Center, 225-4N-14, St. Paul, MN 55144-1000
Manufacturers of specialty optical films to control and enhance lighting for CRTs, LEDs, plasma displays, EL, and LCDs.
Mike Burns
612/733-4403 Toll Free: 800/553-9215 Fax: 612/736-2298

TIMELINE, INC., 23605 Telo Ave., Torrance, CA 90505
Distributor of surplus inventories of LCDs, both graphic and alphanumeric; non-enclosed monitors; computer-related equipment.
Ron Klein
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 semiconductors, 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.
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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.
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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 Stoeppel
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 11716-2596
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.
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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.
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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 1 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.
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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

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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.²/min. at 0.25 mil and 40 in.²/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 33-1-69-09-70-70 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. Schmidt 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, Mngn. 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 Clara, 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 Nemecek, 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 Lincoln 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 SiO₂, dielectric films for large-size AMLCD substrates and most advanced TFT devices. High utilization capability and high throughput provide for extremely low total cost of ownership. Linda Johnson, Sls./Mktg. 408/439-6265 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 backlighting 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: 707/996-3360

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 Schater, 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 specialty 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 Uhler, 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. ■

16

95

OCTOBER

Asia Display '95 – International Display Research Conference

ACT CITY, HAMAMATSU, JAPAN
OCTOBER 16–18, 1995

- An international conference on display research and development aspects of:
 - Display Fundamentals, Display Devices
 - Hard Copy & Storage, Input Systems
 - Integrated Devices and Applications
 - Image and Signal Processing
 - Color Perception, Human Factors

7

95

NOVEMBER

3rd Color Imaging Conference: Color Science, Systems, & Applications
SCOTTSDALE, ARIZONA
NOVEMBER 7–10, 1995

- An international multidisciplinary forum for dialogue on:
 - Creation and capture of Color Images
 - 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 640×480 pixels, with a dot size of 0.21×0.21 mm. The effective viewing area is 150×113.4 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 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 3.2×3.0 -in. LCD panel to project full-color images with 640×480 -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-UIJ, 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 2×20 configuration, the new VFD's size and hole configuration matches many popular 2×20 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 4×20 -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.

When you're ready to power up your display, design in ERG.



ERG inverters and converters are power supplies tailored to your information display. You get performance to spec, with maximum reliability.

ERG has power supplies for:

- CCFT Backlit Flat Panel LCDs
- EL Lamps or Backlit Displays
- Gas Plasma Displays
- Vacuum Fluorescent (VF) Displays

We'll work with you to meet any requirement, from custom dimming to special packaging. And every ERG power supply is made in the U.S.A. Just tell us what you need. When you're ready to power up, design in ERG.



Endicott Research Group, Inc.

**THE POWER BEHIND
THE DISPLAY**

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Endicott, NY 13760
(607) 754-9187
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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.

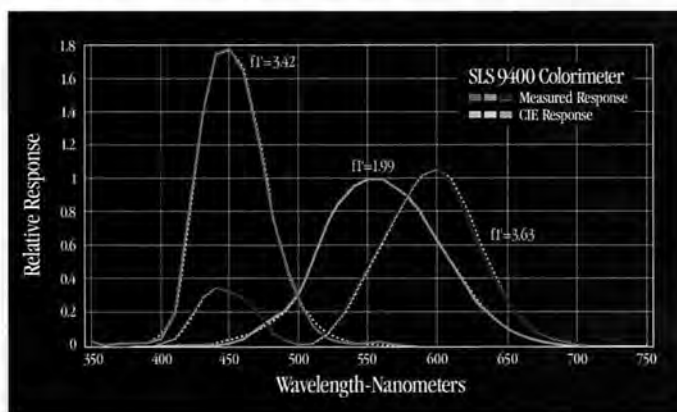
Later, I asked another color expert — my daughter Amber, a fashion designer for a large sportswear company — what she does to print out the fabric colors that she creates on her CAD system. This is obviously a business where subtle changes in shading are very important. She told me that she first prints 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?

Look into the SLS 9400 from Graseby.

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

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

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

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

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

GRASEBY
OPTRONICS

display continuum

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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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

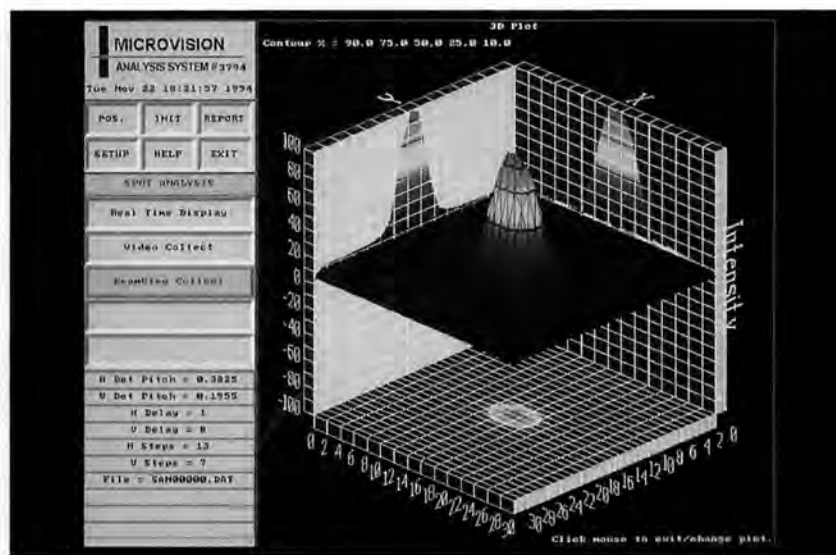
Richard Traczewski as Senior Sales Engineer for the Pacific Northwest. He will be responsible for expanding the customer base for MRC's advanced materials in this region. Prior to accepting his new position, Richard was a Sales Account Manager for Air Products and Chemicals, Inc., of Portland, Oregon.

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, 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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index to advertisers

Accudyne	68	Libbey-Owens-Ford	77
Ad-Vance Magnetics, Inc.	64	Man & Machine	3
American Polarizers	64	Microvision	69
autronic-Melchers GmbH	79	Mitsubishi Electronics America	26,27
Caton Connector Corp.	81	Nikon Precision	71
CELCO	C2	Optrex America	75
Clinton Electronics	9	Panelight Display Systems	82
CRT Scientific Corp.	70	Philips Display Components	83
Data Ray	74	Photo Research	C4
Display Laboratories, Inc.	22	Physical Optics Corp.	81
Display Works 96	80	Plasma-Therm, Inc.	72
Earth Computer Technologies	83	Quantum Data	24
Endicott Research Group	66	Rank Brimar	25
Florod Corp.	19	Rantec Microwave & Electronics	70
H. L. Funk Consulting	82	Specialty Coating Systems	79
Gamma Scientific	74	Tamarack Scientific	13
Graseby Optronics	67	Taylor & Francis	78
Hosiden Corp.	65	Team Systems	63
Imaging Processing Systems, Inc.	73	Texas Instruments	42,43
Infinity Multimedia	76	3M Electronic Display Lighting	60
Interserv	7	3M Optical Systems	6
Intevac	5	Timeline	78
Kent Display Systems	23	TNP Instruments	81
Klein Optical Instruments	77	TÜV Rheinland	21
Korry Electronics	82	Video Instruments	84
Kurdex/Thin Film Products	82	Yamaha	C3
Landmark Technology	83	XMR	8
LCD Lighting	25,64	XTEK Electronics	83

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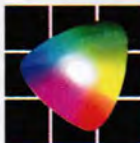


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