

Official Monthly Publication of the Society for Information Display

# INFORMATION DISPLAY

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Vol. 10, No. 7&8

INDUSTRY DIRECTORY ISSUE



Directory of display industry  
Optics for HMDs  
CeBIT '94

Cover: Photonics' 30-in. ac-plasma display panel – which was exhibited at SID '94 in June – has 1024 × 768 full-color pixels on a display area of 24 × 18 in. for a full-color pixel pitch of 0.59 mm. This panel has the largest number of full-color pixels of any emissive flat-panel display made to date. The average white-area luminance is 30 fL, there are 64 gray levels per color primary, and the frame rate is 60 frames/s, progressively scanned.



Photonics Systems, Inc./Photonics Imaging, Inc.

## Next Month in Information Display

### Monitor Issue

- Microprocessor-controlled monitors
- Where are CRT monitors made?
- European monitor market scene
- The Way to San Jose

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## Polizei for the Infobahn

In his "Display Continuum" column this month, Aris Silzars points out that the Information Superhighway – now being called the "infobahn" as the original moniker dies from overuse – is not the ideal conduit for all kinds of information, and that it is not always best for us to receive only the information we think to ask for. There are benefits, Aris shows us, in allowing a third party to assemble the information we

receive, to make that information more accessible, and to surprise us with the selections. There is a name for that third party. The name is "editor."

Editors serve a variety of functions, but one of the most important is quality control. Reviewers and critics stand guard over editors and control – or at least comment upon – the quality of editors' efforts. In the world of scholarly publishing, which includes technical journals such as the *Journal of the SID* and technical books, an elaborate peer-review process usually weeds out the utter nonsense.

The fairly high quality of "gatekeeping" that has grown up with print media over the last five centuries has not yet developed for electronic media. The problem is least serious where there is no pretense of gatekeeping. If you put your dipper into the information sewage on the Internet, CompuServe, or any other largely unregulated network, you may find some diamonds in the brown sludge you scoop up, but you know darn well that sludge is not beef bourguignon. Let's leave my unfortunate metaphor in the sludge where it belongs and simply say that you will have to make up your own mind as to the quality of the information in your dipper.

The problem is far more serious when your source is a glossily produced commercial product that looks enough like its print analog that you think printerly standards apply. One unfortunate example that has come my way is Microsoft's beautifully produced Encarta™ multimedia encyclopedia.

New print encyclopedias (and new revisions) are carefully reviewed in publications aimed at professional librarians – and sometimes in more general publications. As a result, most reference librarians have a hierarchy of major encyclopedias (and other reference works) in their heads. This hierarchy includes intended readership (grade school, high school, literate adult, illiterate adult, etc.), clarity, accuracy and reliability, and whether the work is up to date. If you look very hard at Encarta's documentation, you will find (but only on the copyright page) that it is based on the Funk & Wagnalls *New Encyclopedia*. This is the encyclopedia that is sold in supermarkets, rarely appears on library shelves, and spent some time as a national joke during the heyday of Rowan and Martin's old "Laugh-In" television show.

The extremely successful Encarta is not a worthless product, but it is dangerous because Microsoft's skillful product packagers have put a very high gloss on an unreliable basic source. One example: the article on quantum theory, which is signed by the eminent George Gamow, has a final paragraph that refers to developments that occurred after Gamow died. Gamow's judgments in this field are second to none, but who added the post-Gamow material? Furthermore, since I'm now justifiably suspicious of Encarta's scholarly standards in general, has Encarta (or Funk & Wagnalls) modified the material Gamow wrote and

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## the display continuum



### Just Imagine...

by Aris Silzars

Just imagine. It is a few years from now and the "Information Superhighway" is mostly in place. It is early morning and the start of what you expect to be a typical work day. As usual, there is just barely enough time to enjoy a quick bowl of your favorite cereal and a second cup of coffee. As every morning, you do a little "parallel processing" and catch up on the latest world, business, and technology news. Life is so much more efficient now with the personalized newspaper flashing up on the computer screen in front of you. The articles have been selected from the interest profile you provided and you get exactly the news you said you wanted at a cost per article that seems a little steep, but then "that's the price of progress," you think to yourself.

Meanwhile, what do you think is happening at my house? Well, I too am having my breakfast cereal and catching up on the news. However, mine is still the old get-your-hands-all-dirty kind of newspaper. I decided some time ago that I liked scanning the ads, gaining wisdom from the cartoon strips, tut-tutting over all the weird goings-on in the world, and finding information that I couldn't possibly have thought to put into an interest profile, or perhaps would have been too embarrassed to include. And I like the price – the advertisers are still picking up most of the cost.

Just imagine. It is later that same day. Work was not quite as routine as expected, the commute home was a major hassle, and you are more than happy to have a few hours to relax before calling it a day. Being a bit stressed, you can't quite decide what to do. Maybe read a book – maybe see what's on TV. You scan your computer for the book listings available for printout at home. Finding a new one that looks quite interesting, you go ahead and order it to be sent via remote-printing. While your printer is churning out the pages, you decide to see what might be available on the 500 channels recently installed on the new fiberoptic network. The entertainment portion is easy to find – it's the first 50 channels. The free portion (advertiser supported) is even easier to find – it's the first 12. Of course, there are many other free channels, but they all sell stuff full time. It also seems that every religious organization now has its own 24-hour/day channel. Many of the other channels are set up for "interactivity." However, with the kind of day you've just had, the last thing you want is to do more problem solving or game playing. After all, isn't that what happens at work? In any case, your book will be ready soon, so you just "channel-surf" the no-charge stuff before giving up for the evening.

The book you ordered turns out to be better than expected. The \$25 charge that was instantly billed to your credit card is certainly reasonable, and you only had to wait 20 minutes for it to print. "If only it didn't feel so much like a stack of work papers," you think to yourself. "Oh well, one has to be willing to compromise a little for the benefits of the Information Age, doesn't one?"

What about me? Well, my day didn't go much better than yours. So, I too have tried a bit of free "channel-surfing" and likewise have given up after not finding anything that appeals to my depleted brain cells. However, the previous Sunday I pursued one of my favorite activities and spent a few hours browsing the latest titles at one of the areas larger bookstores. Having found one I liked,

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# Optics for Head-Mounted Displays

*No matter how good the display, it takes a well-designed optical system to get the image to the eye.*

by Robert E. Fischer

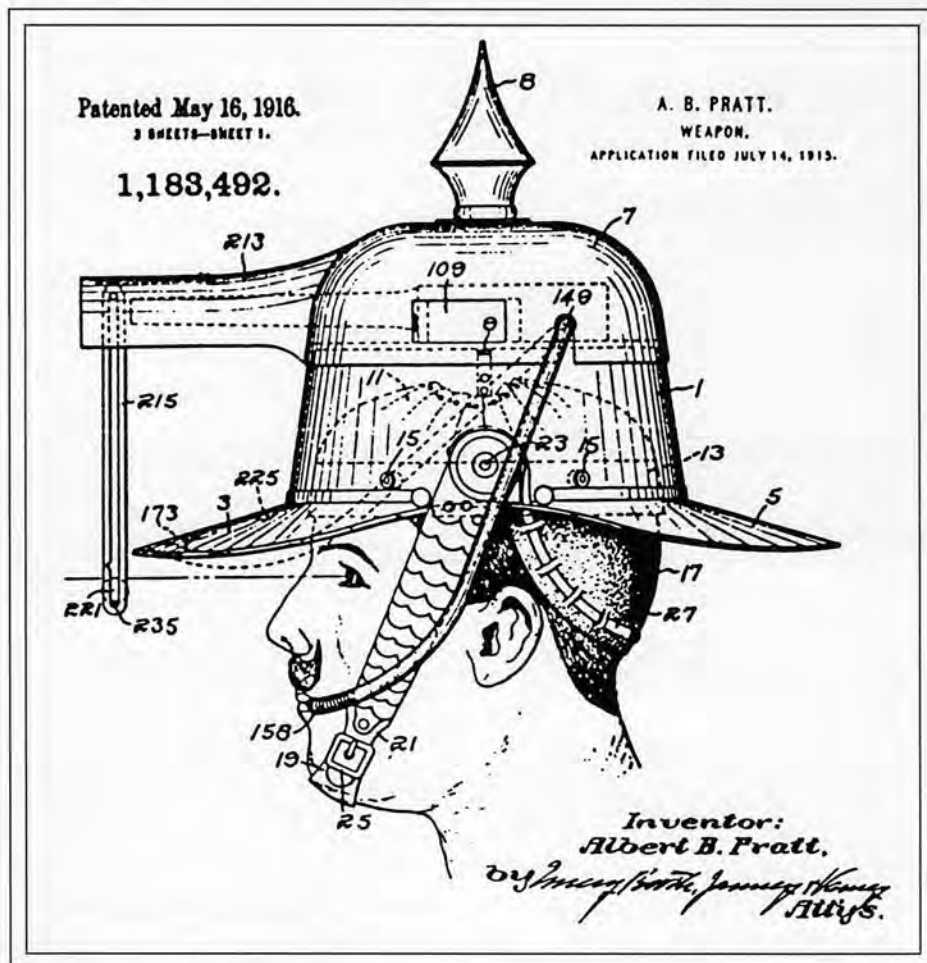
**H** EAD-MOUNTED DISPLAY (HMD) SYSTEMS are finally emerging from the military environment and establishing themselves in virtual-reality (VR), consumer, and industrial applications. The first consumer-oriented HMD product – the Virtual Vision Sport by Virtual Vision, Inc., Redmond, Washington – was exhibited at SID '93 in Seattle, Washington, and similar systems are likely to follow. Our own recently introduced PT-O1 represents another point on the product continuum – a high-end system for industrial and medical applications.

Many military helmet- and head-mounted display systems have been fielded over the years for applications ranging from night-vision systems to avionics. The first helmet-mounted display may have been part of a head-mounted weapon system patented in 1916 (Fig. 1).<sup>1</sup>

HMD systems are dependent on several key technologies:

- **Display device.** Arguably the most technically challenging part of an HMD. Current technologies include LCDs, CRTs, ELDs, and several others.
- **Drive electronics.** Must be small, lightweight, and low in cost.

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**Fig. 1:** This 1916 patent included what may be the first head-mounted display. The technology is more than three-quarters of a century old – and looks it – but embodies the same philosophy that motivates the sophisticated “look-and-shoot” systems now being developed for combat aircraft.

- **Mechanics.** The mechanical housing and the associated mechanism for supporting the HMD on the head in a comfortable yet functionally acceptable way. Included are the frequently required adjusting mechanisms for focus and interpupillary distance.
- **Viewing optics.** Required to view a small high-resolution display. If the eye could focus closely enough, the viewing optics would not be required, but this is not the case.

The display designer's job is frequently considered to be done upon delivery of a prototype panel that meets specifications. During the system-integration and product-refinement phases, design of the viewing optics is often neglected until very late in the game. So, let's embark upon some optical consciousness-raising.

### The Eye: Optical Subsystem

The eye is an optical subsystem that interacts with whatever other subsystems an optical designer creates, so designers must be conversant with the eye's optical properties. The human eye can "see" over a full field of view of slightly over 100°. At the center of this field of view, the eye resolves approximately 1 minute of arc, or 0.0003 radians. This equates to resolving approximately 1 mm at a distance of 10 ft. Beyond 10–15° from the fovea – which is essentially the center of the eye's field of view – the resolution degrades significantly. At only 10° from the fovea, the visual acuity is only 20–25% of that in the foveal region, but a person can rotate or "gimbal" each of his eyes over approximately ±45°. Since this usually allows the eye's foveal region to be aimed at any portion of the display's field of view, the display and its associated viewing optics must perform relatively uniformly over the entire field of view.

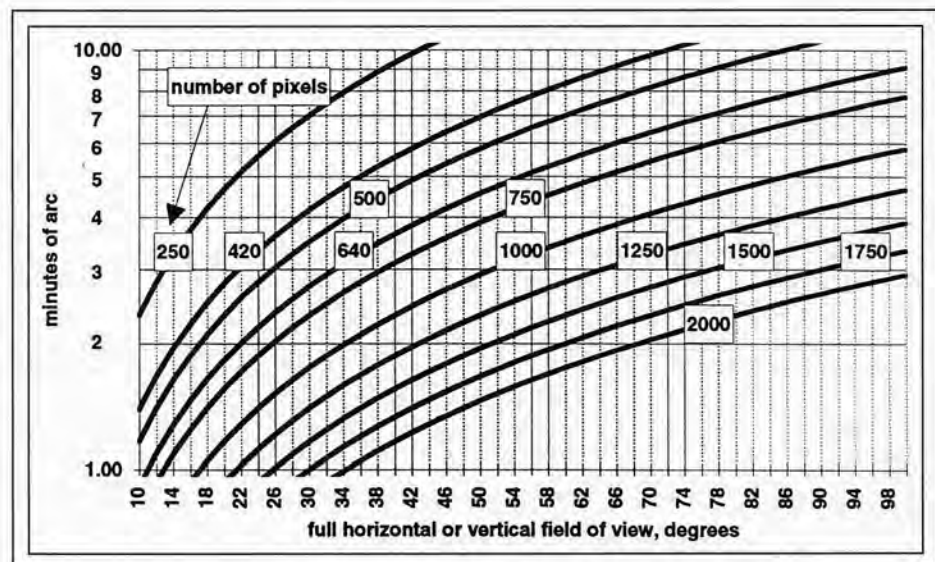
To appreciate what is required of viewing optics, let's first look at the optics involved in a movie theater that uses 35-mm film in its horizontal or landscape mode. A reasonably good lens will have a modulation of about 30% at 50 line pairs per millimeter (lp/mm), which means that a spot (on the film) of about 1/100 mm will be resolvable. Since the film is 36 mm wide, there are 3600 horizontal resolution elements, or 8,640,000 resolution elements over the entire format. If we project the image onto a screen viewed over a visual field of 40° horizontal, we have 90 resolution ele-

ments per degree or 2/3 minute of arc per resolution element. This is well matched to a human being's visual acuity.

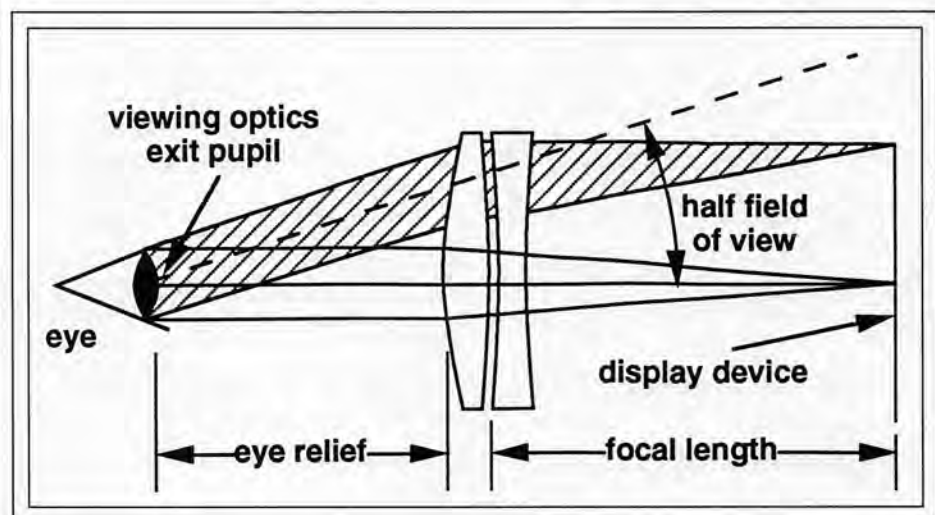
Consider a similar situation, but now let's use a 512 × 512-pixel LCD or similar display device. For the same 40° field of view, we find 12.8 resolution elements per degree – or 4.7 minutes of arc per resolution element.

This is not too bad, but it will take at least a 1000 × 1000-pixel display before the image begins to look really good. (This is approximately the format that will be used for HDTV.)

A plot of resolution (expressed as arc minutes subtended per pixel or line) versus the full field of view (in degrees) for displays



**Fig. 2:** A plot of resolution (expressed as arc minutes subtended per pixel or line) as a function of field of view (in degrees) and the number of pixels or lines quickly tells you that covering a 35° field of view with 1-minute-of-arc resolution requires 2000 pixels. It is also a reminder that the number of pixels in a line is not at all the same as the display's horizontal resolution.



**Fig. 3:** The important first-order optical properties of simple viewing optics for HMDs involve only a few parameters. (First-order optical design is an initial design that assumes ideal optical elements.)



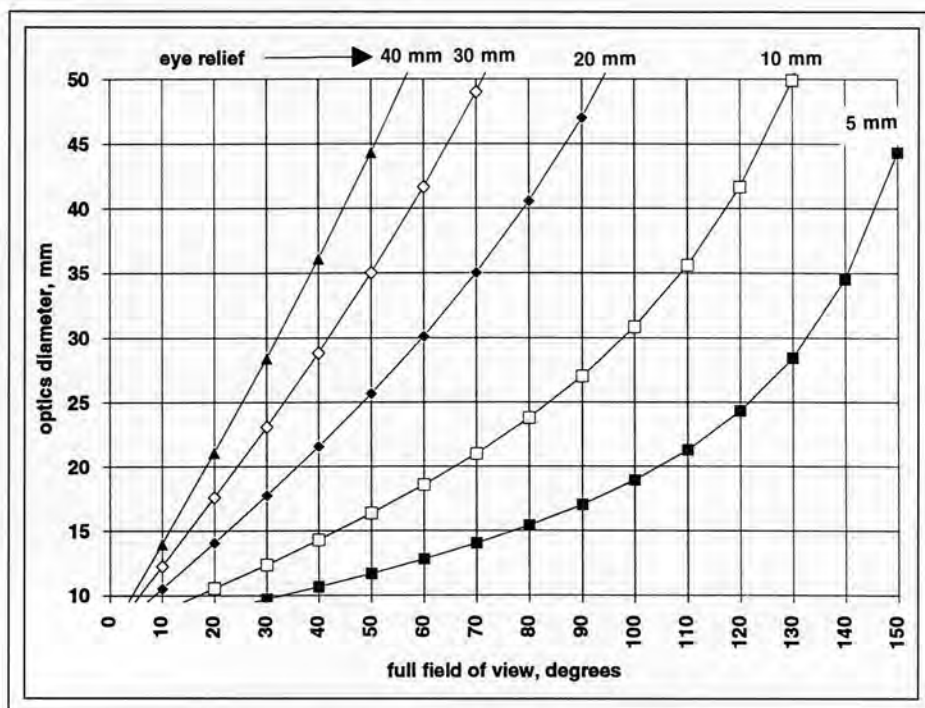


Fig. 4: For a given angular field of view presented to the user, increased eye relief requires larger and heavier viewing optics.

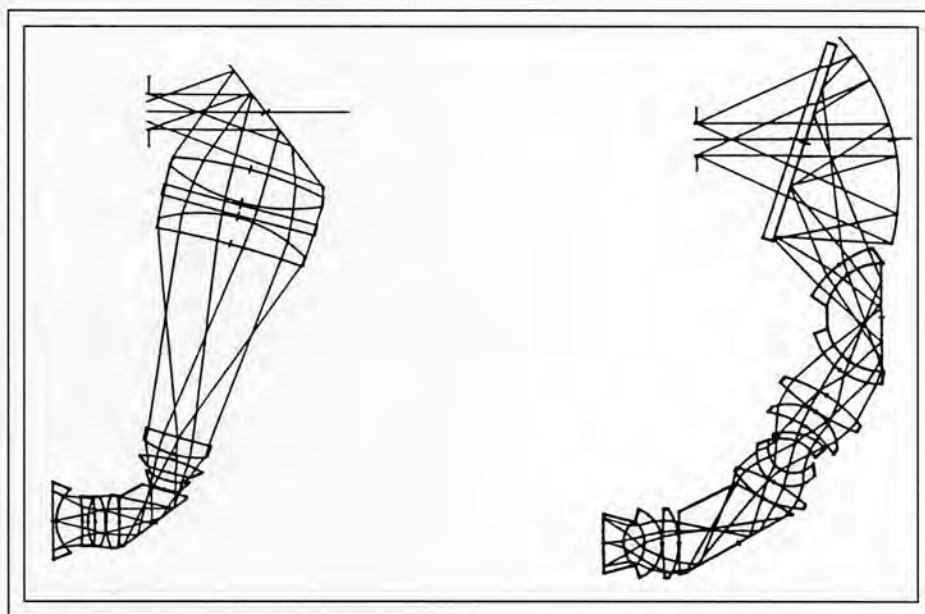


Fig. 5: Bulky display devices, such as CRTs that cannot be mounted in line with the eye, may require complex and heavy relay optics, which inevitably degrade image quality.

having various numbers of pixels or lines is a useful tool (Fig. 2). Such a plot quickly indicates that covering a  $35^\circ$  field of view with 1-minute-of-arc resolution requires 2000 pixels.

### Viewing a Small HMD

Now consider the optics of the eye and the basic "first-order optics" of how we can view a small HMD with a simple lens or magnifying glass (Fig. 3). The most important parameters are labeled in the figure. The diameter of the pupil of the eye can be 7 mm in dim light and can decrease to between 2 and 5 mm in bright light. Viewing optics are typically designed to yield at least a 5–7-mm pupil diameter. A larger pupil is often desired in order to allow the eye to move around without losing imagery. Looking at the exit pupil of the viewing optics is like looking through a porthole – the larger the porthole the better.

The other item of importance is eye relief, or the distance from the rear of the viewing optics to the eye. Optics with extremely short eye relief – a few millimeters – are extremely inconvenient and uncomfortable to use. This is not uncommon in microscopes and similar instruments, but it would be unacceptable in a head-mounted application. Users with glasses require at least 25 mm of eye relief if they are to see the entire display. For a given angular field of view presented to the user, increased eye relief requires larger viewing optics. This becomes a critical design tradeoff because larger size means added weight, as well as degraded optical performance. This is clearly indicated by a plot of the diameter of the first-order viewing optics as a function of field of view and eye relief (Fig. 4). This plot can only be used as a guide; the details of lens designs may change the specific results. As we increase eye relief, we are using more of the outer periphery of the lenses in the viewing optics, and this often produces an increase in image-degrading aberrations. Clearly, designing the viewing optics for today's high-performance displays is a non-trivial and challenging task.

While it would be nice if a single lens element provided high-quality imagery, virtually all imaging optical systems are afflicted with aberrations. These include the following monochromatic aberrations:

- **Spherical aberration.** Rays at the outer periphery of a ray bundle focus closer to or further from the lens than rays closer to the optical axis.

- **Coma.** An off-axis aberration in which the image of a point appears as a small comet-shaped blur.
- **Astigmatism.** An off-axis aberration in which light in one plane – such as the plane of this page – focuses at a different position than light in the orthogonal plane.
- **Curvature of field.** The optimal image surface is curved in a spherical shape rather than flat.
- **Distortion.** A mapping error in which a uniform grid images to shapes resembling either a pincushion (positive distortion) or a barrel (negative distortion).

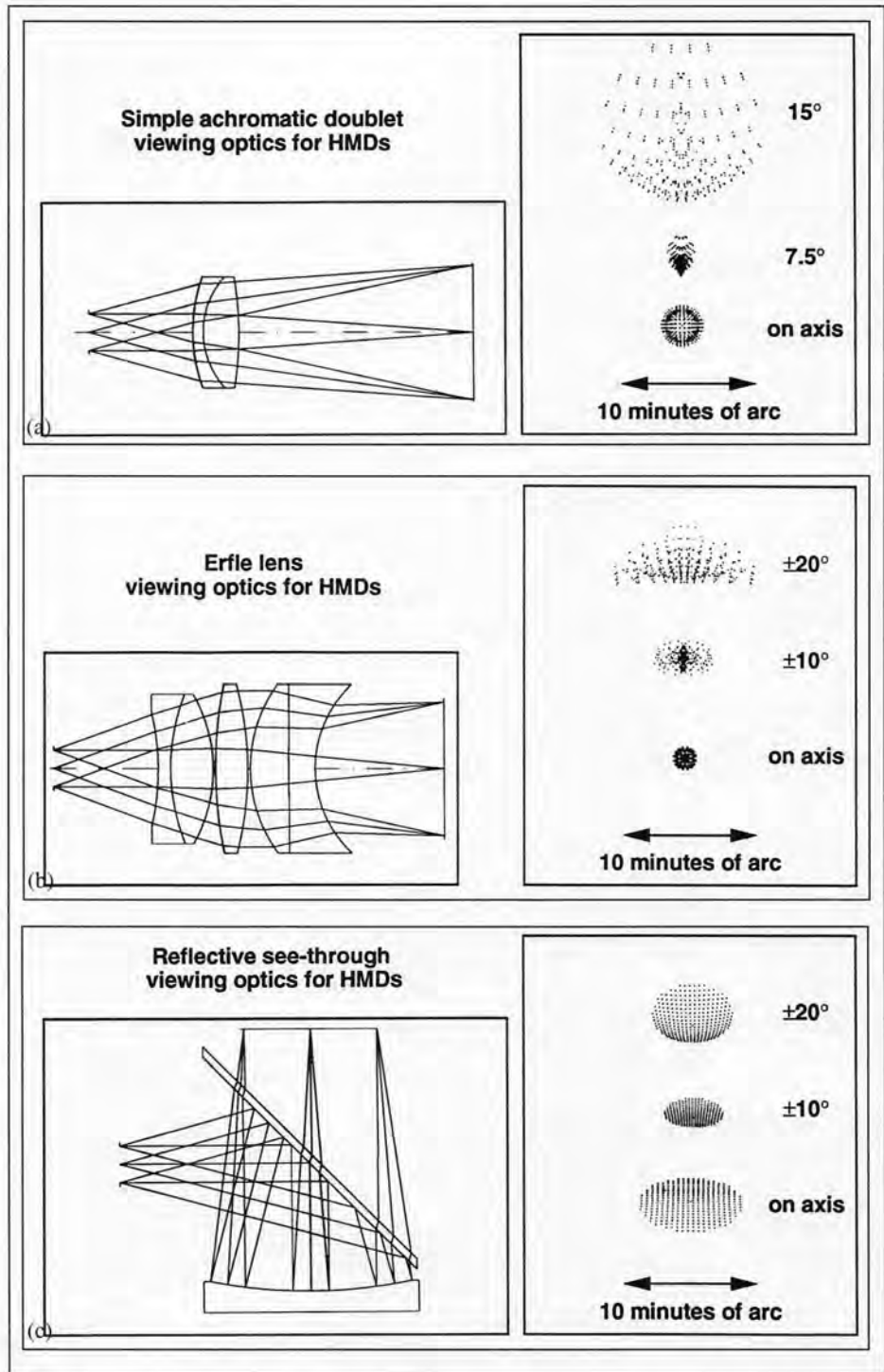
There are also chromatic or color aberrations:

- **Axial color.** Different wavelengths of light focus at different positions along the optical axis. This on-axis aberration tends to carry over the entire field of view.
- **Lateral color.** Otherwise sharp edges appear to have color fringing. Lateral color is a wavelength-dependent change in focal length or magnification that occurs at the outer periphery of the field of view.

All of these aberrations can be present in HMD viewing optics, with lateral color, distortion, astigmatism, and field curvature the most difficult to control. These aberrations increase with pupil diameter, field of view, and eye relief, making the problem more severe for some of today's VR-related "immersive" systems with very wide fields of view. Even though the eye is somewhat forgiving, the presence of lens aberrations clearly affects the perception of reality.

There are two basic forms of HMD optics: (1) a direct-view magnifier approach and (2) relay optics, which are more complex. If the display device is a small LCD panel, the former is often the choice. However, if the display device is a bulky CRT that can only be mounted, for example, on top of a helmet, then the optics must naturally be more complex (Fig. 5).<sup>2</sup> The system in the figure may be one of the more complex examples, but it clearly shows the added size, weight, and cost associated with these kinds of systems. And complexity inevitably degrades image quality.

HMD viewing optics for a compact LCD panel can take the form of a simple magnifier; a conventional eyepiece, as used with tele-



**Fig. 6:** Different designs for HMD viewing optics have different strengths and weaknesses. (a) A simple achromatic doublet offers a good field of view, but its optical quality is poor. (b) A classical eyepiece provides reasonable performance over a field of 30–40°. (c) A concave mirror is inherently free of chromatic aberrations and yields good performance over a reasonable field of view. The spot diagrams on the right of each figure show the optical output image at various angles off the optical axis when the input is a square array of dots.



scopes and microscopes; catadioptric systems, consisting of lenses and mirrors; all-reflective systems; or complex viewing optics, consisting of lenses and/or mirrors. The goal is to provide an acceptable level of image quality over the required field of view, while meeting the other system objectives, including eye relief, low cost, low weight, and small package size.

A variety of design forms have been used for HMD viewing optics. A simple achromatic doublet lens group meets the field of view and some other requirements [Fig. 6(a), left]. The spot diagrams on the right of the figure are a standard technique for indicating the optical quality of a system [Fig. 6(a), right]. In each case, the input to the optical system is a circular bundle of rays 7 mm in diameter – the maximum diameter of the eye pupil. The output patterns on the optical axis and at various viewing angles from the axis are indicated in the spot diagrams. Clearly, the system of Fig. 6(a) has poor optical performance.

A classical eyepiece provides reasonable performance over a field of 30–40° [Fig. 6(b)]. A reflective system obtains its optical power from a concave mirror [Fig. 6(c)]. Mirrors, by their nature, have no chromatic aberrations, and such a configuration yields good performance over a reasonable field of view. While the illustrated configuration offers see-through capability, the beamsplitter limits system throughput to only about 25% and introduces astigmatism, which shows in the spot diagrams.

While spherical surfaces are preferred for lenses because of their low cost and ease of fabrication, aspheric surfaces have great potential for minimizing aberrations and improving image quality. One lens fabrication method that is well suited to aspherics is injection molding. Tooling can be expensive – nearly \$10,000 per element – but the final product can cost on the order of \$0.50 per element.

A technology that has only recently become both popular and producible is diffractive

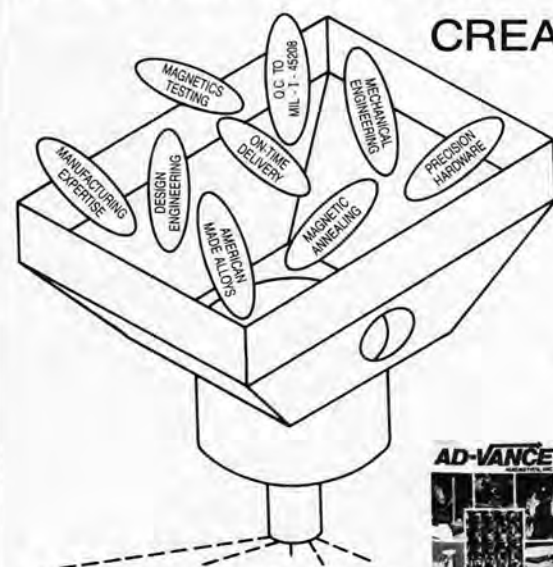
optics. This form of lens surface takes advantage both of refraction, as does a conventional lens, and diffraction, as does a diffraction grating. What is interesting and valuable here is that gratings and base glass elements have opposite signs for chromatic dispersion, and therefore allow designers to control aberrations more effectively with fewer elements. Diffractive surfaces can also modify the wavefront non-spherically, much as aspheric surfaces do, and therefore provide the designer with significant opportunities. But the designer must be careful – scattering and other subtle effects can be a real problem.

Display devices have improved and will continue to improve rapidly. As displays themselves mature, the viewing optics are likely to become one of the more challenging HMD subsystems and may become the limiting factor in system performance. Thinking about optical design early in the development of an HMD system could result in a less expensive system that offers improved performance and gets to market earlier.

## References

- <sup>1</sup>G. F. Marshall, "Back from the Past: The Helmet Integrated System of Albert Bacon Pratt (1916)," *SPIE* 1116, 4 (1989).
- <sup>2</sup>D. J. Rotier, "Optical Approaches to the Helmet-Mounted Display," *SPIE* 1116, 14 (1989). ■

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# CeBIT '94

*Germany's annual March extravaganza is the world's largest information-technology trade show.*

by Bryan Norris

**T**HE HANNOVER FAIR again lived up to its reputation for being one of the world's major forums for advanced and innovative products – posing a major challenge to those trying to cope with dense crowds of attendees, cover an immense area, and see a significant portion of the overwhelming number of exhibitors stands.

Definitely the largest information-technology (IT) and communications trade fair in Europe – probably in the world – Hannover, Germany's CeBIT '94 was nearly as big as CeBIT '93. From March 16-23, 5727 exhibiting firms (5752 in 1993) occupied 308,033 m<sup>2</sup> (309,703 in 1993) in 21 (22 in 1993) of the 25 halls of the enormous permanent Hannover Fair site. The number of countries represented actually increased from 45 to 54, with 2210 exhibitors coming from outside Germany. Canada, famous for its 4000 software supply companies, was this year's "Partner Country," and nearly doubled the number of its exhibitors to over 100 this year.

This year's attendance was 670,000, up 20,000 over last year. With over 50,000 vehicles a day fighting their way into the numerous car parks through CeBIT's traditional bad weather – heavy rain and snow showers – it is perhaps not surprising that a major game in the press lounge was for reporters and editors

to boast how long they had been stuck in the traffic jams.

On the first day, too, the weather affected the electricity supplies to the trams, and scenes reminiscent of Tokyo's subways during rush hour were enacted at each stop as hordes of fairgoers tried to surge aboard already overcrowded No. 8 trams. Only the "pushers" were missing! But once you get to the Hannover Fair site, there is *always* plenty to see and learn at the CeBIT show!

The most notable theme running through the show, especially where monitors and PCs were concerned, was the need to be "green": environmentally friendly, ergonomically acceptable (which includes being flicker-free), overscanned to eliminate unsightly black borders and provide the largest possible image, made of recyclable materials, and generally respectful of the need to save energy. Green is today's favorite color in Germany – as well as in Italy and much of the rest of the world.

At the show many monitor companies promoted their green monitor line, including Nokia, Qume, Samsung, Samtron, and TVM. Some companies now incorporate green into their names: Green Monitor Co., Greentronix, Green Knight Enterprise. Others, most noticeably those from the Nordic/Scandinavian area, employ user-friendly words such as "Ergo" (notably, ICL, Royal, Tandberg, and Taxan, which was also seen on the Computer 2000 stand). The search is on for new features to sell monitor products, especially those that have a green theme to them.

In Europe, MPRII is now almost taken for granted, and virtually all the new monitor introductions at the show have MPRII, at least

as an option if not as standard. (However, there is still some reluctance in Southern European countries on the part of the end user to pay any extra for this "no importante" feature.)

Debate is now warming up as to the merits of reducing emission levels even further to meet TCO '91 requirements. Certainly, from a purely technical point of view, insistence on meeting such stringent test levels is nonsense. But with heavy promotion from certain suppliers and the Swedish professional trade union, TCO, itself, there is no doubt that certain buyers, particularly at certain institutional, governmental, or civil bodies in Sweden, Norway, and, increasingly, Germany, will insist that the monitors they buy meet TCO standards.

Coupled to the fact that TCO '92 incorporates a stringent power-down requirement, it was noticeable at CeBIT '94 that more and more monitors promoted their TCO '92 labels. In addition to the traditional TCO promoters, such as Eizo from Raab Karcher, ICL, Nokia, and Tandberg Data, other companies, including IBM and Mitsubishi, were also showing monitors with this label – even on 21-in. models. This despite the need for a bonded antireflection/antistatic panel to achieve the very tight requirements – a panel that costs about \$300 more than silica coating. It thus seems as though TCO '92 may become a user-requested feature rather than a niche-marketing ploy, albeit this may be true only in Northern European monitor markets.

Power-down is a feature that *does* make real sense for a monitor! It seems hardly believable that this capability was introduced

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in only a few models at last year's CeBIT. This year the majority of models introduced were fitted with one form or another of power management. Some monitors even reduced their power consumption to levels as low as

3 W, well below the "under 8 W" NUTEK requirement.

So, with microprocessor control, low radiation, flicker-free refresh rates, overscan, antiglare, antistatic, environmental friendli-

ness, and power-down monitors now almost being the norm, what else was to be seen at this year's CeBIT?

### Aperture-Grid CRTs to the Fore

On the Nokia stand in Hall 7, there were two new monitor models displayed. Both, naturally, were green and user friendly, with MPRII and TCO '92 certificates, antistatic/antiglare-coated screens, power-saving to VESA DPMS™, microprocessor controlled, and flicker-free to resolutions up to at least 1024 × 768 at 76 kHz. First there were the expected 17-in. models – the 447 30–79.3-Hz *M* version and the 30–102-kHz *X* version. Both of these are fitted with the new Sony Trinitron® SAI 0.25-mm aperture-grid tube. The 447X won the CeBIT Highlight of 1994 award. But also on display was the new 449M 15-in. model, and this was definitely not expected! It incorporates a 0.26-mm-dot-pitch 15-in. Sony Trinitron® tube – yes, a 15-in. Trinitron®. The 449M is the first monitor to incorporate this tube.

Compaq and the high-end graphics-card maker SPEA also introduced new 17-in. Trinitron® models – the QVision 172 ES and 1782 MS, respectively – at the show. Furthermore, Apple added the Apple Multiple Scan 20-in. (Trinitron®) color monitor to its range, and graphics-board producer ELSA added the GDM-20 E40T 29–85-kHz model. In the last half of 1993, MAG monitors have been selling very well in Germany. The sales have been through and are backed by miro – another large German graphics-system producer. The MAG 17S Trinitron® model is especially popular. There are, of course, other Trinitron® models in miro's own-brand range.

The number of suppliers incorporating the 21-in. aperture-grid tube from Mitsubishi (Diamondtron®) has also grown considerably since that tube was introduced in the miro C2185 at CeBIT '93. As well as supplying to miro, Mitsubishi Monitors OEM serves HP and IBM. A Diamondtron® CRT is also in the new IDEK Iiyama 23.5–90-kHz Vision Master 21 (MT-9121), which has the full set of deluxe features, including remote-control setup using the on-screen display (OSD). Mitsubishi itself has two Diamondtron® models on offer, the forthcoming 30–93-kHz THN-9105 SFKL with bonded AR panel and TCO '92, and the now-on-sale less-expensive triple-silica-coated 30–85-kHz Pro 21T.



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Other suppliers are also planning to use this tube.

### Digital Electronics Improves FST Models

On its stand and at a special press conference, Philips introduced the revolutionary Cyber-Screen® technology developed in its R&D laboratories in Saronno, Italy. The technology was shown on the Brilliance 21A FST 30-82-kHz monitor scheduled for production later this year. This monitor uses digital technology to control the beam to each point on the screen and achieve optimum convergence, color, and brightness, and to enter the necessary information into its built-in computer at the factory. The alignment process sharply reduces manufacturing spreads. Furthermore, the monitor's circuits automatically compensate for the effects of external magnetic fields by monitoring an internal magnetic sensor to detect changes and maintain picture quality. Typical figures for traditional specifications at the corners of a CRT for maximum convergence, brightness uniformity, and color uniformity over the screen are thus improved from 0.4 mm to typically 0.14 mm, 75% maximum to over 90%, and 0.015 minimum to 0.006 maximum, respectively. Thus, with the FST itself having a new dynamic astigmatism and focusing (DAF) system with a quadruple lens to reduce astigmatism and produce a smaller spot, and antireflection/antistatic treatment, the 21A monitor promises to give a much improved level of performance.

Still on the environmentally friendly theme, ICL introduced the small AutoBRITE module, which sits on top of the monitor, senses lighting conditions in the room with two detectors, and enables the software program in the new ErgoPRO 17C monitor to modify the brightness and contrast to suit local conditions. The module also includes an infrared transmitter compatible with normal IR-controlled office lighting systems.

### The PC in the Monitor

On the Tandberg Data stand, the new ErgoScan 17c 30-65-kHz monitor joined the existing ErgoScan 15c. Also there was what appeared at first sight to be a 17-in. monitor with front controls sitting behind a keyboard. Hey, wait a minute! This is not just a monitor, it is a 486 PC within a monitor — the Ergo-Station™ 17c PT in fact. This machine can be configured with an internal hard disk and a

floppy disk or a PCMCIA (PC memory interface association) memory-card adapter. Further flexibility is achieved with an ISA (industry standard architecture) bus allowing use of

standard ISA network adapters for connection to all type of networks and environments. For example, the 17c PT can be used as a networked PC or as a replacement for IBM- and

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DEC-compatible terminals (with ErgoTerm software from Tandberg Data installed).

The flexibility to take into account the now rapidly declining terminal market during the transition to networked PCs was also seen on the ICL stand. ICL's ErgoView terminals, based on the "ICL Open Display" concept, can be transformed easily into Ergo-CLIENT™ PCs by swapping the current personality board fitted under the monitor for one that introduces high-performance (486 SLC) PC functionality and a ready-to-use network interface to an Ethernet or Token Ring LAN.

### Challenges to Traditional Suppliers

It was noticeable, looking round the fair, that nearly all of the major PC suppliers also have a good range of up-to-date monitors to go with their PCs, unlike the situation less than 2 years ago. Many of these PC houses will more than likely sell these monitors on the European open market in competition with the traditional monitor suppliers. We have already seen signs of competition from Apple, Compaq, HP, IBM, and ICL.

At CeBIT '94, new monitors were on display from Apple (a 30–82 kHz, 20 in.) and Compaq (a 31–82 kHz, 17 in.). Incomprehensibly, IBM reverted to its old numbering system, baffling to IBM staff and end user alike. Instead of promoting the economy 31–48.5-kHz 14-in. and the 30–64-kHz 17-in. models as the easy-to-remember 14L10 and 17S, IBM identified them at the show as the 6322 and 6327, or even worse, as Part Numbers 68G 2868 and 39G 3388. Unbelievable! Nevertheless, IBM now has a very impressive up-to-date monitor line, and showed off its February 1994 TCO '92 certificates for the 14-, 15-, 17-, and 21-in. "XG" range of monitors.

In addition to the Taiwanese brand names seen and well known in Europe for some years – Acer, ADI, CTX, and Sampo, for example – there were a host of less well-known Taiwanese monitor makers exhibiting at CeBIT '94, often in one of the small booths that formed part of the Taiwanese village. As expected, their prime products are SVGA 14-in. models, but most also offered other screen sizes, especially 15- and 17-in. models, with a few 20- and 21-in. models.

Where price is the only criterion, these companies present a strong challenge to the established suppliers. But where other factors, such as service backup, are taken into consideration, the well-known and well-es-

tablished brand names still have the edge – especially in European countries north of the Alps.

### Flat on the Desktop?

The day when an FPD stand-alone monitor will really challenge the traditional CRT high-resolution data-graphic monitor is still a very long way off. There was the traditional spattering of stand-alone TFT-LCD monitors on show. These were primarily displayed by small niche makers such as Norwegian ASK and German ergoview, but Norwegian Davis did not promote such a unit this year, stating that it was holding production until prices fell and the market grew. A few conventional CRT monitor suppliers – such as Nokia, Raab Karcher (Eizo), Tandberg, and Taxan – also exhibited LCDs on their stands, indicating that they too possessed the complete range of ergonomically friendly monitors. ICL, too, has included an LCD monitor in its range for some time, and HP had a made-for-exhibitions LCD model in the middle of its large

stand in Hall 1. But overall, the emphasis was on LCDs in projector displays, not monitors. Sharp, a major influence on the future of FPD monitors thanks to its dominance of the panel supply, exhibited the relatively new 10.4-in. TFT-LCD computer/video monitor, the QD-100MM, which displays up to 16 million colors and sells to dealers for 8869DM (US\$5199).

However, at much lower prices than this, LCD monitors are beginning to sell. The first 1000-piece order has been received by one supplier from a Swedish customer, and there was talk at CeBIT of 5000-piece orders being negotiated.

The traditional monitor suppliers exhibiting at CeBIT '94 have obviously come to the conclusion that nowadays it is not sufficient to supply their monitors just with all the latest features such as power saving. In order to compete, makers are looking to provide that (hopefully) valuable extra innovation, and be "green" and "user-friendly." ■

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# Industry directory

*ID's eighth Annual Directory of the display industry continues to grow with over 750 entries.*

COMPILED AND EDITED BY 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 27.

## Part I: Products and Services

### ANTIREFLECTION COATINGS

See optical coatings

### ANTIREFLECTION SCREENS

See filters

### ANTISTATIC CHEMICALS AND DEVICES

□ ACL/Staticide □ Bates Mfg. □ W. H. Brady □ Computer Based Controls □ Exxene □ Homalite □ Micro Circuits □ Romag Glass □ Screen Shield □ Tech Spray □ Teknek Electronics □ 3M Electrical Specialties □ Viratec

### ASSOCIATIONS AND PROFESSIONAL SOCIETIES

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

### BACKLIGHTS (for liquid-crystal displays)

□ Axonix □ BKL □ Courtaulds □ Data General □ Delco Electronics □ Densitron □ Dimension Technologies □ Display Engr. □ Display Systems □ Durel □ Elform □ ELtech □ Eucran □ Flat Candle □ Futaba □ General Electric □ Ginsbury □ Hamlin LCD □ Hewlett-Packard □ Hitachi America □ Hoffman Engr. □ IEC □ ILC Technology □ Imaging & Sensing □ **Interface Products** □ IST □ JKL Components □ Landmark Technology □ LCD Lighting □ LEDCO □ Lighting Sciences □ Loctite □ Lumitex □ Modutec □ Pixel Products □ Racal Acoustics □ **Rantec** □ **Raytheon** □ Regisbrook □ **Reynolds Industries** □ SAIC □ Spire □ I. I. Stanley □ Stanley Electric □ Swiss Controls □ Teledyne Electronic Technologies □ TFD □ Thomas Electronics □ Three-Five Systems □ 3M Optical Systems □ Transicoil □ UCE □ Voltarc Technologies □ Wedgelight □ World Products □ Xentek

### BARCODE READERS

□ CBM □ Computer Based Controls □ Craft Data Ltd. □ Densitron □ Panasonic Industrial □ Pentax Technologies □ Percon □ Spectra-Physics

### CATHODE COMPONENTS

□ EEV, Inc. □ Eldor □ UTI Corp.

### CCD IMAGERS AND CAMERAS

□ Burle Industries □ CID Technologies □ Cicon ACMI □ Coreco □ Data Beam □ Delco Electronics □ Eastman Kodak □ EEV, Inc. □ EEV Ltd. □ EG&G Reticon □ Elkonix □ Fairchild Weston Systems □ Hitachi America □ Javelin Electronics □ Kollmorgen □ McMahan Electro-Optics □ MegaVision □ Mekel Engr. □ Optical Radiation □ Optronics □ Panasonic Industrial □ Philips Components □ Photometrics □ Pulnix America □ **Raytheon** □ Sarnoff Research Center □ Security Defense Systems □ Sharp Electronics □ Simtech □ Sony Display Device Group □ Symco □ Telesensory □ Teltron □ Vanzetti Systems □ Xybin

### CHARACTER RECOGNITION DEVICES

□ Computer Aided Technology □ Computer Based Controls □ Coreco □ Data Copy □ Eastman Kodak □ Optigraphics □ Semetex □ Sharp Digital Information Products □ Telesensory □ Voice Connexion □ Xerox Imaging Systems

### CID IMAGERS AND CAMERAS

□ CID Technologies □ Digital Vision □ **Raytheon** □ Xybin

### COMPUTER VIDEO INTERFACES

□ Computer Dynamics □ Covid □ Dolch Computer □ Extron □ Imagraph □ SAIC □ 3D TV □ Univision

### CONNECTORS AND SOCKETS

□ Caton Connector □ Computer Based Controls □ Connector Corp. □ Delco Electronics □ Elastomeric Technologies □ Elform □ Eucran □ General Atomics □ Hoffman Engr. □ ITT Cannon □ Molex □ Panduit □ **Raytheon** □

**Reynolds Industries** □ Stan-Allen □ Teledyne Kinetics □ 3M Electronic Products □ Young Technology

### CONSULTANTS

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### CONVERTERS, DIGITAL/ANALOG

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### CONVERTERS, POWER

□ Advanced Conversion □ Astrosystems □ Best Power Technology □ Computer Based Controls □ Del Electronics □ Endicott □ Flat Candle □ Intl. High Voltage Electronics □ Lorad Power Systems □ Murata-Erie □ Swiss Controls □ Toko America □ World Products □ Xentek □ Zytronic

### 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

□ ADEX □ Astronautics C.A. □ Aydin Controls □ Barco □ Barco Chromatics □ Barco Display □ Barco Video & Commun. □ Burle Industries □ Robert Busch □ Cadvision □ Calcomp □ Canadian Marconi □ Capetronic □ Cardion Electronics □ **Citronix** □ **Clinton Electronics** □ Computer Based Controls □ Computer-Time □ Conrac Display Products □ Craft Data, Inc. □ **Data Ray** □ Delco Electronics □ Digitran □ Display Laboratories □ Display Technologies □ Dotronix □ Eaton IDT □ EDL Displays □ Electrohome □ Electronic Image Systems □ Ellographics □ ETC Computer □ FIMI Philips □ General Electric □ Genius Technologies □ Ginsbury □ Honeywell □ Hughes Aircraft □ IBM □ Ikegami Electronics □ Image Systems □ Infodex □ Intecolor □ Interstate Electronics □ C. Itoh Electronics □ Keltron □ Kristel □ Lockheed Sanders □ Manitr Displays □ MicroTouch Systems □ Microvitec □ Mitsubishi Electronics America □ Monitron □ Monitronix □ MTL Systems □ National Semiconductor □ n-Vision □ Ocean Technology □ Opto-Cal □ Orwin □ Panasonic Industrial □ Pegasys □ Philips Consumer Electronics □ Philips Electronics □ Pixelink □ Pixel Products □ **Rank Brimar** □ Rasterops □ **Raytheon** □ Relisys □ Sampo America □ Sarnoff Research Center □ Sigma Designs □ Simtech □ Sony □ Sony Display Device Group □ Sony Graphic Display □ Stanley Palmer □ Symco □ Systems Research Labs □ Tatum □ Tektronix □ Thomas Electronics □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes



Electroniques □ Toshiba America □ Totoku Electric □ Ultimate Display Solutions □ Video Monitors □ Vidiwall □ Wells Gardner □ XYtron □ Zenith Electronics

#### CRT monitors, high-resolution (1000 x 800 & over)

□ ADEX □ Advanced Video Products □ AEG □ Apple Computer □ Apricot Sigmex □ Astronautics C.A. □ Aydin Controls □ Barco □ Barco Chromatics □ Barco Display □ Barco Video & Commun. □ Cadvision □ Capetronic □ Cardion Electronics □ Citronix □ Computer-Time □ Clinton Electronics □ Conrac Display Products □ Cornerstone Technology □ Dage-MTI □ Data Ray □ Digitran □ Display Laboratories □ Display Technologies □ Display Tek □ Dotronix □ EDL Displays □ Electrohome □ Electronic Image Systems □ Elographics □ ETC Computer □ Evans & Sutherland Computer □ FIMI Philips □ Genius Technologies □ Ginsbury □ Honeywell □ Hughes Aircraft □ IBM □ Ikegami Electronics □ Image Systems □ Imaging & Sensing □ Infodex □ Intecolor □ Interstate Electronics □ IST □ Kristel □ Litton Electron Devices □ Lockheed Sanders □ Mantron Displays □ MicroTouch Systems □ Microvitec □ Mitsubishi Electronics America □ Monitron □ Monitronix □ MTL Systems □ National Semiconductor □ n-Vision □ Ocean Technology □ Orwin □ Panasonic Industrial □ Pegasys □ Philips Consumer Electronics □ Philips Electronics □ Pixelink □ Pixel Products □ Plessey Naval Systems □ Rank Brimar □ Rasterops □ Raytheon □ Relisys □ Sampo America □ Sarnoff Research Center □ Sigma Designs □ Simtech □ Sony □ Sony Display Device Group □ Sony Graphic Display □ Stanley Palmer □ Symco □ Systems Research Labs □ Tatung □ Tektronix □ Thomson-CSF □ Thomson Tubes Electronics □ Toshiba America □ Totoku Electric □ Ultimate Display Solutions □ Video Monitors □ Whittaker □ XYtron □ Zenith Electronics

#### CRT monitors, monochrome

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Thomas Electronics □ Thomson-CSF □ Thomson Tubes Electronics □ Toshiba America □ Totoku Electric □ TSD Display Products □ Video Monitors □ Wells Gardner □ XYtron □ Z-Axis □ Zenith Electronics

#### CRTs, beam-index

□ Astronautics C.A. □ Delco Electronics □ Digitran □ Electronic Image Systems □ Ginsbury □ Honeywell □ Keltron □ Raytheon □ Richardson Electronics □ Sarnoff Research Center □ Sony Display Device Group □ Teltron □ Thomas Electronics □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electronics □ Zenith Electronics

#### CRTs, conventional

□ AEG □ Astronautics C.A. □ Aydin Controls □ Burle Industries □ Robert Busch □ Canadian Marconi □ Cardion Electronics □ Clinton Electronics □ Computer Based Controls □ CRT Scientific □ Delco Electronics □ Digitran □ Dotronix □ EEV, Inc. □ EEV Ltd. □ General Atomics □ General Electric □ Ginsbury □ Hitachi America □ Honeywell □ Hughes Aircraft □ Hughes Display Products □ Ikegami Electronics □ Image Systems □ Imaging & Sensing □ Intecolor □ ISE Electronics □ IST □ Link Technologies □ Mitsubishi Electronics Sales America □ Monitron □ Panasonic Industrial □ Pegasys □ Philips Display Components □ Raytheon □ Resolution Technology □ Richardson Electronics □ Rockwell Intl. □ SAMTEL USA □ Sarnoff Research Center □ Sigma Designs □ Sony Display Device Group □ Stanley Palmer □ Tektronix □ Teltron □ Thomas Electronics □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electronics □ Toshiba America □ Video Display □ Vidiwall □ World Products □ Zenith Electronics

#### CRTs, flat

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#### CRTs, miniature

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#### CRTs, multibeam

□ Delco Electronics □ Digitran □ General Atomics □ Ginsbury □ Honeywell □ Infodex □ Litton Electron Devices □ Richardson Electronics □ Sarnoff Research Center □ Sony Display Device Group □ Teltron □ Thomas Electronics □ Thomson-CSF □ Thomson Tubes Electronics

#### CRT MATERIALS

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

#### DEFLECTION AMPLIFIERS

□ Astronautics C.A. □ Broy Engrg. □ CELCO □ CELCO Pacific □ Citronix □ Computer Based Controls □ Ginsbury □ Infodex □ Motorola □ Orwin □ Pixel Products □ Rank Brimar □ Resolution Technology □ Richardson Electronics □ Teledyne Components □ Thomson-CSF □ XYtron

#### DEFLECTION YOKES

□ Astronautics C.A. □ Broy Engineering □ CELCO □ CELCO Pacific □ Computer Based Controls □ Discom □ Display Components □ EEV Ltd. □ Eldor □ Ginsbury □ Hughes Aircraft □ Infodex □ K & R Engrg. □ Panasonic Industrial □ Philips Display Components □ Rank Brimar □ Raytheon □ Resolution Technology □ Richardson Electronics □ Sampo □ Sarnoff Research Center □ Sony Display Device Group □ Stanley Palmer □ Syntonic Instruments □ Thomson-CSF □ Totoku Electric □ WinTron □ Zenith Electronics

#### DIGITAL FILM RECORDERS

□ AGFA Matrix □ Alden Electronics □ CELCO □ CELCO Pacific □ Eastman Kodak □ ECRM Trust □ Ektron Applied Imaging □ General Parametrics □ Hybrid Micrographics □ Imapro □ Lasergraphics □ Management Graphics □ Mekel Engrg. □ Polaroid

#### DIGITAL VIDEO SYSTEMS

□ Burle Industries □ Colorado Video □ Computer Based Controls □ Computer Dynamics □ Datacube □ Digital Vision □ Dynair □ Eastman Kodak □ Eltime Vision Systems □ Grass Valley Group □ Honeywell □ Imagraph □ Infodex □ Mekel Engrg. □ Primagraphics □ Sarnoff Research Center □ Symco □ Thomson-CSF □ Zenith Electronics

#### DIGITIZING TABLETS

□ Ametek Houston Instrument □ W. H. Brady □ Calcomp □ Computer-Time □ IBM □ Numonics □ Percept □ Personal Writer □ Science Accessories □ Scriptel □ SMART Technologies □ Summagraphics □ Wacom

#### DISABLED DISPLAY USER AIDS

□ Enabling Technologies □ Image Systems □ Personics □ Telesensory □ Virtual Vision

#### DISPENSER CATHODES

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

#### DISPLAY DRIVERS AND CONTROLLERS

□ Advanced Conversion □ Astronautics C.A. □ Avalex □ Barco Chromatics □ Barco Display □ CELCO □ Cirrus Logic □ Clover Display □ Computer Based Controls □ Computer-Time □ Craft Data, Inc. □ Craft Data Ltd. □ Dale Electronics □ Davis □ Diagnostic/Retrieval Systems □ Digitran □ Display Systems □ Dolch Computer □ DRS Military Systems □ EM Microelectronic □ Endicott □ F-P Electronics □ Genius Technologies □ Gennum □ General Digital □ Honeywell □ Hughes Aircraft □ Imagraph □ Infodex □ Interface Products □ Librascope □ Lockheed Sanders □ Metheus □ MicroTouch Systems □ Mizar/Integrated Solutions □ Monitron □ Motif □ Motorola □ National Research Resources □ National Semiconductor □ Norden Systems □ Omega Electronics □ Ocean Technology □ Pixelink □ Positive Technologies □ Primagraphics □ Pulseview □ Regisbrook □ Richardson Electronics □ Ryttrak □ S-MOS Systems □ Supertex □ Tektronix □ Teledyne Components □ Teledyne Electronic Technologies □ Texas Instruments Japan □ Trident Microsystems □ Unigraf □ Univision □ Versatec □ Vidiwall □ Western Digital □ Yamaha Systems Technology

#### DISPLAY HOUSING, RUGGEDIZED

□ Astronautics C.A. □ Automated Monitoring and Control □ Barco Chromatics □ Barco Display □ Burle Industries □ Robert Busch □ CELCO □ Craft Data, Inc. □ Diagnostic/Retrieval Systems □ Digitran □ Display Systems □ Dolch Computer □ DRS Military Systems □ El-Op Electrooptics □ Eucran □ General Digital □ Ginsbury □ Honeywell □ Hughes Aircraft □ Infodex □ Intecolor □ Interface Products □ Librascope □ Lucas Deeco □ Monitron □ Norden Systems □ Ocean Technology □ Plessey Naval Systems □ Rascal Acoustics □ Stanley Palmer □ Syntonic Instruments □ Tektronix □ Thomson-CSF

#### DISPLAY SIMULATION AND MODELING SYSTEMS

□ ALCOM □ Alliant Computer Systems □ autronic □ Robert Busch □ CDC □ CELCO □ Computer Based Controls □ Coryphaeus □ Diagnostic/Retrieval Systems □ DRS Military Systems □ Evans & Sutherland Computer □ Hitachi Denshi America □ Hughes LV Products □ Infodex □ Liberty Mirror □ Norden Systems □ Rank Brimar □ RGB Spectrum □ Sarnoff Research Center □ Star Technologies □ Tektronix □ VI Corp. □ Virginia Polytechnic Institute

#### DISPLAY SUBSYSTEMS

□ Astronautics C.A. □ Babcock Display Products □ Barco Chromatics □ Barco Display □ Canon, Inc. □ CELCO □ Computer Dynamics □ Craft Data, Inc. □ Craft Data Ltd. □ Dale Electronics □ Diagnostic/Retrieval Systems □ Dimension Technologies □ Display Systems □ Dolch Computer □ General Digital □ Hughes Display Products □ IEE □ Interface Products □ Litton Systems Canada □ National Research Resources □ Optical Devices □ Optical Radiation □ Optotek □ Orwin □ Photonics Systems □



Quantum Electronics □ Regisbrook □  
SAIC □ Syntonic Instruments □  
Teledyne Electronic Technologies □  
Thomas Electronics □ UCE

#### DISPLAY SYSTEM INTEGRATORS

□ Astronautics C.A. □ Autodisplay AS □  
Automated Monitoring and Control □  
Babcock Display Products □ Barco  
Chromatics □ Barco Display □ Canadian  
Marconi □ CDC □ CELCO □ Computer-  
Based Controls □ Computer-Time □ Craft  
Data, Inc. □ Craft Data Ltd. □ Dale  
Electronics □ Davis □ Diagnostic/  
Retrieval Systems □ Digitran □ Display  
Systems □ Dolch Computer □ DRS  
Military Systems □ Eastman Kodak □  
Elographics □ El-Op Electrooptics  
Industries □ Eurescan □ Exhibit  
Technology □ F-P Electronics □ Futaba  
□ General Digital □ Honeywell □ Hoya  
Electronics □ Interface Products □  
Kollmorgen □ Librascope □ Litton  
Systems Canada □ Lockheed Sanders □  
Matrix Media □ National Research  
Resources □ NES □ Norden Systems □  
Ocean Technology □ Optical Electronics  
□ Plessey Naval Systems □ Quantum  
Electronics □ Rockwell Intl. □ SAIC □  
Sanders Associates □ Scriptel □ SEOS  
Displays □ Teledyne Electronic  
Technologies □ Thomson-CSF □  
Transicoil □ Vidiwall □ Wacom □  
Whittaker

#### DISPLAYS

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

#### DISTORTION CORRECTION DEVICES

□ Astronautics C.A. □ CELCO Pacific □  
Display Components □ Display  
Laboratories □ Eldor □ Ginsbury □  
Intronics □ K & R Engrg. □ Syntonic  
Instruments □ Thomson-CSF

#### DISTRIBUTION SYSTEMS

□ Covid

#### ELECTROCHROMIC DISPLAYS

□ CDC □ Mito Fine Glass

#### ELECTROLUMINESCENT DISPLAYS

□ Astronautics C.A. □ Aydin  
Computer/Monitor □ Barco Chromatics □  
Barco Display □ BKL □ Canadian  
Marconi □ Capetronic □ CDC □  
CIV-Chem Engrg. □ Craft Data Ltd. □  
Dale Electronics □ Data General □  
Delco Electronics □ Digitran □ Eaton IDT  
□ Eldec □ ELtech □ Honeywell Defense  
Avionics □ Hoya Electronics □ IEC □  
IEE □ Infodex □ Interface Products □  
Interstate Electronics □ Kaiser Electronics  
□ Lamplighter □ Lucas Deeco □  
MicroTouch Systems □ Opto-Cal □  
National Research Resources □ Nippon  
Electric Glass □ Norden Systems □  
PEMM Services □ Phosphor Products □  
Planar Intl. □ Planar Systems □ PPM  
Photomask □ Pulseview □ Quantex □  
Rogers Corp. □ SAIC □ Sarnoff  
Research Center □ Sharp Digital  
Information Products □ Sharp Electronics  
□ Spectrum Sciences □ Spire □ I.I.  
Stanley □ Stanley Electric □ Swiss  
Controls □ Thomson-CSF □ Transicoil □  
James Wilson □ World Products

#### ELECTROMECHANICAL DISPLAYS

□ Ametek Aerospace Products □  
Automated Display Systems □ Delco

Electronics □ Digitran □ Displays Inc. □  
F-P Electronics □ Honeywell Defense  
Avionics □ Hughes Aircraft □ Infax □  
Interface Products □ Korri Electronics  
□ Matrix Media □ Omega Electronics □  
Pulseview □ Rockwell Intl. □ Sharp  
Digital Information Products □ Stan-Allen  
□ Thomson-CSF □ Transicoil

#### ELECTRON GUNS

□ Clinton Electronics □ General  
Atronics □ Hughes Aircraft □ Hughes  
Display Products □ Monitronix □ Philips  
Components □ Raytheon □ Resolution  
Technology □ Richardson Electronics □  
Sarnoff Research Center □ Sony Display  
Device Group □ Thomas Electronics □  
Thomson-CSF □ Video Display □ Zenith  
Components Group

#### EYE AND HEAD MOVEMENT TRACKERS

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

#### FACSIMILE ("FAX") MACHINES

□ Canon, Inc. □ CBM America □ Data  
Copy □ Data Beam □ Eltison Vision  
Systems □ IBM □ Mitsubishi Electronics  
Sales America □ Pacific Basin Distributing  
□ Relisys □ Unlimited Systems

#### FIBER-OPTIC FACEPLATES

□ Computer Based Controls □ Digitran  
□ Galileo □ General Atronics □ Incom  
□ Raytheon □ Schott Fiber Optics □  
Transicoil

#### FILTERS

□ American Polarizers □ Astronautics  
C.A. □ Balzers □ W. H. Brady □ Brewer  
Science □ Robert Busch □ Computer  
Based Controls □ Courtauld □ Denglas  
□ Denton Vacuum □ Dotech □ Flex  
Products □ Fosta-Tek □ Ginsbury □  
Glaverbel □ Hoffman Engrg. □ Homalite  
□ Hoya Electronics □ Hoya Optics □  
IEE □ Intl. Polarizer □ I-Protect □  
Kensington Microware □ Korri Electronics  
□ Liberty Mirror □ LMT □ Lucas Duralith  
□ Metavac □ Mito Fine Glass □  
Multicomp □ Nitto Denko □ NoRad □  
Norden Systems □ O&S Research □  
OCA □ OCLI □ Optical & Conductive  
Coatings □ Optical Devices □  
Panelgraphic □ Panelview □ Physical  
Optics □ Polaroid □ Precision Optical  
Filters □ Raytheon □ Reynard  
Enterprises □ RMF Products □ Rockwell  
Intl. □ Romag Glass □ Schott Glass  
Technologies □ Screen Shield □  
Sierracin/Intrex □ Southwall Technologies  
□ Stanley Palmer □ Sun-Flex □  
Systems Research Labs □ Thin Film  
Devices □ Thin Film Technology □ Toko  
America □ 3M Optical Systems □ U.S.  
Precision Glass □ Viratec

#### 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

□ Astronautics C.A. □ CELCO Pacific □  
Discom □ Display Components □ Eldor  
□ Ginsbury □ George D. Harris  
Associates □ K & R Engrg. □ Multicomp  
□ Rank Brimar □ Raytheon □ Sarnoff  
Research Center □ Syntonic Instruments  
□ WinTron

#### GETTERS

□ Andrews Glass □ Raytheon □ SAES  
Getters

#### GLASS FOR COMPONENTS

□ Andrews Glass □ Balzers □ Denton  
Vacuum □ Donnelly Applied Films □  
Hoya Optics □ Libbey-Owens-Ford □  
Nippon Electric Glass □ OCLI □ Optical  
Devices □ Phillips Components □ Romag  
Glass □ Schott Glass Technologies □  
Viratec

#### GLASS FOR CRTs

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

#### GLASS FOR FLAT-PANEL DISPLAYS

□ Applied Films Lab □ Balzers □ Bilco  
Mfg. □ CIV-Chem Engrg. □ Corning ADP  
□ Denglas □ Denton Vacuum □  
Donnelly Applied Films □ EEV Ltd. □  
Flachglas AG □ Glaverbel □ Hoya  
Electronics □ Hoya Optics □ Kisco  
Santa Clara □ Libbey-Owens-Ford □  
Melavac □ Mito Fine Glass □ Nagase  
California □ National Research Resources  
□ Nippon Electric Glass □ Norden  
Systems □ O&S Research □ Optical  
Devices □ Pilkington Micronics □ Planar  
Systems □ Romag Glass □ Rytek □  
Schott Corp. □ Scriptel □ Specialty  
Coating Systems □ Thin Film Technology  
□ Uniglobe Kisco □ U.S. Precision Glass  
□ Viratec □ Wacom

#### GRAPHICS BOARDS AND PROCESSORS

□ ADEX □ Avalex □ Aydin Controls □  
Barco Chromatics □ Barco Display □  
C&C Technology □ Calcomp □ Computer  
Based Controls □ Computer Peripherals  
□ Computer-Time □ Coreco □ Crystal  
Vision □ Data Translation □ Diagnostic/  
Retrieval Systems □ Evans & Sutherland  
Computer □ General Electric □  
Honeywell □ Human Designed Systems  
□ Hybrid Micrographics □ IBM □  
Imagraph □ Imapro □ KMW Systems □  
Kollmorgen □ Lasergraphics □ Matrox  
Electronic Systems □ Metheus □ Norden  
Systems □ Nth Graphics □ Ornicomp  
Graphics □ Parallax □ Pixelink □  
Polaroid □ Positive Technologies □  
Primagraphics □ PsITECH □ Rasterops  
□ RGB Spectrum □ S-MOS Systems  
□ Sony □ Sony Graphic Display □ Star  
Technologies □ Tatung □ Thomson-CSF  
□ Trident Microsystems □ Unigraf □  
Univision □ Western Digital □ Yamaha  
Systems Technology

#### GRAPHICS SUBSYSTEMS

□ Astronautics C.A. □ Barco Chromatics  
□ Barco Display □ CELCO □ Dale  
Electronics □ Diagnostic/Retrieval  
Systems □ Imagraph □ Positive  
Technologies □ Univision

#### GRAPHICS WORKSTATIONS

□ Alliant Computer □ Astronautics C.A.  
□ Aydin Computer/Monitor □ Aydin  
Controls □ Barco Chromatics □ Barco  
Display □ Computer Based Controls □  
Computer Dynamics □ Computer-Time □  
Diagnostic/Retrieval Systems □ Eaton IDT  
□ Evans & Sutherland Computer □  
Gordon Instruments □ Grass Valley Group  
□ Hughes LV Products □ IBM □  
Librascope □ Lockheed Sanders □  
Management Graphics □ McMahan  
Electro-Optics □ Mizar/Integrated  
Solutions □ Ocean Technology □  
Primagraphics □ PsITECH □ Sanders  
Associates □ Thomson-CSF □ VI Corp.  
□ Video Monitors

#### 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

#### IMAGE COMPRESSION

□ Dolch Computer □ Imagraph □  
Simtech

#### IMAGE STORAGE

□ Astronautics C.A. □ Colorado Video □  
Simtech

#### IMAGE TUBES

□ Burle Industries □ Computer Based  
Controls □ EEV, Inc. □ EEV Ltd. □  
Hughes Aircraft □ IST □ Kollmorgen □  
Litton Electron Devices □ Philips  
Components □ Sony Display Device  
Group □ Symco □ Teltron □ Thomson  
Tubes Electroniques

#### IMAGING BOARDS

□ C&C Technology □ Computer Based  
Controls □ Computer Peripherals □  
Coreco □ CR Technology □ Crystal  
Vision □ Data Translation □ Datacube □  
Eastman Kodak □ EPIX □ IBM □  
Imaging Technology □ Imagraph □  
Kollmorgen □ Matrox Electronic Systems  
□ Philips Components □ Primagraphics  
□ PsITECH □ Sharp Digital Information  
Products □ Simtech □ Symco □  
Univision □ Vicom Systems

#### IMAGING WORKSTATIONS

□ Advanced Video Products □ Alliant  
Computer Systems □ Aydin Controls □  
Data Beam □ Decision Images □  
Diagnostic/Retrieval Systems □ Gordon  
Instruments □ IBM □ Kollmorgen □  
Management Graphics □ McMahan  
Electro-Optics □ McMahan Research Labs  
□ MegaVision □ Microexpert Systems □  
Sarnoff Research Center □ Sharp Digital  
Information Products □ Tamarack  
Scientific □ Vicom Systems □ Video  
Monitors □ Visual Information  
Technologies

#### JOYSTICKS

□ Aydin Controls □ Robert Busch □  
Digitran □ Kraft Systems □ Measurement  
Systems □ Penny & Giles □ Vicom  
Systems □ WICO

## KEYBOARDS

□ Astronautics C.A. □ Aydin Controls □ Robert Busch □ Cherry Electrical Products □ Computer Based Controls □ Computer Keyboards Systems □ Craft Data, Inc. □ Digitran □ Display Systems □ Futaba □ Human Designed Systems □ IBM □ IEC □ Intecolor □ **Interface Products** □ Korry Electronics □ Lucas Duralith □ Ocean Technology □ Penny & Giles □ SAIC □ Texas Instruments □ Transicoil □ Two Technologies □ Vicom Systems

## LARGE-SCREEN DISPLAYS, ALL TECHNOLOGIES

### See also projection displays

□ ADEX □ Advance Display Technologies □ Astronautics C.A. □ Aydin Computer/Monitor □ Barco □ Barco Projection □ Barco Video & Commun. □ Capetronic □ Centaure □ Comfuture □ Computer-Time □ Conrac Display Products □ Convac-APT □ Cornerstone Technology □ Craft Data Ltd. □ Crystop Display □ Data Beam □ **Data Ray** □ Davies □ Digitran □ Display Laboratories □ Display Tech □ Dolch Computer □ EDL Displays □ EEV Ltd. □ Electrohome □ Electronic Image Systems □ ETC Computer □ Eurecran □ Evans & Sutherland Computer □ F-P Electronics □ Futaba □ General Digital □ General Electric □ General Parametrics □ Ginsbury □ Hitachi America □ Hitachi Denshi America □ Hughes LV Products □ IEC □ Image Systems □ Infocolor Corp. □ Intecolor □ Iristal □ Librascope □ Matrix Media □ Micron □ MicroTouch Systems □ Mito Fine Glass □ Mitsubishi Electric Sales America □ Mitsubishi Electronics America □ Monitron □ Norden Systems □ Norsk LCD □ Omega Electronics □ Optical Radiation □ Philips Electronics □ Photonics Systems □ Physical Optics □ Plasmaco □ PPM Photomask □ Pulseview □ Quantum Electronics □ **Rank Brimar** □ Rasterops □ Rediffusion Simulation □ Retroscon □ Rytrak □ Sarnoff Research Center □ SEOS Displays □ Simtech □ SMART Technologies □ Sony □ Sony Display Device Group □ Specialty Coating Systems □ Symco □ Systems Research Labs □ Tatum □ Tektronix □ Telesensory □ TOSD □ Thomas Electronics □ Thomson Tubes Electronics □ Tru-Lyte Systems □ UCE □ Unigraf □ Vidiwall □ Virtual Vision □ World Products □ XYtron □ Zenith Components Group

## LIGHT-EMITTING DIODE DISPLAYS

□ Acculex □ Adaptive Micro Systems □ Astronautics C.A. □ Automated Display Systems □ Bowmar □ Centaure □ Comfuture □ Craft Data Ltd. □ Delco Electronics □ Dialight □ Digitran □ Display Systems □ F-P Electronics □ General Electric □ Hewlett-Packard □ IBM □ IEE □ Infocolor Corp. □ **Interface Products** □ ISCAN □ JKL Components □ LEDCO □ Litton Systems Canada □ MicroTouch Systems □ Mitsubishi Kasei America □ Modutec □ Morrison Electronics □ NES □ Nippon Electric Glass □ Opto-Cal □ Optotek □ PPM Photomask □ Pulseview □ Quantum Electronics □ Reflection Technology □ Rohm □ Sharp Electronics □ I.I. Stanley □ Stanley Electric □ Teledyne Electronic Technologies □ Three-Five Systems □ Weschler/NES Instruments □ Wilbrecht Electronics □ James Wilson

## LIGHT PENS/POINTING SYSTEMS

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

## LIGHT-SHAPING DIFFUSERS

□ Physical Optics

## LIQUID-CRYSTAL DISPLAYS, ACTIVE-MATRIX

□ Acculex □ ASM America □ Astronautics C.A. □ Robert Busch □ Canadian Marconi □ Casio LCD □ CIV Chem Engrg. □ Convac-APT □ Craft Data, Inc. □ Craft Data Ltd. □ **Dale Electronics** □ Davies □ Delco Electronics □ Densitron □ Digitran □ EEV Ltd. □ Epson America □ Flat Panel Display □ GEC Hirst Research Centre □ General Electric □ Ginsbury □ BF Goodrich □ Hitachi America □ Honeywell Defense Avionics □ Honeywell □ Hughes Aircraft □ **Interface Products** □ Interstate Electronics □ Kristel □ Kyocera □ Litton Data Images □ Litton Systems Canada □ Lockheed Sanders □ Lucas Deeco □ Micron □ Micro-Optics □ MicroTouch Systems □ Mitsubishi Electric Sales America □ Miwa □ Modutec □ MRS Technology □ National Research Resources □ NEC □ Nippon Electric Glass □ OIS □ Omega Electronics □ Polytronix □ PPM Photomask □ Pulseview □ Rytrak □ SAIC □ Sarnoff Research Center □ Sayett □ Sharp Electronics □ Specialty Coating Systems □ Spectrum Sciences □ Standish Industries □ Systems Research Labs □ Tektronix □ Teledyne Electronic Technologies □ TFD □ Thomson-CSF □ **Timeline** □ Toshiba America □ UCE □ World Products □ **XMR**

## LIQUID-CRYSTAL DISPLAYS, COLOR

□ AEG □ **ALCOM** □ Astronautics C.A. □ Casio LCD □ Craft Data, Inc. □ Craft Data Ltd. □ **Dale Electronics** □ Display Systems □ Epson America □ Flat Panel Display □ Ginsbury □ Hantronix □ Hitachi America □ Kristel □ Lucas Deeco □ Micron □ MicroTouch Systems □ Motif □ OIS □ Optrex America □ Optrex/Satori □ Polytronix □ SAIC □ Sharp Electronics □ Stanley Electric □ Stalow □ I.I. Stanley □ Systems Research Labs □ Teledyne Electronic Technologies

## LIQUID-CRYSTAL DISPLAYS, FERROELECTRIC

□ **ALCOM** □ Astronautics C.A. □ Autodisplay □ AZ LCD □ Canon, Inc. □ Crystop Display □ Delco Electronics □ Densitron □ Digitran □ EEV Ltd. □ Eurecran □ GEC Hirst Research Centre □ Ginsbury □ BF Goodrich □ Homell Elektrophtik □ Micro-Optics □ MicroTouch Systems □ PPM Photomask □ Rytrak □ Teledyne Electronic Technologies □ Thomson-CSF □ UCE

## LIQUID-CRYSTAL DISPLAYS, PASSIVE

□ AEG □ **ALCOM** □ Ametek Aerospace Products □ Astronautics C.A. □ Autodisplay AS □ AZ LCD □ Batron □ Robert Busch □ Casio LCD □ Clover Display □ Craft Data, Inc. □ Craft Data Ltd. □ Crystaloid Electronics □ Crystop Display □ **Dale Electronics** □ Davies □ Delco Electronics □ Densitron □ Digitran □ Display Systems □ EEV Ltd. □ EM Microelectronic □ Epson America □

Eurecran □ Excel Technology □ GEC Hirst Research Centre □ General Electric □ Ginsbury □ Hamlin LCD □ Hantronix □ Hitachi America □ Homell Elektrophtik □ IEE □ In Focus Systems □ **Interface Products** □ Iristal □ Kyocera □ Litton Data Images □ Lucas Deeco □ LXD □ MicroTouch Systems □ Mito Fine Glass □ Mitsubishi Electric Sales America □ Motif □ National Research Resources □ Norsk LCD □ Ocualar □ Omega Electronics □ Optrex America □ Optrex/Satori □ Polytronix □ Pulseview □ Rascal Acoustics □ Regisbrook □ Rohm □ Rytrak □ Satori Electric □ Sharp Electronics □ Sony Display Device Group □ Standish Industries □ I.I. Stanley □ Stanley Electric □ Talig □ Tektronix □ Teledyne Electronic Technologies □ TFD □ Thomson-CSF □ Three-Five Systems □ **Timeline** □ Toshiba America □ Transicoil □ UCE □ Varitronix □ VGI □ World Products

## LIQUID-CRYSTAL DISPLAYS, PASSIVE, ACTIVE ADDRESSING

□ Astronautics C.A. □ Ginsbury □ Hantronix □ Kyocera □ MicroTouch Systems □ Motif □ National Research Resources □ Optrex America □ Optrex/Satori □ PEMM Services □ Polytronix □ Positive Technologies □ Stanley Electric □ Teledyne Electronic Technologies □ UCE

## LIQUID-CRYSTAL LIGHT-VALVE PROJECTORS

### See projection displays

## MAGNETIC SHIELDING

□ **Ad-Vance Magnetics** □ American Polarizers □ Amuneal □ CELCO □ Davis □ Donteck □ **Eagle Magnetic** □ Elmwood Transflex □ Fosta-Tek □ General Atomics □ Gerome Mfg. □ Ginsbury □ Homalite □ Hoya Electronics □ K & R Engrg. □ Lectro-Magnetics □ Liberty Mirror □ Magnetic Radiation Labs □ Magnetic Shield □ Micro Circuits □ Mushield □ **Raytheon** □ Romag Glass □ Siemens Components □ Sun-Flex □ Thin Film Technology □ Vacuumsmeltze

## MANUFACTURING EQUIPMENT

□ Accudyne □ ASM America □ autronic □ Aydin Computer/Monitor □ AZ LCD □ Balzers □ Best Power Technology □ Billco Mfg. □ Brewer Science □ Computer Based Controls □ Convac-APT □ Display Laboratories □ Donnelly Applied Films □ Eaton IDT □ Glen Technologies □ Hamatech □ Hughes Assembly □ Hybrid Micrographics □ Interserv □ Kisco Santa Clara □ **Kurdex** □ Leybold □ Micron □ Miwa □ MRS Technology □ Nalpak Sales □ Nanometrics □ **Nikon Precision** □ Nippon Seiko K.K. □ OAI □ Optical Radiation □ Photon Dynamics □ Plasma-Therm I.P. □ Semiconductor Systems □ Semitool □ Sony □ Specialty Coating Systems □ Spectrum Sciences □ Spire □ Steag Microtech □ Tamarack Scientific □ Teknek Electronics □ Ultra t □ Uniglobe Kisco □ Watkins-Johnson □ **XMR** □ Young Technology

## MARKET RESEARCHERS/PUBLISHERS

□ Computer Based Controls □ Dempa □ Electronic Trend □ Ergosyst Associates □ FAI □ Future Systems □ Information Associates □ Intl. Resource Development

□ MIRC □ Multimedia and Videodisc Monitor □ Nutmeg Publishing Consultants □ O'Mara & Associates □ Photonics Spectra □ Ramey Scientific □ Research Specialists □ Stanford Resources □ VDC

## MASKS

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

## MATERIALS

### electrochromic displays

□ Donnelly Applied Films □ Indium Corp. □ Vacuum Engineering

### electroluminescent displays

□ Arconium □ BKL □ **Courtauld** □ Display Systems □ Donnelly Applied Films □ ELtech □ General Digital □ Indium Corp. □ Kisco Santa Clara □ National Research Resources □ Planar Systems □ Plasmarc □ Simtech □ Spire □ Stan-Allen □ Uniglobe Kisco □ Vacuum Engineering □ James Wilson

### electromechanical displays

□ F-P Electronics □ Indium Corp. □ Matrix Media □ Vacuum Engineering

### large-screen displays

□ Astronautics C.A. □ Barco □ Barco Video & Commun. □ Dana Enterprises □ Donnelly Applied Films □ Dynair □ General Digital □ Matrix Media □ National Research Resources □ Optical Radiation □ Physical Optics □ Plasmaterials □ Retroscon □ Techneglas □ Vacuum Engineering □ Virtual Vision □ XYtron

### light-emitting diode displays

□ Arconium □ Astronautics C.A. □ Dialight □ Display Systems □ F-P Electronics □ Hewlett-Packard □ Indium Corp. □ Infocolor Corp. □ Matrix Media □ Plasmarc □ Plasmaterials □ Quantum Electronics □ Stanley Electric □ Teledyne Electronic Technologies □ Vacuum Engineering □ James Wilson

### light pens/pointing systems

□ Astronautics C.A. □ Indium Corp. □ MicroTouch Systems □ Plasmaterials □ Scriptel □ Vacuum Engineering

### liquid-crystal displays

□ **ALCOM** □ Astronautics C.A. □ AZ LCD □ BDH □ **Courtauld** □ Dainippon Ink & Chemicals □ Dana Enterprises □ Display Systems □ Donnelly Applied Films □ EM Industries □ F-P Electronics □ General Digital □ Ginsbury □ F. Hoffmann La Roche □ Hughes Aircraft □ Indium Corp. □ Kisco Santa Clara □ Kyocera □ Merck □ Mitsubishi Kasei America □ Nagase California □ National Research Resources □ Optotek □ Optrex/Satori □ Plasmarc □ Plasmaterials □ Rytrak □ Standish Industries □ Thin Film Technology □ 3M Optical Systems □ UCE □ Uniglobe Kisco □ Vacuum Engineering □ VL Electronics



#### plasma displays, ac

Arconium □ Donnelly Applied Films □ IBM Canada □ Kisco Santa Clara □ Nippon Electric Glass □ Spire □ Uniglobe Kisco □ Vacuum Engineering

#### plasma displays, dc

Arconium □ Cherry Electrical □ Displays □ Donnelly Applied Films □ IEE □ Kisco Santa Clara □ Micron □ Panasonic Industrial □ Quantum Electronics □ Spire □ Uniglobe Kisco □ Vacuum Engineering

#### plasma displays, color

General Digital □ Kisco Santa Clara □ Uniglobe Kisco □ Vacuum Engineering

#### spacers

Bangs Labs □ Dana Enterprises □ Kisco Santa Clara □ Uniglobe Kisco □ Vacuum Engineering

#### MICE AND OTHER POINTING DEVICES

Computer Based Controls □ Dale Electronics □ Digitran □ Human Designed Systems □ IBM □ Intecolor □ Kensington Microware □ Kraft Systems □ Lynx Computer Products □ Measurement Systems □ MicroTouch Systems □ Penny & Giles □ Scriptel □ SMART Technologies

#### MICROCHANNEL PLATES

Galileo □ Philips Components

#### OPTICAL COATINGS

##### See also filters, polarizers

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

#### OPTICAL DISCS AND SYSTEMS

Canon, Inc. □ Computer-Time □ DRS Photonics □ Eastman Kodak □ Glaverbel □ Honeywell □ IBM □ Kyocera □ Mito Fine Glass □ Mitsubishi Kasei America □ Nagase California □ Optographics □ Pentax Technologies □ Reference Technology □ Sony Display Device Group □ U.S. Precision Glass

#### PHOSPHORS

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

#### PHOTOLITHOGRAPHY EQUIPMENT

Brewer Science □ Canon USA □ Convac-APT □ Interserv □ Kisco Santa Clara □ MRS Technology □ Nikon Precision □ OAI □ Steag Microtech □ Karl Suss □ Tamarack □ Ultra □ Uniglobe Kisco □ XMR

#### PHOTOMASKS

##### See masks

#### PLASMA DISPLAYS, AC

CIV-Chem Engrg. □ Computer Based Controls □ Craft Data Ltd. □ Densitron □ Donnelly Applied Films □ Electro Plasma □ General Electric □ Interstate Electronics □ Librascope □ Micron □ Mito Fine Glass □ Norden Systems □ PEMM Services □ Photonics Systems □ Plasmaco □ Plessey Naval Systems □ Pulseview □ SAIC □ Spire □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electroniques □ Whittaker □ World Products

#### PLASMA DISPLAYS, DC

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

#### PLASMA DISPLAYS, COLOR

Craft Data Ltd. □ Micron □ PEMM Services □ Spire

#### PLOTTERS

Ametek Houston Instrument □ Calcomp □ Computer Based Controls □ Computer-Time □ John Fluke Mfg. □ IBM □ Insight Devices □ Precision Image □ Summagraphics □ Tempest Technologies □ Versatec □ Xerox Engrg. Systems

#### POLARIZERS

American Polarizers □ Balzers □ Robert Busch □ Courtaulds □ Da-Lite Screen □ Dana Enterprises □ Donteck □ Fosta-Tek □ Hoya Electronics □ Intl. Polarizer □ Kisco Santa Clara □ Nagase California □ National Research Resources □ Nitto Denko □ OCA □ OCLI □ Optical Devices □ Panelview □ Polaroid □ Precision Optical Filters □ Reel 3-D Enterprises □ Reynard Enterprises □ Romag Glass □ Simtech □ Uniglobe Kisco

#### POWER SUPPLIES, HIGH VOLTAGE

Advanced Conversion □ American High Voltage □ Astronautics C.A. □ Astrosystems □ Best Power Technology □ Burle Industries □ Data Translation □ Davalco □ Del Electronics □ Digitran □ Discorn □ Display Components □ Display Laboratories □ Dynatech Computer Power □ EEV Ltd. □ Eldec □ Endicott □ John Fluke Mfg. □ Ginsbury □ HC Power □ Honeywell □ Intl. High Voltage Electronics □ K and M Electronics □ K & R Engrg. □ Keltron □ Kensington Microware □ Librascope □ Lorad Power Systems □ MultiComp □ Murata-Erie □ Rantec □ Reynolds Industries □ Sampo America □ Sanders Associates □ Schott High Voltage □ Teledyne Electronic Technologies □ Wasatch High Voltage □ WinTron

#### PRINTER SUPPLIES

Acculex □ Computer Based Controls □ Computer Peripherals □ Eastman Kodak □ General Parametrics □ Harris Corp. □ IBM □ Kensington Microware □ Lasertechnics □ Mitsubishi Kasei America □ QMS

#### PRINTERS, COLOR GRAPHIC

AGFA Matrix □ CELCO □ Computer Based Controls □ Computer-Time □ General Parametrics □ IRIS Graphics □ C. Itoh Electronics □ Lasergraphics □ Lasertechnics □ Mitsubishi Electronics America □ Polaroid □ QMS □ Syntest □ Tempest Technologies

#### PRINTERS, ELECTROPHOTOGRAPHIC (LASER AND LED)

Canon, Inc. □ Computer Based Controls □ Computer-Time □ Harris Corp. □ IBM □ C. Itoh Electronics □ Lasertechnics □ Mitek Systems □ NBS Southern □ Pentax Technologies □ QMS □ Raytheon □ Teledyne Electronic Technologies □ Tempest Technologies

#### PRINTERS, IMPACT

Computer Based Controls □ Computer-Time □ DH Print □ Epson America □ IBM □ C. Itoh Electronics □ NBS Southern □ Relisys □ Syntest □ Tempest Technologies

#### PRINTERS, INK-JET

Canon, Inc. □ Computer Based Controls □ Computer-Time □ Epson America □ Hewlett-Packard □ IRIS Graphics □ Simtech □ Summagraphics □ Syntest

#### PRINTERS, THERMAL-TRANSFER AND DYE-SUBLIMATION

Acculex □ AGFA Matrix □ Alden Electronics □ Calcomp □ Computer-Time □ Craft Data Ltd. □ DH Print □ Eastman Kodak □ General Parametrics □ IBM □ Lasergraphics □ Lasertechnics □ Librascope □ Mitsubishi Electronics America □ QMS □ Raytheon □ Seiko Instruments □ Syntest □ TEAM Systems □ Toyo Spectrum □ Versatec □ Xerox Engrg. Systems

#### PRINTEHEADS

Craft Data Ltd. □ DH Print □ Epson America □ GEC Hirst Research Center □ Kyocera □ Optotek □ Panasonic Industrial □ Rohm □ Stanley Electric □ Thin Film Technology

#### PROJECTION DISPLAYS

##### Liquid-crystal light-valve projectors

Barco □ Barco Projection □ Data Beam □ Davis □ Delco Electronics □ Eucran □ Evans & Sutherland Computer □ Flat Panel Display □ GEC Hirst Research Centre □ General Electric □ Hughes Aircraft □ Hughes LV Products □ Iristal □ Keltron □ Micron □ Micro-Optics □ National Research Resources □ Polytrotron □ PPM Photomask □ Retroscon □ Rytrak □ Sarnoff Research Center □ Sayett □ Sony Display Device Group □ Stalow □ Standish Industries □ Symco □ Taliq □ Telex Communications □ Thomson-CSF □ 3-D Image Tek □ Video Display

##### Projection CRTs

Barco □ Barco Projection □ Data Beam □ Delco Electronics □ Digitran □

Display Laboratories □ Dynair □ EEV, Inc. □ EEV Ltd. □ El-Op Electrooptics □ Electrohome □ Electronic Image Systems □ Evans & Sutherland Computer □ GE Projection Display Products □ General Atronics □ General Parametrics □ Ginsbury □ Hitachi America □ Hitachi Denshi America □ Hughes Aircraft □ Hughes Display Products □ IST □ Keltron □ Mitsubishi Electric Sales America □ Panasonic Industrial □ Rank Brimar □ Raytheon □ Rediffusion Simulation □ Sarnoff Research Center □ Sony Display Device Group □ Symco □ TDS □ Techneglas □ Thomas Electronics □ Thomson Components & Tubes □ Thomson-CSF □ Thomson Tubes Electroniques □ Video Display □ Vidiwall □ XYtron □ Zenith Electronics

#### REPAIR AND MAINTENANCE

##### of computer systems

Astronautics C.A. □ Aydin Controls □ Computer Based Controls □ Computer-Time □ CDC □ Hitech Intl. □ IBM □ Recognition Concepts □ Tempest Technologies

##### of display systems

Astronautics C.A. □ Automated Display Systems □ Aydin Controls □ Computer Based Controls □ Computer-Time □ CDC □ Display Systems □ Display Technologies □ Dotronix □ Florod □ General Electric □ IBM □ Librascope □ Man & Machine □ Matrix Media □ Micron □ Miwa □ Monitronix □ Norden Systems □ Orwin □ Quantum Electronics □ Signatone □ TEAM Systems

##### of high-voltage power supplies

Advanced Conversion □ American High-Voltage □ Astronautics C.A. □ Astrosystems □ Best Power Technology □ Computer-Time □ CDC □ Del Electronics □ Display Components □ F-P Electronics □ Intl. High Voltage Electronics □ Keltron □ Multicomp □ Reynolds Industries

#### SCANNERS, DOCUMENT AND FILM (GRAPHICS)

Advanced Video Products □ Ametek Houston Instrument □ CELCO □ Computer Aided Tech. □ Computer-Time □ Data Copy □ Data Beam □ Digital Vision □ Eastman Kodak □ ECRM □ Gordon Instruments □ Howtek □ IBM □ Imapro □ Mekel Engrg. □ Mitsubishi Electric Sales America □ Optographics □ Pentax Technologies □ SEOS Displays □ Summagraphics □ Telesensory □ Versatec

#### SCANNERS, DOCUMENT (TEXT)

Computer Aided Tech. □ Computer-Time □ Data Copy □ Data Beam □ Eastman Kodak □ Gordon Instruments □ IBM □ Mitsubishi Electronics America □ Pentax Technologies □ Summagraphics □ Xerox Imaging Systems

#### SCOREBOARDS

EEV Ltd. □ F-P Electronics □ Hughes LV Products □ Infocorp □ Matrix Media □ National Research Resources □ NES □ Omega Electronics Equipment □ Quantum Electronics □ Racial Acoustics



## SCRIBERS

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

## SEALANTS

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

## SEMICONDUCTORS

□ Chips & Technologies □ Cornes USA  
□ Display Laboratories □ Hewlett-  
Packard □ Micro Networks □ National  
Semiconductor □ Panasonic Industrial  
Spire

## SIMULATOR DISPLAYS

□ Barco □ Barco Chromatics □ Barco  
Display □ Barco Video & Commun. □  
Calcomp □ CDC □ Coryphaeus □ **Data  
Ray** □ DRS Military Systems □ El-Op  
Electrooptics Industries □ Evans &  
Sutherland Computer □ Hughes Aircraft  
□ Hughes LV Products □ **Interface  
Products** □ Optical Radiation □  
Primagraphics □ PsiTECH □ Rediffusion  
Simulation □ Retroscan □ Sanders  
Associates □ SEOS Displays □ Ship  
Analytics □ XYtron

## SOFTWARE FOR DISPLAYS

### design & optimization software

□ American Institute Small Business □  
autronic □ Robert Busch □ Cardion  
Electronics □ CDC □ Computer Based  
Controls □ Coryphaeus □ CSERAC □  
Delco Electronics □ Display Laboratories  
□ Display Systems □ DRS Military  
Systems □ El-Op Electrooptics Industries  
□ Honeywell Defense Avionics □ IBM □  
Kollmorgen □ Librascope □ Ligature  
Software □ Lighting Sciences □  
Reference Technology □ Sarnoff  
Research Center □ Sound Decisions □  
V.I. Corp.

### graphics systems software

□ Alliant Computer Systems □  
Automated Display Systems □ Aydin  
Controls □ Barco Chromatics □ Barco  
Display □ Robert Busch □ Cadkey □  
Cardion Electronics □ Computer Based  
Controls □ Computer-Time □ CDC □  
Coryphaeus □ Dalim Computer □ Data  
Copy □ Data Translation □ Display  
Systems □ Dynair □ General Parametrics  
□ Honeywell Defense Avionics □ Hughett  
Research □ Human Designed Systems □  
IBM □ Imagraph □ Infax □ Insight Dev.  
□ Kollmorgen □ Librascope □ Lynx  
Computer Products □ Norden Systems □  
Ocean Technology □ Personics □  
Polaroid □ Primagraphics □ PsiTECH □  
Rediffusion Simulation □ Reference  
Technology □ Sarnoff Research Center □  
Ship Analytics □ Simtech □ Systat □ 3D  
TV □ Trident Microsystems □ Univision  
□ V.I. Corp.

### image processing software

□ Amerinex □ Aydin Controls □ Robert  
Busch □ Cardion Electronics □ Computer  
Aided Technology □ Computer Based  
Controls □ Computer-Time □ CDC □  
Coreco □ CR Technology □ Dalim  
Computer Graphic Systems □ Data Copy  
□ Data Translation □ Decision Images □  
Diagnostic/Retrieval Systems □ DRS  
Military Systems □ Eastman Kodak □

El-Op Electrooptics Industries □ Eltime  
Vision Systems □ EPIX □ General  
Parametrics □ Global Imaging □  
Honeywell Defense Avionics □ Howtek □  
Hughett Research □ IBM □ **Image  
Processing** □ Imaging Technology □  
Imagraph □ Insight Development □  
Kollmorgen □ Librascope □ McMahan  
Electro-Optics □ McMahan Research Labs  
□ MegaVision □ Microexpert Systems □  
Mitsubishi Kasei America □ Photometrics  
□ Positive Technologies □ Rediffusion  
Simulation □ Reference Technology □  
Sarnoff Research Center □ Security  
Defense Systems □ Sharp Digital  
Information Products □ Systat □  
Univision □ Versatec □ Vicom Systems  
□ Videotek Systems □ Vidwall □ Xerox  
Imaging Systems □ Xybion

### optical analysis software

□ autronic □ Robert Busch □ CDC □  
Display Laboratories □ El-Op Electrooptics  
Industries □ Eltime Vision Systems □  
Global Imaging □ IBM □ Honeywell □  
Kollmorgen □ Lighting Sciences □  
Mitsubishi Kasei America □ Photon  
Dynamics □ Positive Technologies □  
Sarnoff Research Center □ Sound  
Decisions □ Telic Optics

### signal processing software

□ Aydin Computer/Monitor □ Cardion  
Electronics □ Computer Based Controls  
□ CDC □ Data Translation □ Diagnostic/  
Retrieval Systems □ Display Systems □  
DRS Military Systems □ Honeywell  
Defense Avionics □ IBM □ Kollmorgen  
□ Librascope □ McMahan Research  
Labs □ Norden Systems □ Positive  
Technologies □ Sarnoff Research Center  
□ V.I. Corp.

### SONIC DIGITIZERS

□ Computer-Time

### SPEECH INPUT/OUTPUT DEVICES

□ Robert Busch □ Computer Based  
Controls □ Computer-Time □ IBM □  
Pacific Basin Distributing □ Simtech

## TEST AND MEASUREMENT EQUIPMENT

### automatic convergence systems

□ Barco □ Barco Projection □ EG&G □  
Electrohome □ General Electric □  
Ginsbury □ **Image Processing** □ Meylan  
□ **Microvision** □ **Photo Research** □  
Telesensory

### automated test equipment

□ autronic □ Control Systems  
Technology □ Coreco □ CR Technology  
□ Cybeq □ Crystop Display □ Data  
Translation □ EG&G □ Eltime Vision  
Systems □ Ergonomics □ **Florod** □  
John Fluke Mfg. □ GenRad □ Hoffman  
Engrg. □ Hughes Aircraft □ **Image  
Processing** □ KLA Acrotec □ KLA  
Instruments □ Kontoy Products □  
Landmark Technology □ Leica □ Lighting  
Sciences □ **Microvision** □ Miwa □ MTL  
Systems □ Nagase California □  
Nanometrics □ Nippon Seiko K.K. □ OAI  
□ Particle Data □ Photon □ Photon  
Dynamics □ **Photo Research** □  
**Quantum Data** □ Rockwell Intl. □ Rytrak  
□ Sencore □ Signatone □ Spectron  
Engineering □ Karl Suss □ **TEAM  
Systems** □ Tencor Instruments □ TNP  
Instruments □ Vanzetti Systems □ J. A.  
Woollam

### convergence gauges

□ Ginsbury □ **Klein Optical**

### gonioreflectometers

□ autronic □ EG&G □ Hoffman Engrg.  
□ Lighting Sciences □ LMT

### hot stages

□ Instec, Inc.

### microscopes

□ CELCO □ EG&G □ **Klein Optical** □  
Leica □ **Nikon Precision** □ OAI □ TNP

### photometers

□ autronic □ EG&G □ **Graseby** □  
Hoffman Engrg. □ Labsphere □ Leica □  
Lighting Sciences □ LMT □ McMahan  
Research Labs □ **Microvision** □ Minolta  
□ Mitsubishi Kasei America □ Opto-Cal  
□ **Photo Research** □ Spectron  
Engineering □ Tektronix □ United  
Detector Technology

### radiometers

□ autronic □ EG&G □ **Graseby** □  
Hoffman Engrg. □ Labsphere □  
McMahan Research Labs □ Minolta □  
OAI □ Opto-Cal □ **Photo Research** □  
Spectron Engineering □ Tektronix □  
United Detector Technology

### video generators

□ Aydin Computer/Monitor □ Barco □  
Barco Chromatics □ Colorado Video □  
Computer Based Controls □ Diagnostic/  
Retrieval Systems □ DRS Military Systems  
□ Extron □ John Fluke Mfg. □ Ginsbury  
□ Leader Instruments □ MTL Systems □  
**Quantum Data** □ Sencore □ Symco □  
**TEAM Systems** □ PsiTECH □ Unigraf  
□ Visual Information Instruments

### video oscilloscopes

□ Colorado Video □ Computer Based  
Controls □ General Electric □ Leader  
Instruments □ Photon □ Sencore □  
Symco

## 3D DISPLAY SYSTEMS

□ Cadkey □ Computer Based Controls  
□ Coryphaeus □ **Data Ray** □ Dimension  
Technologies □ Electronic Image Systems  
□ Evans & Sutherland Computer □  
General Electric □ Matrox Electronic  
Systems □ McMahan Electro-Optics □  
Optical Electronics □ Polhemus □  
PsiTECH □ Reel 3-D Enterprises □  
Sarnoff Research Center □ Security  
Defense Systems □ Seiko Instruments □  
StereoGraphics □ Tektronix □ Thomson-  
CSF □ 3-D Image Tek □ 3D TV

## TOUCH-INTERACTIVE DISPLAYS

□ Aydin Controls □ Barco Chromatics □  
Barco Display □ Carroll Touch □  
Computer Based Controls □ CDC □ Craft  
Data Ltd. □ **Dale Electronics** □ Digitran  
□ Eaton IDT □ Eldec □ Electro  
Mechanical Systems □ Elographics □  
Exzec □ Flat Panel Display □ General  
Digital □ Ginsbury □ IBM □ Intecolor □  
Interaction Systems □ Kristel □ Lockheed  
Sanders □ MicroTouch Systems □  
Mitsubishi Electronics America □ Norden  
Systems □ Phosphor Products □  
Photonics Systems □ RGB Dynamics □  
Scriptel □ SMART Technologies □ I.I.

Stanley □ Taliq □ Teledyne Electronic  
Technologies □ Thomson-CSF □  
Thomson Tubes Electroniques □  
Transcoil □ Varitronix □ Wacom

## TOUCH SCREENS

□ Aydin Controls □ Robert Busch □  
Carroll Touch □ Computer Based Controls  
□ **Courtauld** □ Craft Data Ltd. □ **Dale  
Electronics** □ Electro Mechanical  
Systems □ Elmwood Transflex □  
Elographics □ Epson America □ Exzec  
□ John Fluke Mfg. □ Ginsbury □ IBM  
□ Intecolor □ Interaction Systems □  
**Interface Products** □ Librascope □  
Lucas Control Systems □ Lucas Deeco □  
Lucas Duralith □ MicroTouch Systems □  
Mitsubishi Electric Sales America □  
Norden Systems □ O&S Research □  
**OCLI** □ Optical Devices □ Phosphor  
Products □ Photonics Systems □ RGB  
Dynamics □ Scriptel □ Sierracin/Transflex  
□ SMART Technologies □ Sun-Flex □  
Symco □ Teledyne Electronic  
Technologies □ Telesensory □ TFD □  
Varitronix

## TOUCH TABLETS

□ Robert Busch □ Carroll Touch □  
Exzec □ Microexpert Systems □  
MicroTouch Systems □ Mitsubishi Kasei  
America □ Scriptel □ SMART  
Technologies □ Sun-Flex □ Teledyne  
Electronic Technologies

## TRACKBALLS

□ Aydin Controls □ Computer Keyboards  
Systems □ Digitran □ Intecolor □  
**Interface Products** □ Kraft Systems □  
Librascope □ Lynx Computer Products □  
Measurement Systems □ Ocean  
Technology □ Penny & Giles □  
Polhemus

## VACUUM EQUIPMENT

□ Applied Films Lab □ ASM America □  
Balzers □ Computer Based Controls □  
Kontoy Products □ **Kurdex** □ Leybold □  
**OCLI** □ SAES Getters □ Thomson-CSF  
□ Vac-Tec Systems

## VACUUM FLUORESCENT DISPLAYS

□ Craft Data Ltd. □ Delco Electronics □  
Futaba □ IEE □ ISE Electronics □  
Lucas Deeco □ Morrison Electronics □  
Pulseview □ Regisbrook □ Thomson-  
CSF

## VIDEO AMPLIFIERS

□ CELCO □ CELCO Pacific □ Dynair  
□ Extron □ Ginsbury □ Kollmorgen □  
Motorola □ National Semiconductor □  
Optical Electronics □ Pixel Products □  
Spire □ Symco □ Teledyne Components  
□ Thomson-CSF □ XYtron

## VIDEO AND DISPLAY STANDARDS

□ CELCO □ Display Laboratories □  
Simtech □ **TEAM Systems**

## VIEWING SCREENS

□ Physical Optics

## VIRTUAL IMAGING

□ 3D TV □ Virtual Vision

## X-RAY IMAGE STORAGE SCREENS

□ Levy Hill □ Mitsubishi Kasei America  
□ 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), 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. Brian Smothers, 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: 708/981-9218

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

Manufacturers of LED and incandescent electronic message displays for indoor/outdoor use, respectively. Complete line of standard "off-the-shelf" single or multicolor message displays, as well as custom capabilities for a wide range of markets. Curt Lillie, V.P. Alpha Sls 414/357-2020 Toll Free: 1-800/558-7022 Fax: 414/357-2029

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Manufacturers of flat-panel-display robotic handler. Ali Darvish  
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Manufacturers of antireflective coatings for ant glare 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 CORP., 2540 W. 237 St., Torrance, CA 90505

Manufacturers of AMLCDs, graphics LCD and plasma displays, terminals, interfaces, and intelligent controllers. Kevin Finn, V.P. 213/530-3530 Fax: 213/534-8419

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

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

DH PRINT, Technical Research Park, Riverton, WY 82501

Manufacturers of 40-column dot-matrix printers. Also manufactures the Cypher series of demand barcode label printers. Janet Jones  
307/856-4821 Fax: 307/856-0412

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

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

DIALIGHT CORPORATION, 1913 Atlantic Ave., Manassquan, 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. New for 1993 are the microLED™ SMD CBI and 556 series superbright PMI. Bill Moore, Sls. Mgr. 908/223-9400 Fax: 908/223-8788

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.  
W. Miller  
714/391-4321 Fax: 714/391-4558

DIMENSION TECHNOLOGIES, INC., 315 Mt. Read Blvd., Rochester, NY 14611  
Developers and 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 deflection yokes, focus coils, and associated magnetics. Also, high-voltage power supplies and HV testers.  
Peter Koronis, Sls. Mgr.  
508/692-6000 Fax: 508/692-8489

DISPLAY COMPONENTS, INC. (DISCOM), 334 Littleton Rd., Westford, MA 01886  
Manufacturers of deflection yokes, focus coils, high-voltage power supplies, high-voltage power supply testers, and flyback transformers.  
Peter Koronis  
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., Suite 109, Boulder, CO 80301-2400  
Manufacturers of MIMIC (monitor interface micro controller chip sets), a digital waveform generation system for geometric and chromatic distortion correction; and MIMICAM (monitor inspection and micro computer automated manufacturing), an alignment and inspection system for manufacturing and servicing of digitally controlled monitors.  
James R. Webb, Pres.  
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.  
717/242-5411 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, and controls for meters, process-variable controllers, and industrial controllers. Applications include security systems, medical, military, and industrial.  
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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 "carried graphics," editable messages, full network capability, time scheduling, operated by keyboard or with IBM PC compatible.  
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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

DOLCH COMPUTER SYSTEMS, 372 Turquoise St., Milpitas, CA 95035  
Manufacturers of packaging and driver electronics of flat-panel displays and computer systems for industrial and harsh environments.  
Trina Ciraulo, Sls./Ops. Mgr.  
408/957-6575 Toll Free: 1-800/538-7506 Fax: 408/263-6305

DONNELLY APPLIED FILMS CORP., 6797 Winchester Circle, Boulder, CO 80301  
Manufacturers of transparent thin-film conductive and metallic coatings on electronic-quality flat glass for the FPD industry. Products serve as primary substrates for LCDs, plasma displays, touch screens, and electrochromic devices.  
Graeme L. Hennessey, V.P. Sls./Mktg.  
616/786-5109

DONTECH, INC., 700 Airport Industrial Blvd., Doylestown, PA 18901  
Manufacturers of optical display filters in acrylic, glass, and polycarbonate with anti-reflective finishes; EMI/RFI-shielded panels utilizing fine wire mesh or conductive coatings; custom colors for contrast enhancement, bandpass, and night-vision compatibility.  
Leda Petrov, Sales  
215/348-5010 Fax: 215/348-9959

DOTRONIX, INC., 160 First St., S.E., New Brighton, MN 55112-7894  
Manufacturers of high-resolution CRT displays and video monitors in both monochrome and color. Specialists in custom OEM applications.  
Mike Hopkins, V.P. Sls./Mktg.  
612/633-1742 Fax: 612/633-7025

DRB TECHNOLOGIES, INC., 630 Llewellyn Rd., Berwyn, PA 19312  
Consultants in technology and business development in the areas of flat-panel display, optics, hardware and software, marketing, and finance.  
David R. Baraff  
215/296-7589

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.  
Carl P. Boeche, Sr. V.P.  
201/337-3800 Fax: 201/337-4775

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Manufacturers of optical, optomechanical, and electro-optical components, assemblies, and systems spanning the IR, visible, and UV spectrum for land, sea, and air military and industrial applications.  
Tom O'Neill, V.P.  
516/231-9500 Fax: 516/231-9501

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Manufacturers of EL lamps for backlighting LCDs, membrane switches, and instrumentation.  
Barbara J. Buss, Cust. Svc. Mgr.  
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Manufacturers of PRISM, a large-format interactive video-wall display system that can simultaneously display output from four graphics workstations and four video formats in sizes up to 324 ft.<sup>2</sup> with 1024 x 1024-pixel resolution.  
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513/429-7423 Fax: 513/429-7176

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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 Fochl, 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  
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Manufacturers of radiometric, photometric, and spectral radiometric instrumentation and accessories. A complete line of front-end optical receptors and NIST traceable calibration sources ensuring an equipment configuration to meet almost any light-measurement requirement.  
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EG&G RETICON, 345 Potrero Ave., Sunnyvale, CA 94086  
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Manufacturers of laser imaging recorder, Model 811, a high-resolution output device for generating continuous-tone 8-bit images

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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.  
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206/743-8238; 206/743-8399; Fax: 206/743-8562

**ELDOR CORP.**, 70 Walnut St., Wellesley, MA 02181  
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Manufacturers of commercial monitors for the process control, financial, medical, and imaging markets. Sizes range from 9-23 in. in monochrome and 12-21 in. in color. Customization available.  
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Manufacturers of both totally integrated touch terminals/monitors and custom, infrared touch panels. The totally integrated Jugo touch information display (TID) and

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513/372-7579 Fax: 513/372-8645

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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.  
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44-621-859-500 Fax: 44-621-855-335

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38-35-5111 Fax: 38-35-5403

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Manufacturers of adaptive equipment for the blind and visually impaired: braille printers, speech systems, closed-circuit TV, hearing aids.  
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**ENDICOTT RESEARCH GROUP, INC.**, P.O. Box 269, 2601 Wayne St., Endicott, NY 13760  
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Publishers of reference books and journals in the areas of artificial intelligence, display design, CAD/CAM, ergonomics, human-factors, human-computer interaction and VDT health and safety.  
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**EURECRAN SA**, ZA Cap Alpha Lot No. 1, Rue Monnet, Clapiers 34830, France  
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33-67-594-510 Fax: 33-67-591-712

**EVANS & SUTHERLAND COMPUTER CORP.**, 600 Komar 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.  
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Manufacturers of line-scan and area sensors, line-scan development boards and modules, and line-scan and area cameras. Patty Lippe, Adv. Mgr.  
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Manufacturers of active-matrix LCD panels and modules for direct-view applications; projection systems for professional and consumer use; and datagraphic panels for notebook computers and vertical applications. Leo Pekelharing, FPD Delegate Office  
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NES INC., 3003 Wakefield Dr., Carpentersville, IL 60110

Manufacturers of digital instrumentation, including panel meters, counters, process measurement, speed and rate measurement, and remote displays.

Jerry M. Bestler, Dir. Sls.  
708/426-5900 Fax: 708/426-6630

NIKON PRECISION, INC., 1399 Shoreway Rd., Belmont, CA 94002

Manufacturers of production photolithography systems for large-area and high-resolution displays. Line includes the LS-500P proximity printer, the FX-301D and FX-501D for large high-resolution displays, and the FX-401E and FX-402E for very-high-resolution HDTV projection displays.

David E. Kettering, Prod. Line Mgr.  
415/508-4674 Fax: 415/508-4600

NIPPON ELECTRIC GLASS, 650 E. Devon, Ste. 110, Itasca, IL 60143

Manufacturers of a line of glass products for information displays, including BLC glass substrates for LCDs, OA-2 glass substrates for active-matrix LCDs and EL displays, and image-sensor cover glass.

Tim Tanner, Sls./Mktg.  
708/285-8500 Toll Free: 800/733-9559  
708/285-8510

NIPPON SEIKO CO., LTD., 2-2-34 Higashizaoh, Nagaoka, Niigata, 940 Japan  
Manufacturers of passive LCDs (including TN, STN, and D-STN), LGD modules (including large-area dot-matrix and multi-color), and thick-film EL and driving circuits (inverters).

Intl. Dept. 81-258-24-3311  
Fax: 81-258-24-6543

NIPPON SEIKO K.K., Nissei Bldg., 6-3, Ohaki 1-chome, Shinagawa-ku, Tokyo, 141 Japan

Manufacturers of large high-precision pattern generators (mask making for FPD, exposure for shadow masks); automated test equipment; large high-precision pattern

measuring machine for mask-making process. Main products relate to photofabrication system.

81-466-21-3217 Fax: 81-466-21-3109

NITTO DENKO AMERICA, INC., c/o PERMACEL, U.S. Highway #1, New Brunswick, NJ 08903

Manufacturers of linear and circular polarizing film, retardation film, and other optical plastic materials.

Mike Yoshikawa, Prod. Mgr.  
908/418-2775 Fax: 908/418-2777

NoRAD CORP., 1549 11th St., Santa Monica, CA 90401

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Bruce Sperka, Dir. Mktg.  
213/395-0800 Toll Free: 800/262-3260  
Fax: 213/458-6397

NORDEN SYSTEMS, INC. (UTC), Box 5300, Norwalk, CT 06856

Packagers of plasma panel, LCD, EL and CRT displays for the military. Produced over 2500 battlefield flat-panel crew stations and has an in-house facility to manufacture flat panels.

Al Hudson, Prod. Mgr.  
203/852-6344 Toll Free: 800/426-9374  
Fax: 203/852-7480

NORSK LCD, AS, Eikhaugen Industrifelt, 30 36 Drammen, Norway

Manufacturers of very-large-area LCDs (100 x 1264 cm<sup>2</sup>) using TN or STN technology. Custom design and engineering for wide temperature range and MIL-SPECS.

Tor Ottesen, Plant Mgr.  
47-388-0450 Fax: 47-388-0367

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NUMONICS CORP., 101 Commerce Dr., Montgomeryville, PA 18936

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Morris B. Bowles, Sls. Mgr.  
215/362-2766 Fax: 215/361-0167

NUTMEG CONSULTANTS, 2 Shady Brook Lane, Norwalk, CT 06854

A full-service technical public and press relations firm specializing in clients whose messages have serious technical content. Services include the writing of advertising copy, marketing, developing press and new product releases, press and sales kits, technical/company "backgrounders," brochures, product documentation, and rewriting of technical material.

Kenneth I. Werner, Pres.  
203/853-7069 Fax: 203/855-9769

n-VISION, 800 Follin Lane, Ste. 270, Vienna, VA 22180

Manufacturer of high-performance head-mounted displays (HMDs). Products include a miniature CRT-based monochrome system with a resolution of up to 1.8 million pixels per eye and a field-sequential color system with a resolution of up to 1.1 million pixels per eye.

Christopher Lewis, Dir.  
703/242-0030 Fax: 703/242-5220

OAI (OPTICAL ASSOCIATES, INC.), 1425 McCandless Dr., Milpitas, CA 95035

Manufacturers of UV process and measuring equipment. Newest system is an aligner-bonder for substrates up to 17 in. square. Other equipment includes mask alignment and exposure systems, optical edgebead exposure system, UV light sources, flood exposure systems, UV ozone cleaning systems, UV exposure analyzer, and UV power meters.

Jerry Bachur, V.P. Equipment Group  
408/263-4944 Toll Free: 1-800/843-8259  
Fax: 408/263-6389

O&S RESEARCH, INC., 1912 Bannard St., P.O. Box 221, Riverton, NJ 08077

Manufacturers and suppliers of aircraft instrument lighting wedges, cover glasses, and CRT contrast-enhancement filter glass. Line of antireflection coatings includes MIL-C-14806A, AMS 2521A, and MIL-C-675C.

Anderson L. McCabe, Pres.  
609/829-2800 Fax: 609/829-0482

OCA/OPTICAL CORP. OF AMERICA, 170 Locke Dr., Marlborough, MA 01752

Manufacturers of a variety of optical components including color filters and anti-reflection coatings compatible with a variety of display systems. Included are microplasma products which can be deposited on glass or plastic and which demonstrate excellent hardness and humidity stability.

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Catharine Matthews, Customer Service  
810/362-2738 Fax: 810/362-4149

OMARA & ASSOCIATES, 2443 Ash St.,  
Palo Alto, CA 94306  
*Providers of technical market research in liquid-crystal flat-panel displays, display applications, and display markets. Analysis of technology and markets for display-manufacturing equipment and materials. Display-industry surveys from Japan and other Far East locations.*  
William C. O'Mara, Principal  
415/323-2175 Fax: 415/323-0864

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*U.S. sales office of Omega Electronics SA, Switzerland. See below for description.*  
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717/393-4088 Fax: 717/393-9812

OMEGA ELECTRONICS, S.A., P.O. Box 6,  
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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.  
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Manufacturers of ac plasma flat-panel displays and monitors, compatible with ISA-slot PC, Sun, and Macintosh computers. An X-terminal interface incorporated within the monitor housing is available. The 21.3-in.-diagonal display features 1280 x 1024 resolution with a 0.33-mm dot pitch.  
Jane D. Birk, Appl. Engr.  
914/883-6800 Fax: 914/883-6867

PLASMARC, 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 Sklarski, 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.  
415/277-0440 Fax: 415/277-0469

PLASMA-THERM I.P., INC., 9509 Intl. Ct., St. Petersburg, FL 33716  
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 substrates to 22 in. sq. Complete process support is included.  
Scott DeFerrari, Dir. Sls./Mktg.  
813/577-4999

PLESSEY NAVAL SYSTEMS LTD., 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 curvilinear monochrome displays. Rugged monochrome raster monitors and 512 x 512 ac plasma terminals also available.  
Mike Brooks, Supp. Mgr. Sls./Mktg.  
44-932-824-336 Fax: 44-932-824-723

POLAROID CORP., 1 Upland Road, Norwood, MA 02062  
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 EM/RFI and abrasion resistant coatings in a variety of colors.  
Terry Holmes, Mktg. Mgr.  
617/446-4505 Fax: 617/446-4600



POLHEMUS, P.O. Box 560, 1 Hercules Dr., 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.  
Kenneth J. Richardson, Mktg./Sls. Mgr.  
214/238-7045 Fax: 214/644-0805

POSITIVE TECHNOLOGIES, 6640 Lusk Blvd., Suite 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.  
Robert Hotto, Pres.  
619/457-5151 Fax: 619/457-4646

PPM PHOTOMASK, INC., 4950 Fisher St., 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.  
Vibha Jain  
514/737-7030 Fax: 514/737-9893

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

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

PRECISION IMAGE CORP., 501 Chesapeake Dr., Redwood City, CA 94063

Manufacturers of 400-dpi color electrostatic plotters which produce an E-size drawing in 8 min, a D-size drawing in 6 min, and a monochrome in 1 min. Standard hardware interfaces include serial or parallel with Ethernet offered as an option.  
Ronda L. Turner, Mktg. Spec.  
415/366-8900 Toll Free: 800/338-3377  
Fax: 415/366-2149

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

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

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

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

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

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

PRINCETON GRAPHIC SYSTEMS, 601 Ewing St., Bldg. A, Princeton, NJ 08540

Manufacturers of high-resolution color and monochrome monitors, scanners, and accessory products for IBM/Macintosh PCs.  
T. Barbana, Nat. Sls. Mgr.  
404/664-1010 Fax: 404/924-6358

PSiTECH, 18368 Bandilier Cir., Fountain Valley, CA 92708

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

PULNIX AMERICA, INC., 770 Lucerne Dr., Sunnyvale, CA 94086

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.  
Rolande Young  
408/733-1560 Toll Free: 800/445-5444  
Fax: 408/737-2966

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

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

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

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

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

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

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

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

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

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

QUME CORP., 500 Yosemite Dr., Milpitas, CA 95035

Manufacturers of LC shutter and laser page printers.  
Scott Cochran, V.P. Sls.  
408/942-4000 Fax: 408/942-4052

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

Manufacturers of public information display signs using guest-host LCD technology for indoor and outdoor applications.  
Stephen Hatch, Sls. Controller  
44-81-427-7727 Fax: 44-81-427-0350

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

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

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

Manufacturers of high-performance special-purpose CRTs and display equipment for leisure, commercial, industrial, and defense applications.  
Peter A. Nicholas, COO  
805/295-5770 Fax: 805/295-5087

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

Manufacturers of high-performance special-purpose CRTs and display equipment for leisure, commercial, and defense applications.  
A. J. Rees, V.P. Sls.  
44-61-681-7072 Fax: 44-61-682-3818

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

Manufacturers of standard or custom high-voltage power supplies for CRT displays: commercial (low-cost, highly reliable for mono/color displays, medical, film recorders); ruggedized (for commercial aircraft cockpit displays as well as other industrial programs); and military (for

submarine to space shuttle, meeting full MIL-SPEC).

Francesca Peterson, Sls. Mgr.  
805/528-5858 Toll Free: 800/235-4148 (outside CA) 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., 465 Centre St., Quincy, MA 02169

Manufacturers of ATC monitors, special-purpose CRTs and CRT assemblies, airborne display CRTs, head-up display CRTs, and ground-based/shipboard radar CRTs.  
Tom Holzel, Mktg. Mgr.  
617/984-8256, Fax: 617/984-4196

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

Manufacturers of the Thermal Display Unit with true gray shades at high speeds and high resolution, producing recordings of near-photographic-quality full tonal images, capable of displaying digital data in graphic or alphanumeric forms.  
John Lorea, Sls. Mgr.  
401/847-8000 x2054 Fax: 401/847-8002

RECOGNITION CONCEPTS, INC., 341 Ski Way, P.O. Box 9013, Incline Village, NV 89450

Manufacturers of real-time image processing system and video digital storage systems.  
Ron Earwood, Ad. Mgr.  
702/831-0473 Fax: 702/831-8035

REDIFFUSION SIMULATION LTD., Visual Business Unit, Plant 5, Jenner Rd., Crawley, West Sussex, RH10 6JY U.K.

Manufacturers of monitor, projection, and laser-based large-area displays, primarily for the aviation industry. WIDE is a collimated projection display offering fields of view of up to 40 (V) x 200 (H).  
A.P. Usher, Tech. Sls. Exec.  
44-293-518-941 Fax: 44-293-560-231

REEL 3-D ENTERPRISES, INC., P.O. Box 2368, Culver City, CA 90231

Distributors of viewers and accessories for true stereoscopic 3D imaging, including 3D slide and print viewers, 3D glasses, and books on the subject.  
David Starkman, V.P.  
213/837-2368 Fax: 213/558-1653

REFERENCE TECHNOLOGY, INC., 5775 Flatiron Pkwy., Boulder, CO 80301

Provides services and software to capture, convert and index images for storing on CD-ROM discs and retrieval software to access images on CD-ROM.  
Mike Befeler, V.P. Mktg.  
303/449-4157 Fax: 303/442-1816

REFLECTION TECHNOLOGY, 230 Second Ave., Waltham, MA 02154

Manufacturers and marketers of virtual displays such as The Private Eye®, which creates a full-size image of a 12-in. monitor in a package measuring 1 x 1 x 3 in.

Prototypes of a megapixel information display (1120 x 900 pixels) will soon be available.  
Dave Higgins, V.P. Sls.  
617/890-5905 Fax: 617/890-5918

REGISBROOK GROUP LTD.,  
Units 1&2, Suffolk Way, Drayton Rd.,  
Abingdon, Oxon OX14 5JY, U.K.  
Designers and manufacturers of a range of standard and customer-specific display modules in VFD and LCD technologies. Facilities include fully automatic SMD electronic assembly, clean-room production area, and electrical and optical testing.  
Noah Smallshaw, Sls. Mgr.  
44-235-534-909 Fax: 44-235-528-971

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

RESEARCH SPECIALISTS, 1816 Settlers Reserve Oval, Cleveland, OH 44145  
Marketing research consultants.  
Tim Howard, V.P. Mktg.  
216/871-8909

RESOLUTION TECHNOLOGY, INC.,  
2947 Southbridge Rd., Rockford, IL 61111  
Distributors of monochrome and color CRTs for computer and display applications in sizes from 3 to 24 in. Magnetic deflection components including yokes and flybacks. Plastic monitor cabinets for 14-in. flat monochrome 13V color and 19-21 in. monochrome or color CRTs.  
James G. Wessel  
815/654-9222 Fax: 815/654-0353

RETROSCAN SCREEN, INC., 148 Madison Ave., New York, NY 10016  
Manufacturers of high-resolution rear-projection screens; ultra-high-brightness data/graphics/video. Lightweight-acrylic patented fine-pitch lenticular and fresnel lens system. High resistance to ambient light for highest possible gain and resolution. Screen sizes from 40 to 150 in.  
Michael Assael, Mktg. Mgr.  
212/532-6206 Fax: 212/213-2641

REYNARD ENTERPRISES, INC.,  
26098 Getty Dr., Laguna Niguel, CA 92677  
Suppliers of optical components and thin-film coating service, such as beamsplitters, filters, lenses, mirrors, mounts, polarizers, prisms, retarder plates, wedges, windows, and thin-film coating service.  
Forrest Reynard, Pres.  
714/831-6026 Fax: 714/498-9528

REYNOLDS INDUSTRIES, INC., 5005 McConnell Ave., Los Angeles, CA 90066-6734  
Manufacturers of Avion HV connectors for CRT applications which allow operation at high altitudes without the need to pot the neck; anode leads adapted to high-altitude requirements; HV connectors, wire, and cabling to interconnect CRT power supplies; HV multipliers.  
Dale Hollis, Mgr. Mktg.  
310/823-5491  
Fax: 310/822-8046

RGB DYNAMICS, INC., Research Park,  
419 Wakara Way, Salt Lake City, UT 84108  
Designers and manufacturers of standard and custom touch-entry systems for system

integrators and OEMs using zoned and buried-layer capacitive sensing technology.  
Wayne Maw  
801/581-9200 Fax: 801/543-4105

RGB SPECTRUM, 2550 Ninth St., Berkeley, CA 94710  
Manufacturers of video scan converters, video windowing systems and high-scan-rate analog mixers.  
Dan O'Brien  
415/848-0180 Fax: 415/848-0971

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

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

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

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

ROHM CORP., 8 Whitney, Irvine, CA 92718  
Manufacturers of LED lamps in multiple shapes and colors (including dual), with clear, transparent, and diffused lenses; IR emitters and detectors; single- and multiple-digit and alphanumeric displays; light bars; LED and thermal printheads; and laser diodes.  
Karl Boldt, Prod. Mgr.  
714/855-2131 Fax: 714/855-1669

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

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

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

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

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

SAES GETTERS/U.S.A., INC.,  
1122 E. Cheyenne Mountain Blvd., Colorado Springs, CO 80906  
Manufacturers of getter devices and gas-purification products. Evaporable-barium-based ring and wire getters for CRTs, non-evaporable zirconium-based getters for electronic devices. Mercury sources for plasma displays.  
Patrick Glennon, Mktg. Mgr.  
719/576-3200 Fax: 719/576-5025

SAIC (SCIENCE APPLICATIONS INTERNATIONAL CORP.), 4224 Campus Point Ct., San Diego, CA 92121  
Designers and manufacturers of color VGA, SVGA, and monochrome displays for rugged military, commercial, and industrial applications. Militarized palm-held, arm-held, and laptop computers and workstations with 386 and Intel-based 486 processors and interfaces to all commercial and military applications.  
Brenda Walker, Mktg. Coord.  
619/552-3116 Toll Free: 1-800/447-4373  
Fax: 619/552-3157

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

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

SANDERS ASSOCIATES INC., Information Systems Div., P.O. Box 2035, Nashua, NH 03061-2035

Manufacturers of ruggedized and militarized displays, intelligent terminals, and display workstations for application in aircraft, ground vehicles, shelters, ships, and submarines.  
Robert Perutz, Mgr. Bus. Dev.  
603/885-3524 Fax: 603/885-4603

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

SATORI ELECTRIC (America), INC., 3913 Virginia Rd. #210, Long Beach, CA 90807  
Marketing agent for Optrex LCDs. Optrex is a joint venture between Asahi Glass and Mitsubishi Electric Corp. Optrex offers a broad line of LCDs including alphanumeric and graphic types. Displays are offered with the latest high-contrast fluids.  
David Liu  
310/214-1791 Fax: 310/214-1721

SAYETT GROUP, INC., 17 Tobey Village Office Park, Pittsford, NY 14534  
Designers, developers, manufacturers, and marketers of electronic imaging equipment components for the multimedia marketplace. Recently formed a venture to produce a proprietary innovative active-matrix liquid-crystal display. The newly formed venture has contracted with U.S. manufacturers to produce 1-2-in.-diagonal AMLCDs.  
Ron Carson, Dir. Mktg.  
716/264-9250 Toll Free: 800/678-SHOW  
716/264-9265

SCHOTT CORP., Technical Glass Div.,  
3 Odell Plaza, Yonkers, NY 10701  
Marketers of CRT bulbs for industrial and military displays, and thin glass substrates for LCDs.  
Bill McLaughlin, Product Mgr.  
914/968-1400 x288 Fax: 914/968-8585

SCHOTT FIBER OPTICS, INC., 122 Charlton St., Southbridge, MA 01550-1960  
Manufacturers of a wide range of fused fiber-optic components, including high-expansion faceplates for CRT applications, fiber-optic tapers, bent-image conduit, CCD couplers, image inverters, specially machined fiber-optic components, and flexible fiber-optic bundles.  
Jay DiGregorio, Sls. Rep.  
508/765-9744  
Toll Free: 1-800/343-6120 outside Mass.  
Fax: 508/764-6273

SCHOTT GLASS TECHNOLOGIES, INC.,  
400 York Ave., Duryea, PA 18642  
Manufacturers of glass for precision and technical applications, including contrast enhancement, color and night-vision-goggles, compatible filter glass, CRT faceplate glass, precision optical glass, and custom melted glass.  
Steve Sokach, Prod. Mgr.  
717/457-7485 Fax: 717/457-7330

SCHOTT HIGH VOLTAGE, 1161 W. 2320 S., Salt Lake City, UT 84119  
Manufacturers of high-voltage and



combination high/low-voltage power supplies for use in monitor, imaging, avionics, and medical applications. Jon Day, Sls. Mgr. 801/972-3690 801/972-3699

SCIENCE ACCESSORIES CORP., 200 Watson Blvd., Stratford, CT 06497. Manufacturers of 2D and 3D digitizers. 2D: active areas from 20 x 26 to 60 x 72 in. (no special work surface); 3D: digitizer volumes up to 10 x 10 x 10 ft. H.A. Cleveland, V.P. Sls. 203/386-9978 Fax: 203/381-9270

SCREEN SHIELD, 426 Mulberry St., Suite 410, Scranton, PA 18503. Manufacturers of optical filters for all types of displays to control RFI/EMI emissions for compliance with FCC, VDE, MIL, Tempest, BS6527, and EEC legislation. Jim May 717/961-3727 Fax: 717/969-6274

SCRIPTEL CORP., 4145 Arlington Plaza, Columbus, OH 43228. Manufacturers of patented electrostatic digitizers for use in CAD/CAM, desktop digitizers, and pen computers. Transparent glass and opaque versions available. Sizes range from 12 x 12 in., 12 x 18 in., and custom sizes smaller than 12 x 12 in. Kevin Toshok, Sls. Mgr. 614/276-8402 Fax: 614/276-7615 Fax: 614/276-7615

SECURITY DEFENSE SYSTEMS CORP., 139 Chestnut St., Nutley, NJ 07110. Manufacturers of high-resolution real-time x-ray imaging displays for security and nondestructive-testing quality-control applications. Don Airey, Gen. Mgr. 201/235-0606 Fax: 201/235-0132

SEIKO INSTRUMENTS USA, INC., 1130 Ringwood Ct., San Jose, CA 95131. Manufacturers of the CH-5500 series of thermal-transfer color hard copiers and the GR-4400 series of advanced raster display systems. Cheryl Landman, Mktg. Comm. Mgr. 408/922-5800 Toll Free: 800/255-7617 Fax: 408/922-5840

SEMETEX CORP., 3450 Fujita St., Torrance, CA 90505. Manufacturers of magneto-optic spatial light modulator (MOSLM) systems for applications in optical signal processing, optical pattern recognition, and optical computing. Fred McAdara, V.P. Sls./Mktg. 213/539-0201 Fax: 213/375-7420

SEMICON ASSOCIATES, INC., 1801 Old Frankfort Pike, Lexington, KY 40510. Manufacturers of CPD and I-type dispenser cathodes for all types of monochrome and color CRT applications. Glenn Breeze, Dir. Tech. Sls./Dev. 606/255-3664 Fax: 606/255-6829

SEMICONDUCTOR SYSTEMS, INC., 47003 Mission Falls Ct., Fremont, CA 94539. Manufacturers of a complete line of photoprocessing tools designed to coat, cure, and develop photoresist on large substrates up to 500 x 500 mm. The advanced, fully automatic APEX™ FPD-500 system features a cluster architecture for maximum reliability and complete process flexibility. The system is available with a

field-proven interface for linked operation in a high-throughput factory environment. Jim McKibben, Dir. Sls./Mktg. FPD/MCM 510/683-8858 Toll Free: 1-800/542-9888 Fax: 510/656-3226

SEMITOOL, INC., 655 W. Reserve Dr., Kalispell, MT 59901. Manufacturers of processing equipment. Automated and semiautomated equipment for cleaning, etching, and stripping of glass substrates used for flat-panel displays. Tom Ritzdorf, Product Mgr. 406/752-2107 Toll Free: 1-800/548-8495 Fax: 406/752-5522

SENCORE, 3200 Sencore Dr., Sioux Falls, SD 57107. Manufacturers/Marketers of test instruments for computer and peripheral services, including the CM2125 Computer Monitor Analyzer, SC3100 Circuit & Waveform Analyzer, LC102 Capacitor & Coil Tester, and CR70 CRT Tester and Restorer. Tom Hort, Acct. Exec. 605/339-0100 Toll Free: 1-800/736-2673 Fax: 605/339-0317

SEOS DISPLAYS LTD, Marchants Way, Burgess Hill, West Sussex, RH15 8QY U.K. Manufacturers of out-of-the-window display systems for simulation, CRT monitor-based collimated displays, wide-angle edge-matched multichannel projection displays, and unique laser-scanned imaging and display systems. Owen J. Wynn 44-444-870-888 Fax: 44-444-870-777

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SHARP ELECTRONICS CORP., Microelectronics Group, 5700 N.W. Pacific Rim Blvd., Ste. MS-20, Camas, WA 98607. Manufacturers of monochrome and color passive-matrix LCDs, color TFTs, EL displays, CCD cameras, and LEDs. Joel Pollack, Prod. Mktg. Mgr. 206/834-8926 Fax: 206/834-8903

SHIP ANALYTICS, North Stonington Professional Ctr., North Stonington, CT 06359. Manufacturers of computer-generated ship handling and tactical simulation imagery projected on screens. Roger C. Cook, Mktg. Mgr. 203/535-3092 Fax: 203/535-0560

SIEMENS COMPONENTS, INC., VAC Div., 186 Wood Ave. S., Iselin, NJ 08830. Agency of Vakuumschmelze GmbH. Magnetic shieldings from low-frequency ac fields through to earth's fields; customer-specified monitor shielding, standard monitor shielding, shielding sheets for monitors; foils, parts, and magnetically shielded rooms. Wolfgang Eggert 908/603-5905 + 908/494-3530 Fax: 908/603-5994

SIERRACIN/INTREX, 12780 San Fernando Rd., Sylmar, CA 91342. Manufacturers of transparent conductive sputtered coatings of metals and oxides, including gold and tin indium oxide, on continuous flexible film materials such as optical-grade polyester. Applications include touch screens, filters, and EMI/RFI shielding. David Hayward, V.P. Mktg. 818/362-9131 Toll Free: 800/521-1307 Fax: 818/367-5927

SIERRACIN/TRANSFLEX, 5600 Bandini Blvd., Bell, CA 90201-6407. Manufacturers of flexible circuits and sensors, touch panels, composite heaters and anti-icing systems for commercial and military applications, including telecommunications equipment, point-of-sale devices, and automotive controls. Kerry Miller, West. Reg. Sls. Mgr. 213/269-9100 Fax: 213/264-8336

SIGMA DESIGNS, INC., 46501 Landing Pkwy., Fremont, CA 95050. Manufacturers of a 2-million-pixel 1664 x 1200 resolution monochrome monitor for the IBM PC line and Mac II and SE models. The system is capable of four shades of gray on the PC and Mac II versions. Targeted for desktop publishing and CAD/CAM applications. Gary Felte, Dir. Sls. 415/770-0100 Fax: 415/770-0110

SIGNATONE, Probing Division, 393-J Tomkins Ct., Gilroy, CA 95020. Manufacturers of a line of analytical probe stations, including custom-made flat-panel probes in sizes ranging from 8 to 20 in. sq., and analytical lasers for repair. Brian Dickson, V.P. Mktg. 408/848-2851 Fax: 408/848-5763

SIMTECH, P.O. Box 150, 29 Hamerkara St., Holon 58101, Israel. Manufacturers of videodiscs and video processor boards, high-resolution (1280 x 1024) true-color displays, video projectors, and graphics boards such as Matrox Image. Also, SPEG boards. Ben Beiski, Chief Engr. 972-3-5577680

SMART TECHNOLOGIES, INC., 600-1177 11th Ave. S.W., Calgary, Alberta T2R 1K9, Canada. Manufacturers of a family of large-area (4 x 3 ft.) touch surfaces for use with or without projectors for interactive displays. Software tool kits provided for UNIX, Macintosh, Windows, or OS/2 applications for data conferencing, copyboard replacements, or command and control. Jed Southerland, OEM Project Mgr. 403/245-0333 Fax: 403/245-0366

S-MOS SYSTEMS, INC., 2460 North First St., San Jose, CA 95131-1002. Manufacturers, designers, and distributors of a full line of LCD and other flat-panel display controllers and drivers. Sandeep Gupta, Product Mktg. Engr. 408/922-0200 x3504 Fax: 408/922-0238

ALAN SOBEL, 633 Michigan Ave., Evanston, IL 60202. Consultant on display devices and systems, specializing in flat-panel technologies. Analyses, problem-solving, report and proposal writing and evaluation. Alan Sobel, Principal 708/869-5607 Fax: 708/869-5607

SOCIETY FOR INFORMATION DISPLAY, 1526 Brookhollow Dr., Suite 82, Santa Ana, CA 92705-5421

International society for the presentation, exchange, and preservation of information display technology. Sponsor of annual Symposium, Seminar, and Exhibition. Publishers of Information Display Magazine, Proceedings of the SID, as well as other publications. Lauren Kinsey, Exec. Dir. 714/545-1526 Fax: 714/545-1547

SONY CORP., Display Device Group, 2-10-14 Osaki, Shinagawa-ku, Tokyo 141, Japan. Manufacturers of the super-high-resolution Trinitron™ color CRT; beam-index CRTs; high-resolution image pick-up tubes; projection CRTs; and other display devices. S. Morikawa, Mgr. 81-3-495-3630 Fax: 81-3-495-3724

SONY CORP., 10833 Valley View Street, Cypress, CA 90630. Manufacturers of sensing products that includes both advanced CCD cameras and Station tube cameras. Lisa Tollner 714-229-4170 Fax: 714/229-4333

SONY CORP., 16550 Via Esprillo, San Diego, CA 92127. Manufacturers of 16:9 aspect-ratio 28V 1920 x 1080 graphic wide-monitor computer displays. X-Windows graphic controller, 2048 x 2048, for air-traffic-control applications. Fully integrated camera, speaker, and microphone peripheral to enable desktop video conferencing. GDM 17- and 20-in. multimode color monitors. John Wyckoff, Prod. Mktg. Mgr. 619/673-2860 Fax: 619/451-0412

SONY GRAPHIC DISPLAY, 3300 Zanker Rd., San Jose, CA 95134. Manufacturers of 13-, 16-, 19-, and 20-in. Trinitron color graphic displays, and high-resolution displays with high-performance CRT technology. Kim Nero, Mktg. Coord. 408/955-4202 Fax: 408/955-5631

SOUND DECISIONS, 6646 Clearhaven Circle, Dallas, TX 75248. Thin-film interference program for the study of dielectric mirrors and A/R coatings, reflection characteristics of thin evaporated or sputtered films, and ellipsometric evaluation of layered structures. Runs on an IBM PC. Raymond Whisnant, Pres. 214/404-9445

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Fax: 503/345-7140

**SPECTRON ENGINEERING, INC.**, 255 Yuma Ct., Denver, CO 80223

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*SPIE, The International Society for Optical Engineering, is a nonprofit technical society dedicated to advancing scientific and engineering applications of optical, electro-optical, and optoelectronic technologies through its publications, symposia, and short courses.*  
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206/676-3290 Fax: 206/647-1445

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A nonprofit technical society devoted to meeting the information needs of imaging professionals — scientists, engineers, and technicians working in the area of photographic and electronic imaging. Its purpose is to advance the understanding and application of imaging science and technology.  
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**STANFORD RESOURCES, INC.**, 3150 Almaden Expwy., Suite 229, P.O. Box 20324, San Jose, CA 95118

Market researchers producing multiclient and custom studies of electronic display markets and technologies. Publishers of Electronic Display World and EDIS, a comprehensive database on the worldwide display market.  
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714/222-0777 Fax: 714/222-0555

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Manufacturers of super-bright LEDs, LED displays, LED printheads, LCDs, ELs, CFLs, photoreceptors (OPC, a-Si), subminiature lamps, miniature halogen lamps, and driver and controller electronics for displays.  
Takashi Kashiwagi  
81-3-3710-2222 Fax: 81-3-3792-0007

**STANLEY ELECTRIC CO., LTD.**, R&D Laboratory, 1-3-1 Eda Nishi, Midori-ku Yokohama 225 Japan

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Takashi Kashiwagi  
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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.  
Gregg Brasso, V.P. Consumer Div. Toll Free: 800/323-4258 Fax: 312/647-8526

**WILBRECHT ELECTRONICS, INC.**, LEDCO DIV., 346 Chester St., St. Paul, MN 55107

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Laurie Wilbrecht 612/222-2971  
Fax: 612/222-7639

**JAMES WILSON**, 1640 5th Street, Suite 224, Santa Monica, CA 90401

Manufacturers of illuminated panels and keyboards.  
Trevor Bray, Sales Mgr.  
310/576-0783 Fax: 310/393-6040

**WINTRON, INC.**, (formerly PENN-TRAN CORP.), 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, focus coils, degaussing coils, and custom sweep boards.  
Melissa Hein, Dir. Mktg.  
814/355-1521 Fax: 814/355-1524

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402/477-7501 Fax: 402/477-8214

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Bruce Francisco, Sls.  
707/996-5201 Fax: 707/996-3380

**XENTEK, INC.**, 1770 La Costa Meadows Dr., San Marcos, CA 92069

Designers, manufacturers, and marketers of standard and custom CCFT inverters and dc-dc converters for LCD modules.  
Mike Tanahashi, Product/Sls. Mgr.  
619/471-4001 Toll Free: 1-800/263-4532

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800/538-6477

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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.  
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Fax: 408/522-3800

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Sheau Chen, VP Sls./Mktg.  
408/988-2426 Fax: 408/970-0742

**XYBION ELECTRONIC SYSTEMS**, 8380 Miralani Dr., San Diego, CA 92126-4347

Manufacturers of 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 Sturz  
619/566-7850 Fax: 619/566-2032

**XYTRON, LTD.**, 13010 San Fernando Rd., Sylmar, CA 91342

Manufacturers of CRT displays, display multiplexers, scan converters, projectors, test systems, test amplifiers, and distribution amplifiers. Specialist in fast turnaround quality custom displays.  
William Blowers, Dir. Engrg.  
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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

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315/548-5000 Fax: 315/548-5100

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Richard J. Kurtz  
708/450-8306 Fax: 708/450-8393

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Manufacturers for PC input devices (mice, trackballs, scanners).  
Frank Yeh  
213/493-2790 Fax: 213/493-2790

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Jan St. Pierre, Mktg. Mgr.  
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Fax: 603/623-4009



## Color TV in the 50s

To the editor:

In 1942 I was in high school working after school in a radio repair store. We obtained our first black-and-white DuMont TV set, which used electrostatic deflection. In 1949 I worked for DuMont TV in Clifton, New Jersey, on the Westminster and Hamshire TV assembly line. At the time, they were the most elegant TV sets made. They had a large 12-in. TV picture tube which rose up out of the cabinet when the lid was raised. The set had a 78-rpm record changer and an AM/FM radio receiver. At the time, DuMont was known for their continuous TV/FM tuner.

Around 1954, I was working for the TV Advanced Development lab at Philco. At the time, Philco was manufacturing some pretty good black-and-white TVs and was second to RCA. Color was just around the corner. RCA started to produce shadow-mask color picture tubes and Philco obtained some samples.

I was given the task to design a circuit to include a brightness and contrast control, some trim pots, and fixed resistors. I was told that under no circumstances should I allow the cathode current of any electron gun to exceed 65  $\mu$ A. The goal of the task was to provide a brightness control which would adjust the three beam currents from cutoff to some maximum value, maintaining white balance all the way, with the contrast control set to zero. The second part of the task was to provide a contrast control which would adjust the three beam currents from zero video (brightness control set just to black) to a maximum value of video, while maintaining white balance over the full range. It was an interesting challenge. The results were satisfactory. Less than 2 years later, we had color TV working. For quite a while into evaluation, we measured the anode current. Later, if the average anode current was running high (over 1 mA at 25 kV), the color purity started to change, indicating that the shadow mask was distorting under the influence of heat. We just turned the contrast down and the purity came back.

After we had quite a number of shadow-mask CRTs delivered to Philco, we realized that the engineer who was doing incoming inspection on the CRTs had very weak color

perception. We didn't have a luminance chromaticity meter, but we got along. We didn't have any luminance in our lab, we only had "brightness" (see "Brightness, luminance, and confusion," *Information Display*, March 1993).

As one of the design engineers, I had the privilege to take one of the lab color TV sets home. It was in a cabinet, but it was so big and heavy that I couldn't get it to my third-floor apartment. So I put it in my girlfriend's (present wife) house. When I left Philco (1956), they took it back. Oh well, there weren't many good color programs on the air anyway.

Another thing that happened at Philco in the early 50s was that the Apple Color System (using a Philco beam-index CRT) was in development. That was the first beam-index

color TV designed and built by the research department. They had a special demonstration room in which they had a shadow-mask and a beam-index color TV set side by side. The Apple (no connection with Apple Computer) had a better, brighter, and bigger (21-in. rectangular) picture than the shadow mask (16-in. round). The Apple electronics using vacuum tubes was a genuine challenge for the circuit designers. The cost to manufacture was prohibitive. Index (technique for making the right color at the right time) was a problem then as it is today, but for different reasons.

Thanks to Charlie Comeau, one of the Philco research engineers who helped design the beam-index TV, for comments on this memo.

— Charley Halsted  
Warminster, Pennsylvania



Could this precocious child be anyone other than Charlie Halsted's granddaughter, Christine Marie? No, she couldn't. (For an explanation, see *Information Display*, March, 1993.)

To participate as an exhibitor at DTMC '95 in Santa Clara, please call Erika Suresky, Exhibit Manager, Palisades Institute for Research Services, Inc., at 212/620-3375, fax -3379.

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

Edited by JOAN GORMAN

### Rugged flat-panel touch monitors

MicroTouch Systems, Inc., Methuen, Massachusetts, has introduced TruePoint Ruggedized Flat-Panel-Display Touch Monitors designed specifically for harsh industrial or public environments. The fully integrated touch monitors combine MicroTouch's capacitive touch-screen technology with dual-scan color or black-on-white monochrome FPDs in a compact, ruggedized housing, completely sealed against splashes and dirt. The scratch-resistant touch screen is unaffected by dirt, grease, or water. The 9.5-in.-diagonal display is only 11.0 (W) × 7.5 (H) × 1.3 (D) in., providing a very small footprint for touch applications where space is critical. The color FPD provides 640 × 480 VGA resolution, 20:1 contrast ratio, 0.30-mm dot pitch, and up to 256 vibrant colors. The monochrome FPD provides 640 × 480 resolution, 18:1 contrast ratio, 0.30-mm dot pitch, and 64 gray shades. An evaluation unit is guaranteed to ship within 24 hours of order. The list price for the TruePoint Ruggedized FPD is \$2080 for dual-scan color and \$1310 for monochrome. Volume discounts are available. The touch screen and controller each have a 5-year warranty and the monitor has a 1-year warranty.

Information: Janet Pannier, MicroTouch Systems, Inc., 300 Griffin Park, Methuen, MA 01844. 508/659-9000, fax 508/659-9100.



Circle no. 1

### Microprocessor-controlled monitors

Aydin Controls, Fort Washington, Pennsylvania, has introduced two new Ranger™ Autosync® tabletop monitors which quickly adapt to a variety of video-imaging and workstation requirements. The 20T1 20-in. Trinitron and 21F1 21-in. FST, with front-panel microprocessor controls and LCD readouts, are autosynchronous and deliver high-speed synchronization from VGA to 1600 × 1200 resolutions. The microprocessor automatically sizes and centers the screen. The new Ranger™ models feature a 30–82-kHz range, VGA to 1600 × 1200 flicker-free operation, dynamic aperture focus (DAF), and 0.30-mm Trinitron 20T1/0.28-mm Invar 21F1. Both models are offered to dealers with high discounts.

Information: Aydin Controls, 414 Commerce Drive, Fort Washington, PA 19034-2699. 215/542-7800, fax 215/628-4372.



Circle no. 2

### Stereoscopic 3-D display kits

Tektronix Display Products, Beaverton, Oregon, has introduced a series of three-dimensional display kits for use with a customer-supplied monochrome or full-color monitor to obtain true stereoscopic 3-D displays. Composed of a liquid-crystal modulator, viewing glasses, and driver box, these kits enable the user to produce high-quality stereoscopic 3-D images. To create these distinctive 3-D dis-

plays, left- and right-eye images are alternately displayed on the monitor; full horizontal resolution is displayed for each eye. The liquid-crystal modulator mounted on the monitor encodes the images with circular polarization for a wide field of view. The special low-cost glasses decode the images, providing a clear stereoscopic 3-D display, and allow the user to view multiple unsynchronized displays. The SGS 310, 410, and 610 display kits allow complete freedom of movement because the viewing glasses are not connected to the monitor. High transmission created by the liquid-crystal switch makes viewing possible even in brightly illuminated work areas. The anti-reflective coating on the front surface of the SGS 610 minimizes reflections. The kits can be used with either 60- or 120-Hz raster displays.

Information: Tektronix Display Products, P.O. Box 500, M/S 46-943, Beaverton, OR 97077. 1-800-835-9433 ext. 5000, fax 503/627-1070.



Circle no. 3

### Electrically switchable RGB color filter

Displaytech, Inc., Boulder, Colorado, has announced the RGB FAST Filter™, a new electrically switchable red-green-blue (RGB) color filter for use in field-sequential color display systems. The RGB FAST Filter™ combines with small high-resolution black-and-white CRT tubes to create full-color display systems, and opens up new design possibilities for the miniaturization of displays. Traditional CRT shadow-mask technology limits color displays to large dimensions, and color LCDs are either low in resolution or large in size. The RGB FAST Filter™ solves



these problems by sequentially displaying red, green, and blue fields of a video image through the red, green, and blue states of the color filter, respectively. The individual color fields are displayed at three times the normal 60-Hz video rate, and the human visual system fuses the triplets into full-color images. The 1-in. clear aperture RGB FAST Filters are available for immediate delivery. Alternate sizes, including square apertures, are available on a custom basis.

Information: Christopher J. Sherman, Director of Marketing, Displaytech, Inc., 2200 Central Ave., Boulder, CO 80301. 303/449-8933, fax 303/449-8934.



Circle no. 4

### Auto-scanning monitors

Hitachi America, Ltd., Office Automation Systems Div., Montvale, New Jersey, has introduced the Accuvue® Galaxy Series of auto-scanning 20- and 21-in. color monitors that enhance visual clarity for the most sophisticated high-resolution graphics applications, such as CAD/CAM, DTP, document imaging, Windows™, and multimedia. The Series has been designed to meet the EPA's Energy Star Program standards and many other domestic and international energy, safety, and ergonomic standards. The auto-scanning monitors automatically adjust to various modes from VGA to 1600 × 1280 and provide flicker-free performance with a wide horizontal frequency range from 28 to 90 kHz, allowing for a high refresh rate of 84 Hz at 1280 × 1024; vertical refresh rates range from 50 to 152 Hz. The GX-21 features a flat screen and a 0.28 dot pitch for sharper images and less reflection. The Accuvue® Galaxy Series provides maximum adjustability, with 20 timing modes, including factory presets and user-programmable timings. Front-panel controls adjust screen size, side pincushion,

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## new products

color temperature and RGB color balance, and rotation (GX-21). The GX-20 includes a proprietary moire reduction circuit for reproduction of accurate graphics. The GX-20 is priced at \$1749 and the GX-21 is priced at \$2099.

Information: Hitachi America, Ltd., Office Automation Systems Division, 110 Summit Ave., Montvale, NJ 07645. 1-800/225-1370 or 201/573-0774 (East Coast), 510/785-9770 (West Coast).



Circle no. 5

### Fully automatic filter photometer/colorimeter

Photo Research, Division of Kollmorgen Instruments Corp., Chatsworth, California, has introduced the Pritchard® PR-880, a fully automatic filter photometer/colorimeter. Equipped with patented Pritchard optics, the PR-880 can perform complete photometric, colorimetric, and radiometric measurements in seconds. Applications include AMLCD display 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 the MS-55, a standard objective 55-mm f/2.8 (1:1 magnification) MacroSpectar® lens which can be focused from 1.75 in. to infinity, thus enabling the instrument to be used for either macrophotometry or telephotometry, with no accessory lens or change in calibration. Software is contained on a 512K ICM card in a chamber just below the focusing lens; over 100 measurements can be stored. Program and calibration data reside in the battery-

maintained RAM. The software can be restored to the ICM card using a PC and the SAVE/RESTORE program provided. The backlit 4 × 20-in. LCD displays menu choices and measurement results. All software functions are controlled via eight backlit push-buttons adjacent to the display. The PR-880 can also be controlled from a remote host (PC, MAC, etc.) over the built-in RS-232C interface using simple commands.

Information: Sue Mesecher, Photo Research, 9330 DeSoto Avenue, P.O. Box 2192, Chatsworth, CA 91313-2192. 818/341-5151, fax 818/341-7070.



Circle no. 6

### Video test-pattern generator

MTL Systems, Inc., Dayton, Ohio, has introduced the MTL 2803, a PC-based RGB programmable video test-pattern generator designed to appeal to the end user operating in a Windows™ environment. The MTL 2803 is the first test-pattern generator to implement DOS-based Windows-like computer technology through a serial-port interface and sells for less than comparable equipment currently on the market. Special Window operations include: Formats Window, a list of user-specified sync formats; Pull-down Menus, for quick and easy access to all programming options and tools; Sequence Window, a list of user-specified test sequences; Pattern Win-

dow, a list of user-specified test patterns; and Status Window, descriptions of format, sequence, pattern, and other status information.

Information: Ray Wabler, Director, Products Division, MTL Systems, Inc., 3481 Dayton-Xenia Road, Dayton, OH 45432-2796. 513/426-3111, fax 513/426-8301.



Circle no. 7

### New 35-in. direct-view TVs

Panasonic Co., Secaucus, New Jersey, has introduced the CT-35S31 and the CT-35S21, Panasonic's first 35-in.-diagonal-screen direct-view televisions. In addition to the PanaBlack Picture Tube, both sets feature Panasonic's Easicon Menu icon system for simple operation, picture-in-picture for dual-TV viewing, and Artificial Intelligence (AI) Circuitry, which digitally controls color and contrast. The PanaBlack Picture Tube with Invar shadow mask achieves a 40% improvement in contrast over Panasonic's conventional sets. Combined with bright phosphors, the result is a lifelike picture with deep blacks, bright whites, and true colors. The Easicon Menu system offers a set of on-screen icons from which viewers can choose to set the clock, implement AI circuitry, or make audio or video adjustments. Picture-in-picture enables the viewer to watch one source while monitoring another, select two sizes for the inset picture, place it at one of four screen locations, and freeze the frame. The main and inset pictures can be instantly swapped. The suggested retail price for the CT-35S31 is \$2099.95 and \$1899.95 for the CT-35S21.



Information: Panasonic Co., Display Products Dept., 2 Panasonic Way, Secaucus, NJ 07094. 201/392-4502, fax 201/392-4815.



Circle no. 8

### Enhanced lower-cost monitor

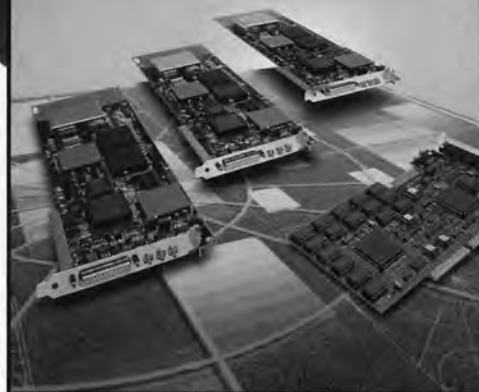
NSA, a Hitachi Group company, Westwood, Massachusetts, has announced enhancements and a price reduction on its top-of-the-line Hitachi SuperScan™ Elite 21 monitor. Ideally suited to large-screen business applications in Windows™ and imaging environments such as professional electronic publishing, CAD/CAM, document/image management, medical imaging, and multimedia, the SuperScan™ Elite 21 is now available at a suggested price of \$1995 – more than 25% less than its \$2695 original selling price. Technical enhancements to the SuperScan™ Elite 21 include: a scanning capability of 90 kHz, 1600 × 1200 resolution at 72 Hz, increased bandwidth to 160 MHz, full compliance with VESA's DPMS specifications for Energy Star guidelines, and digital rotation adjustment. The SuperScan™ Elite 21 also offers an advanced flat-screen square 0.28-mm dot-pitch CRT with Invar mask and AR coating, 31 microprocessor-based screen presets that automatically adjust the display for optimal performance with all graphic standards, pincushion adjustment, two inputs enabling dual-system configuration, and an optional computer control package.

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Information: Nissei Sangyo America, Ltd. (NSA), 100 Lowder Brook Drive, Suite 2400, Westwood, MA 02090. 1-800/441-4832 or 617/461-8300.



Circle no. 9

### Plasma display modules

Dale Electronics, Inc., Columbus, Nebraska, has introduced a new series of full-field dc plasma displays for applications in amusement and gaming machines, industrial controls, and medical equipment. Using a 128 × 64-pixel format, the displays provide a choice of two different viewing areas: 5.10 × 2.55 in. (APD-128G064) and 12.75 × 6.35 in. (APD-128G064A and APD-128G064A-1). The new displays offer easily read neon-orange characters and graphics, high brightness (minimum 50 fL), and a wide 150° viewing angle. Each has a slender profile which allows easy integration into new or existing designs. The smaller model (APD-128G064) is only 0.75-in. thick, while the larger models (APD-128G064A and APD-128G064A-1) are only 1-in. thick. Data is delivered through a TTL-level CRT-type interface. An ASCII interface controller and dc converter are optional. Prices in 100-piece quantities are \$120 for the APD-128G064, \$154 for the APD-128G064A, and \$204 for the APD-128G064A-1. Delivery is from stock to 4 weeks.

Information: Keith Raysby, Dale Electronics, Inc., 1122 23rd St., Columbus, NE 68601-3647. 402/563-6413, fax 402/563-6296.



Circle no. 10

### Filter glass for night vision

Schott Glass Technologies, Inc., Duryea, Pennsylvania, has introduced the S-8612, a new blue-colored filter glass for night vision and other display applications designed for maximum performance in the visible spectrum while completely attenuating transmission in the near-infrared. The glass exhibits a peak transmission of 90% at 500 nm and less than 2% at 700 nm. With a coefficient of thermal expansion of  $96 \times 10^{-7}$  between 20 and 300°C, the glass is ideally suited to fabrication and coating operations. The glass is offered in stock sizes of 165.1 × 165.1-mm squares with a standard thickness of 3-4 mm. Custom dimensions, configurations, surface qualities, and tolerances are available upon request.

Information: David W. Schimmel, Schott Glass Technologies, Inc., 400 York Ave., Duryea, PA 18642. 717/457-7485, fax 717/457-6960.

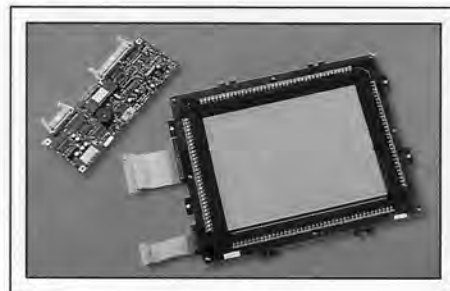
Circle no. 11

### IR touch system

Deeco Systems, Hayward, California, has introduced the T6 Infrared Touch System from Lucas Control Systems Products for use by OEMs, systems integrators, and large-volume end users who require rugged touch-screen capability for their 10.4-in. VGA flat-panel displays. Moisture, dust, contaminants, vibration, and heat that are encountered in extreme operating conditions do not affect its performance. When properly installed with the gaskets provided, the T6 is capable of meeting the requirements of NEMA 4 & 12

(IP-65). The T6 consists of a Deeco sealed bezel filter, infrared touch array, mounting frame, and controller card. There is a choice of either a clear filter for LCD and plasma displays, or an amber filter for electroluminescent displays. Prices begin at \$525 for either the clear-screen (T6-C) or amber-screen (T6-A) model. Applications range from hostile environments in steel mills, automobile plants, and oil refineries to hospital point-of-care, food processing, clean-rooms, and military and commercial vehicles.

Information: Deeco Systems, 31047 Genstar Road, Hayward, CA 94544-7831. 510/471-4700, 1-800/376-1154 in USA and Canada, fax 510/489-3500.



Circle no. 12

### Display-evaluation system

MTL Systems, Inc., Dayton, Ohio, has introduced CODES, a new performance-evaluation system for electronic displays that allows a relatively non-skilled operator to complete the performance evaluation of an electronic display on a CRT in just a few minutes. The comprehensive display-evaluation system is a hand-held lightweight testing device designed to provide an easy check for electronic-display degradation of an installed system in its working environment. CODES has been incorporated into MTL's Model 17001 high-resolution 17-in. RGB monitor, making it the only monitor currently on the market with built-in comprehensive performance evaluation.

Information: Robert W. Bissell, Director of Business Development, MTL Systems, Inc., 3481 Dayton-Xenia Road, Dayton, OH 45432-2796. 513/426-3111, fax 513/426-8301.

Circle no. 13 ■



## editorial

*continued from page 2*

neglected to make a note of it? If I can't believe the authorship of an article, what in an encyclopedia can I believe?

Perhaps I can believe what is said about a currently lively technology – light-emitting diodes. The main coverage of LEDs in Encarta consists of a nice digitized color photo and a figure caption that, inexplicably, accompanies the section on vacuum-tube diodes in the electronics article. The caption informs us that digital LED displays "are often used on...digital watches." There is no hint that this application has been obsolete for 15 years and that continuing developments have been opening substantial new markets for LEDs. Yes, this is a general, not a technical, encyclopedia – but 15 years out of date is a long time.

Until electronic publishers are held to the same standards as print publishers, and until the infrastructure evolves to the point that reviewers look as closely at major electronic information sources as they do at major print information sources, I'm afraid we will see more Encartas – third-rate print publications pretending to be first-rate electronic publications.

I should note that this issue of *ID* contains the eighth annual edition of our Industry Directory, a valuable and painstakingly edited print information source for the electronic-display industry. But it doesn't have to be limited to print. We prepare the directory electronically and would seriously consider publishing an (extra-cost) searchable electronic version if there were sufficient demand. Please let us know.

– Ken Werner

## SID '95

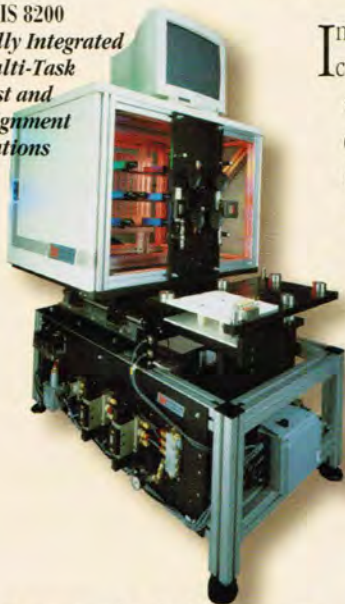
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## display continuum

*continued from page 4*

and having satisfied my bodily as well as my intellectual needs with a slice of my favorite Black Forest chocolate torte at the bookstore coffee shop, I considered myself well set for the week. I must admit I never tire of the feel of a good book. It's just *right* to have the covers in my lap, and turning the pages is a nice measure of progress. And I like saving the books I have read. My bookshelves just wouldn't look right holding stacks of computer printout.

Just Imagine. One of your colleagues mentions that he has bought a new digital still camera that has some interesting capabilities for allowing higher-resolution image manipulation when combined with a writable CD. You dial up one of your favorite high-tech shopping services and search their database for a full description of this camera as well as all others that have similar performance capabilities. You print out the spec sheets and detailed descriptions of all of them. And why not? They're free. With your new color printer, the quality of the brochures is comparable to what you could pick up in a store.

What about me? Did you forget? I'm the colleague who mentioned this new camera to you. I found it the same way you did. Interactive shopping has become the rage for "tekies" like you and me. While mail-order catalogs are still being sent for gift items and such, shopping by computer has become the way that all "serious" items are purchased. There are still a few stores left that have knowledgeable clerks – very few. Interactive shopping has completed the trend started in the 60s with discount stores.

Just Imagine. You are preparing a report on a new display technology and want to make sure that you have surveyed all pertinent work from both industry and universities. You access one of the well-known databases and request a search and printout of this and related topics. Within 10 minutes you have the complete list, and have ordered the full text of several references that are new to you. You request that the cost of the search be billed directly to your company's account.

What about me? I just did the same thing.

These vignettes all pertain to data zipping around on the "Information Superhighway." But, data is not all alike – just bits and bytes all fitting some convenient transmission and/or manipulation scheme. Databases range in size from little bitty ones to gigantic ones, and from time-stable ones to highly time-vari-

ant ones. (At this point, I am having a very difficult time resisting the temptation to include a graph.) However, I have decided NO GRAPH, so please do a little more visualizing along with me. The size of the database

will be conveyed along the vertical axis and the degree of time variance will be along the horizontal axis. On this plot, a 250-page history book would be near the lower left-hand corner (origin) as a relatively small and time-



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## display continuum

invariant database. News would be near the bottom right-hand corner as a small and highly time-variant database. In the upper right-hand corner would be large and time-variant databases such as airline reservations

and credit-card transactions. In the upper left-hand corner might be some huge text with a title like *The Complete History of Civilization*. And right in the middle – maybe something like a good sized encyclopedia.

The "Information Superhighway," I believe, will provide the most benefit for accessing the more time-variant and/or larger databases. In other words, if you can write it on a 3 x 5 card, you don't need a "computerized notepad that runs on batteries." Little pieces of paper are great. You can file them in your pocket, on your bulletin board, give them to your secretary, etc.

But then, why wouldn't a newspaper be ideal for the Information Superhighway "off-ramp" into your home? Because a newspaper isn't just news. It's mostly ads, comics, opinions, human-interest stories, and data that we don't even know we want until we see it. It's information we scan with little specificity. And that's hard to do from a computer screen.

Perhaps this column fits a similar mold. You never know what topic I am going to write about next and you never know what I will have found to put into the industry news section. Nevertheless, I hope you find it interesting and entertaining.

A few weeks ago (this is being written mid-May) the **United States Display Consortium (USDC)** held its Washington Display Days. The objective was to educate Members of Congress and Administration officials on the strategic importance of a strong U.S. flat-panel-display industry and the Government's role in its development. The meeting was coordinated by USDC and co-sponsored by the **American Electronics Association (AEA)** and **Semiconductor Equipment and Materials International (SEMI)**. Key messages that were discussed by the over 100 attendees and subsequently conveyed to Congressional staffers were: the large economic and employment impact of the display industry, displays as keys to growth in advanced electronics, the importance to national security, the need to overcome barriers to volume manufacturing, and the window of opportunity that is currently available. **Malcolm Thompson**, as Chairman of the Board of USDC, was the master of ceremonies, with **Peter Mills**, CEO of USDC, providing additional key information and guidance. Unfortunately, the unexpected death of former President Nixon resulted in his funeral on the very day that visits had been planned to the various public officials. Extensive last-minute replanning was required. In spite of this, many Congressional and staff members still took the time to meet with industry representatives. As I drove by the Pentagon parking lot later that

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day, it looked more like a Sunday than a mid-week workday.

The **1994 Color Imaging Conference** will be held November 15-18 at the Registry Resort in Scottsdale, Arizona. This will be the second of what will become an annual conference. It is expected to be the premier conference for color imaging. The theme of this year's conference is Color Science, Systems, and Applications. Among the invited speakers at the conference will be **Robert Hunt, William Schreiber, Jan Allebach, Fred Billmeyer, Gerald Murch, David Travis, Jay Rennilson, and Rob Cook**. You can get further information on this meeting from **Lauren Kinsey** at the SID office, 714/545-1526.

Two major contracts were recently awarded by **ARPA** relating to the development of diamond cathode technology for flat-panel displays. **Advanced Technology Materials, Inc.** of Danbury, Connecticut, received one of these contracts for funding up to \$1.1 million. The other contract was awarded to **SI Diamond Technology, Inc.** of Houston, Texas, in the amount of \$975,000. Both contracts are for the optimization of the diamond emission surface, with particular attention to the manufacturability of field-emission-based displays. The SI Diamond program is part of the Government's **National Center for Advanced Information Components Manufacturing (NCAICM)** and will be performed in cooperation with the **Microelectronics and Computer Technology Corporation (MCC)** in Austin, Texas. **Advanced Technology Materials, Inc.** is a strategic partner with **Silicon Video Corporation** of Cupertino, California.

**Motif, Inc.** of Wilsonville, Oregon, the developer and manufacturer of Active Addressing liquid-crystal display technology, has announced the signing of a strategic alliance with **Standish Industries, Inc.** of Lake Mills, Wisconsin. The agreement marks Motif's second partnership of this kind. Motif signed a similar alliance with **Tottori Sanyo** of Tokyo, Japan, in December. Through the agreement, Motif will sell Active Addressing integrated circuits to Standish, allowing Standish to manufacture displays based on this technology, thus expanding Standish's product line to include the video-rate high-information-content LCD market. **Henry Lewinsohn** is the chief operating officer at Motif.

**Motorola** and **In Focus Systems** have also announced their intent to invest about \$21

million over the next 3 years in **Motif** to speed up the development of a new less-costly Active Addressing application-specific integrated circuit and to cover the costs resulting from a 6-8-month slippage in the development of Motif's first and more complex IC design. This year's additional investment is expected to be in the \$7 million range.

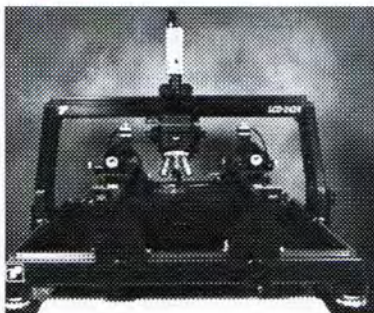
**S. K. Garg** has sent an announcement that **Super-Vu International** of Hyderabad, India, is making and selling various types of TV video data projectors and related items. They have indicated an interest in participating in SID activities and plan to become SID members.

**Steve Lieberman**, V.P., Marketing and Sales, for **Projection Imaging** of San Juan Capistrano, California, writes that they will

have a prototype product ready for demonstration in June, with initial product shipments scheduled for October. Steve admits that this is a bit of a slippage from earlier estimates but feels that, in spite of that, **Projection Imaging** is the "darling of the LCD manufacturers" because of their extensive experience in effective illumination design and expertise in this area of optics.

As always, contributions to and comments about this column are most welcome. You may call me in person at 609/734-2949, or fax me at 609/734-2049. If you prefer the mail, please send your information to **Aris Silzars**, Contributing Editor, **Information Display**, c/o **Palisades Institute for Research Services, Inc.**, 201 Varick Street, Suite 1006, New York, NY 10014. ■

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