3D hard copy
Miniature CRTs
1987 award winners
Industry directory
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Equality is an appealing concept. But not in CRTs. Because in certain demanding applications, most notably in photo-recording, an ordinary CRT often will not be able to meet the required specifications. That's when you'll want the enhanced performance of a Litton tube. And the freedom it gives you from typical CRT problems.

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Litton
Electron Devices
Hard copy for true three-dimensional images
You won’t need special glasses to see the 3D image on page 13—just a little practice and concentration. Our article covers all known techniques for producing 3D hard copy for aided and unaided viewing except for holography, which will be addressed next month.

Larry F. Hodges, Shaun Love, and David F. McAllister

Applications of miniature CRT displays
The mini-CRTs that fit so neatly into pilots’ helmets could revolutionize the way we see and work. Imagine a set of “visual headphones” for a typist or a surgeon’s head-down display for monitoring a patient’s vital functions during surgery.

Jim E. Wurtz

1987 SID honors and awards
Meet some of the pioneers in display technology, the distinguished recipients of this year’s honors and awards.

Nearly 300 companies are listed, first by product/service category, then alphabetically with full addresses, telephone/telex/fax numbers, sales contacts, and capsule descriptions.

Have You Read?

Directory of the Display Industry

New Products

Calendar

ID Classified

Sustaining Members

Index to Advertisers
Large-screen fiber-optic system installed at Vegas airport

Advance Display Technologies, Inc., Golden, CO, has completed a $960,000 agreement with Videoview Airport Advertising, Inc., to install three of its 6 x 8-ft. FiberVision display screens and three full-color video laser projectors at McCarran International Airport, Las Vegas, NV. The FiberVision system, invented and manufactured by Advance Display, uses a fiber-optic screen and laser projector. Any type of still or moving picture or text can be projected.

Earlier this year, Advance Display reached a $5.1 million licensing agreement, stock purchase, and product sale with Mitsubishi Rayon Co., Tokyo, Japan, to manufacture and market the FiberVision display board in Japan. The sale to Videoview represents the first commercial application of the system.

Riverfront Stadium installs giant screen

Riverfront Stadium, Cincinnati, OH, unveiled Sony's Jumbotron video screen on May 24, the 52nd anniversary of major league baseball's first night game. The 24 x 32-ft. screen is a version of the world's largest video screen (82 x 131 ft.) exhibited at the 1985 Japan Expo. The Jumbotron is part of a $5 million overhaul of the stadium's scoring and storage facilities, which include three new matrix-type conventional scoreboards and a remodeled plaza message board outside the stadium. The screen's image sharpness and brightness come from more than 100,000 Sony Trini-Lite high-luminance high-efficiency light-emitting cells.

Multi-national company will make color LCDs

Thomson-CSF, France, General Electric Co., and VDO Luftfahrtgeräte Werk Adolf Schindling GmbH, West Germany, have signed an agreement to develop and manufacture LCDs, particularly flat-panel and active-matrix full-color LCDs. Thomson-CSF and VDO Luftfahrt will form a joint subsidiary, Eurodisplay, which will benefit from the technologies developed by General Electric in the U.S. Eurodisplay will enable the three companies to pool their R&D efforts to develop new products for volume production as well as special-purpose devices.

People

Norman Rhodes has been named vice president of engineering and consulting by Concentration, Heat and Movement (CHAM), Huntsville, AL.

John V. Giordano has been appointed corporate controller of Diagnostic/Retrieval Systems, Inc., Oakland, NJ.

DocuPro, Inc., Mountain View, CA, has appointed Austin F. Ford, Jr., director of corporate communications.

Hyundai Electronics America, Santa Clara, CA, has appointed Carmen T. Reitano vice president and general manager of its newly formed Information Systems Division.

Alex MacDonald has been promoted to vice president and controller of Interstate Electronics Corp., Anaheim, CA.

Joseph Wielock has been appointed national sales manager for the Still Image Systems Group, New Business Division, Sony Information Systems Co., Park Ridge, NJ.

Dennis K. Medler has been appointed vice president of sales and marketing for 3d Systems, Inc., Sylmar, CA.

Isaac R. Barpal has been appointed general manager, research and development, of the Westinghouse Electric Corp., Pittsburgh, PA.

Concept Development, Inc. (CDI) of Costa Mesa, CA, has named David J. Herby as general manager.

In memoriam

With deepest sorrow, Lucitron Inc., Northbrook, IL, announces the death of its co-founder and vice chairman Joseph Markin on June 9 after a long illness. After working on flat television display devices at Zenith Radio Corp. for 13 years, he co-founded Lucitron to pursue gas-electron-phosphor technology. Mr. Markin specialized in television technology and in military electronics, and also taught at the Illinois Institute of Technology and the University of California at Santa Barbara. He was also an accomplished pianist and teacher of piano for some 50 years, and a judge at Chicago's Science Fairs for 14 years.

Joseph Markin was educated at the Illinois Institute of Technology and the University of Chicago. He published papers on microwaves, cable and subscription TV, and electronic displays, and was awarded six patents. He was a senior member of the IEEE, a member and director of the SID and Sigma Xi, and a registered professional engineer in Illinois. Mr. Markin was a program committee member for the annual SID International Symposium for many years, served as General Chairman in 1975, and was a SID outstanding service award recipient.

Mr. Markin is survived by his wife Jean, three daughters, two granddaughters, and two sisters. He will be greatly missed by his family, friends, and colleagues.
Our "Directory of the Display Industry" in this month's issue of Information Display is, insofar as we know, the first of its kind attempted, and we feel that it will prove to be of real reference value. Creating such a directory "from scratch" has been an interesting experience, as they say. Howard Funk volunteered to get us started by dipping once again into his databases to give us a printout listing of all U.S. firms engaged in information display. It soon became obvious that limitations would have to be made. Even confining it to firms employing over 100 people with sales over $10 million resulted in a 1.5-in.-thick printout, with hair-splitting categories only a bureaucrat could love. But it was an excellent start. By combining our own lists with selections from Howard's printout, we were able to send out questionnaires to over 1,000 firms.

And now for the directory itself. Part I consists of product categories. Companies are listed alphabetically by name only under as many categories as applicable. Part II is a single alphabetical listing of all companies, giving addresses, telephone numbers, sales contacts, and a brief description of each company's product line. You will notice that certain companies have been listed in boldface type. These are the companies that have placed advertisements in this month's issue, because we wanted to have some distinctive way of recognizing their support for our Society and its journal (that we would be doing so was pointed out in the cover letter sent with each questionnaire, of course.) Because this directory is the first of its kind we can indulge in a bit of hyperbole and state that it is the most comprehensive ever. We feel confident that you, our readers, will refer to the directory on numerous occasions in the coming year. Obviously, though, we welcome your comments, so that next year we can announce how updated and improved our second directory is. We feel confident, too, that our current advertisers, an important component in the kind of ID we are trying to provide, will be joined by others who recognize the value of this endeavor.

Our feature article this month is on hard-copy 3D printing technologies. Larry Hodges, Shaun Love, and David McAllister have provided a comprehensive overview, following up on their article in the May issue of ID. Because of the size of the Directory, we are running the non-holographic half this month; holography will appear in October's issue.

In the April issue of ID, Jim Wurzt gave "A Fond Farewell to the Display Industry." Obviously, this farewell did not mean goodbye forever, as his article on applications of miniature CRTs illustrates. Although he outlines the history and current uses of miniature CRTs, he also gives intriguing and far-reaching future applications that should give many of you much to think about.
INTERESTED IN A VIDEO GENERATOR?

Take This “Test” To Make A Better Buying Decision.

<table>
<thead>
<tr>
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<th>YES</th>
<th>NO</th>
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<td>1.</td>
<td>Do you want to display at least 100 levels of gray scales simultaneously at the top speed of your video generator?</td>
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<tr>
<td>2.</td>
<td>Do you want to display the seven color bars simultaneously at the top speed of your video generator?</td>
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<td>3.</td>
<td>Do you want to set the analog level of your video output to +/− 50% of 7V into 75Ω?</td>
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<td>4.</td>
<td>Do you need horizontal/vertical timing setting accurate enough to give you what you select — not just a &quot;good&quot;?</td>
<td>□</td>
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<td>5.</td>
<td>Do you need completely independent dot clock control?</td>
<td>□</td>
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<tr>
<td>6.</td>
<td>Do you want to edit &amp; store up to 100 programs and setups from the front panel of your video generator without an external disk drive?</td>
<td>□</td>
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<tr>
<td>7.</td>
<td>Do you want individual pixel-by-pixel control for patterns from the front panel?</td>
<td>□</td>
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<tr>
<td>8.</td>
<td>Do you want to use your PC to control the video generator; design your own test routines and store it all on a floppy disk?</td>
<td>□</td>
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...and if your answers are predominantly “Yes” one of the following Video Generators is the right choice:

- **120 MHz**
  - *ASTRO VG-811*

- **200 MHz**
  - *ASTRO VG-809S*

- **400 MHz**
  - *ASTRO VG-850*

Call (408) 720-8877 for a demo.
Most recently, I have used this column for a number of personal observations and comments. It would seem appropriate, therefore, for the sake of balance, to devote this month's column more to Society news and issues.

SID '87 in New Orleans has now become part of history. The attendance of 866 missed the record of SID '86 in San Diego by a fair amount, but Seminar attendance was excellent and the exhibits topped the 100-booth mark for the first time ever. Thus, SID '87 was definitely a success, but it raised again two difficult questions for Tom Credelle's Symposium committee: "How important is site selection to Symposium attendance?" and "How important is the local concentration/presence of display activity and SID members?" We discussed these issues at length, also with a number of our most loyal exhibitors, and Tom Credelle has appointed one of their representatives to his committee to help in the future site selections. As usual, your ideas and opinions, or criticisms, are most welcome.

Yet another important meeting is planned for next spring, the 57th annual meeting of the Inter-Society Color Council (ISCC) to which SID belongs. SID and ISCC are jointly sponsoring this meeting (May 8–10, 1988, in Baltimore, Maryland) just prior to the SID '88 Symposium (May 23–27 in Anaheim, California). The focus of the meeting will be the accurate transfer of colors from computer graphics and video presentations to hard copy, and vice versa. Larry Tannas, SID Vice President, is also Program Chairman of this meeting; a Call for Papers has just been prepared and Larry is eagerly looking forward to receiving a large number of abstracts.

A difficult decision reached by the Board of Directors at its last meeting was prompted by the realization that the mailing costs for our publications to members outside the North American continent are close to our present membership dues. After extensive deliberation and consultation with our overseas colleagues we decided to charge overseas members a mailing surcharge next year as is, in fact, quite common for most other technical societies. I would like to emphasize that we reached this decision reluctantly and that we are working with the overseas chapters to find ways to minimize the effects of this surcharge. Here again we welcome your comments.

Sincerely,

J.A. van Raalte
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THE BEAM INDEX CRT IS MORE THAN AN ALTERNATIVE TO THE SHADOW MASK COLOR TUBE. IT HAS...

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Hughes special-purpose CRTs range in size from one-half-inch diameter to thirteen inch diagonals. They serve avionics, ground vehicles, manportable displays, helmet-mounted displays and high-performance commercial applications such as phototypesetting and medical research.

Hughes has one of the world's finest engineering and technical facilities devoted to CRT production. High manufacturing and testing standards result in the production of tubes of consistent performance, outstanding brightness and resolution factors, low power consumption and high reliability.

For total CRT capability—off the shelf or custom—look to Hughes. You are invited to examine our facilities and discuss your exact requirements. Call (619) 931-3587 or write: Hughes Aircraft Company, 6155 El Camino Real Carlsbad, CA 92009.
Pardon me, but isn't that my parallactiscope?

In their survey article on 3-D ("True Three-Dimensional CRT-Based Displays," ID, May 1987), Larry Hodges and David McAllister give a brief mention to my parallactiscope, referring to it as an "autostereoscopic time-interlaced display" (Fig. 8 in the article). However, they erroneously attribute its development to SOCS Management Co. (Lowell Noble). Although Lowell has done some fine work—such as projecting the image so that it "appears to float in space"—the use of a moving slit must not be attributed to him.

The fact is, Lowell purchased a parallactiscope from me to use in some of his experiments!

The authors' description of parallactiscope operation is not quite accurate. My new book, The 3-D Oscilloscope, just published by Prentice-Hall, has a detailed description of the parallactiscope and a complete history of 3-D.

—Homer B. Tilton
Tucson, Arizona

The authors reply—

We are aware that the parallactiscope was developed by Mr. Tilton and apologize if our article seemed to attribute the origin of this idea to Mr. Noble. SOCS Research has built a display system which uses an electro-optical moving slit. This display has been demonstrated at SIGGRAPH '85 and at SPIE's O/E LASE Symposium in 1986 and 1987.

It was not our intent to present a complete history of 3D display or to describe all viable technology implementations. Our goal was to present an overview of non-holographic true 3D display techniques of current interest and give examples of their implementations. We apologize to Mr. Tilton if our article upset him.

—Larry F. Hodges and David F. McAllister
North Carolina State University
Raleigh, North Carolina

What is your opinion? ID's editors welcome letters from readers on specific articles or topics of general interest to the display community. Write to the Editor, Information Display, c/o Palisades Institute for Research Services, Inc., 201 Varick St., New York, NY 10014.

"Puff-piece" leaves questions unanswered

Marv Hodges and I were in business together about 20 years ago and, as a small-time entrepreneur myself, I appreciate first-hand the trials and tribulations of bringing a unique product to market.

So it troubles me all the more to complain about Ted Lucas' article on Marv's new video projector ("Improved Single-Lens Projection TV System," ID, June 1987). As a scientific journal, mention—and comparison—should have been made of the well-known (and of similar design) Electrohome three-gun one-lens projector. Surely such a comparison would have been scientifically useful to help elucidate what advantage the curved faceplate and full liquid immersion of dichroics provides compared to the otherwise similar Electrohome design. As it was, no useful claim was made for choosing this different CRT design.

The full liquid fish tank is said to eliminate an air-to-glass surface. But conventional projection CRTs are decoupled from the glass-to-air interface by multicoating their external surface, or by liquid coupling of the lenses to the CRT. Elimination of shadow masks is an odd "advantage" to tout. Shadow masks are found in no three-gun projector on the market, and never have been. So what advantages does Marv's projector offer? One obvious disadvantage not mentioned in the article is that the electron beam incidence is at an acutely sharper angle in the corners of Marv's CRT than on flat-faced CRTs, so one should expect greater spot aberration. How does Marv handle that very real problem?

Yes, small entrepreneurs have a tough time of it; and yes, American industrial ingenuity is being suffocated by the quarterly bottom-liners. Those real issues do not excuse such a deliberate puff-piece posing as a technical article in our prestigious journal.

—Tom Holzel, President
Arcturus, Inc.
Acton, Massachusetts

Editor's Note: We regret having omitted a comparison of the Triuniplex system to other similar projection devices, which we agree would have enhanced the usefulness of the article. We have asked Marv Hodges to respond to the technical questions raised by Mr. Holzel.

This letter is a response to Tom Holzel's letter to you criticizing the June report on our patented inventions "posing as a technical article." Tom identifies five areas of confusion and/or lack of comprehension: (1) wanted a comparison of our system vs. the Electrohome product because of "similar design"; (2) saw "no useful claim" for our new CRT design; (3) confused anti-reflection, coupling, immersion, and "fish tank"; (4) stated that a direct-view, full-color image without a shadow mask "is an odd advantage to tout"; and (5) stated that any curved faceplate has a greater beam incidence than any flat faceplate, without any knowledge of deflection angles.

(1) The Electrohome projectors are not single-lens systems, but three-lens designs sharing a common exit element: three separate projection lenses are positioned before the dichroics, and the common exit element comes after (used for corner focus, not magnification); they can be focused down to a 5-ft. image by compressing the sweep and enlarged to a 14-ft. image by expanding them, and nothing beyond these limits. Our design is infinitely variable from 1 ft. to infinity because the magnification optics are outside and are baresighted to the combined color images (like film projectors). TDS generates 1000 lum of peak brightness at
PHOTOMETRIC MEASUREMENTS?
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• Laboratory grade photometers and integrating spheres.
• Colorimeters with high accuracy (±0.0005 x,y) and high speed.
• Retro-reflectance meters that also measure color.
• Photometer heads with mosaic filters with accuracy of < 1%
• Goniophotometers for luminaire and automotive measurements

It all started with the fabrication of mosaic filters for correcting detector response to the photopic curve. From the start, this filter type has been reputed to yield the world's best photopic fit. It just seemed natural to follow on with optics and electronics that match the high quality of the photopic filter. And, as people asked for different things, one thing led to another. Before we knew it, a whole product line dedicated to quality photometric instruments had evolved!

Just because the product line is broad doesn't mean we stopped paying attention to the basics. We realize that photopic correction must be good, or any resulting measurement won't be right. Our colorimeters also contain virtually perfect tristimulus filter corrections that make incorrect color measurements just about impossible. That is why we pay the same amount of attention to the photopic filter correction of the battery powered Pocket-Lux as we do the room filling goniophotometers used to measure total luminous flux of luminaires and automobile head lights.

In this age of computers, we have naturally computerized. All of our colorimeters contain microcomputers. All of our laboratory systems (and most of our battery powered field units) can be interfaced via IEEE-488 so that your computer can not only take the data, it can also control our instruments. Computers take over in a big way when it comes to the goniophotometer systems. We have software that controls the operation of the whole system and delivers an astonishing array of computer generated plots and data. For total luminous flux, we have integrating spheres from 0.5 to 3 meters.
Hard copy for true three-dimensional images

BY LARRY F. HodGES, SHAUN LOVE, AND DAVID F. McALLISTER

IN an earlier article [ID, May 1987], we surveyed current technologies for true three-dimensional (3D) CRT-based display systems. In that article we identified four basic approaches to producing a display system for interactive manipulation of 3D images: multiplanar displays, alternating pair displays, time-parallel stereo pair displays, and time-multiplexed stereo pair displays. Multiplanar displays create a 3D image by presenting, in rapid succession, a series of two-dimensional (2D) slices of an object. The slices are optically or physically positioned in space so that a 3D image is perceived by the observer. Alternating pair displays create a depth effect by alternating between two perspective views of an object which differ by a vertical rotation of approximately 1 to 2°. Time-parallel stereo pair displays present left- and right-eye perspective views simultaneously on a single CRT screen or on separate screens. The correct view is delivered to each eye using special viewing hardware such as polarized glasses, colored glasses, or projecting lenses. Time-multiplexed stereo pair systems include both those that switch rapidly between right- and left-eye views of an image, using an electro-optical shutter or moving slit system to deliver the proper view to each eye; and systems that scan horizontal parallax information across a CRT screen while using a moving slit to direct the proper view to each eye. Moving slit systems have recently been described in a new book (Prentice-Hall, 1987) by Homer B. Tilton entitled, The 3-D Oscilloscope: A Practical Manual and Guide.

In this article we treat the problem of producing hard-copy representations of computer-generated 3D images for archiving, dissemination, and presentation. We should first note that images that have been generated digitally may require large amounts of memory. For example, to store a single bit-mapped stereo pair that has been produced on a graphics frame buffer with 1024 by 1024 resolution using true color (24 bits/pixel) would require 6 Mbytes of memory, assuming no data compression. A 30-sec animation consisting of 30 stereo pairs/sec would require over 5 Gbytes of storage. There are more efficient techniques for archiving and disseminating computer-generated 3D images. We now examine some alternative techniques for hard-copy representation of such 3D images.

We begin by surveying the possible approaches to producing 3D hard copy. We have divided the general techniques into several categories [Fig. 1]. All the currently useful methods for digital images, including holography, make use of stereo pairs or slices. At the highest level, these techniques may be divided between unaided viewing, or autostereoscopic techniques, and aided viewing, in which some type of viewing apparatus is needed to deliver the correct image to an observer. Autostereoscopic techniques may be further divided into holographic and non-

Larry F. Hodges and Shaun Love are visiting instructors and David F. McAllister is a professor in the Department of Computer Science at North Carolina State University, Raleigh, North Carolina.

Fig. 1: Techniques for 3D hard copy.
holographic categories. Holography will be covered in a separate article next month. Techniques that require viewing apparatus are divided into static versus dynamic images. Dynamic images allow the introduction of movement into the 3D display.

Free viewing
Perhaps the simplest representation of a 3D image based on stereo pairs is the presentation of the pair side by side. The pair can be created on a graphics printer or plotter, or printed from film. The stereo pair can be viewed without optical aids using a technique called free viewing. (This technique is used by stereo photographers when registering transparencies.) There are two different methods of free viewing: parallel viewing and cross-eyed or transverse viewing. With parallel viewing the observer looks at the right perspective view with his right eye and the left perspective view with his left eye [Fig. 2a]. The 3D image appears to be in between the two perspective images. Because it is difficult for most persons to look wall-eyed (i.e., diverge their lines of view, Fig. 2b), corresponding points in the left and right-eye perspective views should not be separated by more than the average horizontal distance between the eyes: approximately 2.5 in. This requirement limits the size of the stereo pair.

With transverse or cross-eyed viewing, the positions of the left- and right-eye perspective views are reversed, so that the left eye focuses on the perspective on the right and the right eye focuses on the perspective view on the left [Fig. 2c]. This method is usually easier for most people to learn and can be used to view stereo pairs whose perspective views are much larger than 2.5 in. [Fig. 2d].

Figure 3 illustrates both a parallel-view stereo pair and a transverse-view stereo pair of a twisted torus. The three perspective views are: a left-eye perspective view, a right-eye perspective view, and another left-eye perspective view. To see the corresponding 3D images using parallel or transverse viewing, follow the instructions in the figure caption.

Readers can obtain numerous examples of the side-by-side stereo presentation technique from books of stereo pairs such as Photographing in 3-D by Burder and Whitehouse or The World of Stereograms by Darrah, both of which are available from Reel 3-D Enterprises, Duarte, California.

Fig. 2: Methods for free-viewing stereo pairs.

Fig. 3: Exercise in 3D viewing. Both a parallel-view stereo pair and a transverse-view stereo pair of a twisted torus are illustrated. The three perspective views are: a left-eye perspective view, a right-eye perspective view, and another left-eye perspective view. To see the corresponding 3D image using parallel viewing, look at the leftmost perspective with the left eye and the center perspective with the right eye. The viewer's face should be approximately 1 ft. from the page. It is often helpful for beginners to place an index card or sheet of paper between the views so that each eye can see only the proper perspective. The 3D image will appear to be in space between the two perspective views.

To transverse view a stereo pair, look at the perspective view printed in the center of the page with the right eye and the perspective on the right of the page with the left eye. To help in doing this, try holding the sharpened end of a pencil, parallel to this magazine and between the eyes and the perspectives. Position the pencil so that, when only the left eye is open, the pencil point covers a point in the center of the rightmost twisted torus; when only the right eye is open, the pencil point should cover the same point on the leftmost twisted torus. Once the pencil is positioned, look at the pencil point with both eyes, then relax the eyes and pay attention to the image beyond the pencil point—a 3D twisted torus between the two flat perspective views.
Projection of polarized film images

A common method for presenting stereo-pair images to large groups (especially those who may not have mastered the art of free viewing) is to capture left- and right-eye images on film (using two 35mm slides or movie film in which the left- and right-eye images in a stereo pair are stored top and bottom in a frame) and project left- and right-eye perspectives onto a special screen using polarized light. The technique requires two projectors (or a lens mechanism to separate the left- and right-eye images in the case of movie film), polarizers for each lens, a screen with a metallic surface (usually called a silver screen) that retains the polarization of the light after reflection, and polarized glasses for each observer [Fig. 4]. A well-known example of this technique is the Captain EO 3D movie at Disneyland. Inexpensive stereo slide viewers are available for individual viewing of 35mm stereo pairs.

The optics of polarized light limit the amount of light reaching the observer of a 3D display. A light ray has an electric field that vibrates perpendicular to the direction in which the ray is traveling. This electric field may be thought of as being composed of two orthogonal components. A linear polarizer absorbs the component perpendicular to its transmission axis. If a second polarizing filter is placed in front of the first, with its transmission axis rotated 90° with respect to the first polarizer (crossed orientation), then the light rays that pass through the first filter are blocked by the second. If the transmission axes are oriented in the same direction (parallel orientation), then light passing through the first polarizer is also passed through the second. An ideal set of polarizers would transmit 50% of the visible light rays in a parallel orientation and 0% in a crossed orientation. In practice, using dichroic polarizers, we realize about 0.1% transmission in the crossed orientation and 32% transmission in the parallel orientation.

When used for stereo viewing, the projector polarizers are arranged so that the angle of polarization between perspective views is 90°. The polarized glasses are correspondingly polarized so that each eye’s polarizer is in the parallel state with respect to its intended perspective view and in the crossed state with respect to the opposite eye view when the observer’s head is in a vertical position. A problem with this technique is that ghosting (one eye seeing part of both perspective views) occurs in the image if the observer tilts his head from the vertical position. Recently, circularly polarized filters and glasses have been developed that eliminate this problem.

Another variation of this approach is Polaroid’s Vectograph, a clear plastic laminate of two sheets of polyvinyl alcohol that can be used to record 3D images using pen plotters. The left-eye perspective is plotted on the front side of the material, and the right-eye perspective is plotted on the back side. The 3D image is viewed with polarized glasses.

Video tape

Video tape is an inexpensive technique for storing medium-resolution stereoscopic images. On a 30-Hz interlaced video display the raster screen is scanned at a rate of 30 times/sec. The raster is divided into two fields: one consisting of all the odd scan lines (the odd field) and the other consisting of all the even scan lines (the even field). Each field is updated 30 times/sec producing an interlaced image that is scanned out alternately at a rate of 60 times/sec. To display the dual image of a stereo pair, the perspective image to be seen by one eye is written to the odd field; the perspective image for the other eye is written to the even field. The interlaced update cycle will then actually present not one image, but two different perspectives of a stereo pair that alternate with each other at the rate of 60 times/sec. Fast phosphors are required to reduce ghosting.

To view the image a mechanical or electro-optical shutter system is used to occlude the appropriate eye when the opposite eye image is scanned. Current systems use a liquid-crystal shutter that is placed in front of the monitor screen and is synchronized to the vertical refresh cycle. The shutter uses liquid-crystal π-cells and one circular polarizer to polarize the perspective on the even scan lines and the perspective on the odd scan lines in opposite directions. The observer wears passive glasses with the left and right lenses circularly polarized to allow the proper views to be seen. The primary problem with this method is that some flicker occurs in the image, because the technology dictates the refresh rate.

Parallax barriers

The preceding methods require special hardware to display and view the 3D image. Autostereoscopic hard copy is clearly more desirable. Parallax barrier methods, whose history dates from the early 1900s, provide an autostereoscopic alternate. These techniques include the parallax stereogram (described in our May article) and parallax panoramagram. A parallax stereogram consists of a fine vertical slit plate which is placed behind a specially prepared image consisting of right- and left-eye perspective views printed in alternate strips. The slits and perspectives are placed so that, from the proper viewing position, each of the observer’s eyes can see only the proper perspective view of a stereo pair. For a parallax panoramagram, the width-to-pitch ratio of the slit
plate is made smaller to provide a wider viewing angle [Fig. 5].

A variety of problems has kept parallax barrier techniques from becoming a popular method for autostereoscopic display. One drawback is that the image is often dark because so much light is blocked by the barrier itself. Another problem has been a lack of clarity caused by improper registration of the parallax barrier with the image strips. Very fine slits are used so that they are not observable. These narrow slits result in diffraction phenomena that also reduce clarity. In addition, the number of perspectives placeable on the image plane without overlap is usually fairly low, resulting in a narrow depth of field.

**Lenticular sheets**

A lenticular sheet is a linear array of cylindrical lenses. The thickness of the sheet is chosen so that its rear surface coincides with the focal plane of the lenses. Several perspectives of an image are printed in strips on the rear surface of the lenticular sheet so that the right and left eye will each see different perspective views of a stereo pair. (When creating lenticular images of real objects the sheet is placed on the front of the film within the camera and the camera is then slewed along an arc-shaped track.) Because the lenses can be fabricated inexpensively from plastic, 3D lenticular-sheet pictures have been published in magazines and are often used for 3D postcards, greeting cards, or novelty items.

Lenticular sheet displays exhibit a measureable depth of from 2 to 4 in. Image sizes larger than approximately 16 by 20 in. are unusual. Image quality is usually worse than parallax-barrier displays because of imperfections in the plastic lenticulars and a lower obtainable strip resolution. Because of small parallax separation between perspectives, lenticular-sheet pictures often also exhibit what is known as the *puppet theater effect*, in which the closest objects in the image look small and extremely near.

**Marshall's grating method**

Many of the problems with parallax-barrier techniques and lenticular sheets have been solved or minimized by Grayson Marshall using a method originated in concert with Gregory E. Gundlach. Although the method was originally developed for making 3D photographs of real objects, it is readily extendable to 3D images created from a series of computer-generated perspectives.

The method creates the parallax barrier from a piece of film containing a fine-line grating referred to as a *line raster*. The dimensions of the line raster are chosen to maximize diffraction phenomena by concentrating a single Fresnel zone on the film during each exposure of a perspective view onto the master 3D image. From the flexible computer model, different perspective views are photographically transferred to Cibachrome display transparency film CTDF7. The 3D transparency is printed using a line raster that is identical to the one which will be used to view it. A refractive material between the film and the raster during exposure and while viewing the final image allows the compression of more information onto the film, thus increasing the apparent depth of field of the 3D image. Currently, 12 perspectives are put onto the film. The Cibachrome transparency is then laminated onto a sheet of Plexiglas. The line raster is laminated onto the other side of the Plexiglas. Lamination of the line raster requires careful registration of the raster with the image.

The resulting image is viewed by putting a light box consisting of a light source and a diffusion screen on the film-carrying side of the Plexiglas. A bright high-quality 3D image can be seen on the line raster-carrying side of the Plexiglas. Images have been produced up to 52 by 70 in. An observer can view the image from 3 to 25 ft. away. At the optimal viewing distance, approximately 9 ft. for a large picture, the measurable depth of field can range up to 32 in. Movement from side to side produces different perspective views of the image within a range of approximately 45° to either side of a perpendicular to the center of the image. Because the technique is based on raster graphics and photographic technology, full-color images can be created.

It is also possible to produce a master 3D transparency of an image and contact print the image from the master mounted in the vacuum frame and illuminated by a point light source, so that images may be created in mass quantity. Duplicate line rasters can also be made from a master. A combination of automation and bulk purchase of materials could eventually bring the cost of a large 3D image down to a price competitive with a perspective image of the same quality and size.

Examples of this technique have been displayed at Cannes Film Festival, the January 1987 SPIE Conference on True Three-Dimensional Imaging Technologies and Techniques in Los Angeles, and at Disneyland, Tokyo.

**Conclusions**

We have reviewed several hard-copy techniques for computer-generated true 3D images. Each has its advantages and disadvantages, depending on the ultimate use and requirements of the medium. Except in the recording of multiplanar data in a multiplexed hologram and fringe writing (which will be covered next month), all current techniques depend on the ability to record either single or multiple stereo pairs, and therefore all have the attendant problems with accommodation and convergence [see ID, May 1987]. It is therefore crucial that the stereo pairs be computed correctly to avoid image distortion and depth inconsistencies.

For non-autostereoscopic techniques the preferred methods all use polarized light.

*continued on page 25*
Applications of miniature CRT displays

BY JIM E. WURTZ

What exactly is a miniature cathode ray tube? As a rule of thumb, it is one whose diagonal face diameter is less than 2 in., usually less than 1 in. A typical miniature CRT [Fig. 1] is 25 mm in diameter, including an integral magnetic shield. Its overall length is approximately 115 mm, and its spot size is less than 20 \( \mu \text{m} \) at 100-FL output on a TV raster.

In terms of pixels per unit, the CRT can produce a much higher resolution picture than just about any of today's competing flat-panel technologies. Miniature CRTs are available that can produce 1000-line pictures in roughly a \( \frac{3}{4} \)-in.-diagonal rectangle. Because the picture is generated sequentially from a single electron beam, there must be some depth to the device to generate and deflect the beam. For high-resolution displays on a CRT with a 25-mm nominal diameter, it is not possible, with today's technology, to make the tube much shorter than about 110 mm. This is sufficiently small so that the tube still does not take up much room. It is small enough and light enough, for instance, to mount on headgear.

The optics can be designed so that the presentation on this miniature face will look much larger to the observer, the effect being that of looking at a 12-14-in. monitor. With proper optics the display will appear to be at a normal viewing distance.

A little bit of history

Miniature CRTs were first used to record dots on aerial film [Fig. 2] to encode information such as date, altitude, and elapsed time.

In the late 1960s, experimenters in the Air Force began to look at helmet-mounted displays as an aid to pilots.\(^1\) Eventually, small tubes were used to provide large apparent displays in a small space in armored vehicles. This application used a CRT approximately 25 mm in diameter that was viewed through an ocular. To the observer, the face of the tube would appear to be over 100 mm in diameter [Fig. 3]. This application is useful only in cases in which the operator's head movement is minimal. Typically, the information displayed is that from a forward-looking infrared (FLIR) camera.

In the early 1970s, researchers at the University of Utah did some noteworthy work with miniature CRTs.\(^2,3\) Two tubes were mounted on a helmet, one for each eye, along with suitable combiners [Fig. 4]. With the computer memories and data-processing power then available, only simple figures such as cubes could be generated. A stereoscopic effect was created by suitably offsetting the tubes for

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Until his recent retirement, Jim E. Wurtz was senior applications engineer, cathode ray tubes, at Litton Electron Devices, Tempe, Arizona.

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Fig. 1: A typical miniature CRT, 25 mm in diameter and 115 mm in overall length.
Fig. 2: Early miniature CRTs "read" dots on film from aerial surveillance for date, altitude, elapsed time, etc.

Fig. 3: Miniature CRTs provide large apparent displays in a small space by placing an ocular between the CRT and the viewer.

Fig. 4: In the early 1970s, the University of Utah ran an innovative study on stereoscopic imaging using two miniature CRTs.

Fig. 5: The University of Utah experiment coupled miniature CRTs with computers to generate 3D objects in space.

Fig. 6: The Mergenthaler CR Tronic used a miniature CRT to "read" typeset copy.

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A number of years has passed since the pioneering work at the University of Utah. In terms of progress in processing power, 10 years in the semiconductor chip industry is equivalent to a new age. Today’s processing power, combined with a dual-tube helmet-mounted display, should provide some very “far out” applications in simulations, medical electronics, and games, although the intriguing games on the market such as the one from Utah, given a series of adjacent images, can produce a 3D image of the space scanned. Examples of suitable scan subjects are the skull, abdominal areas, or joints. Implants can be designed for an injured area, and surgery planned using the data derived from the 3D image.

With the same information applied to a stereo helmet-mounted display, it appears that it would be possible to generate a life-size 3D hip joint, for instance, in space that would allow a doctor to actually rehearse an operation. With the same spatial data, a second helmet could allow another doctor to view the same object from another position. Actually, one doctor could see the volumetric display from any position, even inside out!

Other applications might include the ability to “walk through” a building that has been designed by computer, or the ability to arrange furniture in a simulated space as if one were actually in the room.

For air traffic control, one could function like an overseer standing over the airport with the ability to look around and see airplanes traveling along in various positions within the space covered by the radar. Another often-mentioned application is remotely piloted vehicles, both ground and airborne.

In the future, these miniature displays can be useful whenever it is desired to view the displayed image simultaneously with a real-world task or another image so that the operator does not have to take his eyes off what he is doing in order to see other information. Examples include a head-up display for an aircraft pilot or the driver of any other kind of vehicle, for an operating surgeon who would like to see the patient’s electronic function readouts without taking his eyes off his task, or for an office worker at a CRT terminal where it is desired to replace the bulky terminal on the desk with a “visual headphone.”

With a stereo arrangement, one could view synthetic scenes on a micro or macro scale, such as the inside of a computer-generated atom or cell or all the space around an airport or a galaxy. It is expected that these tubes may be useful in volumetric displays that were formerly limited in memory and speed of data processing. Continuing advances in computing power should one day even allow the observer to integrate himself into the 3D display.

References
As pointed out by Bob Knepper in his history of SID in our April issue, it is a privilege of a professional society to honor distinguished accomplishments in its field. SID is proud to honor this year’s award recipients.

The Karl Ferdinand Braun Prize, named after the inventor of the CRT, is a newly created prize, sponsored by RCA, and awarded annually by SID for outstanding achievements in display technologies. The first recipient is T. Peter Brody for his pioneering efforts in the development of thin-film-transistor active-matrix displays. Dr. Brody has devoted his career to the development and commercial realization of flat-panel displays. At Westinghouse, where he worked for 19 years, he established the first programs in active-matrix-addressed EL and LC displays; demonstrated an active-matrix 6 × 6 in. LCD in 1972; EL in 1974; active-matrix EL-TV in 1975; and LCD-TV in 1977. He later founded Panelvision, which introduced the world’s first commercial active-matrix LCD in 1984, the Minigraphic. He is now president of Active Matrix Associates, a consulting firm in Pittsburgh, Pennsylvania. Dr. Brody holds approximately 20 patents and has authored numerous publications, having been the first to introduce the term “active matrix” into the literature in 1975. He is a Fellow of the SID (1983) and recipient of a SID Special Recognition Award (1976).

The Johann Gutenberg Prize, named after the inventor of moveable metal type, is a newly created prize, sponsored by IBM, and awarded annually by SID for achievements in hard-copy technology. This year’s recipient is Gary K. Starkweather for outstanding contributions to the development of laser xerography. At Xerox in the 1960s, Mr. Starkweather did pioneering work on the early uses of laser-scanned xerographic systems. His later work on laser scanning led to the development of the Xerox 9700 high-speed laser printer, for which he received the Xerox President’s Award in 1977. He is currently senior research fellow at the Xerox Palo Alto Research Center, where he manages a group involved in color imaging systems research, including digital color printing and imaging as well as electronic color reprographics. Mr. Starkweather is the author of many papers on optics and laser scanning and holds 26 patents in optics and electronic printing.

The Beatrice Winner Award is named in memory of the late wife of Lewis Winner, who together with her husband devoted many years to the management of the SID Symposia. The award is bestowed periodically for exceptional and sustained service to the Society. It is fitting that in this silver anniversary year, the award should go to the man who more than anyone else was responsible for the founding of the Society, SID’s first elected President, Harold R. Luxenberg. It was Dr. Luxenberg’s course on “Display Systems Engineering” (a course that is still being offered by UCLA, where it has the distinction of being the University’s longest-running summer seminar) that first sparked interest in forming a display society in the early 1960s. A mathematician and meteorologist by training, Dr. Luxenberg has pursued a teaching career, and has taught courses on information display systems, operations research, computer graphics, digital/analog signal processing, robotics, and microprocessor systems design. He is currently Professor Emeritus in Computer Science, California State University, Chico, California. Dr. Luxenberg is a Fellow of the SID (1966).
Shunsuke Kobayashi has been elected to the grade of Fellow for his pioneering and continuing contribution to liquid-crystal displays with high legibility and for his leadership in the display community. Dr. Kobayashi is a Professor on the Faculty of the Department of Electronic Engineering, Faculty of Technology, Tokyo University of Agriculture and Technology, which he joined in 1973. From 1964 to 1973 he worked at the Institute of Physical and Chemical Research on infrared lasers, detectors, and liquid crystals. At Tokyo University of Agriculture and Technology, his principal areas of research have been optoelectronics and liquid-crystal displays.

Andras I. Lakatos has been elected to the grade of Fellow in recognition of his many contributions to the development of electro-optic devices. Dr. Lakatos is manager of the thin-film device area at the Xerox Webster Research Center in Webster, New York. He joined Xerox in 1966 and during the 1970s was responsible for the modelling and characterization of the Ruticon, a deformographic light valve. In 1977 he began work on thin-film transistors for LCDs and the next year was appointed manager of the group responsible for research and development of LCDs and other thin-film devices. In 1985 he was co-recipient of a Xerox Special Recognition Award.

Omesh Sahni has been elected to the grade of Fellow for his significant technical contributions in gas discharge displays, electroluminescent devices, and gaseous electronics. Dr. Sahni is department manager of printer technologies at the IBM Thomas J. Watson Research Center, Yorktown Heights, New York. At IBM, he has been involved with all aspects of the physics and technology of information output devices, making major contributions in the areas of plasma panel displays, thin-film electroluminescent displays, and resistive ribbon thermal-transfer printing. Before joining IBM, he did research in flame plasmas and gaseous electronics. Dr. Sahni received a SID Special Recognition Award in 1983.

Dwight W. Berreman is a recipient of a Special Recognition Award for significant and continuing contributions to the theory and the reduction to practice of high information content liquid-crystal displays. Dr. Berreman has been on the technical staff of AT&T Bell Laboratories, Murray Hill, New Jersey, since 1961. He is the author of more than 60 papers in the fields of physical optics, x-ray optics, lattice dynamics, and liquid-crystal physics, and holds 14 patents on x-ray and visible-light optical devices including LCDs.

Eiji Kaneko has been given a Special Recognition Award for significant and continuing contributions to the theory and the reduction to practice of high information content liquid-crystal displays. Since joining the Hitachi Corp. in 1957, Dr. Kaneko has done research on instrumentation for atomic reactors, hybrid and monolithic integrated circuits for computer-aided design, and thin-film magnetic heads for computers. More recently, he has worked on LC, EL, and gas discharge displays and their driving circuits. He is now chief researcher at Hitachi Research Laboratory, Ibaraki, Japan, and responsible for all display work including hard-copy devices such as ink-jet printers, laser-beam printers, and facsimiles.

E. Peter Raynes has been given a Special Recognition Award for significant and continuing contributions to the theory and the reduction to practice of high information content liquid-crystal displays. Dr. Raynes has studied liquid-crystal materials and their applications since joining the Royal Signals and Radar Establishment in 1971. For his work on cyanobiphenyl liquid crystals he was awarded the Rank Opto-Electronics Prize in 1980 and his division received a Queen’s Award for Technological Achievement in 1979. He is currently leader of the liquid-crystal materials section as RSRE, Malvern, U.K.

Martin Schadt is a recipient of a Special Recognition Award for significant and continuing contributions to the theory and the reduction to practice of high information content liquid-crystal displays. Dr. Schadt is head of the liquid-crystal R&D section at Hoffman-LaRoche, Basel, Switzerland. Apart from his pioneering work on the twisted nematic and other field effects on which liquid-crystal displays are based, he has investigated electro-optical phenomena and correlations between molecular structures on macroscopic physical properties leading to new liquid-crystal materials and display applications.
Terry J. Scheffer
Special Recognition Award

Terry J. Scheffer has been given a Special Recognition Award for significant and continuing contributions to the theory and the reduction to practice of high information content liquid-crystal displays. Dr. Scheffer is best known for the discovery and development of the supertwisted birefringence effect (SBE) liquid-crystal display in 1983, while he was at Brown Boveri Research Center in Baden, Switzerland. Dr. Scheffer is currently with the display research group in the Imaging Research Laboratory at Tektronix, Inc., Beaverton, Oregon.

Jurgen Nehring
Special Recognition Award

Jurgen Nehring is a recipient of a Special Recognition Award for significant and continuing contributions to the theory and the reduction to practice of high information content liquid-crystal displays. Since 1971, Dr. Nehring has been with the Brown Boveri Research Center in Baden, Switzerland, working on liquid-crystal displays and optoelectronics. He was part of the research team that discovered the supertwisted birefringence effect (SBE) liquid-crystal display.

Larry F. Weber
Best Paper at SID '86

The Award for Best Contributed Paper at SID '86 has been given to Larry F. Weber and Richard C. Younce for their paper “Independent Sustain and Address Technique for the ac Plasma Display Panel” (12.3). Dr. Weber is currently a Research Associate Professor and group director at the University of Illinois at Urbana-Champaign Computer-Based Education Research Laboratory, where, since 1969, he has been actively engaged in the plasma display research group. He lectures frequently, in the U.S. and abroad, on plasma display technology, and holds five patents relating to the ac plasma display panel. Dr. Weber received a SID Special Recognition Award in 1982.

Richard C. Younce
Best Paper at SID '86

Richard C. Younce, co-recipient of the Award for Best Contributed Paper at SID '86, was enrolled at the University of Illinois at Urbana-Champaign as Larry Weber's student while they worked together on the independent sustain and address plasma panel design that became the subject of their award-winning paper. Mr. Younce is currently working toward his Ph.D. at the University of Notre Dame and is employed at the Tellabs Research Center in South Bend, Indiana.

Brian W. Epps
Best Student Paper at SID '86

The award for the Best Contributed Student Paper at SID '86 has been given to Brian W. Epps for the paper “Comparison of Six Cursor Devices on a Target Acquisition Task” (17.1), which was co-authored by Harry L. Snyder. Mr. Epps was Dr. Snyder's student at Virginia Polytechnic Institute and State University when he presented the paper last year. After receiving his Ph.D. in human factors engineering from VPI, he joined the user systems engineering group at Texas Instruments in Dallas, Texas, where he is now working on projects related to the design of computer-human interfaces for expert systems, manufacturing processes, and large databases.

Dr. Epps is the first recipient of the Best Student Paper Award, which was initiated last year as part of the SID student/professor travel grant program. Under the program, a limited number of travel grants are made available to student authors of accepted papers and their professors to attend the Symposium. To become eligible for the Best Student Paper Award, which carries with it a $500 cash prize, the student must present his or her own paper at the Symposium.

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Circle no. 8

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Device for the Electrophotographic Manufacturing of Printing Forms

Inventor: KLAVS-PETER DE SCHONEN
Assigned to: HOECHST A.G.

Disclosed is a device for the electrophotographic manufacture of printing forms, comprising a loading table, an exposure table, and a developing table arranged in the device one after the other in the transport direction of printing plates. The loading table is pivotable and is equipped with spring suction devices, by means of which the uppermost printing plate can be removed from a plate magazine. After the printing plate has been removed, the loading table is swung into its horizontal position, a corona is moved over the loading table and the photoconductive layer of the printing plate is loaded to the required voltage. The printing plate is transported from the loading table to the exposure table and from the latter to the developing table by means of compressed air which forms a cushion underneath the printing plate. The printing plate is guided on the cushion in suspension from processing station to processing station. For this purpose, at least two rows of air nozzles are arranged in the tables of the processing stations. The air nozzles extend at an angle inside the tables and are charged with compressed air. The loading table, at its narrow sides, is equipped with pivotable flaps. The exposure table, at its narrow sides, has fixed guide plates, whereas the developing table is equipped on all four sides with pivotable flaps and, moreover, has two additional rows of air nozzles which are arranged at right angles to the air nozzles which extend along each of the tables in the transport direction.

Interface Process for an All-Points-Addressable Printer

Inventors: ALEXANDER HERZOG, JAMES W. MARLIN, BRIAN G. PLATTE, FILIP J. YESKEL
Assigned to: IBM CORP.

This invention is a process for interconnecting an all-points-addressable printer with a host application program wherein the application presents output to be printed to the printer; and wherein the host application can be present on a variety of different computer equipment, such as a large host computer, a standalone workstation, or workstation on a local area network; and wherein the all-points-addressable page printer can utilize any type of printing technology such as electrophotographic, magnetic, or other; and wherein the printer and the application host are interconnected by communicating means, such as a channel, local area network, or telecommunication line; and wherein any type of transmission protocol can be used; and wherein the process enables the transmission of commands and data from the host application to the printer in a manner which is independent of the communication means and transmission protocol; and finally, wherein the process enables the transmission of a variety of types of data including text, graphics, image, or bar code which may be merged together on a single printed page.
linearity compensation coil is also wound. The linearity compensation coil and the deflection yoke are connected in series and the compensation control signal effectively reduces the series inductance of these elements so as to provide linearity compensation for horizontal deflection yoke current.

A liquid crystal display apparatus is disclosed wherein laser beams, which are modulated in accordance with modulating signals such as video signals, are irradiated on a liquid crystal cell for writing the display image or picture on the cell. In the present invention, the laser beams emitted from two laser beam sources are combined at a polarization beam splitter with an angular offset between the respective optical axes equal to delta theta, and the picture components corresponding to two scanning lines are simultaneously written into the liquid crystal cell during one scanning period, for increasing the image writing speed.

U.S. Pat. No. 4,654,616; Issued 3/31/87

*Blue Bow Correction for CRT Raster*

**Inventors:** DENNIS L. DODDS, JOSEPH L. WERST

**Assigned to:** RCA CORP.

In a video display system in which a cathode ray tube exhibits blue bow misconvergence, a correction arrangement includes areas of magnetizable material located within recesses formed in the deflection yoke insulator. The material lies between the end turns of the horizontal coils along the sides of the yoke. The material is magnetized to form a four-pole field to effect correction of the blue bow error.

U.S. Pat. No. 4,653,867; Issued 3/31/87

*Liquid Crystal Display Apparatus*

**Inventors:** MIKIO SUGIKI, TETSUO URABE, HIROYA USUI

**Assigned to:** SONY CORP.
Compiled by Howard L. Funk
IBM Corp.


"Fast Write and Erase Surface-


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### 3D hard copy

For showing static images to large groups, 35mm slides are projected through polarizers with crossed orientation onto a metallic screen and viewed through properly polarized glasses. The advantages are that almost no specialized equipment is needed except for polarizers and glasses, that 3D images can be shown to large groups, that the images can be printed in publications for free viewing, and that images can exhibit full color and high resolution in the image. For dynamic images, use of a large liquid-crystal shutter to view interlaced stereo pairs on video tape seems to be the most practical compromise. It requires the least amount of specialized equipment while producing full-color images that can be shown on a standard monitor or projected for large-screen viewing. Some problems exist with flicker, because each eye sees a perspective that is updated only 30 times/sec. These problems can be minimized (but not eliminated) by proper room lighting, brightness of the image, and choice of colors in the image.

For long-term storage of any film-based system, problems such as image fading and distortions can occur because of the recording medium. For example, changes in humidity cause the photographic emulsion to swell and shrink. If these changes are not perfectly reversible, then image distortion will result. Other undesirable features such as printout and microspotting are seen in old photographs and are of concern.

The competing autostereoscopic techniques for static images appear to be multiplexed holograms, which will be discussed next month, and Marshall’s grating technique. Both can be made in large sizes and both have good depth. Marshall’s technique has the advantage that images can easily be made in full color. It has the disadvantage that images are rigid so that large 3D pictures are not as easily transportable as holograms, which can be rolled up to fit in mailing tubes.

### Acknowledgments

We would like to thank Louis Harrison, a graduate student at North Carolina State University, for creating and photographing the stereo pair for Fig. 3, which is also on the cover of this issue of *Information Display*. We would also like to thank Grayson Marshall of Los Angeles, California, who spent many hours of his time answering our questions about his technique.

### New this month

#### ID Classified

- job opportunities
- positions wanted
- consultants
- business opportunities

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Expand Your Professional Horizons

Enhance your view of the entire spectrum of the electronic imaging industry. Come see and hear about its state-of-the-art products, its leading-edge technology, and its future applications.

On November 3-5, 1987, Boston will host the Electronic Imaging Conference/Expo at its World Trade Center. Leading manufacturers will display their latest products and equipment in the imaging field covering such areas as image sensors and scanners, video cameras, computers, memory systems, fiberoptics, recorders, video test equipment, image processing equipment, vision systems, and much more.

The four-day EI Conference Program, beginning on November 2, will explore imaging topics, including raster image processing, intelligent vision systems, advances in solid state sensors, optical data disc technologies, to name just a few. Bigger and better than ever, the conference of minicourses, seminars and applications sessions, to be held in Boston, will cover a whole gamut of leading edge technologies and new developments in electronic imaging.

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For more information and/or to register, Contact Irene at MG Expositions Group, 1050 Commonwealth Avenue, Boston, MA 02215, 617-232-3976 or 800-223-7126.
# Industry Directory

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COMPUTER PERIPHERALS
Colorado Video, Inc.
Computer Peripherals, Inc.

CONNECTORS
AEG Corp.
Connector Corp.
Daburn Electronics and Cable Corp.
Elforn, Inc.
Folsom Research Inc.
Hoffman Engineering Corp.
ITT Cannon Components Div.
PCK Elastomerics
Teledyne Kinetics
Thin Film Device, Inc.

CONSULTANTS
Leo Belair Inc.
Carroll Consulting Co.
CBI Consulting
International Planning Information, Inc.
International Resource Development Inc.
Monterey Technologies, Inc.
Anis K. Silzars
Tannas Electronics
Venture Development Corp.

CONVERTERS
Analogic Corp.
DataSpan Inc.
Endicott Research Group, Inc.
Texas Instruments, Inc.
Toko America Inc.

CRT DISPLAYS

CRTs, beam-index
Ginsbury Electronics Ltd.
Litton Electron Devices Division
Raytheon Co., Industrial Components Operation
Sony Component Products Division
Thomas Electronics, Inc.
Thomson-CSF, Division Tubes Electroniques
Thomson Electron Tubes and Devices Corp.

CRTs, conventional
AEG Corp.
Burke Industries, Inc. (formerly RCA Tube Operations)
Clinton Electronics Corp.
CRT Scientific Corp.
DataBeam Corp.
EEV Inc.
Electrohome Ltd.
Ginsbury Electronics Ltd.
Global Imaging, Inc.
Hitachi, Ltd.
Hughes Aircraft Co.
Hughes Aircraft Co., Industrial Products Division
Litton Electron Devices Division
MagnaVox/NAP Consumer Electronics
MII Corp./Teltron, Inc.
MODGRAPH Inc.
The M-O Valve Co. Ltd.
NEC Home Electronics (USA), Inc.
Panasonic Industrial Co.
Rank Brimar, Inc.

CRTs, multibeam
Ginsbury Electronics Ltd.
Raytheon Co., Industrial Components Operation
Sony Component Products Division
Thomas Electronics, Inc.
Thomson-CSF, Division Tubes Electroniques
Thomson Electron Tubes and Devices Corp.

CRT monitors, full color
Barco Electronics, Inc.
DataRay Corp.
Electrohome Ltd., Video Display Products
Elston Electronics Corp.
Ginsbury Electronics Ltd.
Hartman Systems, a Figgie International Co.
Hitachi, Ltd.
Hitech International
Hughes Aircraft Co.
Ikegami Electronics
Infodex, Inc.
International Business Machines Corp.
McMahan Electro-Optics, Inc.
MagnaVox/NAP Consumer Electronics
Manitron Displays Ltd.
MODGRAPH Inc.
The M-O Valve Co. Ltd.
NEC Home Electronics (USA), Inc.
Panasonic Industrial Co.
Rockwell International Corp.
Sanders Associates, a Lockheed Co.
Sanyo Business Systems Corp.
Sigmax Ltd.
Thomson-CSF, Division Tubes Electroniques
Thomson Electron Tubes and Devices Corp.
Toko America, Inc.
Toshiba Corp.
Totoku Electric Co., Ltd.
TSD Display Products, Inc.
Video Display Corp.
Video Monitors Inc.
Wacom Co., Ltd.
Wells Gardner Electronics

CRTs, electron guns and deflection yokes for
CELCO
Clinton Electronics Corp.
Display Components, Inc.
(DISCOM)
Ginsbury Electronics Ltd.
George D. Harris Assoc., Inc.
Hughes Aircraft Co.
K&R Engineering Sales Corp.
Penn-Tran Corp.
Rank-Brimar, Inc.
Rank-Brimar Ltd.
Syntronic Instruments
Thomson Electron Tubes and Devices Corp.
Toko America, Inc.

CRTs, other
CELCO
CRT Scientific Corp.
Electro Mechanical Systems, Inc.
George D. Harris Assoc., Inc.
Rockwell International Corp.
International High Voltage Electronics, Inc.
McMahan Electro-Optics, Inc.
Manitron Displays Ltd.
MicroTouch Systems Inc.
MODGRAPH Inc.
The M-O Valve Co. Ltd.
Orwin Associates, Inc.
Photo Research Division
Kollmorgen Corp.
Precision Electronic Glass Inc.
Rank Brimar, Inc.
Rank Brimar Ltd.
StereoGraphics Corp.
Tektronix, Inc., Liquid Crystal Shutter SPU
Thomson Electron Tubes and Devices Corp.
XYtron, Inc.
Zenith Electronics Corp.

**FILTERS**

Hornell Panelgraphic Corp.
Hoya
Brewer Hemate, Optical Color filters
Sharp 3 M
Tokoto Elec tronic Co., Ltd.
Tho mson Electron Tubes and Thomas Electronics, Inc.
The Dow Chemical Co.
Thin Film Device, Inc.

**FIBER-OPTIC DISPLAY PRODUCTS**

BDH Ltd.
Centronic E-O Division, Inc.
Corning Glass Works
CRT Scientific Corp.
Daburn Electronics and Cable Corp.
The Dow Chemical Co.
EM Industries
Galileo Electro-Optics Corp.
Hughes Aircraft Co.
Incom Inc.
Lewy Hill Labs. Ltd.
SAIT
Sharp Electronics Corp.
Thin Film Device, Inc.
Thomas Electronics, Inc.
Thomson Electron Tubes and Devices Corp.
3M Industrial Optics
Toshiba America, Inc.
Totoku Electronic Co., Ltd.
Transilc Inc.
Tripplet Corp.
UCE, Inc.

**FILTERS AND POLARIZERS**

Color filters
Brewer Science, Inc.
Dainippon Ink and Chemicals, Inc.
Futaba Corp. of America
Ginsbury Electronics Ltd.
Greene Marketing Corp.
Homalite, Inc.
Hornell Electrooptik AB
Hoaya Optics, Inc.
Infodex, Inc.
Metavac, Inc.
Optical Coating Laboratory, Inc.
Panelgraphic Corp.

Raytheon Co., Industrial Components Operation
Thin Film Device, Inc.
Thomson Electron Tubes and Devices Corp.
3M Industrial Optics
Toshiba Corp.
Xtaltie Display Systems Inc. USA
Xtaltie Technology Ltd. Canada

**POLARIZERS**

Ginsbury Electronics Ltd.
Hoya Optics, Inc.
International Polarizer, Inc.
Optical Coating Laboratory, Inc.
Optical Devices Inc.
Raytheon Co., Industrial Components Operation
Thin Film Device, Inc.
Thomson Electron Tubes and Devices Corp.

**FLAT PANEL DISPLAYS**

Backlights
IEC Co.
IEE
NEC Home Electronics (USA), Inc.
Futaba Corp. of America
SAIT
Sharp Electronics Corp.
Thin Film Device, Inc.
3M Industrial Optics
Toshiba Corp.
Tripplet Corp.
UCE, Inc.
Varitronix Ltd.
Watcom Co., Ltd.

**Electrochrome displays**

Asahi Glass Co., Ltd.

**Electroluminescent displays**

Bonar Kard-O-Lite, Inc.
The Cherry Corp.
Craft Data Ltd.
Digital Electronics Corp.
Emerald Computers, Inc.
Finlux Inc.
Hoffman Engineering Corp.
Hycom, Inc.
IEE
Infodex, Inc.
Interstate Electronics Corp.
Phosphor Products Co. Ltd.
Planar Systems, Inc.
SAIT
Sanders Associates, a Lockheed Co.
Sharp Electronics Corp.
Sigmatron Nova, Inc.
Texas Instruments, Inc.
Thin Film Device, Inc.
UCE, Inc.

**Electro-mechanical displays**

Denison Corp.
Ferranti-Packard Electronics
Industrial Service Labs (ISL) Corp.

**Gas-discharge displays**

Babcock Display Products.
The Cherry Corp.
Craft Data Inc.
Craft Data Ltd.
Dale Electronics, Inc.
Hughes Aircraft Co.
IEE
Industrial Service Labs (ISL) Corp.
Photonics Technology
SAIT
Texas Instruments, Inc.
Tripplet Corp.

**Light-emitting diodes**

Bowman/All, Inc.
Centronic E-O Division, Inc.
Craft Data Inc.
Craft Data Ltd.
Display * Tech Inc.
Ferranti-Packard Electronics
General Instrument Optoelectronics Division
IEE
Industrial Service Labs (ISL) Corp.
Optotek Ltd.
Sharp Electronics Corp.
Siemens Components, Inc.
Optoelectronics Division
Texas Instruments, Inc.
UceCorp.
Tripplet Corp.

**Liquid-crystal displays**

AEG Corp.
Asahi Glass Co., Ltd.
Clover Display Ltd.
Craft Data Inc.
Craft Data Ltd.
Denison Corp.
EEV Inc.
Electronic Display Systems, Inc.
Emerald Computers, Inc.
Excel Technology Corp. Int'l.
Grayhawk Systems, Inc.
Hitachi, Ltd.
Hornell Electrooptik AB
Hughes Aircraft Co.
IEE
Industrial Service Labs (ISL) Corp.
Kyocera America Inc.
Litton Panelvision
Norsk LCD
Racal Microelectronic Systems Ltd.
SAIT
Sanders Associates, a Lockheed Co.
Sharp Electronics Corp.
Tektronix, Inc., Liquid Crystal Shutter SPU
Thomson Electron Tubes and Devices Corp.
Toshiba America, Inc.
UceCorp.
Varitronix Ltd.
Watcom Co., Ltd.
Xtaltie Display Systems Inc. USA
Xtaltie Technology Ltd. Canada

**Vacuum fluorescent displays**

Babcock Display Products.
Craft Data Inc.
Craft Data Ltd.
Digital Electronics Corp.
Displays, Inc.
Emerald Computers, Inc.
Futaba Corp. of America
IEE Corp.
IEE
Industrial Service Labs (ISL) Corp.
SAIT
Texas Instruments, Inc.
Tripplet Corp.

**Matrix addressing**

Display * Tech Inc.
Hughes Aircraft Co.
SAIT
Tektronix, Inc., Liquid Crystal Shutter SPU
Thin Film Device, Inc.
UCE, Inc.
Varitronix Ltd.

**Plasma displays**

The Cherry Corp.
Craft Data Inc.
Craft Data Ltd.
Dale Electronics, Inc.
Denison Corp.
Displays, Inc.
Electro Plasma Inc.
Emerald Computers, Inc.
Hughes Aircraft Co.
IEE
Industrial Service Labs (ISL) Corp.
Interstate Electronics Corp.
Lucotron inc.
Magnavox Electronic Systems Co.
Panasonic Industrial Co.
Photonics Technology
SAIT
Texas Instruments, Inc.
Thomson-CSF, Division Tubes Electroniques
Thomson Electron Tubes and Devices Corp.
World Products, Systems Devices Group

**Liquid-crystal displays, active matrix**

AEG Corp.
Denison Corp.
Hitachi, Ltd.
Hughes Aircraft Co.
Litton Panelvision
Ovonic Imaging Systems, Inc.
SAIT
Sharp Electronics Corp.
Thomson Electron Tubes and Devices Corp.
Toshiba Corp.
UCE, Inc.
Xtaltie Display Systems Inc. USA
Xtaltie Technology Ltd. Canada
products & services

Flat panel displays, other
EEV Inc.
Hughes Aircraft Co.
IEC Co.
International High Voltage Electronics, Inc.
Lucitrain Inc.
MicroTouch Systems Inc.
NEC Home Electronics (USA), Inc.
Photo Research Division, Kollmorgen Corp.
UCE, Inc.
Wacom Co., Ltd.

FLAT-PANEL MATERIALS
Andus Corp.
BDH Ltd.
Bonar Kard-O-Lite, Inc.
Brewer Science, Inc.
Corning Glass Works
Dainippon Ink and Chemicals, Inc.
Deposition Technologies Inc.
EM Industries
Futaba Corp. of America
Infodex, Inc.
International Polarizer, Inc.
Kelex Ltd.
Levy Hill Labs, Inc.
Locktite Luminescent Systems Inc.
Mitsubishi Chemical Industries America Inc.
Optical Coating Laboratory Inc., Optical Devices Inc.
Phosphor Products Co. Ltd.
SABetsGettersUSA Inc.
SAIT
Sharp Electronics Corp.
Supertex Inc.
Thin Film Device Inc.
Thomson Electron Tubes and Devices Corp.
UCE, Inc.

GLASS PRODUCTS
Applied Films Lab. Inc.
Applied Glass Technology, Inc.
Artistic Glass Products Co.
Asahi Glass Co., Ltd.
Brewer Science, Inc.
Corning Glass Works
CRT Scientific Corp.
Deposition Technologies Inc.
Displays, Inc.
Flachglas AG
Hoya Optics, Inc.
Interaction Systems Inc.
Leyhill Labs, Ltd.
O&I Research Inc.
Optical Coating Laboratory, Inc.
Optical Devices Inc.
Owens-Illinois, Inc.
Precision Electronic Glass
Triunplex Display Systems, Inc.
UCE, Inc.

HIGH-VOLTAGE POWER SUPPLIES
Craft Data Ltd.
Del Electronics Corp.
Display Components Inc. (DISCOM)
Ginbori Electronics Ltd.
Infodex, Inc.
International High-Voltage Electronics, Inc.

Keltron Corp.
K&R Engineering Sales Corp.
P.B.E., The Repair Specialists
Penn-Tech Corp.
PKR/Interact Division, Emerson Electronics Co.
Toko America, Inc.
Wasatch High Voltage, Inc.
Wells Gardner Electronics

IMAGE PROCESSORS
Datacube, Inc.

IMAGE TUBES, CCD IMAGERS
AEG Corp.
Burle Industries, Inc. (formerly RCA Tube Operations)
Dage MTI Inc.
EEV Inc.
EG & G Reticon
Hughes Aircraft Co.
Incom Inc.
McMahen Electro-Optics Inc.
MR Corp/Teltron Inc.
RCA Tube Operations (see Burle Industries, Inc.)
Sharp Electronics Corp.
Texas Instruments, Inc.
Thin Film Device, Inc.
Thomson-CSF, Division Tubes Electroniques
Thomson Electron Tubes and Devices Corp.
Toshiba America, Inc.
Toshiba Corp.
Westinghouse Electronics Corp., Imaging and Sensing Technology Division

LARGE-SCREEN DISPLAYS
Large-screen matrix displays
Display * Tech Inc.
IEC Co.
Lucitrain Inc.
Omega Electronics SA
Photonics Technology
UCE, Inc.
Varitronix Ltd.
Xtalite Display Systems Inc. USA
Xtalite Technology Ltd. Canada

Large-screen plasma displays
Craft Data Ltd.
 Displays, Inc.
Electro Plasma Inc.
Emerald Computers, Inc.
MagnaVox Electronic Co.
Photonics Technology
Quantum Electronics Inc.
SAIT
Thomson Electron Tubes and Devices Corp.
World Products, Systems Devices Group

Large-screen text displays
Display * Tech Inc.
EEV Inc.
Lucitrain Inc.
Omega Electronics SA
Photonics Technology
Triunplex Display Systems, Inc.
UCE, Inc.

Xtalite Display Systems Inc. USA
Xtalite Technology Ltd. Canada

Liquid-crystal light-valve projectors
DataBeam Corp.
Excel Technology Corp., Int'l.
Greyhawk Systems, Inc.
Hughes Aircraft Co.
Hughes Aircraft Co/Industrial Products Division
Ovonics Imaging Systems, Inc.
UCE, Inc.
Varitronix Ltd.

Message boards
Craft Data Inc.
Craft Data Ltd.
Display * Tech Inc.
EEV Inc.
Futaba Corp of America
Ginsbury Electronics Ltd.
HECON Corp.
Hornell Electrooptik AB
Lucitrain Inc.
Norsk LCD
Omega Electronics SA
Quantum Electronics Inc.
Racal Microelectronic Systems Ltd.
Xtalite Display Systems Inc. USA
Xtalite Technology Ltd. Canada

ProJECTION CRTs
Arcturus, Inc.
Barco Electronics, Inc.
Clinton Electronics Corp.
DataBeam Corp.
EEV Inc.
Electrohome Ltd.
Electrohome Ltd., Projection Products
Electrohome Ltd., Video Display Products
General Electric, Projection Display Products
Ginsbury Electronics LTD.
Hitachi, Ltd.
Ikegami Electronics
Image Amplification Inc.
Infodex, Inc.
Sony Component Products
Division
Thomson Electronics, Inc.
Thomson-CSF, Division Tubes Electroniques
Thomson Electron Tubes and Devices Corp.
Toshiba America, Inc.
Triunplex Display Systems, Inc.
XYtron, Inc.
Zenith Electronics Corp.

Simulator displays
Arcturus, Inc.
DataBeam Corp.
Display * Tech Inc.
Ginsbury Electronics Ltd.
Hughes Aircraft Co.
Infodex, Inc.
Lucitrain Inc.

Large-screen displays, other
Futaba Corp of America
General Electric, Projection Display Products
HECON Corp.
Incom Inc.
Lucitrain Inc.
MicroTouch Systems Inc.
Norsk LCD
Photo Research Division, Kollmorgen Corp.
Rediffusion Simulation Inc.
StereoGraphics Corp.
Syntronics Instruments, Inc.

MAGNETIC SHIELDING
Ad-Vance Magnetics, Inc.
AEG Corp.
Amoneal Manufacturing Corp.
Eagle Magnetic Co., Inc.
The Inter-Technical Group, Inc.
K&R Engineering Sales Corp.
Magnetic Radiation Labs., Inc.
Magnetic Shield Corp., Perfection Mica Co.
Optical Coating Laboratory, Inc.
Tech Spray, Inc.
Thin Film Device, Inc.
Thomson Electron Tubes and Devices Corp.

MARKET RESEARCHERS
Stanford Resources, Inc.

OPTICAL COATINGS
Anti-reflection coatings
Asahi Glass Co., Ltd.
BDH Ltd.
Craft Data Ltd.
Deposition Technology Inc.
Ginsbury Electronics Ltd.
Greeneville Marketing Corp.
Hallcrest Products Inc.
Hokalite, Inc.
Hornell Electrooptik AB
Hoya Optics, Inc.
Infodex, Inc.
Metavac, Inc.
O&S Research, Inc.
Optical Coating Laboratory, Inc.
Optical Devices Inc.
Panelographic Corp.
Raytheon Co., Industrial Components Operation
Tech Spray, Inc.
Thin Film Device, Inc.
Thomson Electron Tubes and Devices Corp.
3M Industrial Optics

Custom coatings
Andus Corp.

Resolution-enhancement coatings
BDH Ltd.
Brewer Science, Inc.
Ginsbury Electronics Ltd.
Hallcrest Products Inc.
Optical Coating Laboratory, Inc.
Optical Devices Inc.
Panelographic Corp.
Raytheon Co., Industrial Components Operation
Thin Film Device, Inc.
Thomson Electron Tubes and Devices Corp.
### Transparent conductive coatings
- Applied Films Lab, Inc.

### PACKAGING FOR DISPLAYS
- Barco-Industries, Inc.
- The Cherry Corp.
- Chromatics, Inc.
- Craft Data Inc.
- Craft Data Ltd.
- DataBeam Corp.
- DataSpan Inc.
- Electro Plasma Inc.
- Elform, Inc.
- Emerald Computers, Inc.
- Ginsbury Electronics Ltd.
- Hartman Systems, a Figgie International Co.
- IEE
- Infodex, Inc.
- Intelligent Light, Inc.
- Korry Electronics Co.
- Mega Vision, Inc.
- Modgraph Inc.
- Panelgraphic Corp.
- Raytheon Co., Industrial Components Operation
- Sanders Associates, Inc.
- A Lockheed Co.
- Syntronic Instruments, Inc.
- Thomson Electron Tubes and Devices Corp.
- Toshiba Corp.
- Transcoll Inc.
- UCE, Inc.
- Zenith Electronics Corp.

### POWER CONVERSION SYSTEMS
- Venus Scientific, Inc.

### PRINTERS AND OTHER HARD-COPY DEVICES
#### Digital film recorders
- CELCO
- Ektron Applied Imaging, Inc.
- Lasergraphics, Inc.
- Mega Vision Inc.

#### Electronic photography
- Cilas Alcatel
- Dainippon Ink and Chemicals, Inc.
- Mega Vision Inc.
- Toshiba Corp.

#### Electrophotographic laser printers
- Cilas Alcatel
- DataBeam Corp.
- DeRex Inc.
- International Business Machines Corp.
- NBS Southern, Inc.
- OKIDATA
- QMS, Inc.
- Tempest Technologies, Inc.
- Texas Instruments, Inc.
- Toshiba Corp.

#### Facsimile devices
- Cilas Alcatel
- DataBeam Corp.
- International Business Machines Corp.
- McMahan Electro-Optics, Inc.
- Sanyo Business Systems Corp.
- Toshiba Corp.

### Impact printers
- DeRex Inc.
- Eaton Printer Products
- International Business Machines Corp.
- NBS Southern, Inc.
- OKIDATA
- Sanyo Business Systems Corp.
- Tempest Technologies, Inc.
- Texas Instruments, Inc.

### Ink-jet printers
- DeRex Inc.
- Diagraph Corp.
- International Business Machines Corp.
- Mega Vision Inc.
- Texas Instruments, Inc.

### Optical disks/video disks
- Craft Data Ltd.
- Dainippon Ink and Chemicals, Inc.
- Flachgas AG
- International Business Machines Corp.
- Mega Vision Inc.
- Mitsubishi Chemical Industries America Inc.
- Sanyo Business Systems Corp.

### Pen plotters
- Houston Instruments, Division of Ametek, Inc.
- International Business Machines Corp.
- Tempest Technologies, Inc.
- Wacom Co., Ltd.

### Thermal-transfer printers
- Craft Data Inc.
- Craft Data Ltd.
- Eaton Printer Products
- Industrial Service Labs (ISL) Corp.
- International Business Machines Corp.
- Lasergraphics, Inc.
- Mega Vision Inc.
- OKIDATA
- QMS, Inc.
- Test and Measurement Systems, Inc.
- Texas Instruments, Inc.
- Toshiba Corp.

### 3D hard-copy devices
- Cilas Alcatel

### Videotape
- Dainippon Ink and Chemicals, Inc.
- Mega Vision Inc.

### Hard-copy devices, other
- Enabling Technologies Co.
- HECON Corp.
- NBS Southern, Inc.
- Raytheon Co., Submarine Signal Division

### PRINTER PERIPHERALS
- Craft Data Inc.
- Craft Data Ltd.
- Dainippon Ink and Chemicals, Inc.
- DeRex Inc.
- Diagraph Corp.
- Eaton Printer Products

### International Business Machines Corp.
- James River Corp.
- Kyocera America, Inc.
- Mitsubishi Chemical Industries America Inc.
- Optotek Ltd.
- Peripheral Connections, Inc. (PERCON)
- Supertex Inc.
- Thomson Electron Tubes and Devices Corp.

### REPAIR AND MAINTENANCE
- P.B.E., The Repair Specialists
- TRW Customer Service Division

### SOFTWARE FOR DISPLAYS
- The Cherry Corp.
- Chromatics, Inc.
- Computer Peripherals Inc.
- Craft Data Inc.
- Craft Data Ltd.
- DataBeam Corp.
- DataSpan Inc.
- Digital Electronics Corp.
- Display Technology Inc.
- Emerald Computers, Inc.
- Enabling Technology Co.
- Endicott Research Group, Inc.
- Futaba Corp. of America
- Gibson Electronics Ltd.
- Global Imaging, Inc.
- Hughes Aircraft Co.
- International Business Machines Corp.
- MicroTouch Systems, Inc.
- Modgraph Inc.
- Omega Electronics SA
- QDP Computer Systems, Inc.
- Racial Microelectronic Systems Ltd.
- Raytheon Co., Submarine Signal Division
- SAIT
- UCE, Inc.
- Wacom Co., Ltd.
- Xtalite Display Systems Inc. USA
- Xtalite Technology Ltd. Canada

### TEST AND MEASUREMENT EQUIPMENT
- Analogic Corp.
- Ball Corp., Electrical Systems Division
- Boeing/Alliant, Inc.
- CELCO
- Control Systems Technology
- DataSpan Inc.
- Del Electronics Corp.
- Display Components Inc. (DISCOM)
- Dranetz Technologies Inc.
- EG&G Gamma Scientific Inc.
- Eltime Vision Systems
- Gibson Electronics Ltd.
- Greenwich Marketing Corp.
- Hallcrest Products Inc.
- Hoffman Engineering Corp.
- IEC Co.
- Industrial Service Labs. Corp.
- K&R Engineering Sales Corp.
- Korn Electronics Co.
- LMT
- LMT GmBH Berlin
- McMahan Electro-Optics, Inc.
- Magnetic Shield Corp., Perfection Mica Co.
- Meylan Corp.
- Microvision
- Minolta Corp.
- Optical Radiation Corp.
- Optotek Ltd.
- Particle Data, Inc.
- Peer Protocols, Inc.
- Photon, Inc.
- Photo Research Division/Kollmorgen Corp.
- PTXRantec Division, Emerson Electronics Co.
- Quantum Data Inc.
- Test and Measurement Systems, Inc.
- Triplet Corp.
- United Detector Technologies
- Visual Information Institute, Inc.
- Wahl Instruments, Inc.

### 3D DISPLAYS
- Chromatics Inc.
- Futaba Corp. of America
- Hughes Aircraft Co.
- QDP Computer Systems, Inc.
- Stereographics Corp.
- Telebeau Inc., Liquid Crystal Shutter SPU

### TOUCH-INTERACTIVE DISPLAYS
- Carroll Touch, Inc.
- The Cherry Corp.
- Craft Data Inc.
- Craft Data Ltd.
- Dale Electronics Inc.
- DataBeam Corp.
- Digital Electronics Corp.
- Electro Mechanical Systems Inc.
- Electro Plasma Inc.
- Emerlad Computers, Inc.
- Futaba Corp. of America
- Houston Instruments, Division of Ametek, Inc.
- Interaction Systems, Inc.
- Interstate Electronics Corp.
- Magnavox Electronic Systems Co.
- Magnavox/NAP Consumer Electronics
- MicroTouch Systems Inc.
- Phosphor Products Co. Ltd.
- SAIT
- Thomson-CSF, Division Tubes Electroniques
- TSD Display Products Inc.
- UCE, Inc.
- Vantronix Ltd.
- Wells Gardner Electronics
- Zenith Electronics Corp.

### VACUUM EQUIPMENT
- Hornell Elektrooptik AB
- SAES Getters/USA Inc.

### VIDEO AMPLIFIERS
- Citronix Inc.
- Gibson Electronics Ltd.
- Rank Bramar Ltd.
- Video Monitors Inc.
AD-VANCE MAGNETICS, INC.
625 Monroe St.
Rochester, NY 49675
Manufacturers of custom-fabricated magnetic shields, magnetic-tape and disk protectors, and magnetic-shielding alloy ray material, foil and sheet.
Kay Nixon, Sales Mgr.
219/223-3158 TWX: 810/290-0294
Fax: 219/223-2524

AEG CORP.
Route 22—Orr Dr.
P.O. Box 3800
Somerville, NJ 08876-1259
Manufacturers of LCDs for special applications, automotive dashboards, sign boards (bus terminals, stock exchange), military/aerospace. Features: anti-reflective coatings, chip-on-glass approach, multicolors. Also monochrome CRT assemblies, head-up and head-down displays, high-resolution ruggedized face plates. Monochrome color CRTs.
G. Barone, LCD Sales Mgr.; P. Mikkel, CRT Sales Mgr.
201/231-1830 Telex: 833409 Fax: 210/722-4905

AMUNEAL MANUFACTURING CORP.
4737 Darrath Rd.
Philadelphia, PA 19124
Manufacturers of custom and standard magnetic shields for magnetic-sensitive tubes and devices including CRTs, photomultipliers, and transformers. In-plant equipment includes CNC Turret Punch Press (Amada) and hydrogen annealing, automated heliarc welding, hydroforming, and CMM inspection equipment.
Raymond P. Pagliaro, Sales Mgr.
215/535-3000 Fax: 215/743-1715

ANALOGIC CORP.
Data Conversion Products
380 Audubon Road
Wakefield, MA 01880
Manufacturers of display-related products including video D/A converters.
Jim Siege, Mktg. Dir.
617/246-0300 Telex: 466-069 Fax: 617/245-1274

ANALOGIC CORP.
Data Precision Group
16 Electronics Ave.
Danvers, MA 01923
Manufacturers of test and measurement equipment including high-speed video waveform analyzer (Data 6100).
Dave Madson, Mktg. Mgr.
617/246-1600 800/343-8150
800/392-0528 (MA only)
Telex: 681/7144 DATA PRCN Fax: 617/777-7625

ANDUS CORP.
2101 Osborne St.
Canoga Park, CA 91304
Manufacturers of custom coatings on flexible substrates.
Linda A. Holt, Dir., Mktg./Sales
818/865-5744 Telex: 182374 Fax: 818/862-6519

APPLIED FILMS LAB, INC.
6797 Winchester Circle
Boulder, CO 80301
Manufacturers of sputtered thin-film components including ITO and metal-coated front and rear display electrodes.
Cecil VanAlburg, Pres.
303/530-1411 Telex: 450110 APPL FILM Fax: 303/530-3214

APPLIED GLASS TECHNOLOGY, INC.
2575 Sidney Ln Dr.
Brunswick, GA 31520
Manufacturers of seal rods and spacer rods for flat-panel displays. Also special glasses, redrawn tubing and rod, glass-to-metal and sapphire-to-metal seals. Spacer rods and seal rods available in any cross section, tolerances to suit.
Bob Plumbo
912/265-7386

ARCTURUS, INC.
304 School St.
Acton, MA 01720
Manufacturers and distributors of high-bandwidth video projectors, switches, RGB distribution amplifiers for terminals operating at 30-70 kHz horizontal scanning frequency.
Tom Holzel, Pres.
617/263-1122 Fax: 617/293-9419

ARTISTIC GLASS PRODUCTS CO.
Kumry Road, Postal Drawer C
Trumbull, CT 06610
Manufacturers of specialty-fabricated glass parts. Capabilities include all edge-finishing operations, drilling, chemical strengthening, and laminating.
215/830-9237 Fax: 215/830-9237

ASahi GLASS CO., LTD.
1-2, Marunouchi 2-chome,Chiyodaku
Tokyo 100, Japan
Manufacturers of glass products: glass bulbs for CRTs, substrates for LCD and EL devices.
T. Shimamura, Foreign Trade Dept.
03-210-5432 Telex: J24616 Fax: 03-211-5071

BABCOCK DISPLAY PRODUCTS
1051 E. East St.
Anaheim, CA 92805
Manufacturers of gas-discharge displays and VFDs.
John Hackney, Dir. Sales
714/491-5100 Telex: 249646

BALL CORP.
Electronic Systems Div.
P.O. Box 589
9343 W. 108 Circle
Brookfield, WI 53002
Manufacturers of high-speed inspection system and industrial instrumentation (temperature measurement system).
Robert Heiser, Dir. Mktg.
303/460-5272 800/565-1215
Telex: 244826 BALL UW Fax: 303/460-5423

BARCO ELECTRONICS, INC.
1500 Wilson Way, Suite 250
Smyrna, GA 30080
Manufacturers and marketers of CRT-based video projectors, primarily for the computer market. Top-of-the-line unit will scan an area entirely from 15 to 72 kHz with 100-MHz bandwidth. Also a full line of direct-view monitors.
Frank Genovese, Dir. Sales
404/432-2346 Fax: 404/436-2961

BARCO-INDUSTRIES, INC.
Th. Sevensealans 16
Kortrijk, Belgium 8500
Manufacturers and marketers of graphic displays, broadcast monitors, rugged displays, and cockpit displays.
32 (56) 23231 Telex: 85842 Fax: 32 (56) 200418

BARCO-INDUSTRIES, INC.
472 Amherst St., Suite 10
Nashua, NH 03063
Manufacturers of graphic displays, broadcast monitors, rugged displays, and cockpit displays.
603/880-1430 Telex: 023656/0247465 MCIUW Fax: 603/880-8918

BARCO-INDUSTRIES, INC.
170 Knowles Dr., Suite 212
Los Gatos, CA 95030
Manufacturers of graphic displays, broadcast monitors, rugged displays, and cockpit displays.
Barry Turner, Prod. Mgr.
408/707-3721 Telex: 023656/0247465 MCIUW Fax: 408/886-9103

THE BATES MANUFACTURING CO.
Newburgh Road Hackettstown, NJ 07840
Manufacturers of CRT anti-glare screens and maintenance products.
Eileen Magno, Dir. Sales
201/852-6300 800/222-2837
Fax: 201/852-7837

BDH, LTD.
Advanced Materials Div.
Broom Road
Poole, Dorset, U.K. BH12 4NN
Manufacturers of LCs for electro-optic displays and thermochromic devices. Also makes single crystals for IR, UV, and scintillator applications; nonlinear optical materials; and inorganic fluorides for fiber-optic use.
M. G. Pellett, Bus. Mgr.
0202 745520 (Nat'l.) 44 202 745520 Fax: 41186 TETRA G
0202 738290 (GP 3)

LEO BEISER INC.
151-77 Ave.
Flushing, NY 11354
R&D and consultation in image and data scanning and recording. Specializing in laser-based printing, graphics, industrial, display, and information systems, including CRT and discrete element development. Patent expertise and company guidance and training.
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718/353-7298

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421 Fealey Dr.
King of Prussia, PA 19406
Manufacturers of EL lamps and materials for backlighting LCDs, membrane switches, and electronic displays. Total EL lamp thickness is 0.012 - 0.018 in.
Dean G. Smith, Vice Pres.
215/277-2910 Fax: 215/277-2956

BOWMARIAL, INC.
531 Main St.
Acton, MA 01720
Manufacturers of 3-, 5-, and 10-in. analog bargraph/LED panel meters and 5- and 10-in. analog bargraph/digital panel meters.
617/263-8365 TWX: 710347-1441 Fax: 617/263-3386

BREWER SCIENCE, INC.
2401 High Tech Dr.
P.O. Box 66
Rolla, MO 65401
Manufacturers of a wide range of specialty chemicals for use in manufacturing flat-panel displays. Products and services include: patterned I-3 color plates made to the customer's specifications; polyimide coating and engineering support for companies developing processes for making active-matrix LCDs.
Jeffrey Hunminghake, Mktg. Dir.
314/364-0300 Telex: 351471 Fax: 314/364-7150
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(formerly RCA Tube Operations)  
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Lancaster, PA 17601-5688  
Complete line of high-resolution photorecording and projection CRTs for industrial, medical, and military applications. High-resolution CRTs available in 3- and 5-in. configurations. Projection CRTs available in 5- and 7-in. configurations.  
Carlton L. Rintz, Mgr., Mktg. Planning  
717/295-6027 Fax: 717/295-6097

CARDINAL TECHNOLOGIES, INC.  
P.O. Box 7628  
1827 Freedom Road  
Lancaster, PA 17604  
Manufacturers, designers, and sellers of a full line of OEM and standard color and monochrome CRT monitors. 9, 12, 13, 15, and 19-in. designs available.  
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512/444-3500  
Fax: 512/444-2595

CARROLL CONSULTING CO.  
15951 Los Gatos Blvd., Suite 9  
Carmichael, CA 95608  
Consulting and design services in CRT systems including VDTs, HUDs, HHDs, projection, recording, and test equipment; CRT circuits including deflection, video, geometry correction, and color conversion; cameras and solid-state imagers; project management and new product development.  
Gus Carroll, Pres.  
408/958-0023

CARROLL TOUCH, INC.  
2800 Oakmont Dr.  
Round Rock, TX 78664  
Manufacturers, designers, and developers of both infrared and resistive overlay touch input products. Also market a line of Total-Touch products specifically designed for the systems integrator looking for a packaged solution rather than an add-on product.  
Robert Dehm, Natl. Sales Mgr.  
512/244-3500

CBI CONSULTING  
2022 Haskell Dr.  
Belmont, CA 94002  
Consulting services in the fields of high-resolution displays, graphics, and analog technologies.  
Carlo Infante, Pres.  
415/963-5098

CELCO  
70 Constantine Dr.  
Mahway, NJ 07430  
Manufacturers of deflection yokes, deflection amplifiers, CRT test equipment, CRT digital film-recording systems.  
Art Weigend, Sales Engineer  
201/327-1123 TWX: 710/990-1018

CENTRICRON E-O DIV., INC.  
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Newbury, CA 91320-1702  
Standard and custom designers/manufacturers of high-performance silicon photodetectors, detector-filter combinations, multielement linear arrays, hybrids, fiber-optic detectors, quadrants, and bi-chip.  
George Pankow, Vice Pres./Gen'l. Mgr.  
805/499-5902 Fax: 805/499-7770

THE CHERY CORP.  
3600 Sunset  
Waukegan, IL 60085  
Manufacturers of segmented and dot-matrix gas-discharge displays, EL display systems, industrial control, and alphanumeric display systems.  
512/367-3022 Fax: 512/360-3566

CHROMATICS, INC.  
2558 Mountain Industrial Blvd.  
Tucker, GA 30084  
Manufacturers and designers of high-resolution color graphic computers and display systems for military, aerospace, scientific, and commercial applications. CK 2000 series features 1,000,000 vectors; 50,000 flat shaded polygons; and 150-sec full-screen erase.  
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404/493-7000 TWX: 810/786-8099 Fax: 404/493-1314

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100 Crescent Road  
Newbury, MA 01950  
Manufacturers of a comprehensive line of image printers for video, digital, radar, sonar, facsimile, aerial mapping, and reconnaissance applications.  
617/444-9011 Telex: 262255 CILA UR Fax: 617/444-5384

CRITONIX, INC.  
5342 Halsted Ave.  
Carmichael, CA 95608  
Manufacturers of magnetic deflection amplifiers; magnetic focus amplifiers; and video amplifiers.  
Al Plitz  
916/961-1938 Telex: 910/350-6540

CLINTON ELECTRONICS CORP.  
6701 Clinton Road  
Rockford, IL 61111  
Manufacturers of CRTs for data display, imaging, and consumer electronics. Products include grade-high-resolution CRTS with special phosphors, "Spectrum" segmented screens, anti-glare options, and ultra-high-resolution CRTs.  
James Wussel, Dir. Mktg.  
815/633-1444 Telex: 25-7484 Fax: 815/633-8712

CLOVER DISPLAY, LTD.  
156 Wai Yip St., 11/F, Karon Bldg.  
Kwun Tong, Hong Kong  
Manufacturers of 7 segment LCDs and 5 x 7 dot-matrix modules.  
Mr. C. L. Chou, Oper. Dir.  
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COLORADO VIDEO, INC.  
Box 528  
Boulder, CO 80306  
Manufacturers of a wide variety of video products, which can be used with any computer if so desired. Also design freeze-frame video telephones.  
Glen Southworth, Pres.  
303/530-9580 Fax: 303/530-9569

COMPUTER PERIPHERALS, INC.  
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Newbury Park, CA 93020  
Manufacturers of a complete line of enhancement board products for IBM's PS/2, PS/1 and other boards.  
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805/493-5751 800/654-7600 Telex: 760099 CPI Fax: 805/496-8846

CONNECTOR CORP.  
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Chicago, IL 60646  
Manufacturers of high-reliability sockets for CRTs featuring Connector Corp.'s unique tube neck retaining clamp. Secures socket to tube to withstand shock and vibration; is resilient and conforms to the tube neck. Available for most JEDEC and other basking.  
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312/539-3108 TWX: 910/221-6059

CONRAC DISPLAY PRODUCTS GROUP  
600 N. Rimsdale Ave.  
Covina, CA 91728  
Manufacturers of a variety of high-performance color and monochrome video monitors for broadcast and computer graphic displays.  
W. Ems, Dir. Sales  
818/966-3511 Telex: 67-0437 Fax: 818/966-9028

CONTROL SYSTEMS TECHNOLOGY  
19045 Cherry Bend Dr.  
Georgetown, MD 21452  
Manufacturers of a data line monitor which diagnoses hardware/software communications problems on RS-232 lines. Captures/display data and signal status on 2 x 40 LCD. Runs up to 15 hours on internal battery.  
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301/540-8614

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Corning, NY 14831  
Manufacturers of large and small CRT bulbs and components for industrial and military applications; core rod for fiberoptic faceplates; Corning glass code 7697 sheet glass for flat-panel applications; FOTOFORM® glass and FOTOCERAM® glass ceramic materials for plasma displays, dot-matrix printers, and inkjet nozzle applications.  
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607/974-4102 Telex: 932496 Fax: 607/974-8150

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Mission Viejo, CA 92692  
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Manufacturers of high-quality custom and production CRTs. Also offer application of phosphors to a wide range of substrates and lamination of EMI panels to any CRT. 
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Manufacturers of high-resolution auto-locking monochrome monitors and high-resolution video instrumentation cameras. 
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DAQINPON INK & CHEMICALS,
INC.
Imaging and Reprographic Products Div.
7-20, Nihonbashi 3 chome, Chuo-ku
Tokyo 102, Japan
Manufacturers of a variety of LC materials for LC displays and related products such as sealants and color filters. 
T. Takahashi, Gen'tl Mgr. 03/372-4511

DALE ELECTRONICS, INC.
P.O. Box 609
1122 23 St.
Columbus, NE 68601
Manufacturers of dc plasma (gas discharge) displays and display modules. Types include segmented (numeric and alphanumeric), bar graph, dot matrix, and graphic displays. 
Darrell Smejkal, Sales Mgr. 402/564-3131 Telex: 685046 Fax: 402/663-6418

DATA RAY CORP.
P.O. Box 368
452 Burbank St.
Broomfield, CO 80020
Manufacturers of monochrome and color CRT displays for the OEM market. Monochrome: screen sizes, 7-23 in. (15.750-100 khd); color: screen sizes, 13-19 in. (48-64 kHz).
Ann Woodley, Sales Rep. 303/483-5173 Fax: 303/466-9524

DATA SPAN, INC.
3515 California Road
Orchard Park, NY 14127
Manufacturers of converters; video acquisition display stations; image enhancement stations; image communications systems; graphic controllers; and NTSC frame stores. 
Allen D. Harper 716/692-5360

DATABASEAM CORP.
3256 Lonchess Dr.
Lexington, KY 40503
Manufacturers of high-resolution display and communication systems (1000 lines of better) which provide ability to view and interact with a full 8 x 11 in. document, providing error free communications, interactive pointers and real-time handwriting annotation. 
Peter G. Gammon, Dir. Sales 606/273-3204 Fax: 606/273-3619

DATAUCBE, INC.
4 Dearborn Road
Peabody, MA 01960
Manufacturers of the Max-View image processor, which consists of a frame buffer that displays high-resolution video up to 2K x 1K pixels on any monochrome or RGB high-resolution monitor, plus a DIA board containing timing and graphics overlay circuitry. 

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Distributors of plug compatible printer systems from 200 CPS through 8000 LPM. Impact and non-impact for IBM, Unisys, H-P, DEC, Prime, DG and other popular mini and mainframe computers. 
Robert Jamison, Vice Pres. 305/753-0540 800/245-7282 Fax: 305/755-0944

DEL ELECTRONICS CORP.
250 E. Sandford Blvd.
Mt. Vernon, NY 10550
Manufacturers of high-voltage CRT power supplies for commercial and military applications. A series of switching supplies are available with ratings to 27kV 40-W multi-output for shadow-mask color and monochrome modular construction with replaceable modules. 

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2540 W. 237 St.
Torrance, CA 90505
Manufacturers of flat-panel display products including LCDs and plasma displays. 
Rob Turner, Sales Mgr. 213/530-3530 Fax: 213/534-8419

DEPOSITION TECHNOLOGY, INC.
4540 Viewridge Ave.
San Diego, CA 92123
Manufacturers of standard and custom ITO coatings on glass and plastic and other sputter metalized plastic films for the electronics and display industries. 

DIAGRAPH CORP.
13789 Rider Trail N.
St. Louis, MO 63105
Manufacturers of a complete line of marking and labeling systems for product identification, coding and materials handling, including the Telemark large-character inkjet printer. 
Glenda O'Neil, Dir. Mktg. 314/739-1221

DIGITAL ELECTRONICS CORP.
31047 Genstar Road
Hayward, CA 94544
Manufacturers of VF modules, graphic and text terminal equipment, display modules, graphic and text controllers, plus a variety of flat-panel (EL, VF, plasma) and infrared panel adapter cards. 
I. McKinney, Vice Pres. 415/471-4700 Fax: 415/489-3500

DISCOM, Display Components, Inc.
334 Littleton Road
Westford, MA 01886
Manufacturers of precision high-resolution CRT deflection yokes and high-voltage power supplies. 
B. C. Iannotta, Vice Pres., Mktg. 978/692-6000 Telex: 951888 Fax: 617/692-8489

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Designers and manufacturers of medium-to-large scaled electric displays. Fully trained staff to support unusual and custom applications. 
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Manufacturers of standard and custom dc plasma displays including alphanumeric, dot-matrix, and bargraph designs or combinations of these. 
R. C. Kennedy, Pres. 717/242-2541 Telex: 842540

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Manufacturers of Cortene* PS-4 polymeric optical fiber and novel profiles including hollow and square specialty waveguides; also a coherent 7 x 7 solid polymer coherent array for imaging applications. 
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Manufacturers, designers, and marketing of precision electronic measuring and monitoring instrumentation for many industrial and commercial applications worldwide to provide critical data for analysis of electric power line and environmental disturbances. 
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Manufacturers of Miniscan CRT display systems; CRTs, including magnetically deflected CRTs; military and avionic tubes; monitor and projection TV tubes; miniature high-resolution electrostatic tubes; iridescent and fiber optic tubes. 
Stu Hesselson, Mktg. Mgr. 914/592-6050 800/431-1230 Telex: 661806 Fax: 914/682-6922
companies/f-i

FUTURE SYSTEMS, INC.  
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Falls Church, VA 22046  
Publishers of research and information on interactive video, video-disc, compact-disc technology, and related fields. The firm publishes newsletters, reports, books, and market studies.  
Rockley Miller, Pres.  
703/241-1799 Telex: 4998279

GALILEO ELECTRO-OPTICS CORP.  
Galileo Park  
Sturbridge, MA 01568  
Manufacturers of fiber-optic and electro-opto products.  
Lawrence T. Guzowski, Key Acct. Exec.  
617/347-9191 800/648-1800 (out-side MA)  
Telex: 4998014 Fax: 617/347-3849

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PDPO MKTG  
Fax: 315/456-3255

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Manufacturers of a wide range of optoelectronic displays, including photocouplers, LED lamps and displays.  
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Fax: 415/493-7055

GINSBURG ELECTRONICS, LTD.  
108 High St., Strood  
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Offers full engineering support in the design of industrial, commercial, and military CRT-based display systems.  
Newell Millward, Displays Prod. Mgr.  
(03) 721484 Telex: 96235  
Fax: (034) 712589

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201 Lomas Santa Fe Dr.  
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Software and systems integration. Turnkey digital imaging-processing systems.  
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619/481-5750 800/345-4624  
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Eliminates glare, electrostatic build-up, and both ELF and VLF emissions.  
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408/945-1776 Fax: 408/945-0385

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1820 Pickwick Lane  
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Manufacturers of cholesteric and chiral nematic LC inks, films and temperature-related products.  
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Representatives for manufacturers of magnetic detection components for CRTs: yokes, focus coils, stigmators, centering coils, precision in-line and delta magnetic components.  
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201/796-5200 Fax: 201/796-0070

HARTMAN SYSTEMS  
A Figge International Company  
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Manufacturers of monochrome and full-color CRT displays for spaceborne, airborne, ground and land-based military application. Available as MIL-qualified or ruggedized configurations.  
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Fax: 510/351-1008

HECON CORP.  
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Eatontown, NJ 07724  
Manufacturers of large-dig LED display displays of assorted sizes combined with counter, tachometer, rate meter and timer circuitry, thermal-hard-copy screen printer (Screen Scriber®).  
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Telex: 132457 Fax: 201/544-1343

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Baltimore, MD 21223  
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Paul Ficosa, Sales Mgr.  
415/263-3300 Telex: 501422

HITT CH  
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Old Greenwich, CT 06870  
Manufacturers of EL lamps, laser light-valve projectors including CRT-based, laser-based, and temperature-related products.  
Jeffrey O. Brown, Sales Mgr.  
203/325-6833 Telex: 643621 Fax: 203/357-8412

HOMALITE, INC.  
11 Brookside Dr.  
Wilmington, DE 19804  
Manufacturers of color filters and anti-glare contrast-enhancement filters.  
Susan Steptuck, Sales Rep.  
302/652-3686 800/346-7802 Telex: 510/600-0874 Fax: 302/652-4578

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Gagnef, S-78041 Sweden  
Manufacturers of LCD shutters for use in welding filters and similar applications. Custom designed optical components based on LC technology.  
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(66) 461 02030 Fax: 742787

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Manufacturers of input and output devices for the CADIACAM industry. For use with any computer using RS232C serial communications. Input devices include large-format scanners, and digitizing tablets. Output devices include pen plotters.  
Adam Sebben, Mgr. Reg'l Sales West  
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HOYA OPTICS, INC.  
3400 Edison Way  
Fremont, CA 94538  
Manufacturers of low-expansion glass substrates for EL panels; color glass substrates for CRT image enhancement; sunlight-readable glass filters for LED displays; anti-reflection coatings; polarizers and laminates; flat-panel image-enhancement filters.  
Donald L. Bailey, Sales Mgr.  
415/490-1880 Telex: 172-647 Fax: 415/490-1988

HUGHES AIRCRAFT CO.  
6155 El Camino Road  
Carlsbad, CA 92009  
Manufacturers of special-purpose CRTs, direct-view storage tubes, LC light-valve projectors, and custom display equipment.  
John Roy, Mktg. Mgr.  
619/331-3566 Telex: 510/32-1393 HAC/WPD  
CSBD Fax: 619/331-3334

HUGHES AIRCRAFT CO.  
7200 Hughes Terrace  
P.O. Box 45666  
Los Angeles, CA 90045-0066  
Manufacturers of CRTs and monitors; helmet-mounted, large-screen, and 3D displays; display drivers; fiber-optic cables and connectors; EM 2888, and custom display equipment.  
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213/688-6388 Telex: 190/328-6566 Fax: 213/688-7565

HYCOM, INC.  
16841 Armstrong Ave.  
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Designers and manufacturers of standard Sharp Corp. TFEI products and accessories. Hycom designs and produces custom TFEI display systems, specializing in handheld and video equipment.  
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714/261-6224 Fax: 714/261-9221

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San Antonio, TX 78207  
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Van Nuys, CA 91405
Manufacturers of LED displays, sealed bezel assemblies and display mounting hardware, VF, dc plasma and LCD modules, military EL display modules and interactive touch panels of various technologies.
Darryl Bloom, Dir. Sales
818/787-0311 Telex: 4720693 IEE
IPD Fax: 818/901/9045 G2G3

IKEGAMI ELECTRONICS
37 Brook Ave.
Maywood, NJ 07607
Manufacturers of a complete line of high-resolution color and black-and-white display monitors.
Don Mason, NE Reg.
Sales Mgr. 201/369-9171

IMAGE AMPLIFICATION, INC.
30 Chapin Road, P.O. Box 699
Pine Brook, NJ 07058
Manufacturers and distributors of three models of composite video three-tube color projectors with audio. The Ultravision 2000 and 3000 are monitors with monaural audio. The Ultravision 4000 has MTS stereo tuner, IF remote, and built-in stereo audio. Amie Ginsburg, Vice Pres./Gen'Mgr.
201/882-0584 Telex: 130 236

INCOM, INC.
205 Chapin St., Drawer G
Southbridge, MA 01550
Manufacturers of fiber optic faceplates; flexible light guides; spot-to-line converters; image conduits; rear-projection screens; large fiber-optic CRT screens; image tubes; and CCD imagers.
Jerry Burke, Cust. Serv. Mgr.
617/765-9161 TWK: 710/247-1604 Fax: 617/765-0041

INDUSTRIAL SERVICE LABS. (ISL), CORP.
4354 Olive St.
St. Louis, MO 63108
Dist. of 3-5 digit LED digital panel meters, up to 8-digit counters, timers, rate indicators; LCD and vacuum fluorescent displays.
Peter A. Racon, Vice Pres.
314/535-5760 800/325-8653

INFODEX, INC.
395 W. Main St.
Waterbury, CT 06702
Manufacturers of CRT monochrome and color displays for military, medical, and ruggedized industrial applications, and EL displays.
Roger J. Lemire, Sales Applc. Eng.
203/757-9291 Fax: 203/757-9291, ext. 230

INTELLIGENT LIGHT, INC.
P.O. Box 65
Fairlawn, NJ 07410
Manufacturers of 3-D computer graphics system terminal systems. Supplier of hardware and software for Apollo converters, complete turnkey systems, graphics boards and displays, and video input/output to VTRs or film recorders.
Gary Attanasio, Mgr. No. Amer.
Sales 201/794-7550 Telex: 178066

INTERACTION SYSTEMS, INC.
130 Lincoln St.
Brighton, MA 02136
Manufacturers of high-quality solid-glass capacitive touch screens and controllers. Touch screens available in spherical, cylindrical shapes for sizes 9-25 in. and flat-panel shapes up to 22 x 22 in. Touch controllers available in serial interface, parallel interface, IBM PC compatible plug-in board, and stand-alone configurations.
Joanne Dawson, Mktg. Mgr.
617/789-5900 Telex: 753 582

INTERNATIONAL BUSINESS MACHINES CORP.
Old Orchard Road
Arlington, MA 02601
Manufacturers of a full line of mainframe interactive displays, personal computer displays, intelligent terminals, image and graphics displays, and a wide range of printers and display software.
National organization. Please refer to your local telephone directory.

INTERNATIONAL HIGH VOLTAGE ELECTRONICS, INC.
Flying Cloud Dr., Commerce Park
Danbury, CT 06810
Manufacturers of OEM high-voltage dc power supplies. Applications include FQA, CRTs, video display terminals, projection CRTs, and ELPs.
Doug Steers, Dir. Sales/Mktg.
203/790-1188

INTERNATIONAL PLANNING INFORMATION, INC.
465 Convention Way, Suite 1C
Redwood City, CA 94053
Market research reports and consulting.
Murray Disman, Pres.
415/364-9040 Telex: 371 6217

INTERNATIONAL POLARIZER, INC.
320 Elm St.
Marlboro, MA 01752
Manufacturers of linear polarizing sheet, wave retarder films, and polarized products for LCDs. High-transmittance high-efficiency polarizers and very-high-efficiency polarizers. Wave retarder films up to 19 in. wide. Polarizing filters.
Richard Phillips, Pres.
617/481-7495 Telex: 601645 INTL POLARIZ

INTERNATIONAL RESOURCE DEVELOPMENT, INC.
21 Locust Ave., Suite 1C
New Canaan, CT 06840
High-tech market research and consulting firm which publishes multi-client, research reports for vendors involved in several markets.
203/886-2625 Telex: 64 3452

INTERSTATE ELECTRONICS CORP.
100 E. Ball Road
Anaheim, CA 92803
Manufacturers of military flat-panel display terminals, tactical severe environment and sheltered; console-mounted system components, touch panels, keyboards. Russ Summers, Nat’l Sales Mgr.
Display Prod.
714/758-4332 Telex: 47-22046
714/758-3222

THE INTER-TECHNICAL GROUP, INC.
One Bridge St., P.O. Box 23
Irvington, NY 10533
Manufacturers of CAD/CAM laser-cut magnetic shielding.
Gary Faye, Sales Mgr.
914/591-8822 Telex: 710564802
914/591-7336

ITT CANNON
Components Div.
10550 Talbert
Fountain Valley, CA 92708
Manufacturers of parallel interconnects for flat-panel displays.
judson Clark, Dir. New Prod. Dev.
714/967-7400 800/845-7900

JAMES RIVER CORP.
1 Mechanic St.
Groveton, NH 03582
Manufacturers of computer paper and film for non-impact printers: Pro-Tech line includes ink jet, thermal transfer, laser, penplotter papers, as well as printer bonds for impact printers.
D. Wendell, Mktg. Mgr.
603/636-1154 800/258-0372 Fax: 603/636-2917

K&R ENGINEERING SALES CORP.
354 Route 206
Flanders, NJ 07836
Product representative for Display Components, Inc. and Advance Magnetics, Inc.
Robert J. Resker, Pres.
201/854-5325 800/631-5632
Fax: 201/854-4375

KELTRON CORP.
225 Crescent St.
Waltham, MA 02154
Manufacturers of a complete line of high-voltage power supplies, both custom and standard, for applications with color and digital video monitors, plasma and LCD modules, military, ruggedized displays, and ultra-high density displays. Cabling, terminations, and high-speed dynamic focus supplies.
Ted Chadurjian, Mktg. Mgr.
617/894-8700 Fax: 617/894-9602

KETEK, LTD.
11 Trojan Industrial Park, Borough Close, Paignton
Devon, U.K. TQ4 7EP
Manufacturers and designers of research and production equipment for the LCD industry including rubbing machines, adhesive dispensers, polyimide printers, spacer applications, assembly machines, and filling equipment. Machines range from single units to integrated automatic production lines.
Dr. J. Varney, Mgr.
0803 557250 Telex: 261507
MONTREF G 2827

KING LABORATORIES, INC.
127 Solar St.
Sycamore, NY 13204
Manufacturers of vaporable barium getters for use in any size CRT.
George King, Applications Eng.
315/471-9123 Fax: 315/471-9267

KORRY ELECTRONICS CO.
901 Dexter Ave., N.
Seattle, WA 98109
Manufacturers of thin li-

uuminated control panels with in-
tegral switches; MIL-qualified switches and ennunciators; and digital video light meters, projection displays, and multi-function displays.
Steve Larson, Exec. Vice Pres.
Mktg.
206/281-1300 Telex: 285842 KORY UR Fax: 206/281-3576

KYOCERA AMERICA, INC.
8011 Balboa Ave.
San Diego, CA 92123
Manufacturers of ultradistinct LCDs, featuring chips-on-glass, thin-film thermal print heads.
Rick Collins, Sales Mgr.
619/576-2651 Telex: 472-3069 Fax: 619/696-0396

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LASERGRAPHICS, INC.
17671 Cowan Ave.
Irvine, CA 92714
Manufacturers of a full line of color hard-copy systems incorporating printers, film recorders and rasterizing computers which drive today's most popular color output devices, with over one million colors and virtually unlimited software compatibility. PC to mainframe.
A. William Brown, Dir. Sales/Mktg.
714/660-9497 Telex: 753527
Fax: 714/860-8042

LEVY HILL LABORATORIES, LTD.
5 Sheffield House, Fieldings Road Cheshunt, Herts., U.K. EN8 1TJ
Manufacturers of fluorescent screens for x-ray, electron microscope, particle beams, scintillators. Consultant services on CRT phosphors and screens.
Guy Hill, Mng. Dir.
(0) 922-30808 Telex: 23977 (SCHN-TI-G)

LITTON ELECTRONIC DEVICES DIV.
1215 S. 52 St.
Tempe, AZ 85281
Manufacturers of a variety of CRTs, including the mini-CRT for film recording and other applications.
John Kylander, Mgr. U.S.
Distributors
602/968-4471, ext. 347 Telex: 841430
Fax: 602/968-4471, ext. 223

LITTON PANELVISION
265 Kappa Dr.
Pittsburgh, PA 15238
Manufacturers and developers of active-matrix LCDs for government, commercial, and industrial applications. Dot-matrix displays include both reflective and transmissive types in either black-and-white or color, using TN or GH LCDs.
Fred Prins (Litton Systems Canada, Ltd.)
416/248-2510 (Canada)
412/963-9635 (U.S.)
Telex: 314621 Fax: 412/963-9652

LMT Lichtmesstechnik GmbH
Berlin Helmhorststrasse 9
D-1000 Berlin 10, West Germany
Manufacturers of illumination meters, spot photometers, colorimeters (tristimulus filter types), luminance standards, integrating spheres, goniospectrophotometers, retroreflectance meters. Raymond Hammer, Gen'L Mgr.
49-30-393-4028 Telex: 184659
LMTB Fax: 49-30-391-8001

LOCTITE LUMINESCENT SYSTEMS, INC.
Elina Road
Lebanon, NH 03766
Manufacturers of EL lights for backlighting LCDs, membrane switches or graphics; EL panels, emergency button lights and formation lights.
603/448-3444 Telex: 710/386-0667
Fax: 603/448-3444

LUCITRON, INC.
1918 Raymond Dr.
Northbrook, IL 60062
Manufacturers of SuperSize™ gas-electron-phosphor flat-panel displays: 4 ft.² and up, full color, wide gray scale, only 3 in. thick, capable of real-time TV or computer outputs.
Alan Sobel, Pres.
312/564-6383 Telex: 297175

McMAHAN ELECTRO-OPTICS, INC.
2160 Park Ave., N
Winter Park, FL 32796
Provides systems and application assistance for the military certification of CRTs and flat-panel displays.
305/645-0483 Fax: 305/644-9000

MAGNAVOX ELECTRIC SYSTEMS CO.
1313 Production Road
Fort Wayne, IN 46808
Manufacturers of a complete line of militarized flat-panel plasma displays and display terminals.
Display sizes range from 4 to 8 in. in 4 to 42 in. 42 in. The 42 in. display accommodates video inputs and provides 2048 x 2048 resolution.
219/429-6014 Telex: 23-2478
MAGNAVOX FWA Fax: 219/429-7600

MAGNAVOX/NAP CONSUMER ELECTRONICS
I-40 and Straw Plains Pike
Knoxville, TN 37914
Manufacturers of a full line of color and monochrome CRT display devices. Custom products can be built to order.
Ed Fleisner, Sales Mgr.
216/323-8280 Fax: 216/245-1248

MAGNETIC RADIATION LABORATORIES, INC.
92 N. Lively Blvd.
Elk Grove Village, IL 60007
Manufacturers and designers of all forms of shielding; CRTs, monitors, transformers, PMTs, Tempest, projection displays, printers. Magnetic shielding materials available. Serving navigation, avionics, information display, instrumentation, radar, oscilloscope, and computer markets.
312/437-5200 Telex: 510/601-1013

MAGNETIC SHIELD CORP.
Manufacturers of EL lights for
740 N. Thomas Dr.
Bensenville, IL 60106
Manufacturers of magnetic shielding materials in foil and sheet, lab kits, custom magnetic shields.
Art Mate, Sales Mgr.
312/765-7800 TWX: 910/256-4815

MANITRON DISPLAYS, LTD.
Sandy Lane, Moston Road
Bensbach, Cheux, U.K. CW11 9HT
Manufacturers of monochrome and color video monitors with up to 125 kHz line rate; raster radar monitors (16- and 20-in. round; 20- and 30-in. square); and "Scanpack" drive electronics for high-brightness CRTs.
Alan Hesketh, Mng. Dir.
(0270) 764171 Telex: 367227

MANNIONS, INC.
45-68 162nd St.
Flushing, NY 11358
Manufacturers of high-efficiency reflection reducing coating and transparent conductive coatings for contrast-enhancement filters, imaging panels, and glass covers for displays.
Clifford E. Sitzer, Sales Mgr.
718/445-0400

MEYLAN CORP.
264 W. 40 St., 20th Fl.
New York, NY 10018-1585
Manufacturers and distributors of time study equipment including stopwatches, counters, event loggers to chart downtime, productive time. Also tachometers, temperature probes, gas detectors, internal timers, hour meters, and vibration meters.
Gary Caporusso, Nat'l. Sales Mgr.
212/391-9150

MICROTOUCH SYSTEMS, INC.
Ten State St.
Woburn, MA 01801
Manufacturers, designers, and marketers of touch-screen hardware and software products for the OEM and systems integrator marketplace.
617/935-0080 Telex: 530264MTS Fax: 617/935-0133

MICROVISION
591 W. Hamilton, Suite 250
Campbell, CA 95008
Manufacturers of CRT measuring equipment.
Stan Bucksted, Pres.
408/374-3158 Fax: 408/374-9394

MII CORP./TELTRON, INC.
P.O. Box 395
Birdsboro, PA 19508
Manufacturers of x-ray images; high-quality x-ray TV camera tubes, and CRTs for rf, specialty, and heart catheter applications.
Clyde Mock, Pres.
215/382-5361 800/835-8766 Telex: 493 Fax: 215/382-0851

MINOLTA CORP.
101 Williams Dr.
Ramsey, NJ 07446
Manufacturers of light and color measurement instrumentation.
J. McCauley, Mktg./Sales Mgr.
201/825-4000 Telex: 842111 Fax: 201/423-0590

MITSUBISHI CHEMICAL INDUSTRIES AMERICA, INC.
5 Polo Alto Square, Suite 225
Palo Alto, CA 94306
Manufacturers of inkydye flush for ink-jet printers; dye transfer and color receiving sheets for thermal-transfer printers; transparent conductive film for flat-panel displays; hard-copy materials and parts; CRT phosphor materials; and optical and video disks.
Seishi Shishido, Mgr./Chief Rep.
415/855-9333 Fax: 415/855-9024
and CRTs. Also market thermal headers.

Wood Dale, cut offs, EL backlighting and metal monochrome monitors, chassis, printers, electrophotographic laser deposition printers.

813144·1981

Fax: 614/891·2192

MONTEREY TECHNOLOGIES, INC.
P.O. Box 223696
Carmel, CA 93922
Consulting services and research in vision and visual-display human factors.

Robert T. Hennessy, Pres.
906865·5285

NBS SOUTHERN, INC.
100 North Belcham Rd.
Clearwater, FL 34525
Manufacturers of impact printers, electrophotographic laser printers, and non-impact ion-deposition printers.

013/441·1981 Telex: 522135
Fax: 813/447·3012

NEC HOME ELECTRONICS (USA), INC.
1255 Michael Dr.
Wood Dale, IL 60191
Manufacturers and marketers of high-resolution color and monochrome monitors, chassis, and CRTs. Also market thermal cutoffs, EL backlighting and metal headers. Sell to large OEM customers.

Monica Calik
312/860-9500 800/447-4700
Telex: 910/222-1776 Fax: 312/860-5382

KORSK LCD
Elkhagen
3000 Drammen, Norway
Manufacturers of very-large-area LCDs (14 x 11 in.) used in public-information boards, computers, full-color/fulldiscolor advertising boards, based on patented Dynoscope® space technology. Tel.: (47) 3-8804150 Telex: 72975 LCD N
Fax: (47) 3-860837

OCEAN COATING LABORATORY, INC.
2789 Northpark Parkway
Santa Rosa, CA 95407-7397
Manufacturers of high-technology thin-film coatings on glass, plastic, germanium, and other substrates for the control of light. Products include high-efficiency anti-reflection coatings, bandpass filters, beamsplitters, high-performance mirrors, headlight separators, transparent conductive coatings, optically variable coatings. Bill Grenawalt, OEM Sales Mgr.
707/725-6400 800/227-8508 Telex: 510795-2083 Fax: 707/725-5740

OKI DATA
532 Fellowship Road
Mount Laurel, NJ 08054
Marketers of PC printers and modems. Printers include ColorStar® laser printer, Microline® dot-matrix printers, Okimate® 20 thermal transfer color printer. Modems include Okitel® PC modems and OLX9600 terminal modems.
Donna Volpe, Mktg. Asst.
609/256-6400 800/227-8508 Telex: 710967-0792 Fax: 609/778-4184

OMEGA ELECTRONICS SA
Rue Stamftili 96
Bienne, Switzerland 2504
Manufacturers of color video replay scoreboards; black-and-white matrix scoreboards; alphanumeric and numeric scoreboards; and timing and judging equipment for all sports.
C. Calderara, Vice Pres., Mktg.
32 429 713 Telex: 931·207 OE CH Fax: 32 413·321

OPTICAL DEVICES, INC.
825 Via Alondra
Camarillo, CA 93010
Manufacturers of linear polarizers for use in LCDs; contrast-enhancement filters for alphanumeric displays, which incorporate such features as circular polarizers and antireflection glass; and bandpass filters and EMI/RFI layers.
Barbara Winters, Mktg./Sales
805/987-8801 Telex: 18·2233 Fax: 805/389·1123

OPTICAL RADIATION CORP.
1300 Optical Dr.
Azusa, CA 91702
Manufacturers of UV exposure systems, mask aligners, and proximity printers. Photomaging equipment for flat-panel displays, hybrids, TAB and PCBs.
Chuck Sahli, Mktg. Mgr.
818/969·3344 Telex: 910·584·4851 Fax: 818/969·3681

OPTOTEL, LTD.
62 Steeple Rd.
Kanata, Ont., Canada K2K 2A9
Manufacturers of custom LED displays in alphanumeric and matrix formats, integrated hybrid drive electronics, and test equipment.
David I. Kennedy, Pres.
613/591·0336 Telex: 053·3524 Fax: 613/591·0584

ORWIN ASSOCIATES, INC.
88 Seabro Ave.
Amityville, NY 11701
Manufacturers of specialty-purpose random write displays.
21-in. high-speed vector display with 11µsec writing speed and 3-MHz small-signal bandwidth.
Kevin Volpe, Seyc-Treas.
516/842·7177 Telex: 5102248114 Fax: 516/842·7410

OVONIC IMAGING SYSTEMS, INC.
1890 Barrett St.
Troy, MI 48084
Manufacturers of active-matrix LCDs: MIL-SPEC, black-and-white, gray scale, and color.
Lionel Robbins, Vice Pres., Sales
313/362·2738 Fax: 313/362·4866

OWENS-ILLINOIS, INC.
711 Southwood Ave.
Columbus, OH 43207
Manufacturers of CRT glass parts.
614/443·6551, ext. 306 Telex: 4993701 Fax: 614/443·6551, ext. 346

PANASONIC INDUSTRIAL CO.
2 Panasonic Way
Secaucus, NJ 07094
Manufacturers of CRTs, plasma displays, and monitor displays.
Dave Thompson, Prod. Spec., CRTs
213/481·5280; Paul Wasek, Prod. Spec., Plasma Displays
213/392·4710

PANELGRAPHIC CORP.
10 Henderson Dr.
W. Caldwell, NJ 07006
Manufacturers of "Elivan"-type anti-glare and contrast-enhancement display filter materials and complete readout windows for all types of optoelectronic and CRT displays.
Stewart Nellis, Vice Pres., Mktg./Sales
212/227·1500 800/222·1618 Fax: 212/227·7750

PARTICLE DATA, INC.
Box 285
Elmhurst, IL 60126
Manufacturers of "Elizon" particle-size analyzer, using highest resolution electrode method (3-D sensing of displacement volume of each particle in an electric field), completely computerized.
P. H. Berg, Pres.
312/832·5653 800/332·6140
Telex: 910·254·0180

P.B.E., THE REPAIR SPECIALIST
23 Knox Ave.
Stonebky, NY 11780
Service company for the repair, refurbishment, modification, and analysis of power supplies utilized in all CRT applications. CRT phototypesetter power supply repair specialists.
Barbara Steers, Gen'l. Mgr.
516/889·3010

PCK ELASTOMERICS
2940 Tumpkie Dr.
Hatboro, PA 19040
Manufacturers of connectors for connection to flat-panel displays. STAX (layered elastomer connector) and MOE (metal-on-elastomer connectors) provide high-density-surface-to-surface contact while sealing out contaminants.
John Seibert, Sales Mgr.
215/672·0787 Fax: 215/672·4633

PEER PROTOCOLS, INC.
3176 Pullman, Suite 101
Costa Mesa, CA 92628
Manufacturers and designers of software and hardware that plugs into an IBM PC, XT, AT, or Cioe that exercises the small computer systems interface (SCSI) for both target (peripheral) and initiator (host) devices.
Adrienne Turenne, Product Mgr.
714/682·1929

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THIN FILM DEVICE, INC.
2021 Via Burton Ave., Unit F
Anahiem, CA 92806
Manufacturers and distributors of transparent conductors, ceramic hybrid and VHSC package; precision gauge blocks and reticles; custom optical filters and AR coatings; composite matrix fiber coatings; single or multilayered metals, semiconductors, insulators, carbides and cermets.
Saleem Shaikh, Pres.
714/563-1984 Telex: 215435 COLI

THOMAS ELECTRONICS, INC.
100 Riverview Dr.
Wayne, NJ 07470
Manufacturers of custom-design special-purpose CRTs for industrial, military, and commercial applications.
Bruce Pieaget, Vice Pres., Sales
201/696-5200 Telex: 310685-3326 Fax: 201/696-8298

THOMSON-CSF
Div. Tubes Electroniques
38, rue Vautheyr, BP 305
Boulogne-Billancourt, FRANCE
Manufacturers of professional CRTs for civil and military applications: very-high-resolution, head-up, head-down, helmet viewing, projection, and beam-index CRTs. Rugged ac plasma display panels up to 1280 x 1280 pixels.
G. Sulpice, Display Sales/Mktg. Mgr.
sson, Telex: THOM- 5 20772F Fax: (33.1) 46 04 209

THOMSON ELECTRON TUBES AND DEVICES CORP.
550 Mount Pleasant Ave.
Dover, NJ 07801
Manufacturers of a range of CRTs and plasma panels for military and industrial applications including avionics, C4I, photorecording, projection, and ATC. Sizes from 0.5 to 30 in. clamshell, monochrome, color, and full-shielded "MIL- SPEC" shadow-mask CRT assemblies.
George Petro, Mktg. Mgr.
201/328-1400 Fax: 201/328-1747

3M INDUSTRIAL OPTICS
Bldg. 223-IN-03, 3M Center
St. Paul, MN 55144
Manufacturers of louvered filters for increased high-ambient-light readability, security viewing, contrast enhancement, and light directional control. Lighting systems for backlights and displays.
Martin Simonet, Mktg. Mgr.
612/736-2240

TOKO AMERICA, INC.
1250 Feehanville Dr.
Mt. Prospect, IL 60056
Manufacturers of dc-dc converters for powering vacuum fluorescent displays. Microcontrol, with high reliability and low cost, they provide stable power for modems, RS-232 interfaces and other subsystems requiring mixed operating voltages.
Mark Sullivan, Mktg./Dist. Mgr.
312/257-0070 Telex: 72-4372 Fax: 312/659-7964

TOSHIBA AMERICA, INC.
1101 Lake Cook Road
Northbrook, IL 60062
Vendors of CRTs, conventional, "Flat and Square," and miniature; monochrome and color CRT monitors; flat-panel displays; fiber-optics products; large-screen displays; image tubes and CCD imagers.
Craig Westcott, Sales Eng.
312/945-1500

TOSHIBA CORP.
1-1-1 Shibaura, Minatoku
Tokyo 105, Japan
Manufacturers of CRT displays and materials; LCDs; LCD displays and backlight; and hard-copy printers.
Mktg./Sales Div., Electron Tubes and Devices
(303)457-3310

TOKUTO ELECTRIC CO., LTD.
3-21, Okubo 1-Chome, Shinjuku-ku
Tokyo 160, Japan
Manufacturers of CRT displays and materials for high-resolution CRT monitors.
Isao Oriuchi, Gen’l. Mgr.
(3) 020-2121 Telex: 2322757 TOTOKU
Fax: (3) 209-5057

TRANSICIL, INC.
Trooper Road
Worcester, PA 19490
Manufacturers of fiber optic alphanumeric displays. Packaging of CRTs, CRT displays and CCR assemblies for high-reliability military applications.
Mark LeMire, Prod. Mgr.
219/577-1300 Telex: 510660-0132 Fax: 219/577-1300

TRIPLETT CORP.
1000 Triplet Dr.
Bluffton, OH 45817
Manufacturers of complete line of digital, analog, and LCD panel meters with broad-base use in manufacturing, processing, industrial, utility, and military sectors.
Ken Dahlstrom, Vice Pres., Mktg./Sales
419/358-5015 800/3-TRIPLETT
TWX: 810/406-2400 Fax: 419/358-7956

TRIUNPLEX DISPLAY SYSTEMS, INC.
50 W. Easy St.
Simi Valley, CA 93065
Designers and manufacturers of custom and off-the-shelf projection TV systems; also lenses and optical products for projection TV.
Albert Malang, Vice Pres., Prod. Planning
805/256-4850 Telex: 874061 BAUD

TRW
Customer Service Div.
15 Law Dr.
Fairfield, NJ 07006
Third-party maintenance and repair company. TRW services monitors of varying manufactures, with both on-site and depot service options.
Jim Larkin, Sales Dir.
201/575-7110 800/257-7464

TSD DISPLAY PRODUCTS, INC.
35 Coryville Dr.
Bohemia, NY 11716
Manufacturers of high-resolution CRT display monitors (monochrome and touch-screen digitizers, retrofit kits for existing systems).
Steven R. Sloan, Dir. Sales
516/569-8800 Telex: 14-4559

UCE, INC.
24 Fitch St.
Norwalk, CT 06856
Manufacturers of custom LCDs and modules, clear heaters, backlighting, light valves and shutters. Product development support for evolutionary display technology. Principle strength is in rapid response prototypes, TNFE, dye, dynamic scatter, EL, frit seal and others.
Dennis Sterlboimsteiner
203/838-7509 Fax: 203/838-2566

UNITED DETECTOR TECHNOLOGY
1252 Chadron Ave.
Hawthorne, CA 90250
Manufacturers of display testing equipment including luminescence meters and spectroradiometers for color measurement.
Ian K. Edwards, Mktg. Mgr. - Instruments
213/978-5016 Telex: 4949979 Fax: 213/644-1727

VARINTRONIX, LTD.
4/1 Liven House, 1/63 King Yip St.
Kwan Tong, Kwoloon, Hong Kong
Manufacturers of LCD modules, dot-matrix LCD modules, touch-sensitive overlay for LCDs and modules. Customized LCDs and LCD modules. OEM subassemblies, and turnkey projects.
C. C. Chang, Sales
852-3-894317 Telex: 36643

VENTURE DEVELOPMENT CORP.
One Applehill
Natick, MA 01760
Specialists in providing business planning, product planning, and market research services to display companies. VDC furnishes four levels of assistance: proprietary research, multichannel services, industry reports, and the ventures catch data base.
Mark Regberg, Dir. Mktg./Sales
617/653-9000 Telex: 709190

VENUS SCIENTIFIC, INC.
399 Smith St.
Fitchburg, MA 01029
Manufacturers of power conversion systems.
Chris Rowe, Eastern Reg’l. Accts.
516/293-4100 Telex: 510-2246492 Fax: 516/752-7976

VIDEO DISPLAY CORP.
P.O. Box 307
5530 E. Ponce de Leon Ave.
Stone Mountain, GA 30086
Manufacturers and importers of replacement color and monochrome CRTs for the service industry. With almost 100,000 tube in stock of 3,500 types, VDC ships 95% of orders received the same day.
Hulon Forrester, Dir. Mktg.
404/383-2080 800/241-5005
Fax: 404/646-3003

VIDEO MOUNTS, INC.
3653 N. White Ave.
Eau Claire, WI 54703
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CRT MEASUREMENT SYSTEM

The SUPERSPOT 100 System coupled with the SPOTSEEKER II Positioning System (with Automatic Focus) allows fully automatic characterization of Color and Monochrome CRT Displays without operator intervention.

Measures:
- Luminance (Footlamberts & Nits)
- Line Width, Including Color Line Width (Gaussian Fit) (1 Second)
- Color Misconvergence (2 Seconds)
- Linearity, Pincushion and Focus
- Line Jitter, Swim and Drift
- Contour Maps of Spots, Lines or Characters (10 Seconds)
- Beam Landing & Crowding
- FFT for Discrete Frequency Spectra (1024 points in one second)
- High Voltage Regulation Tests
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Provides:
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Circle no. 12
Flexible EL material comes by the roll

Bonar Kard-O-Lite, Inc., (BKL) has developed a thin flexible EL material that comes in continuous strips 5 and 8 in. wide, with a 12-in. width to be introduced later this year. Called KARD-O-LITE™, the material is particularly suitable for backlighting electronic displays and instrument clusters (such as in automotive applications), membrane switches, graphic panels, point-of-purchase displays, and emergency lighting. The material is less than 0.014-in. thick, can be die cut or hand-trimmed with scissors, is simple to interface with a power supply through BKL terminations, and easy to drive with BKL inverters. Non-glare BKL lamps have low energy consumption, are cool, emit very little infrared energy, and provide a bright light that is visible through smoke and fog.

BKL recently created what it believes is the world’s largest flexible lamp (see photo) by snipping off 10 ft. from a 100-ft. roll of KARD-O-LITE™ and connecting it to a suitable power source. The company can provide complete EL systems, including lamps and inverters, and also sells the KARD-O-LITE™ material, which can be converted into a quality EL lamp in five easy steps. Customer support in fabricating EL lamps is provided under a licensing arrangement.

For further information contact Don Kardon, president, Bonar Kard-O-Lite, Inc., 421 Feheley Drive, King of Prussia, PA 19406. 215/277-2910.

Circle no. 13

Streamlined tubular degausser

Video Display Systems, U.K., has invented a more-compact easier-to-handle tubular degausser. The degausser is connected to an AC supply, and the coil is held in a vertical position at the top left-hand side of the tube, the face in contact with the glass. The operator slowly sweeps the tube across the top and then the bottom half of the screen; the process is continued away from the tube for 6 ft. before the switch is released. The shadow mask is then demagnetized. The degausser measures 11 x 1.5 in., weighs approximately 19 oz., and is equipped with an 8-ft. electrical cable.

For further information contact J. Wilman, Video Display Systems, c/o British Information Services, 845 Third Ave., New York, NY 10022. 212/752-8400.

Circle no. 14

Multifunctional CRT display

XYtron, Inc., announces its Model MFD multifunctional display system. Utilizing a color CRT monitor and a stroke raster multiplexer, the new system combines the flexibility of raster-generated colors and backgrounds with the accuracy and sharpness of stroke-type graphics. The system’s high-resolution CRT and dynamic convergence achieve extreme accuracy. The system achieves a 10-µsec full-screen linear writing rate and a 6-µsec raster flyback time. Internal adjustments provide full control for all geometrical distortion parameters while automatic degaussing and an external magnetic shield isolate a signature library; if a valid signature is not submitted, the system will reject the transaction and inform the host. Electromagnetic principles track the invisible flourishes of the hand off the surface of the paper—even an expert forgery can be detected. Up to 13 unique signature algorithms can be extracted and stored, and the system has defenses to prevent illegal copying.


Circle no. 15

Signature-verification system

SECURISIGN, from AI Transaction Security, U.K., offers an alternative to existing password systems for computer access and data protection. A user’s signature is analyzed and checked against
the system from interference caused by external magnetic forces. The MFD accepts both standard RGB video and analog stroke data which are formatted, synchronized, and time-shared for monitor display.

For further information contact Bill Lockshaw, XYtron, Inc., 13010 San Fernando Rd., Sylmar, CA 91342. 818/362-8341.
Circle no. 16

Compact computer terminal

Honeywell Bull, Inc., introduces a new terminal, the Honeywell Bull Display Station Model 5 (HDS 5), for use with its large and small computer product lines. The compact monitor houses both power supply and logic assembly in a tilt-and-swivel base. The non-glare 14-in. screen is available with green or amber phosphor. The 800 x 350 dot-resolution screen displays 80 or 132 standard-sized characters per line, as well as double-height and double-width characters. The new terminal also supports both fast jump and smooth scrolling, and up to five screen partitions. Additionally, an expanded forms mode capability provides new form-validation attributes and immediate transmission of numeric and edited fields. Standard and multilingual keyboards are available for the HDS 5 terminal, and each has 12 programmable function keys, which can be custom configured.

For further information contact Bruce J. MacDonald, Honeywell Bull, Inc., 300 Concord Rd., Billerica, MA 01821. 617/671-2517.
Circle no. 17

Desktop publishing system

The new Epsilon Graphics AT+ Publishing System comes complete with a QMS 300-dots/in. 8-page/min. laser printer, 300-dots/in. Canon IX-12 scanner, Wyse 1280 x 800 resolution 13-in. monochrome display or 13-in. color EGA display system, MS-Mouse and a JLASER Plus scanner/printer controller interface with 2-Mbyte EMS memory board, and is 8-MHz AT-compatible with 30-Mbyte hard disk.

The heart of the Epsilon system, the JLASER PLUS controller, combines scanning and printing in a single board. The 8-MHz AT system combined with the JLASER PLUS board allows the printing of a full page of 300-dots/in. text and graphics in seconds. The Lotus/Intel/ Microsoft standard EMS interface of the JLASER PLUS card is compatible with over 20 other publishing-related software products. The system is priced at $7995.

Circle no. 18

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High Permeability Shielding Alloy Foil in thicknesses of .002", .004", .006" and .010" can be fabricated by Ad-Vance Magnetics for your specific requirements.

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FAX 219-223-2524

Circle no. 19

Information Display 9/87 45
High-line-rate color monitor

The HG-6905BK high-line-rate color monitor with analog input is now available from Mitsubishi Electronics America, Inc., Computer Peripherals Division. The HG-6905BK has a wide scan range from 40 to 67 kHz horizontal, and from 50 to 75 Hz vertical, and features a high-resolution CRT with a self-convergence in-line gun, 0.31-mm dot pitch and 90° deflection angle. Resolution is 1280 x 1024 pixels non-interlaced. The HG-6905BK comes in a compact ergonomically styled chassis with external controls easily accessible on the front panel.

To ensure picture stability, the HG-6905BK incorporates a high-voltage stabilizer circuit. A tap-changing power supply operates on 90-132 VAC or 198-264 VAC for use anywhere in the world. Suggested list price is $3790.

For further information contact Evie Turner, Mitsubishi Electronics America, Inc., Computer Peripherals Division, 991 Knox St., Torrance, CA 90502. 213/515-3993.
Circle no. 20

Portable graphics terminal

Image Storage/Retention Systems, Inc., introduces a portable IBM PC-compatible workstation with a touch screen and half-high CD-ROM storage. Two configurations of the workstation will be available. One allows interface to a standalone CD-ROM, and the second has an integrated half-height CD-ROM drive. The system provides two levels of zoom to display graphics, and a touch screen and on-screen keyboard facilitate data entry. The portable unit is powered by either rechargeable batteries or normal wall outlets. Using MS/DOS 3.2, the workstation runs IBM PC software with an optional IBM-compatible keyboard and low-cost printer. It also contains 640 bytes of main memory, up to 4 Mbytes of display memory and an internal 2400-baud
MNP-3 modem.
Circle no. 21

**CRT with 500-MHz range**

AEG Corp. has announced the availability of a CRT for oscilloscopes and other instrumentation with the broadest range currently available—of the order of 500 MHz. The D14-410 features high deflection sensitivity, high writing speed, and wide bandwidths in excess of 250 MHz. The high deflection sensitivities (vertical, 1.2 V/cm; horizontal, 6 V/cm) are achieved with the aid of scan expansion through quadrupole lenses. High writing speed and good line definition are achievable by means of a recently developed electron gun and by increasing the anode voltage to 24 kV.

For further information contact AEG Corp., Route 22—Orr Dr., P.O. Box 3800, Somerville, NJ 08876-1269. 201/231-8300.
Circle no. 22

**TRUST WESTINGHOUSE TO DELIVER CRTs FOR MILITARY DUTY.**

For the extra-tough needs of military applications, Westinghouse CRTs will meet your requirements.

No matter what application you have in mind—from Head-Up Displays to FLIR Tank Sights—Westinghouse has proven its capability with many customers for their special designs.

We've been meeting rugged military requirements for years. The CRT we design for you will meet your specifications.

Westinghouse uses the latest technology in computer software to model the electron optics for your design. We can quickly make design changes or alterations. There's no need to manufacture prototypes for testing because our computer can mathematically "test" a design that's just a drawing.

So next time you need a CRT designed, no matter what the application, or how tough the specs, come to Westinghouse. Our years of experience will solve your problems.

To find out more, just call or write—Westinghouse Electric Corporation, Industrial and Government Tube Division, Westinghouse Circle, Horseheads, NY 14845. (607) 796-3350. TWX 510-252-1588. FAX (607) 796-3279.

You can be sure... if it's Westinghouse

Circle no. 23
High-voltage power-supply test system

The new DISCOM Model DTL30 high-voltage test system comprehensively analyzes CRT anode high-voltage sources for engineering performance evaluation, incoming inspection, quality control, and system troubleshooting and diagnostics. The DTL 30 is capable of testing supplies to 30 kV with up to 1.99 mA of output current. Supply loading modes such as constant current, constant resistance, or load switching (dynamic loading) with varying frequency are available, and the DTL 30 is easily adapted to an automated test environment. Using A/D and D/A converters, the DTL can be controlled and monitored by a PC. Automated set-up, data collection, and testing are a sampling of the system's capabilities. The DTL 30 is single unit priced at $5950 FOB; discounts are available for purchases of three or more units.

For further information contact Peter C. Koronis, Display Components, Inc., 334 Littleton Rd., Westford, MA 01886. 617/692-6000. Circle no. 24

A 1-in. electrostatic CRT

AEG Corp. announces the availability of their 1-in. electrostatic CRT for use in forward looking infrared (FLIR) systems, compact film recorders, and helmet-mounted displays. The D3-E8515 is a high-resolution CRT, extremely useful for portable applications because of its exclusive 0.55-V heater, rugged construction, and short overall length (less than 5 in.). Also available are larger sizes of electrostatic CRTs with a similar format for
Step-up/step-down dc/dc voltage regulator

ERG’s E400 Series provides a small highly efficient low-cost solution for providing regulated “logic-type” voltages from unregulated power sources—without a heat sink or other external components. Units are just 1.00 x 1.38 x 0.70 in. high, operate typically at 80% at full load, and provide output voltage regulation of 1% line/load (3% line/load/set point). Minimum input or output voltage is 5 V dc; maximum input or output voltage, 35 dc. Price is $7.34 ea. in quantities of 1000.

For further information contact Michael Foldes, Endicott Research Group, Inc., P.O. Box 269, Endicott, NY 13760. 607/754-9187.
DEFLECTION AMPLIFIERS
FOR PRECISE CRT BEAM CONTROL

Contact: A. Pletz
Applications Engineer

CITRONIX INC.
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Our X—Y deflection amplifiers can deliver up to +/− 20 amps with a
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are also available with our PS-200 series of regulated or unregulated
power supplies.

• Over 80 D.B. power supply ripple rejection.
• 2MHZ closed loop bandwidth
  (with <25μH yoke inductance).
• Optional Voltage on Demand
  (up to 150 volts) for fast retrace time
  (less than 5μs).
• Optional Resonance Fly Back
  Switch for fast retrace time
  (less than 2μs with 25μH yoke
  and 20 amps PP).
September


AEEE East '87. Cahners Exposition Group, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017-5060. 312/299-9311. Sept. 15-17 Boston, MA

Symposium on Environmental Issues in Photofinishing. Pam Forness, SPSE, 7003 Kilworth La., Springfield, VA 22151. 703/642-9090. Sept. 15-17 Los Angeles, CA


Fourth Toner and Developer Industry Conference. Diamond Research Corp., P.O. Box 128, Oak View, CA 93022. 805/649-2209. Sept. 20-22 Santa Barbara, CA

NORTHCON '87 Electronics Show and Convention. Dale Litherland, NORTHCON '87, 8110 Airport Blvd., Los Angeles, CA 90045. 213/772-2965. Sept. 22-24 Portland, OR


October

COMPSAC '87. Dr. Stephen S. Yau, Northwestern Univ., Dept. of EECS, Evanston, IL 60201. 312/491-3641. Oct. 5-9 Tokyo, Japan


Seventh Gulf Computer Exhibition. Sandra Royan/Abdullah Mohammed, Trade Center Management Co., P.O. Box 9292, Dubai, United Arab Emirates. 372200. Oct. 12-15 Dubai, UAR


New Directions in Photodynamic Therapy. SPIE, P.O. Box 10, Bellingham, WA 98227-0010. 206/676-3290. Oct. 25-30 Cambridge, MA


Computer Communication for Developing Countries '87. Dr. P. P. Gupta, CMC Ltd., 1 Ring Rd., Kilokri Opp. Maharani Bagh, New Delhi, India. 631699, 635086, 630827. Oct. 27-30 New Delhi, India

The Artificial Intelligence and Advanced Computer Technology Conference and Exhibition. Tower Conference Management, 331 W. Wesley St., Wheaton, IL 60187. 312/668-8100. Oct. 28-30 Atlantic City, NJ

November

Advances in Intelligent Robotics Systems and IEEE '87 Joint Conference. SPIE, P.O. Box 10, Bellingham, WA 98227-0010. 206/676-3290. Nov. 1-7 Cambridge, MA
**Stanford Resources' Fourth Annual**

**Flat Information Display Conference**

The primary purpose of this two day meeting is to provide an interactive forum where display users and suppliers can discuss their needs and approaches in order to develop plans for taking advantage of the Impact of Flat Information Displays.

This year's conference will have four main points of focus -
- Evolving Display Technologies
- Military Display Market Opportunities
- Emerging Consumer Applications
- Flat Panel Use in Portable Computers

**October 27 & 28, 1987  San Jose, California**

Contact International Planning Information, 465 Convention Way #1, Redwood City, CA 94063, (415-364-9040) for additional information about the program and exhibit space.
FOR DEMANDING APPLICATIONS
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For Low-Reflectance And Contrast
Enhancement Display Filters

- For demanding applications demand HOMALITE thermosetting plastic display filters.
- The advantages of HOMALITE thermosetting plastic display filters are clear:
  - Optimum contrast and readability for virtually any instrument display.
  - Wide range of standard and custom colors.
  - Low-reflectance surface is cast into the material, so it can’t chip, peel or rub off.
  - More rigid and resistant to impact, heat, abrasion and chemicals than other plastic filters.
  - Can be cut, drilled, milled, beveled, silkscreened, mirrored or coated to meet your specifications.
  - Available in standard and custom thicknesses from 3/32” to over 2”.
  - Available in standard CRT filter sizes from 5” to 19”, contoured and rectangular, plus custom sizes and configurations.

HOMALITE™ Grades Available

Select the material best suited for your display filter or safety application:

- H-100™ thermosetting polyester offers excellent chemical resistance, and good abrasion and heat resistance for general purpose applications. Available in all colors.
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- H-141™ thermosetting polyester with additives is permanently anti-static. For use in medical and other applications where elimination of static is mandatory.

For samples and technical data on how you can put HOMALITE to work in your application, contact:

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Circle no. 33
POST DEADLINE PAPERS

LASERS '87, the Tenth International Conference on Lasers & Applications, will be held at Harveys Resort Hotel, Lake Tahoe, Nevada, December 7-11, 1987, under the sponsorship of the Society for Optical and Quantum Electronics.

Papers are now being accepted in the areas of:

LASER PHYSICS
APPLICATIONS
SCIENCE & MEDICINE
ENGINEERING & TECHNOLOGY
RADIATION & QUANTUM ELECTRONICS
SYSTEMS OPTICAL & LASER

Authors are requested to submit two copies of both a 35-word abstract and a 200-word summary of their paper to: LASERS '87, P.O. Box 245, McLean, VA 22101. Since papers will be selected on basis of their summary they should include specific information. The Deadline for receipt of Abstracts and Summaries is November 25, 1987. Earlier submission is appreciated.

LASERS '87 AWARD

Sponsored by EG&G Princeton Applied Research Commemorative plaque and $500 to be awarded to the best contributed paper. Selection by the Program Committee is based on originality and timeliness.

KEYNOTE SPEAKER: M.O. SCULLY (U. New Mexico & Max-Planck Inst.)
"Laser Probes of the Micro and Macro Cosmos"

PLENARY SPEAKERS:
R. Alfano (CUNY), Ultrafast Phenomena
A. Aspect (L'ENS), Laser Test of Bell's Inequalities
C. Brau (LANL), Free Electron Lasers
H.J. Caulfield (U. Alabama), Optical Computing
R. Drever (Caltech), Gravitational Waves
R.A. Fisher (R.A. Fisher Cons.), Phase Conjugation
K. Fujii (Ibaraki U.), White Light Lasers
L. Goldman (U. Cincinnati), Laser Cancer Phototherapy
J. Hammond (SDIO), Directed Energy
L.W. Hillman (Cornell U.), Chaos and Instabilities in Dye Lasers
R. Menzies (JPL), IR Doppler Lidar
J. Miller (TRW), High Power Chem. Lasers
W.T. Silfvast (Bell Lab), VUV & X-Ray Lasers
C.R. Vidal (Max-Planck Inst.), VUV Laser Spectroscopy
C.W. Webb (U. Oxford), Copper & Gold Vapor Lasers
L.E. Wilson (AF Weapons Lab), Excimer Lasers

Exhibits of the manufacturers of lasers, accessories and systems will be conveniently located to insure a good flow of traffic. Information on booth space can be obtained as indicated below.

Full proceedings of Lasers '87 will be published in hard-cover copy following the conference. The announcement of the Call for Papers or other information, including exhibit brochures can be obtained by writing:

LASERS '87, P.O. Box 245, McLean, VA 22101
or calling (703) 642-5835

Circle no. 34
not limited to, the following areas: AI at the turn of the century; user interface at the workstation; AI in healthcare; AI and multiple languages; expert systems; cognitive modeling; knowledge information processing systems (KIPS); AI and aerospace; expert systems development systems; natural language interfaces; AI in training; AI and SDI; imaging; speech recognition; parallel computing; fifth generation computers; machine translation; AI on a CHIP; advisory system and management decision support; AI and CIM; artificial intelligence models; AI in entertainment and sports; AI tools; machine diagnosis and maintenance; AI in non-manufacturing environment; AI workstations; AI languages; AI in space technology; building expert system by the non-programmer; computer vision; AI and business; AI in microcomputers; military application of AI; AI in office automation; AI and machine vision; neural networks; AI and manufacturing; and AI and simulation. Send a 200–300 word abstract to Dr. Murray Teitell, General Program Chairman-Al ’88, c/o Intelligent Choice, 1050 Duncan Ave., Suite D, Manhattan Beach, CA 90266. 213/379-9680. Deadline for abstracts: Nov. 20

SPIE’s 1988 Technical Symposium
Southeast on Optics, Electro-Optics, and Sensors. April 4–8, Orlando, FL. Papers are solicited for, but not limited to, the following areas: precision engineering of optical elements and systems; electro-optical components and systems; infrared imaging; remote sensing and imaging through varied media; and pattern

SID Honors and Awards

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

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

Nominations should comply with the Guidelines for SID Honors and Awards Nominations (see ID, July-August 1987, p. 34) and should be submitted to the Honors and Awards Committee Chairman before October 1, 1987.
Design Engineers

The GE Brand of Technology

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WILMINGTON, MASSACHUSETTS...

committed to tomorrow's technology, like advanced display systems that feature high resolution technology—flat plasma panel development and other next generation systems for commercial and military aircraft instrumentation. We are currently seeking nine (9) engineers with the following talent to join our growing Advanced Displays Engineering Team:

- ELECTRICAL DESIGN ENGINEERS who can provide leadership in the design and development of advanced solid state display systems. We seek 3-5 years of experience in electronic design with emphasis on digital and analog implementations. If your background is in OPTICS or LIGHTING DESIGN, unique opportunities are also available in liquid crystal displays and display lighting systems.

- MECHANICAL DESIGN ENGINEERS to design high-density electronic and optical packaging for state-of-the-art liquid crystal display systems. Requirements include 2-4 years of electronic packaging experience, preferably in a military product environment.

Additional engineering opportunities in design assurance include:

- SENIOR DESIGN ASSURANCE ENGINEER to prepare reliability and maintainability studies and predictions, failure mode and effects analysis for electronic, mechanical, and E/M systems, design assurance test plans for innovative devices and technology, and development of reliability data base for liquid crystal and flat panel display technology. BSEE/BSME with 3 years of design assurance experience required.

- DESIGN ASSURANCE MANAGER to provide strong leadership in the execution of the above-described design assurance process. The successful candidate will be degreed with a minimum of 3 years design assurance experience and demonstrated management skills.

We're ideally located 20 minutes from Boston, right in the heart of New England. For immediate consideration, please forward your resume and salary history, in complete confidence, to Employee Relations, General Electric Company, Aircraft Instruments Department, 50 Fordham Road, Wilmington, MA 01887. An equal opportunity employer.

General Electric

Circle no. 35

Calendare

recognition and signal processing. Send SPIE four copies each of the following: author application, a brief professional biography, and a 200-300 word abstract typed double-spaced on 8½ x 11" white paper. For a detailed copy of the call for papers and an author application, write SPIE Technical Program Committee/1988 Symposium Southeast, P.O. Box 10, Bellingham, WA 98227-0010. 206/676-3290. Late submissions may be considered. Deadline for abstracts: Sept. 28.

Letters

continued from page 10

NTSC scan rates and 800 lum with 1000 lines of resolution—greatly exceeding the brightness of conventional projectors, including the Arcturus modifications.

(2) The "useful claim" for the new CRT design seemed abundantly clear in the article, but is now repeated: any lens prefers a curved image surface, not a flat one. Further, by curving the phosphor surface towards the lens, a greater quantity of light can be concentrated into the lens aperture—light that is now wasted in all conventional CRTs (beam spot luminance is gaussian, not lambertian). Technically, one of the TDS inventions is a quad-element lens system, with three of the lens elements being phosphor coated (the CRT is now an integral lens element as well as an image source).

(3) Anti-reflection, coupling, and immersion are as different as is their spelling: coupling and anti-reflection are aspirins and only provide relief. We have totally changed the art and have perfected a liquid lens system in which the phosphor lens elements are immersed into a master lens system. By creating a heat-sinking optical fluid, rather than a solid lens, we can tolerate more beam current than conventional CRTs.

(4) With all three color images optically converged within the master lens, a direct-view image is now available free of shadow-mask defects and immune to ambient light. How the above can be confused with his own products that can only be mechanically converged at a fixed distance and only viewed off a separate display surface is perplexing.

(5) Lastly, I don’t know how to discuss electron beam incidence without first knowing the deflection angles being used: we selected a 6.5-in. radius faceplate for optimum luminous efficiency, then designed a 30° deflection envelope for aberration free corners.

—Marv Hodges, President
Triumph Display Systems, Inc.
Simi Valley, California
id classified

Classified ad rates: $55/column-inch (min.): $100/ad (free for fractions of an inch); $10/ad insertion for blind box no. at ID (replies forwarded). Size: 1 column-inch = 10 lines (ave. 6 words/line). Large-type all-caps heading (max. 17 characters) takes up 2 lines. Allow 1 line for blind box no. Deadline: One month before issue date. Payment: Send minimum $55 payment with order to: Information Display, c/o Palladiscope Institute, 201 Varick St., Suite 1140, New York, NY 10014. Questions? Call 212/620-3371.

job opportunities

Consultants

Monitorix Corporation is a high growth company that designs, manufactures, and markets ultra high performance color monitors used in CAE workstations where unusual levels of brightness and clarity are required to ensure superior user productivity. We are seeking to fill two of the following positions.

VICE-PRES. OF R&D

We are searching for a Vice President of Research and Development to provide technical leadership, oversee all activities of the Engineering Department, and conceive and develop new products. The ideal candidate will be someone with a successful track record in leading both engineering and applied research activities. Excellent oral and written communication is expected along with information displays industry presence. A Master's Degree in Electrical Engineering is required.

ADV. DEV. ENGINEER

Also a vacancy exists for a senior development engineer to design advanced circuitry for high resolution color graphic monitors, develop new graphics display products, and provide technical leadership in the application of new high performance components. The ideal candidate will be an enthusiastic self-motivated person with a background in high speed logic circuit design. A Bachelor's Degree in Electrical Engineering with five to ten years' experience in CRT deflection and video drive technology is needed.

An excellent company benefits package including both medical and dental plans, tuition reimbursement, and a modern professional work environment are some of the many benefits offered. For immediate consideration, please send your resume including salary history to:

Monitorix Corporation
Attn: Human Resources Department
920 Eastwind Drive, Suite 220
Westerville, OH 43081
An Equal Opportunity Employer

Sr. Lighting Engineer

Korry Electronics, a leading manufacturer of cockpit display systems, is seeking a senior lighting engineer with five years experience in the design of cockpit lighting for aerospace and military displays and components. Requires solid background in a wide range of lighting methods: incandescent, EL, LED, etc. Degree in optics or equivalent experience preferred. Come join us in our new facility in livable Seattle with unmatched recreational opportunities. We offer excellent salary, educational support, and comprehensive benefits including an innovative vacation plan. For confidential consideration please send resume to: Korry Electronics, Ctronix Technologies, ATTN: Personnel, 901 Dexter Ave. No., Seattle, WA 98109.

Laser Beam Information

LEO BEISER INC.


business opportunities

Xelteq is seeking a corporate partner with the resources, capital, and/or vacuum equipment to clean, rework, and converting their expertise and patentable process for making full color thin film EL (TFCEL) into engineering samples. For details contact Mr. Van Asperen at 805-498-0266 or TWX 209953.

miscellaneous

SID '87 PUBLICATIONS

The SID '87 Digest of Technical Papers and Seminar Lecture Notes are available from SID. The SID '87 Digest (400 pp., ilus.) contains the texts of 106 papers presented during the three-day Symposium May 12-14, 1987. Topics include VDT standards, automotive displays, active-matrix LCDs, large-screen projection displays, plasma and VFDs, human factors, CRT technology, printing technologies and materials, EL technology, color display applications, display systems, and workstations. Price is $55 ($45 for SID members).

The SID '87 Seminar Lecture Notes comes in two volumes. Vol. 1, May 11-12 (269 pp., illus.), contains seven seminar lectures: "State of the Display Industry" (Tanaka); "Visual Perception Basics" (Murch); "EL Displays" (Muehle); "Direct-Multiplexed LCDs" (Scheffer); "Active Matrices for LCDs" (Finster); "Display Measurement Technology" (Miller); and "The Evolutionary CRT?" (Seita). Vol. 2, May 15 (237 pp., illus.), contains eight lectures: "Colorimetry of Displays" (Benzschawel); "Tactical Aircraft Displays" (Arm); "Plasma Displays" (Mikoshiba); "Color Hard Copy" (Miller); "Advances in Image Processing for Art, Medicine, and Mapping" (Bernstein); "Image Synthesis and Computer-Generated Animation" (Bacon); "Electronic Projection Displays" (Felgenblatt); and "Touch Input Technology" (Carroll and Carstedt). Price is $30 for either volume ($20 for SID members) or $50 for the two-volume set ($35 for SID members).

Prices include book rate or surface postage. Add $10 per order for air-mail shipment overseas. Order from: Society for Information Display, 8055 W. Manchester Ave., Suite 615, Playa del Rey, CA 90293, 213-305-1502. Back issues of SID publications are also available. Ask for a publications brochure.

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- Responsible for configuration/design of various CRT/LCD color display systems: head-down color multifunction raster/stroke displays, head-up multi-color holographic displays, helmet-mounted displays, light steering/stereoscopic displays.
- Ability to supervise a group of six engineering professionals and technicians involved in modeling, measurement and system design.
- Knowledgeable in system performance trades for sunlight readable cockpit CRT display systems: phosphors, electron optics, colorimetry, electronics.
- Have working knowledge of human factor trades: color separation, shades of gray, resolution.
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