

Official Monthly Publication of the Society for Information Display

INFORMATION DISPLAY

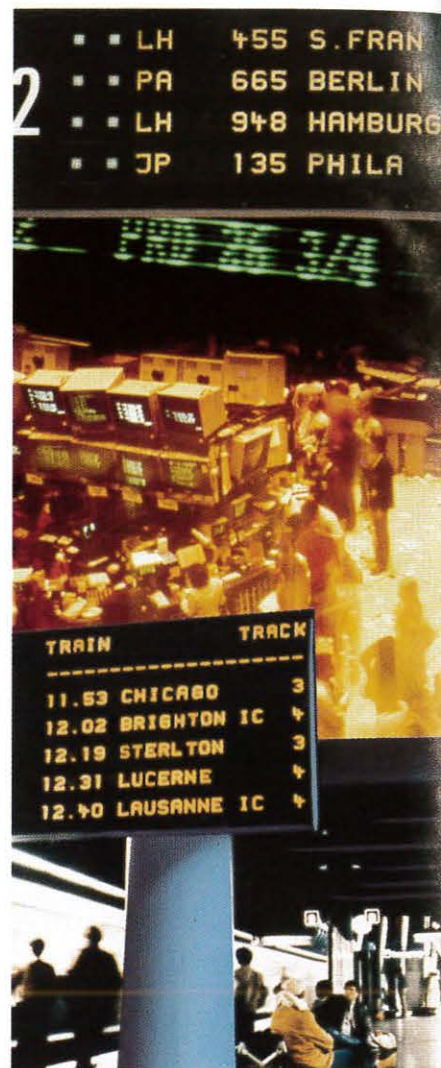
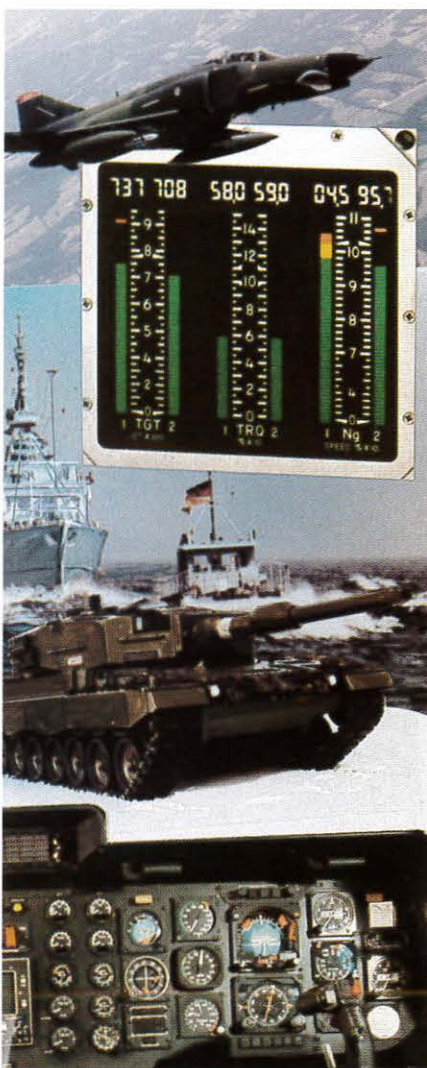
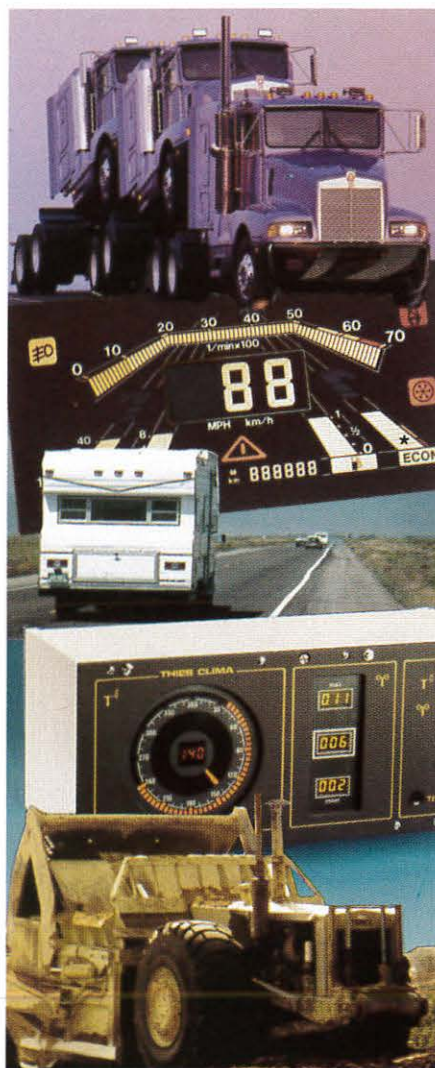
May 1988
Vol. 4, No. 5

SID'88
Show Issue



Using displays for
market differentiation
Economic display design
SID exhibit preview

Non-Profit Organization
U. S. Postage
PAID
Phillipsburg, N. J.
Permit No. 187



**LCDs from AEG...
any way you look
at them,
they're clearly
superior**

Engineers throughout the world have specified AEG custom designed LCDs when their display requirements demanded the best technology available. Our displays are highly engineered to perform under the most stringent environmental conditions.

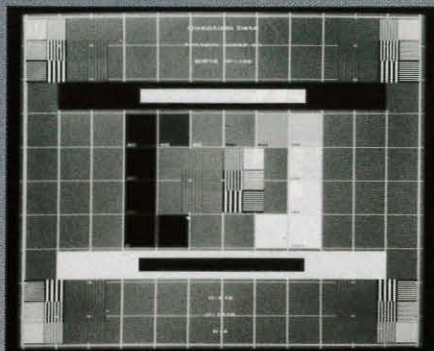
Reliability and long life is provided by our chip-on-glass technology, eliminating the need for interconnecting to a PCB. The result is an LCD only 3mm in thickness that is completely shock and vibration resistant with an operational temperature range of -55°C to $+95^{\circ}\text{C}$ (w/heater).

If you are looking for the best in LCDs for automotive, for avionic/military or for public display applications, such as airports and financial centers (stock exchanges) ... you should look to AEG where clear viewing, at any angle is superior...

For more information contact:
AEG Corporation, Route 22 — Orr Drive
PO Box 3800, Somerville, NJ 08876-1269
(201) 231-8300

AEG

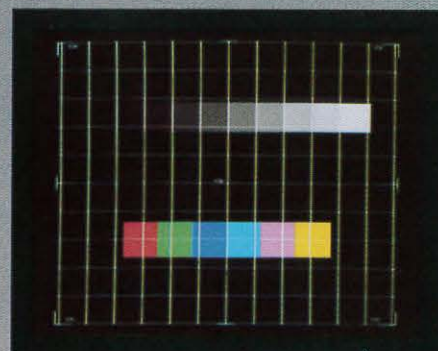
*Instrument panel in first column,
courtesy of Borg Instruments



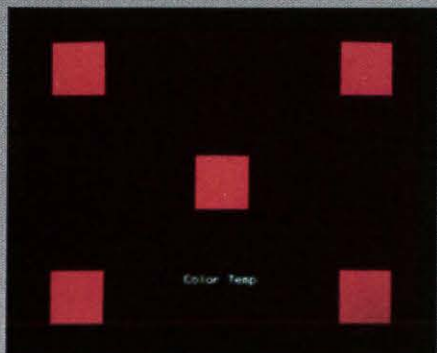
SMPTE RP-133



Color Bars



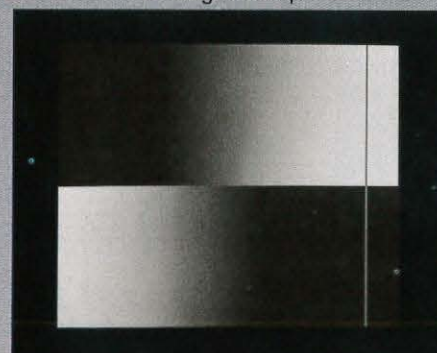
Signal Setup



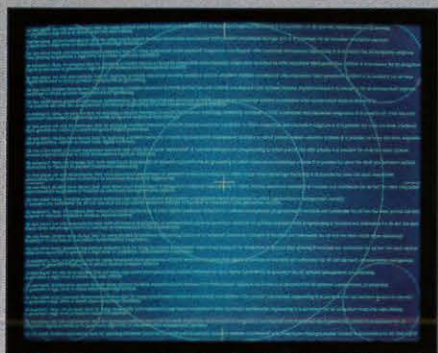
Color Temperature



Cross Talk



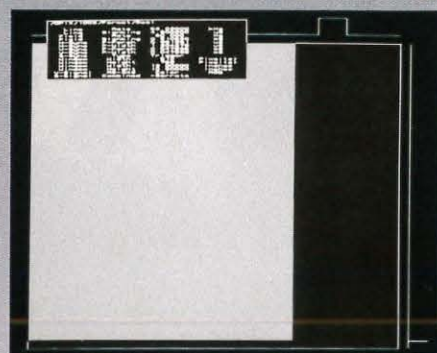
256 Level Gamma Pattern



Text with Circle



RGB Delay

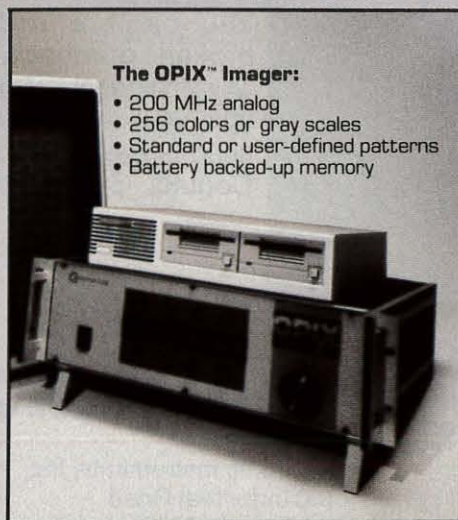


Timing

THESE PROBLEM SOLVING PATTERNS ARE YOURS AT THE TOUCH OF A BUTTON.

The OPIX™ Imager:

- 200 MHz analog
- 256 colors or gray scales
- Standard or user-defined patterns
- Battery backed-up memory



The OPIX™ Imager carries 56 built-in Instant-Expert™ test patterns that allow anyone to perform sophisticated diagnostic and correlation tests from day one. It's the only signal generator on the market that offers this capability. And you can design your own tests. Or build off the Instant-Expert patterns by copying a test pattern on disk and modifying it.

The possibilities are endless. The results as exacting as your video parameters require. Do "what if" experiments. Precision test your monitor specifications when hardware logic is still weeks away. Store and recall design specifications that have been out of production for years. You can do it all with the OPIX Imager. Why settle for less? Get the OPIX Imager and bring your video testing to a point of performance you can trust.

For technical data, or a hands-on demonstration contact: **QUANTUM DATA**, 2111 Big Timber Road, Elgin, IL 60123. Phone: (312) 888-0450 FAX: (312) 888-2802 Telex 206725

QUANTUM DATA®

ONE DESIGN ENGINEER CHOSE SYNTRONIC AS THE YOKE SUPPLIER...

THE OTHER IS STILL WAITING.



Syntronic

Instruments

Delivers

You can trust Syntronic not only for high-quality deflection components, but to deliver on every promise as well.

We're more than a supplier. Syntronic engineers team with your design personnel to make sure your display specifications are met. And when we pledge to create a product for you, we do it. No excuses. No delays. This value-added level of support is unmatched.

Our precision components are known throughout the industry as the standard of excellence. In fact, we pioneered display system technology. And today we are the largest custom designer of deflection yokes, focus coils, beam alignment/shaping coils, micro-positioner alignment devices and related CRT mounting hardware.

The Syntronic expertise in magnetic components will continue to meet the display challenges of avionics, military ground and shipboard, medical imaging, and demanding color systems.



You can't afford broken promises. Trust the people who take your needs as seriously as you do. Contact Syntronic today.



syntronic

Syntronic Instruments, Inc.
100 Industrial Road
Addison, IL 60101
Phone (312) 543-6444

Official Monthly Publication of the Society for Information Display

INFORMATION DISPLAY

MAY 1988
VOL. 4, NO. 5

Cover: Different flat-panel displays optimize laptop computers for different market segments. Clockwise from top: transfective backlit LCD, 640 × 200 transmissive backlit LCD, plasma, 640 × 400 transmissive backlit LCD, and electroluminescent.
(page 20)



Photo: GRiD Systems Corporation

Next Month in Information Display

CRT Technology Issue

- Computer modeling of guns and yokes
- Bulb design
- Automated CRT testing

-
- 7 Editorial
 - 11 President's Message
 - 16 Economic display design
Why design displays that provide more information than the eye can see? Image science tells how to match what is shown to what is seen.
Curtis R. Carlson
 - 20 Technical marketing case study: using displays for market differentiation
Putting different displays on the same computer is one way to reach different segments of the marketplace.
Lee Watkins
 - 27 Software Notes
 - 28 Products on Display
We preview some of the products on display at the largest exhibit in SID's history.
 - 46 Sustaining Members
 - 46 ID Classified
 - 46 Index to Advertisers

LEADER



“At lunch today, I learned to use this programmable video generator. And still had time to eat.”

While other RGB video generators take weeks to learn, ours take minutes. No digital training needed. No countless key combinations to learn. No need to use your PC unless you want to. Unlike other generators, Leader's have an integral programmer (LVG-1604A and 1603A) or are available with a programmer unit (1601A). And you can get any of dozens of test patterns simply by touching one clearly marked key.

All the functions you need.

The LVG-1604A lets you test even the most advanced high-resolution CRT's and

wide-band video transmission systems. Present or future.

Analog, TTL and ECL outputs. 125 MHz. 64-color capability. Storage of up to 200 display formats. Wide range of raster architectures, and most common test patterns with both stock and user-designed characters. Ability to change format conditions. These features are easy to learn—but hard to beat.

Now you can choose.

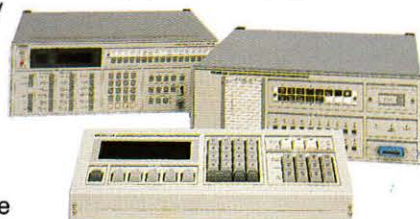
You shouldn't pay for more functions than you need. So call us for a free copy of our full-line catalog. Pick the video generator

that's right for you. Then, in just 30 minutes, we'll show you how to use it. It'll be up and running before you finish your lunch.

Call toll-free
1 800 645-5104
In NY State
516 231-6900

Leader Instruments Corporation
380 Oser Avenue, Hauppauge, New York 11788
Regional Offices:
Chicago, Dallas, Los Angeles, Boston, Atlanta
In Canada call Omnitronix Ltd. 416 828-6221

LEADER
FOR PROFESSIONALS WHO KNOW
THE DIFFERENCE



Select a Leader Video Generator with all the features you need.

Circle no. 39 for product demonstration

Circle no. 87 for product information

HUGHES

Subsidiary of
GM Hughes Electronics

*Hughes Aircraft Company
invites you to experience a whole
new world of shared information.*

The introduction of the

HUGHES

SUPERPROJECTOR

MODEL 1000 COLOR GRAPHICS PROJECTOR

at SID, May 24-26
The Hughes/Delco Booth
408-509

HOYA

Display Contrast Enhancement Filters

Maximize the luminous contrast of your CRT and LED displays with Hoya's specially developed optical-quality contrast-enhancement color glass filters. Sunlight readability as well as meeting other intense ambient cockpit conditions are satisfied by antireflection coatings on narrow-band monolithic color glass filters and combinations with polarizers.

GV Series—Green monochromatic CRT display filters of various thicknesses most effective in transmitting the P-43 phosphor emission in the 545–548 nm range. Highest contrast ratio is realized with 11–18% peak transmission.

AC Series—Color CRT display filters optimized for the blue-green-red emission of the P-22, P-43, and P-55 phosphors. Best contrast ratios are obtained in the 22–32% peak transmission range for these respective wavelengths.

HLF Series—Yellow, green, and red contrast-enhancement filters for sunlight viewable alphanumeric LED displays. Combines antireflection-coated colored glass filters with a circular polarizing interlayer for maximum luminous contrast.

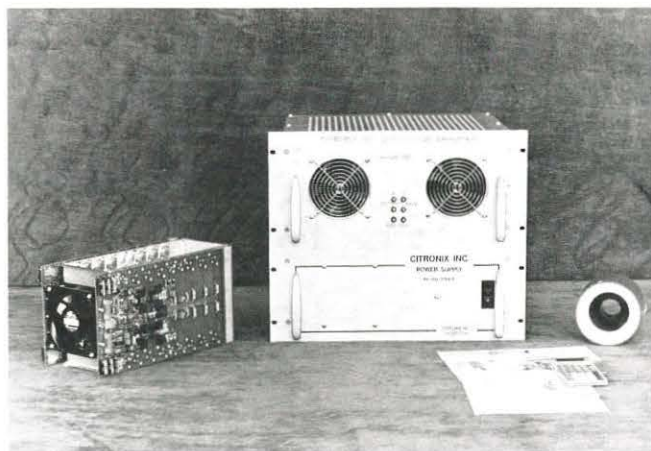
Please contact Hoya Optics for additional information and quotation of such applications and your other optical/filter requirements.

HOYA OPTICS, INC. 3400 Edison Way, Fremont, CA 94538 (415) 490-1880, Telex 172-647
East Coast office: Route 131, Suite 3, Sturbridge, MA 01566 (617) 347-2671

Circle no. 41

DEFLECTION AMPLIFIERS

FOR PRECISE CRT BEAM CONTROL



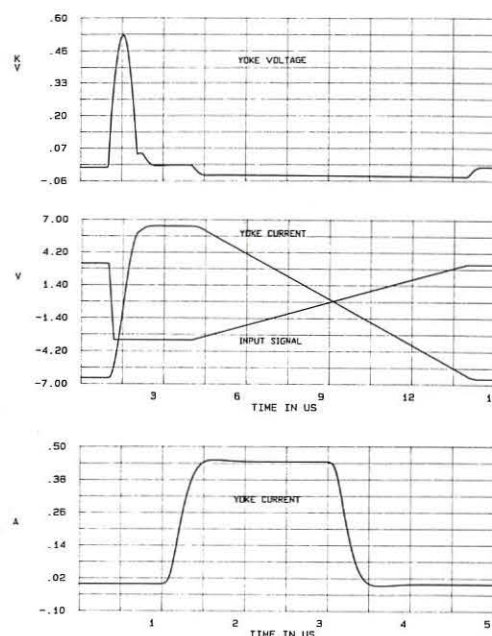
Can your deflection system retrace a beam in less than $2\mu\text{s}$ (30 μh yoke, 30APP)?

Then trace a geometrically corrected raster line? And then trace an image in a calligraphic mode, all in a single frame?

Ours can, and much more!

CITRONIX INC.
THE DEFLECTION AMPLIFIER COMPANY

Integrated Raster/Calligraphic System



Contact: Al Pletz
CITRONIX INC.

Post Office Box 288
Orangevale, Ca. 95662
(916) 961-1398, TWX 9103506540

Editor: Kenneth I. Werner
Managing Editor: Hildegard Hammond
Contributing Editor: Ronald Cohen
Departments Editor: Lynne A. Henderson
Art Director: Hildegard Hammond
Advertising Manager: Jay Morreale
District Sales Managers: Ted Lucas (West), Stephen Steeves (Midwest), Becky Akers (East)

Editorial Advisory Board

Dr. Ifay F. Chang, Chairman
*Director of Research
Institute of Systems Science
National University of Singapore*
Dr. Frederic J. Kahn
*Vice President
Greyhawk Systems, Inc.*
Koh-Ichi Miyaji
*Professor
Shibaura Institute of Technology*
Jan Rajchman
Consultant
Aron Vecht
*Director
Phosphor Consultants*

INFORMATION DISPLAY (ISSN 0362-0972) is published monthly for the Society for Information Display by Palisades Institute for Research Services, Inc., 201 Varick Street, New York, NY 10014; David Slater, Chief Executive Officer; Leonard H. Klein, President; Harold R. Summer, Vice President; Hildegard Hammond, Secretary; Laura Mangone, Treasurer.

EDITORIAL AND BUSINESS OFFICES: Palisades Institute for Research Services, Inc., 201 Varick Street, New York, NY 10014; telephone 212/620-3371. Send manuscripts to the attention of the Editor, ID.

DISTRICT SALES OFFICES: WEST—Ted Lucas, P.O. Box 852, Cedar Glen, CA 92321; telephone 714/337-6627. MIDWEST—Stephen Steeves, The Pattis Group, 4761 West Touhy Avenue, Lincolnwood, IL 60646; telephone 312/679-1100. EAST—Becky Akers, The Pattis Group, 310 Madison Avenue, Suite 1804, New York, NY 10017; telephone 212/953-2121.

SID HEADQUARTERS, for correspondence on subscriptions and membership: Society for Information Display, 8055 West Manchester Avenue, Suite 615, Playa del Rey, CA 90293; telephone 213/305-1502.

SUBSCRIPTIONS: Information Display is distributed without charge to those qualified and to SID members as a benefit of membership (annual dues \$35.00). Subscriptions to others: U.S. & Canada: \$36.00 one year, \$64.00 two years, \$90.00 three years, \$3.00 single copy; elsewhere: \$72.00 one year, \$128.00 two years, \$180.00 three years, \$6.00 single copy.

PRINTED by Sheridan Printing Company, 1425 Third Avenue, Alpha, NJ 08865. Third-class postage paid at Alpha, NJ.

POSTMASTER: Send address changes to Society for Information Display, 8055 West Manchester Avenue, Suite 615, Playa del Rey, CA 90293.

PERMISSIONS: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limits of the U.S. copyright law for private use of patrons, providing a fee of \$2.00 per article is paid to the Copyright Clearance Center, 21 Congress Street, Salem, MA 01970 (reference serial code 0362-0972/88/\$2.00+\$0.00). Instructors are permitted to photocopy isolated articles for noncommercial classroom use without fee. This permission does not apply to any special reports or lists published in this magazine. For other copying, reprint or republication permission, write to Society for Information Display, 8055 West Manchester Avenue, Suite 615, Playa del Rey, CA 90293.

Copyright © 1988 Society for Information Display. All rights reserved.

editorial



Nearly four decades ago, Albert Rose laid the foundations of image science at what were then the RCA Laboratories. Since then, the David Sarnoff Research Center, now a part of SRI, has been a leading developer of this expanding science and its applications. An indication of the degree of expansion is the establishment of an Image Science Institute at New York City's Polytechnic University (formerly Brooklyn Polytechnic Institute), under the direction of Arnost Reiser, and another at the Rochester Institute of Technology, under the direction of

Rodney Shaw.

In this issue, Curt Carlson, director of Sarnoff's Information Systems Research Laboratory, presents some particularly applicable results of image science and a convenient graphic tool for using them in display design.

In a technical marketing case study, Lee Watkins tells how different segments of the laptop computer market can be targeted by putting different display panels on what is essentially the same computer. A sidebar shares the experience of using a plasma display laptop.

This issue also features *Information Display's* first software review. The applications program is for designing multilayer interference filters, which sometimes appear on displays as antiglare coatings or for other purposes. The reviewer is Warren Smith, author of the now classic textbook, *Modern Optical Engineering*.

And, to preview the rapidly approaching International Symposium, Seminar, and Exhibition of the Society for Information Display (to be held May 23-27 in Anaheim, California), we highlight some of the products to be displayed at the largest SID exhibit in the society's 26-year history.

Finally, we'd like to rectify an editorial omission and make an editorial note. The omission was of three worthy companies from the large table in "The Flowering of Liquid-Crystal Technology" (February *ID*). We should have included UCE of Norwalk, Connecticut, Crystalloid Electronics of Hudson, Ohio, and Litton Data Images of Ottawa, Canada, all manufacturers of avionic displays. And EDS, which was listed, has changed its name to Hercules Aerospace Display Systems and is now located in Hatfield, Pennsylvania.

Editorially, we note that Howard Funk's popular columns on patents and publications will be appearing irregularly for the next few months because of space limitations. We're well aware how highly *ID's* readers value Howard's contributions, and we will restore them as regular departments as soon as page allocations permit.

The editorial and advertising staff of *Information Display* looks forward to meeting as many of our readers as possible in Anaheim.

—Kenneth I. Werner

AC Plasma Displays ...

Not just for big spenders anymore.

For all their superiority, AC plasma displays have always been an expensive proposition.

Until now.

We've eliminated half the address drivers. The result is lower cost than ever before possible.

But that's not all.

Our new energy recovery sustain circuit requires surprisingly little power. This puts AC Plasma well within the reach of battery powered PCs.

As of now, AC plasma displays are no longer for big spenders.

They're for smart ones.

Call us for more details.

PLASMACO

268R Clinton Avenue, Kingston, NY 12401 914-338-0201

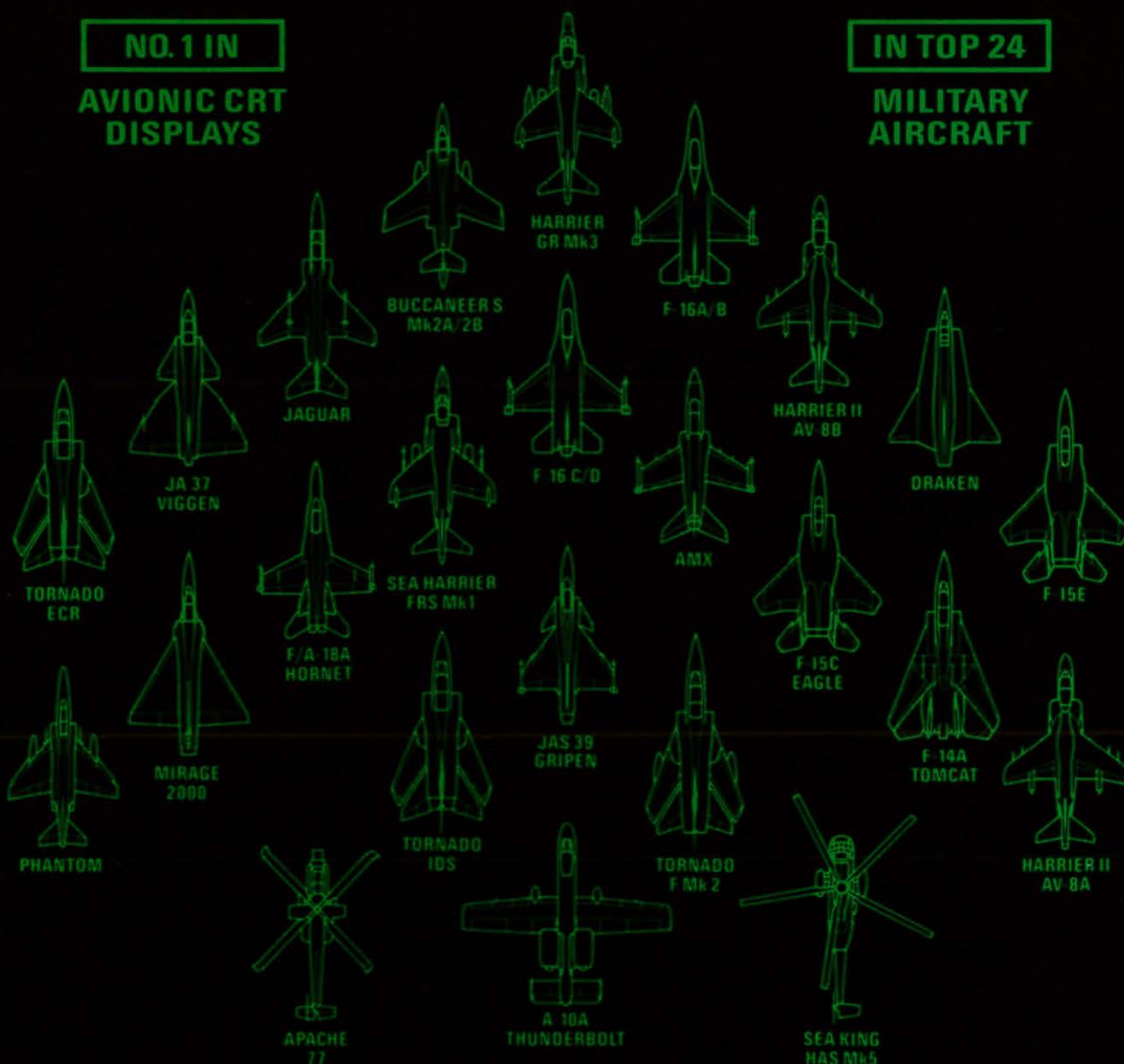
See us at SID '88 Booth 323

BEFORE LOOKING INTO CRTs, STUDY THE PLANE FACTS FROM RANK BRIMAR.

RANK BRIMAR

**NO. 1 IN
AVIONIC CRT
DISPLAYS**

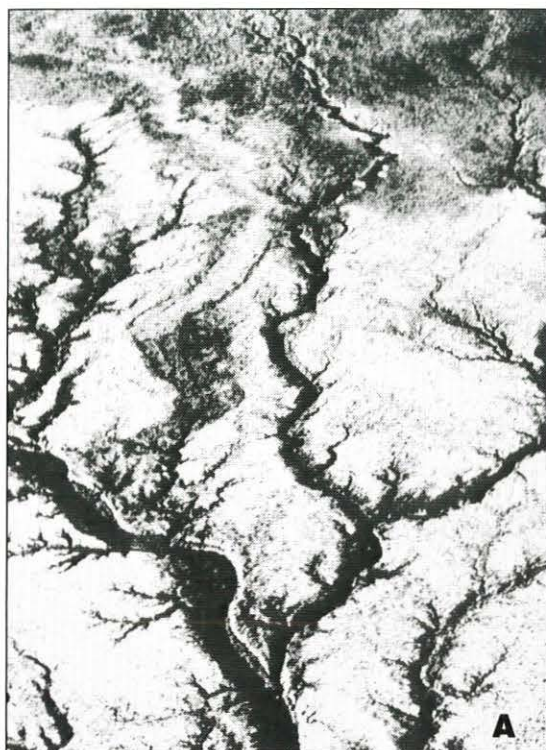
**IN TOP 24
MILITARY
AIRCRAFT**



Our CRTs are at the heart of the head up, head down and helmet mounted displays seen in 24 of the world's leading military aircraft. It's a simple fact that reflects our continuing commitment to remain world leaders in advanced display technology at the Man:Machine interface.



Rank Brimar
Viewed as the finest in the World



Delta or Aorta? Which is Which?

No problem here because both of these images were processed on Raytheon's new TDU-850 Thermal Display Unit.

The TDU-850 is the only thermal recorder to display true grey levels (not mere halftone representations) at such high speeds and resolutions. Utilizing 203 dots per inch, the unit offers 64 grey levels and can provide 256 grey levels through the use of super pixels. The TDU-850 is your assurance of high quality images. Standard units about \$5,000. (Slightly higher overseas). RS-170 video and IEEE-488 computer interfaces are available.



When you must know what you're looking at, look for equipment that knows what to look for. For details call or write **Marketing Manager, Recorder Products, Raytheon Company, Submarine Signal Division, 1847 West Main Road, Portsmouth, RI 02871-1087. Phone: (401) 847-8000.**

Raytheon

A. Satellite view of river delta. **B.** Arterial angiogram.

Note: These began as continuous tone images which were processed in black and grey by a TDU-850. The TDU-850 images, however, had to be converted to conventional halftones in order to be shown in this magazine. Thus the high quality of the original TDU-850 images have been obscured. For true results ask to see a demonstration.

SID Executive Committee

President: J.A. van Raalte
Vice President: L. Tannas, Jr.
Treasurer: W. Goede
Secretary: P. Pleshko
Past President: I.F. Chang

President's Advisory Council

B. Lechner, Chairman
T.V. Curran, W. Good, A. Kmetz, P. Pleshko,
I. Reingold, H.G. Slottow

Regional Directors

Minneapolis/St. Paul: T. Werner
Canada: J. Wright
Dayton: R. Holmes
Delaware Valley: S. Filarsky
New England: T. Cheek
Mid-Atlantic: H. Funk
Bay Area: H. Sherman
Los Angeles: R.C. Knepper
San Diego: R.E. Thoman
Japan: M. Ashikawa
U.K. & Ireland: A. Woodhead
European: C.J. Gerritsma

Committee Chairmen

Academic: L. Weber, L. Todd, Jr.
Archives/Historian: R.C. Knepper
Bylaws: A. Silzars
Chapter Formation: A. Lakatos, C.J. Gerritsma
Conferences
IDRC—R. Durbeck
Symposium—T. Credelle
Definitions & Standards: P. Keller
Honors & Awards: W. Howard
Intersociety: A.I. Lakatos
Memberships: R. Feigenblatt
Nominations: I.F. Chang, G. Carroll, T. DuPuis
Publications: P. Heyman
Proceedings Editor: S. Sherr
Information Display Editor: K. I. Werner
Publicity: J. Price
Special Technologies
Workstations—R. Schmah
Hard Copy—W. Lloyd

Chapter Chairmen

Bay Area: C. Infante
Canada: A. Moffat
Dayton: W. Watkins
Delaware Valley: R. Seifert
Detroit: J. Erskine
Japan: C. Suzuki
Los Angeles: P. Baron
Mid-Atlantic: T. Nelson
Minneapolis/St. Paul: V. Born
New England: W. Hamilton
San Diego: J. Lipscombe
U.K. & Ireland: N. Bartlett

Office Administration

Headquarters Office Manager: Bettye Burdett

president's message



Just prior to SID '88 my term as president of SID will come to an end and Larry Tannas will be taking over. As I step down I realize how fortunate I have been to serve with the strong support and dedication of so many SID colleagues who have helped to make our society strong and vital and have caused it to grow steadily. I can only hope that each of you will give Larry the same enthusiastic support, including the benefit of your ideas and constructive criticisms, that you have given me.

The past two years have brought numerous positive changes and accomplishments, almost all of them made possible by the extra efforts of SID's officers and committee chairmen. Our membership has continued to grow steadily, as has the number of sustaining members. And, as a result of a lot of hard work, the new membership directory was recently mailed to all our members.

The new SID chapters in Dayton and Detroit were formed, while the Canada Chapter, which began two years ago, has now joined the ranks of our other strong active chapters. Regrettably, the Midwest Chapter was deactivated since it was unable to maintain regular activities; we certainly hope that this chapter will return to active status in the future, as seems likely soon for the Washington, D.C., Chapter.

We have continued to wrestle with the high costs of our publications, both for the *Proceedings* and the *Information Display* journal. I believe that publications and conferences represent SID's primary obligations to its membership and we must continue to look for ways to reduce these costs without sacrificing the quality of our service.

Our two major annual conferences, the Symposium and the IDRC, continue to be well-attended, both confirming and enhancing SID's reputation as *the premier information display society in the world*. SID '88 promises to set new records in almost all categories as, increasingly, our conferences are used as role models for other societies' conferences.

Two new prizes, the Karl Ferdinand Braun Prize and the Johann Gutenberg Prize, were established, replacing the society's earlier F. R. Darne Award. These prizes, each consisting of a medal and an industry-supported \$2000 award, annually reaffirm SID's support for excellence and innovation in displays and hard-copy technology.

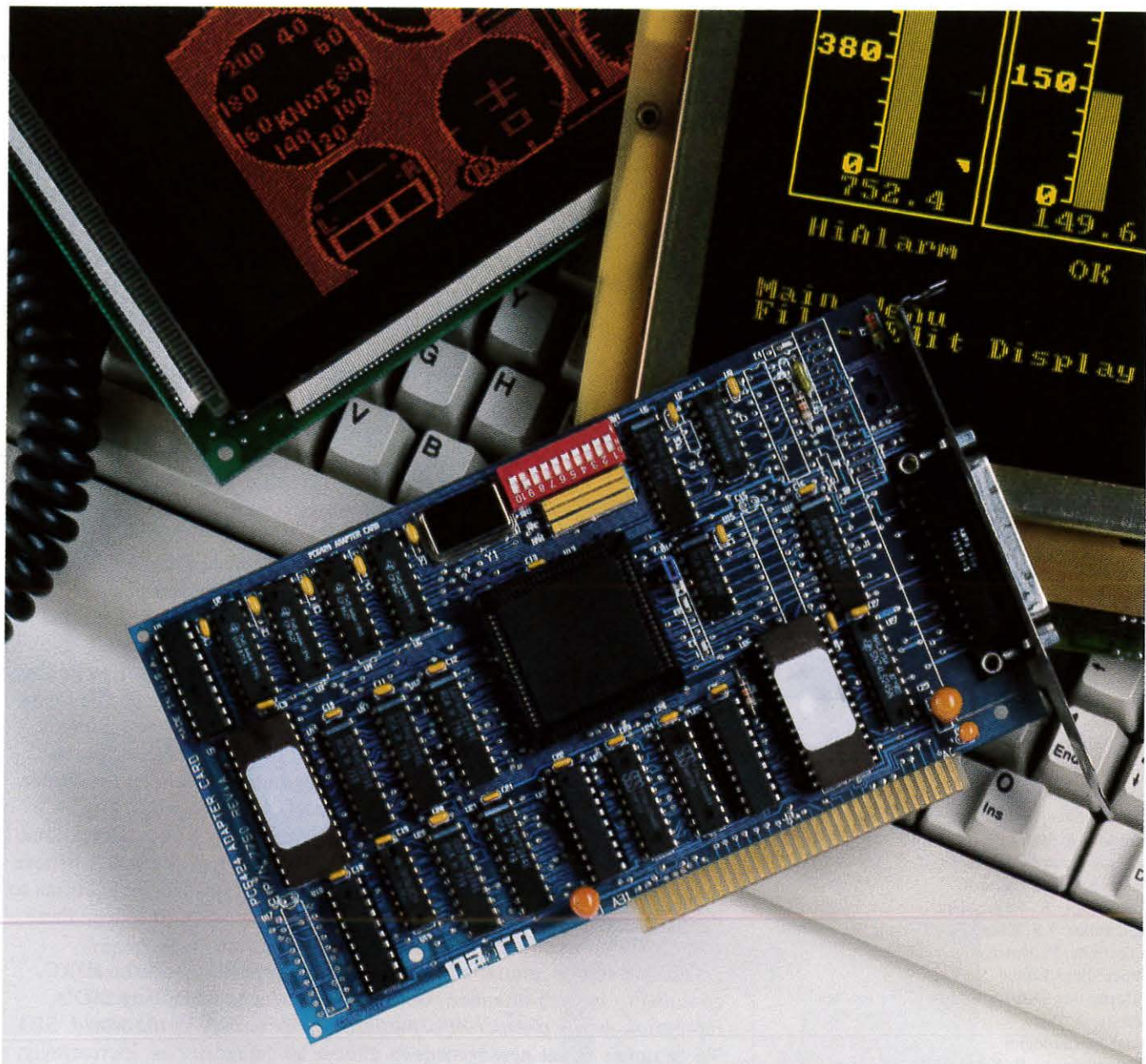
I believe our society is strong and I feel privileged to have served while we passed our quarter-century milestone. The society must continue to evolve and change with the times. We have had many serious constructive debates about our future course and the pace of change; this is healthy and must continue.

In conclusion, I would like to acknowledge and thank all the volunteers who have helped me so generously, as well as Bettye Burdett for her dedication in managing the SID headquarters office, and all my friends at Palisades Institute for Research Services, Inc., for taking care so ably of many of the society's administrative matters; you have made my term as SID president a truly enjoyable one. I wish Larry Tannas and the new board and committee chairmen the best of luck as they chart our future.

—John A. van Raalte

Society for Information Display

8055 W. Manchester Ave., Suite 615
Playa Del Rey, CA 90293
213/305-1502



DEECO PC ADAPTER CARD. THE QUICKEST WAY TO INTERFACE A FLAT-PANEL DISPLAY.

When it comes to driving a flat-panel display with your PC, only Deeco offers you an easy-to-use, off-the-shelf solution.

Simply plug our PC 6424 adapter card into your PC XT, or AT. That's all there is to it. No software, no hardware, no modifications.

What's more, our PC adapter card can drive electro-luminescent, AC plasma and split-screen LCD display technologies with standard software. And it's completely compatible with 640x200, 640x400 and 720x350

resolution display matrices.

The PC adapter card also features onboard BIOS firmware. And it operates in CGA, DSCGA, MDA, HGC, and Deeco's full 400-line resolution modes, and can coexist with other monitor adapter cards.

To find out more about how the PC 6424 adapter card can slash your design time, call or write Deeco today. We'll show you the fastest way to drive a flat-panel display.

DEECO®

Digital Electronics Corporation, 31047 Genstar Road, Hayward, CA 94544-7831 (415) 471-4700

Deeco is a registered trademark of Digital Electronics Corporation. PC, XT, and AT are trademarks of International Business Machines.



***Micro* Color Film Recorder**

35mm Slide Production



The CELCO *Micro* Color Film Recorder is the 35mm workhorse of the computer graphics industry.

- Business Graphics
- Rugged design
- 24 hr./day continuous operation
- Low cost
- Compact size
- Fast film recording speed:
— Less than 1 minute for a complex 35mm slide
- Excellent image quality
- Precise addressability: 8192 x 8192
- Full tonal imagery: 68 billion addressable colors
- Optional CELCO Control Software

CELCO introduces the 35mm workhorse to meet the rigorous demands of volume producers of high-quality business graphics.

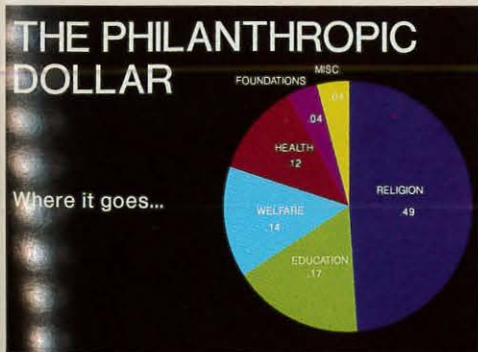
The CELCO *Micro* 35mm Color Film Recorder features fast film recording and excellent quality graphics. Colors are bright and rich.

Also featuring low cost, compact size and rugged design, the CELCO *Micro* is built to yield unprecedented reliability.

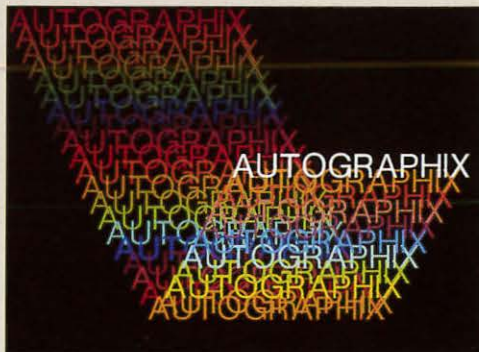
CELCO *Micro* saves time and makes money for producers of 35mm slides.

OPTIONAL CELCO CONTROL SOFTWARE

- Plotting control
- File handling
- Complete diagnostic and calibration routines
- Job Control Block (JCB) for animation files handling



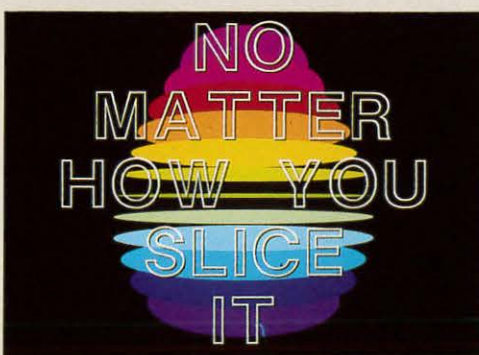
Service bureau business graphics. Data courtesy MAGI/MAGICorp.



CELCO *Micro* saves time and money for volume producers of high quality business graphics. Data courtesy Autographix.



"Sexy Robot"
Data courtesy Ketchum Advertising for Abel Image Research, Hollywood, CA.

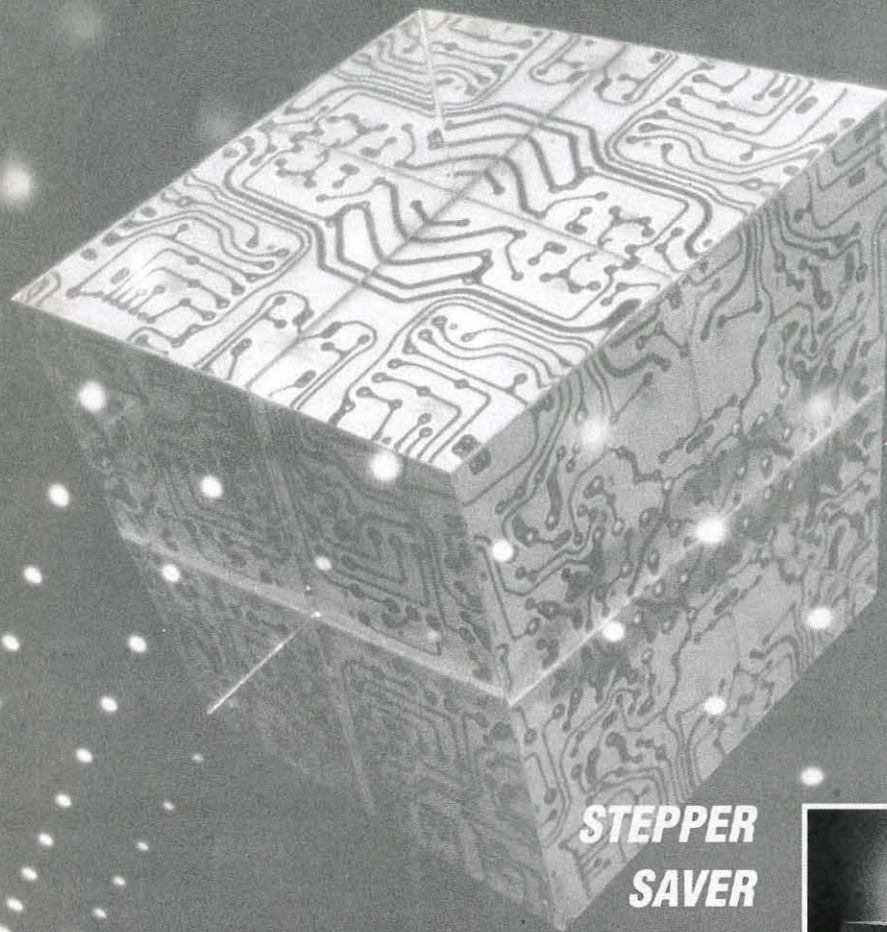


"No matter how you slice it," you never get a lemon.
Data courtesy Management Graphics

For more information, call CELCO today.

CELCO-Constantine Engineering Labs, Co.
70 Constantine Drive, Mahwah, NJ 07430
201-327-1123

CELCO, Pacific
1150 E. Eighth Street, Upland, CA 91786
714-985-9868



STEPPER SAVER

*Now there's no need to
spend over a million
dollars for a stepper.
The alternative is the
Opti-Beam® 7106 UV
Exposure System.*

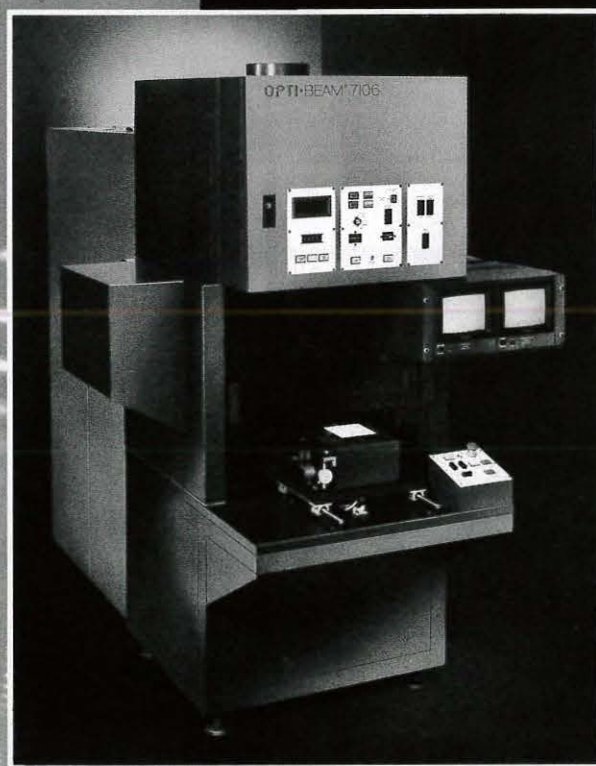
The Opti-Beam 7106® Stepper Saver, shown, is one of the 7000 Series product line of UV exposure systems for:

- Flat panel displays
- Hybrid circuits
- Printed circuit boards

This advanced primary image transfer system provides:

- A large 14" x 14" image area
- 2 Micron registration accuracy
- 5 Micron resolution in proximity
- Video alignment system, 20-200X
- Microprocessor controlled

You owe it to yourself to step up in technology and down in costs. So, contact us today for more information.



Optical Radiation Corporation

*Electronic Products Division
1300 Optical Drive, Azusa, CA 91702
818 969-3344 • TWX 910-584-4851*

Circle no. 48

Introducing

The Lowest Cost EL Lamp

The thinnest, lowest-costing EL lamps — with the fastest turnaround in the industry — are available now from BKL.

BKL's new soft touch EL lamps are made with KARD-O-LITE,[™] a revolutionary flexible material that can be die-cut quickly and easily to any shape, any size. Our exclusive, patented manufacturing process minimizes tooling and drastically reduces labor costs and turnaround time.

BKL's EL lamps are extremely thin (.012" to .018"). Ideal for backlighting LCDs, membrane switches, flat panel displays, emergency and safety lighting.

Call (215) 277-2910.



Lighting Today With Tomorrow's Technology

BONAR KARD-O-LITE,[™] Inc.
421 Feheley Drive, King of Prussia, PA 19406
(215) 277-2910

Economic display design

BY CURTIS R. CARLSON

THE FINAL TEST of an imaging system comes when a viewer looks at it and says, "That's a good picture." This judgment is easily made and requires no understanding of the complex visual processing performed by the eye and brain. But that processing defied understanding until the 1950s, when Otto Schade made a major contribution by looking at the eye as part of an overall optical system and characterizing its performance using the techniques of linear systems analysis.

Schade quantified human visual sensitivity by using gratings with sinusoidal luminance profiles—the same inputs he had used for studying optical and electro-optical systems.¹ By measuring the minimum contrast necessary for detection at different spatial frequencies [Fig. 1], Schade derived the contrast-sensitivity function (CSF), which is closely related to the modulation-transfer function (MTF) familiar to engineers.

The CSF is a natural quantity to measure if the visual system is viewed as containing a single broadly tuned linear filter followed by a detector stage having

Curtis R. Carlson is director of the Information Systems Research Laboratory of the David Sarnoff Research Center, Princeton, New Jersey, where he is responsible for programs in advanced image processing, artificial intelligence, computers and communications, and user interface design. He received his B.S. degree in physics from Worcester Polytechnic Institute in 1967 and his M.S. and Ph.D. degrees from Rutgers University in 1969 and 1973, respectively.

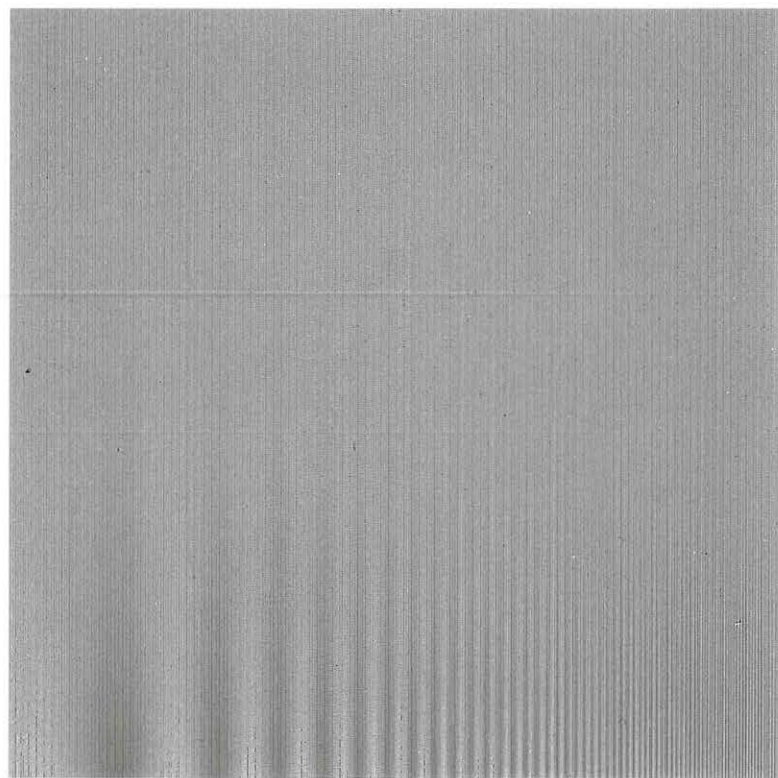


Fig. 1: This is a sinusoidal grating whose frequency is swept logarithmically along the horizontal axis and whose contrast is swept logarithmically along the vertical axis. You should see your own contrast-sensitivity function (CSF) in the form of an inverted U-shaped envelope beneath which the gratings are visible. The envelope is not in the picture, but is part of your perception of the grating. Move the page either closer to or farther from you, and the peak will shift.

a fixed threshold. But the system is more complicated than that, and more complicated measurements are needed to model the eye effectively. The current view, pioneered by Campbell and Robson and others around 1968, is that the visual system contains a bank of spatial-frequency-tuned filters, which function more or less independently of each other.² In this model, the overall CSF of the eye is the sum of the CSFs of the individual filters [Fig. 2].

No more than meets the eye

Economic display design requires a display's performance—the resolution of future high-definition television (HDTV)

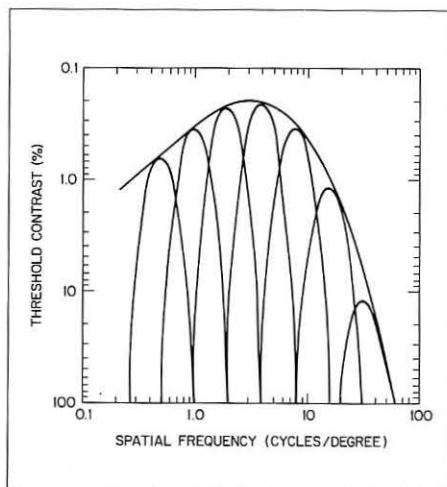


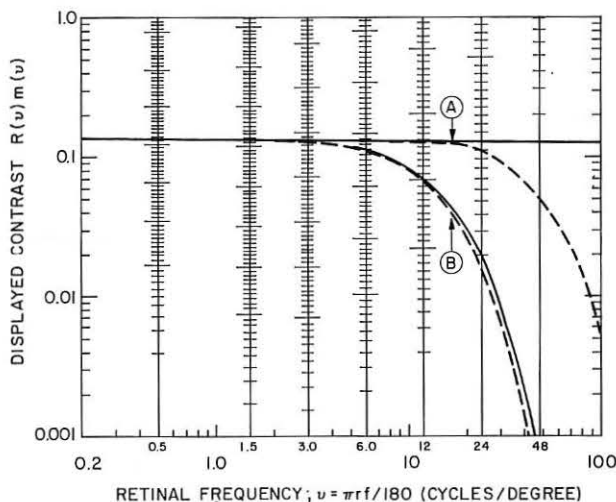
Fig. 2: The human visual system's contrast-sensitivity function can be represented as the outer envelope of a bank of spatial-frequency filters having different center frequencies.

systems, for example—to just match the perceptual requirements of the observer. The puzzle has been to determine what those requirements are in terms that are useful to display designers.

The JND diagram—a powerful tool for display design

The JND diagram is a simple graphical tool for converting changes in a display's modulation transfer function to just-noticeable-differences (JNDs) of perceived quality. The diagram presents displayed contrast on the vertical axis vs. retinal frequency ν —the spatial frequency of the image on the viewer's retina in cycles/degree—on the horizontal axis. (ν is obtained from the display frequency f , expressed in cycles/in., by using the equation $\nu = \pi r f / 180$, where r is the viewing distance in in.) The quantity $R(\nu)$ on the vertical axis represents the display MTF; $m(\nu)$ characterizes the scene being viewed. In what follows, we will deal only with a 100% contrast edge transition [where $m(\nu) = 0.14$], so differences between curves are due only to differences between display MTFs.

The vertical lines in the JND diagram are located at the key frequencies of 0.5, 3.0, 6.0, 12, 24, and 48 cycles/degree, which are the center frequencies of the filters in the human visual system. On each vertical line the distance between adjacent tic marks indicates the change in $m(\nu)R(\nu)$ needed for an observer to perceive a 1-JND change. When JND changes occur over more than one filter, the total perceived change can be approximated by adding the JNDs in the individual filters.



Now for an application. Curve A (the dotted line) represents the MTF of an extremely good display. There exists only one full JND, at 24 cycles/degree, between this display and a perfect one [represented by the solid horizontal line, $R(\nu) = 1$]. If the bandwidth of this display were increased infinitely, an improvement of only 1 JND would result.

This means that a potential HDTV system, for example, with a cut-off frequency of roughly 24 cycles/degree would look "perfect." This contradicts the commonly stated view that the design objective for HDTV systems

should be 60 cycles/degree because that is the limiting frequency response of the visual system. For the sake of affordable HDTV, it is fortunate that such high bandwidths are not required.

Dotted curve B is typical of current television displays viewed at normal distances. Here, the increase in display bandwidth, at $R(\nu) = 0.5$, needed for a 1-JND improvement in image sharpness is only about 0.7 cycles/degree. Thus, for typical displays, perceivable increases in image sharpness can result from relatively small changes in display MTF.

—C. R. C.



(a)



(b)



(c)

Fig. 3: Analysis of just-noticeable-differences (JNDs) is a useful way of determining the perceptual effect of changes in a display system. Viewed from a distance of 18 in., there is a 3-JND degradation in image sharpness between (a) and (b). Three-JND differences are perceived by viewers 99% of the time. At 18 in., the degradation between (a) and (c) is 10 JNDs—a significant change.

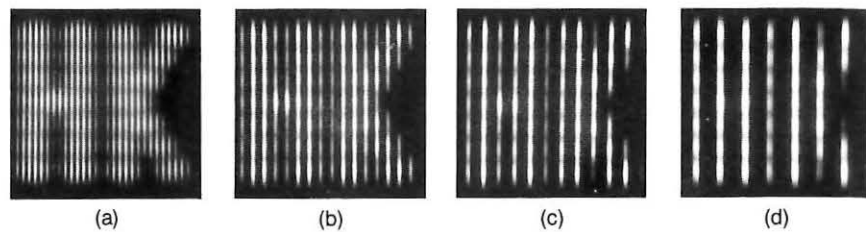


Fig. 4: The model described in this article can predict the number of samples needed to produce good renderings of alphanumeric characters. Here, a simulated HK without sampling (a) is sampled at twice the Nyquist frequency (b), at 1.5 times the Nyquist frequency (c), and at the Nyquist frequency itself (d). Viewed from a distance of 15 ft., these images correspond to the calculated predictions of Fig. 6 and compare well with them.

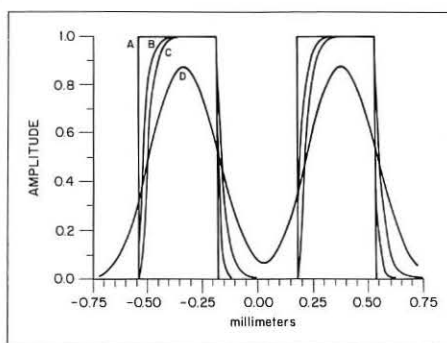


Fig. 5: The on-off-on input test image for alphanumerics (A) suffers the effects of receiver filtering (B), tube nonlinearity or gamma (C), and smoothing by a Gaussian electron spot (D).

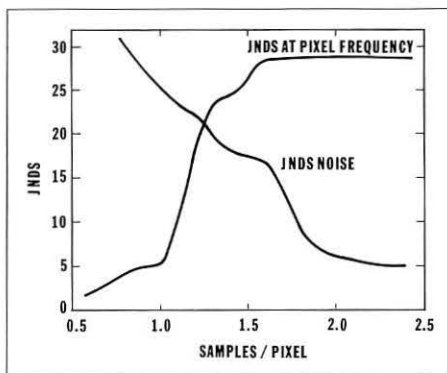


Fig. 6: The predicted number of JNDs at pixel frequency and number of JNDs of pixel noise are plotted against the number of samples, normalized to the Nyquist sampling rate. In this example the Nyquist rate is one sample per pixel. The results compare well with the simulated results of Fig. 4.

Thanks to Schade, researchers now know that the overall spatial-frequency response of a display determines its perceived image sharpness. A measure of that frequency response is given by the MTF: the ratio of the displayed contrast of sine-wave gratings to their input contrast. But when do changes in display MTF result in perceivable changes in displayed image sharpness? This question is answered by just-noticeable-difference (JND) analysis.

One JND is the amount of change a viewer will perceive 75% of the time. It's a small unit. But a 3-JND change can be seen 99% of the time, and 10-JND changes represent significant perceptual effects [Fig. 3].

Whether a change in MTF will be seen depends on what is displayed. In pictorial scenes, for example, observers are very sensitive to small changes in MTF when they look at edges. Once a scene has been selected, a model we've developed at the David Sarnoff Research Center can be used to predict visible changes in MTF. The operation of the model is straightforward—it simply converts the MTF changes within each visual filter to the appropriate number of perceived JNDs. (In addition to image sharpness, the model handles such display parameters as brightness and signal-to-noise ratio.) The model's predictions correspond nicely to experimental results.³

We've simplified the application of the model with a graphical representation called a JND diagram. [See accompanying article, "The JND diagram—a powerful tool for display design."]

Seeing letters and numbers

The model can also predict the number of image samples required to reproduce

alphanumeric information—a determination required for all sampled imaging systems. These systems include CCDs, LCDs, and conventional tube displays (in which the sampling arises from the red, green, and blue phosphor stripes).

The problem we wish to solve arises when we sample the letter combination HK, for instance, at rates ranging from 1–2 times the Nyquist frequency [Fig. 4]. The visibility of the letters is a very strong function of the sampling rate.

In order to apply the model we must again select a test image for $m(v)$. Here, we select an on-off-on profile as a one-dimensional test image characterizing the information needed to replicate the letters [Fig. 5]. This image also shows how other aspects of the display system—such as receiver filtering, tube nonlinearities or gamma, and tube electron spot profiles—can be incorporated into the model. Sampling the image of Fig. 5 produces images similar to those of Fig. 4b, c, and d.

We can characterize the result of sampling by the number of JNDs of signal that can be seen, along with the JNDs of “noise” introduced by the visibility of the sampling structure. Plotting the calculations of these quantities against the number of samples produces an interesting result [Fig. 6]. The number of samples has been normalized to the Nyquist sampling rate, which, in this example, is one sample per pixel.⁴ (That is, the on-off-on pattern of Fig. 5 requires three samples.) The Nyquist rate is the sampling rate at which all the information in the displayed image can theoretically be recovered. However, Fig. 4 makes it clear that the Nyquist rate is not sufficient for the visual system to see all the displayed information, a result that can be traced back to the filter bandwidths in the human visual system.

In summary, the JND model predicts:

Sampling Frequency (multiples of Nyquist frequency)	JNDs of Information	JNDs of Sampling Noise
1.0	5	26
1.5	25	18
2.0	27	6

The JND analysis indicates very poor performance at the Nyquist frequency. The visibility of the signal is low and the visible sampling noise is high [Fig. 4d]. However, nearly the full information visibility has been achieved at 1.5 times

the Nyquist frequency, although significant levels of sampling noise still remain. Finally, at 2.0 times Nyquist, in this instance, we can achieve both high levels of information visibility and low levels of sampling noise.

From knowledge, power

We now have sufficient understanding of the human visual system to quantitatively model a number of important display characteristics. Models have been developed and applied to a variety of imaging problems, such as predicting the required signal-to-noise ratio of different displays and establishing the convergence requirements for color television. They have also been used to quickly and economically design advanced display systems, such as the recent David Sarnoff Research Center proposal for advanced compatible television (ACTV), an extended-definition system with increased aspect ratio that is backward compatible with the current NTSC system.

THE OEM STANDARD FOR MONITOR ENGINEERING.



ASTRO VG-809S Video Generator

If you are qualifying, testing, evaluating or designing monitors, shouldn't you use the standard? We call our video generators “standard” because companies such as Hitachi, Mitsubishi, Panasonic, NEC, Sony, Monitronix and Toshiba have selected the ASTRO Generators for R&D, engineering,

manufacturing, and quality control. So, if you're

serious about engineering of high resolution displays, give us a call today.

1-800-338-1981

(408) 720-8877 (in Calif.)

TEAM
systems

Circle no. 50

Test & Measurement Systems, Inc.

Notes

¹O. H. Schade, Sr., “Optical and Photoelectric Analog of the Eye,” *Journal of the Optical Society of America*, Vol. 46 (1956), p. 721.

²F. W. Campbell and J. G. Robson, “Application of Fourier Analysis to the Visibility of Gratings,” *Journal of Physiology* (London), Vol. 197 (1968), p. 551.

³C. R. Carlson and R. W. Cohen, “A Simple Psychophysical Model for Predicting the Visibility of Displayed Information,” *Proceedings of the SID*, Vol. 21, No. 3 (1980), p. 229.

⁴Strictly, the Nyquist criterion applies only to bandlimited signals. The images described only approximately satisfy this criterion. For details, see “Application of Psychophysics to Display Evaluation” by C. R. Carlson, *Proceedings of the 1982 International Display Research Conference* (October, 1982). ■

Technical marketing case study

using displays for market differentiation

BY LEE WATKINS

THE CRITERIA that customers use when choosing personal computers are generally straightforward, unambiguous, and predictable. Few users, for example, would willingly buy a system that housed the slower of two microprocessors, the smaller of two disc drives, or the more awkward of two keyboards. Users tend to want the same things from most important computer components and, all else being equal, they will do their best to get them.

Of course, all else is rarely equal. Price is usually a factor in computer purchases, and a customer's desire for speed, capacity, and ergonomics is invariably tempered by budgetary realities. But with the price constraint removed, most customers have similar "wish lists." And that is a happy circumstance for computer manufacturers, who can design products with a reasonable degree of certainty about their reception in the marketplace.

The myth of the "ideal" display

But there is one important feature of computers, especially laptop computers, on which customer agreement vanishes—the screen display. Certainly, all laptop users want easy readability from their screens, but both backlit LCDs and plasma displays—the two major screen technologies in regular commercial use today—achieve this goal handily.

There are a number of other attributes of screen displays—none of them related

to price—that make one or the other of these technologies better suited to a particular group of users. Knowledgeable laptop customers choose their screens based on the specific applications they have for their systems. (The lingering perception that plasma screens are inherently and always superior to LCD screens rarely persists when customers have a chance to see one of the current generation of good LCDs.)

We at GRiD have moved both to serve this fragmented market and to benefit from it by offering laptop computers with more different display technologies than any other manufacturer. (In addition to backlit LCD and plasma screens, we also sell electroluminescent (EL) screens—though mostly to government customers.)

What, then, is the most appropriate screen for a given laptop user? Six major display characteristics lead to a (usually) unambiguous answer.

Price

We will not discuss price, except to note that plasma panels are typically 3–4 times more expensive than backlit LCD modules.

Power consumption

Because laptop computers operate from batteries whenever they are "on the road," a display's power requirement is a serious concern. Here, plasma screens are at a considerable disadvantage.

A plasma screen uses 10 W of power; an LCD uses 200 mW, and its backlight uses 2 W. That fivefold difference has a substantial impact: an average LCD system will run 4 hours on a single

charge; change to a plasma screen, and that time period plummets to under 2 hours. We've compensated for this to some extent in GRiD computers by providing rechargeable lightweight batteries that are easily slipped into and removed from a pocket accessible from the computer's exterior. But, compact as they are, the number of batteries a typical user would happily carry around is likely to be limited.

Portability

Plasma displays, by themselves, weigh 2 lbs. while backlit LCDs weigh 1.3 lbs. In a typical 12-lb. portable computer, the display is one of the heaviest components. And because plasma screens need more power, the power supply is usually larger, adding even more weight to the overall system. Users who spend a lot of time carrying their machines, or who actually use their laptops on their laps, are likely to find the weight difference is an important factor.

Optical response

Each pixel that makes up a screen display is "refreshed" by hardware many times a second. The amount of time it takes a newly activated pixel to become visible (or a newly deactivated one to extinguish) is the optical response time. Here, the difference between the leading technologies is dramatic: the optical response time of plasma is about 2 μ sec; for LCD units, the figure is almost 50,000 times slower—about 0.8 sec. It takes many refresh cycles after an LCD pixel is changed before the change becomes visible.

Lee Watkins is director of hardware development at GRiD Systems Corporation, Fremont, California.

For the majority of computer displays, which are relatively static exhibitions of text and numbers, the LCD's slow response is not a problem. But animated displays can suffer considerably: what was intended by a programmer or an artist to be a crisp display of moving lines could turn into an undiscernible blur. Whether this should affect a purchase decision depends, of course, on the types of software the user plans on running.

Brightness and contrast

In these two related parameters, plasma systems are considered superior. In fact, it is the razor-sharp lines of plasma displays that attract most buyers to them in the first place. But, though LCD screens have less brightness and contrast than their plasma counterparts, they have enough to make them easily viewable under most indoor conditions.

But viewability indoors is not sufficient for those laptop customers who need to take their systems outdoors and use them in broad daylight. Here, both plasma and backlit LCD come up short, as both of them are washed out by sunlight. The answer for this application is a regular LCD screen, which uses reflected light and is all the brighter in the sun.

Viewing angle

Imagine a line extending outward perpendicularly from the middle of a screen. When the user's eyes are directly on this line, virtually any computer screen can be seen clearly. But when the eyes move off this line, viewability is reduced. For LCD systems, viewing angles exceeding 30° diminish viewability substantially. This is not the case with plasma, which presents no problem with viewing angle other than the foreshortening that the principles of geometry inflict on any display.

The narrow viewing angle of LCDs is usually not a concern for single users, who can adjust the screen to ensure viewability; but it is a serious liability when more than one person is looking at the system, as often happens when a laptop is used for presentations. In such cases, a viewer who is very far off axis will scarcely be able to tell whether or not the machine is turned on.

What? . . . and for whom?

With an understanding of the different laptop display technologies, we can map their individual characteristics onto the real-world applications for which users buy them.

THE ENGINEERING STANDARD FOR MONITOR TESTING.



ASTRO VG-809S Video Generator

Speed, accuracy, precision, and flexibility are

primary concerns in any engineering project. The combination of these qualities has made ASTRO Video Generators the engineering standard at companies like Hitachi, Mitsubishi, Panasonic, NEC, Sony,

Monitronix and Toshiba. Find out why ASTRO is

the standard, give us a call today.

1-800-338-1981

(408) 720-8877 (in Calif.)

TEAM
systems

Circle no. 51

Test & Measurement Systems, Inc.

When auditors, for instance, rely on laptops, they are usually on site and working with their machines all day—keyboard sessions of 8 hours or more are not uncommon. They are, therefore, highly concerned with issues such as eye fatigue and they are likely to prefer the crisp images of plasma devices. Plasma is also preferred by traveling sales personnel who give computer presentations to groups of prospective customers, all of whom must be able to see what is on the screen. (Another advantage plasma screens have in sales situations is the frequent perception that they are more “professional” than LCD panels, which results in a better impression.)

Field-service workers typically travel with their computers from job site to job site, which causes several concerns. Since these workers are frequently away from power supplies, they need to use their machines for long periods between rechargings. Because they are constantly lugging their systems around with them,

they want them to be as light as possible. Backlit LCD screens are usually the best answer in these cases.

Corporate managers usually work indoors in well-lit areas, and use their machines for relatively brief stretches of time—to compose a memo or examine a spreadsheet, for example. A backlit LCD, which has the added advantage of convenient portability, is often the best match.

Who supplies the display?

GRiD relies on several well-known Japanese suppliers for display screens. At present, NEC is the source for plasma displays, Hitachi for LCDs. (No North American company currently manufactures competitive modules.)

All panels are manufactured to our size specifications but are otherwise off-the-shelf units with unmodified operating specifications, though we do have close relationships with our suppliers and have often suggested features that later appeared in new panels.

LEVER-LOC® CUSTOM DISPLAY CONNECTORS

The Lever-Loc® series connectors are a fast, reliable solution for interconnecting your flat panel display and driver pcb.

A proven performer, Lever-Loc® connectors are used for applications such as automotive instrument clusters, avionics equipment and medical instrumentation.

The unique "ramp" design allows fast, easy installation with a low insertion force. Pressure contacts provide a reliable interface to the display apron and can be provided on .050", .075", .100" or 2mm spacing.

Each Lever-Loc® connector is custom designed by Teledyne Kinetics to meet our customer's requirements.

The display apron acts as a "lever" to provide a mechanical advantage over the pressure contacts. The display is then slid into place, providing a wiping action.



Call today
for a free catalog

Continental USA

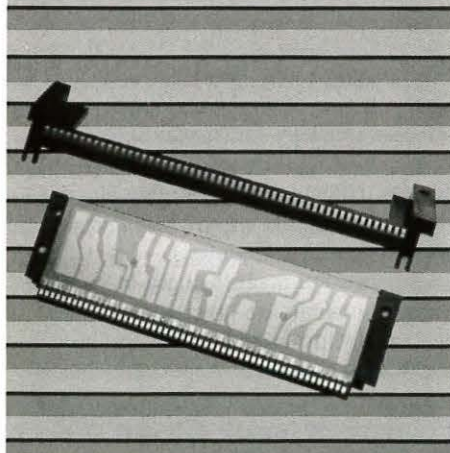
1-800-344-4334

California Only

1-800-992-9988

**TELEDYNE
KINETICS**

410 S. Cedros Avenue
Solana Beach, CA 92075
(619) 755-1181
EasyLink 62877770



Circle no. 52

Using a plasma display

Most of *Information Display's* readers are not strangers to plasma displays. But despite their rapidly increasing use, personal computers with plasma displays are not yet ubiquitous, and it is likely that most readers have not had a chance to use these machines for extended periods. To provide some sense of what it is like to use computers with these displays, GRiD Systems was kind enough to lend *ID* a GRiDCase 3 Plus laptop computer for a "test drive."

The GRiDCase 3 Plus is an IBM PC compatible personal computer with an 80C86 microprocessor and a 640 × 200 bit-mapped gas plasma display that measures 9.5 in. diagonally and presents 80 characters × 25 lines. The unit we received was equipped with an internal 10-Mbyte hard disc, which brought the weight of the unit, in its solid-feeling magnesium case, to 12 lbs.

The display's appearance lives up to plasma's favorable reputation. The display is admirably crisp and, to my eyes, flicker free, though plasma specialists inform me that there can be some flicker on this kind of plasma display. The soft orange color is pleasing and easy on the eyes, even over extended periods of time. The display's glass faceplate becomes warm to the touch, but not unpleasantly so.

The GRiDCase's display, as GRiD drives it, produces well-formed alphanumeric characters, most of whose strokes are more than 1 pixel wide. Although a slide switch at the

lower right corner of the panel allows three levels of brightness through changing the sustain frequency, there is no provision for selectively brightening certain characters. Therefore, the kind of highlighting usually done on CRTs by brightening characters is done on the GRiDCase's screen by displaying the characters with strokes just 1 pixel wide—"lightface" rather than "boldface."

The display washes out readily in the early afternoon sunlight that shines through my office's south-facing windows. The amber CRT sitting next to the plasma display does quite a bit better on its maximum brightness—it is readable with great difficulty instead of being completely unreadable.

The plasma display's power consumption is not helped by the internal hard disc. A fully charged battery lasts about 1 hour during my straightforward word-processing sessions. GRiD has taken measures to deal with the battery's final Ampere-seconds: a red light goes on in the lower right corner of the display's frame. If you see it, and if you're fast, you have time to save what you're working on, exit from your applications program to the operating system, and turn off the machine. You can then replace the battery in a matter of seconds or substitute the ac power supply, which is the same size as the battery and slips into the same easily accessible pocket.

—K.I.W.

Engineers know best, but the customer is always right

Even when skilled application engineers carefully discuss anticipated uses with customers and explain to them the relevant characteristics of each display, more than a few consumers end up buying systems that are "wrong" for them—and many of these customers remain pleased with their purchases. When that occurs, a manufacturer has no choice but to assume that customers do, in fact, know best, and that they should be left to their own (display) devices. ■

In memoriam

Dave Glaser, display scientist for Cherry Display Products Corp., died on March 29. He was 61 years old. Dave held numerous patents and authored several papers in the information-display field while he worked for Burroughs, Zenith, Lucitron, and Cherry. He co-founded Panel Technology, Inc., and worked for many years as a consultant for both display manufacturers and users. His technical contributions and his unique personality will be sadly missed by friends and colleagues.

Multilayer Interference Program

by Sound Decisions, 6646 Clearhaven Circle, Dallas, TX 75252. \$135 plus \$4 shipping.

Reviewed by WARREN J. SMITH

The Multilayer Interference Program (MIP) is a computer program that calculates the reflection and transmission of thin-film coatings. It will handle absorbing or nonabsorbing coatings and will calculate their characteristics at normal or oblique incidence. In addition to reflection and transmission values, the program will calculate the ellipsometric principal azimuth angle and phase angle.

This is a basic program that simply calculates the characteristics of a given film structure. It does not have optimization ("automatic design") capability, so that, unless the user is reasonably expert in thin-film design, it will not be very useful as a design tool.

MIP does, however, have a number of convenient features. One may choose almost any numerical aspect of the calculation as a variable and have the program print or plot a performance characteristic (e.g., transmission or reflection) as a function of that variable. Thus, plots of transmission vs. angle of incidence, or wavelength, or the thickness of a given layer, for example, are easy and convenient to obtain.

The program does this sort of thing "one at a time" so that one can get reflection or transmission, but not both, in one pass. To get both, one repeats the output sequence.

With a certain amount of design savvy, one could design a thin-film system by manually optimizing the value of one variable, accepting only a fraction of the optimum change, and then going on to

the next variable, and so on, until all the variables had been adjusted. Several iterations of this procedure could result in a design comparable to that produced by an automatic optimization program, although the amount of labor involved would be more than a little overwhelming.

Manipulation of the program by a menu screen is reasonably convenient once one gets used to it. However, as with most "user friendly" interfaces, one sometimes wonders if the alleged friendship is worth the trouble.

I compared the results of several calculations on MIP with Genesee Computer Center's THIN FILMS program (one of the larger comprehensive programs, which includes automatic optimization and many "deluxe" features). Given the same input data, the two programs produced the same results. On my 8087-equipped IBM PC they did it in what seemed at first blush to be almost the same time. For example, MIP took about 17 sec to output the reflection of a 7-layer stack for wavelengths from 0.4–0.7 μm in 0.01- μm steps. The GCC THIN FILMS program took 13 sec. *But*, it also printed out transmission, YR, and YI and made a printer plot of the reflection at the same time.

The MIP program will not accept dispersive index data, so that if there is a significant change of index in the spectral bandpass of interest, the user must change it manually and rerun the data through the program for each segment of the bandpass.

MIP, at a price of \$134 plus \$4 shipping, is the lowest-priced thin-film program that I know of. Its capabilities are limited to the basic calculations, without any frills. It is accurate and reasonably fast. Thus, if one has a need for an occasional interference-film calculation, MIP should fill that need and it is certainly well worth the price.

MIP requires an IBM PC, PC-XT, PC-AT, or compatible computer with MS-DOS or PC-DOS version 2.0 or later; 160K RAM; disc drive (hard or double-sided floppy); and an 80-character display. An IBM, Compaq, or Hercules graphic option will allow one to see the graphics produced on the monitor. An 8087 coprocessor is optional. ■

Warren J. Smith is chief scientist at Kaiser Electro-Optics, Inc., Carlsbad, California. He has worked in lens design, optical engineering, and optical manufacturing for many years. His book Modern Optical Engineering is widely used as a text and is considered by many to be the current definitive work on the development of optical systems.

Approaching ZERO DEFECTS



PEG CRT BULBS

- Continuous Process Control
- More Uniform Wall Thickness
- 1/2" to 7" Diameter Range
- Low Tooling Cost
- Prototype Design Work
- Better than Machine Made Round CRT Bulbs

**The Leader in Hand-Crafted
CRT Bulb Blanks**

For details call 609/691-2234.

PEG

**PRECISION ELECTRONIC
GLASS, INC.**

1013 Hendee Road
Vineland, NJ 08360
FAX: 609/691-3090

products on display

AD-VANCE MAGNETICS, INC.
Rochester, IN 219/223-3158
Booths 128, 130

Protection for flexible discs

Infogard is a magnetically shielded enclosure that protects flexible computer discs from distortion, erasure, or degradation of valuable recorded data. Damage to recorded data could occur from a variety of causes: local severe thunderstorms, power generating equipment, electromagnetic pulse, airline transport, and ambient magnetic pollution. Infogard provides inexpensive protection against these hazards while discs are being stored or transported. Laboratory tests indicate a shielding effectiveness in excess of 35 dB through an applied frequency range of 1-25 Os. Available for 5 1/4- or 8-in. flexible discs.

Circle no. 1

ASAHI GLASS CO., LTD.
Tokyo, Japan 03-218-5426
Booths 415, 417

Full-color 9-in. LCD

Optrex Corp., a joint venture by Asahi Glass and Mitsubishi Electric, reports that it has produced the largest full-color LCD ever made with simple matrix technology. The display has a viewing area of 180 x 140 mm, equal to a 9-in. TV screen. The number of pixels is 320 (RGB) x 240 and the size is 0.57 mm square. With a backlight, it produces very high contrast of 22:1 (maximum).

Circle no. 2

BREWER SCIENCE, INC.
Rolla, MO 314/364-0300
Booth 404

Polyimide color filter materials

Brewer Science, Inc., introduces PIC®, polyimide color filter materials developed for the production of high-quality multicolor displays, color camera chips, and color copiers. PIC offers outstanding colors, which are uniform and reproducible. These filters can be patterned on one level using standard positive photoresist equipment and processes. The simple photolithographic process gives high yields even with very large substrates. Excellent light and heat stability make PIC perfect for harsh environments. A special technology transfer program allows your lab to produce three-color devices successfully in three days or less.

Circle no. 3

CELCO (Constantine Engineering Labs. Co.)
Upland, CA 714/985-9868
Booths 427, 429

Crosshatch/dot generator

The model CHD359B crosshatch/dot generator from CELCO provides crosshatch and dot patterns for CRT system evaluation. A unique vector design provides extremely accurate and stable crosshatch and dot patterns suitable for testing even the highest-resolution CRTs. The CHD359B provides 9-81 dots or crosshatch scan lines in three discrete ranges. Its 12-bit accuracy makes it ideal for evaluating important CRT parameters such as resolution, linearity, and pincushion distortion.

Circle no. 4

CITRONIX, INC.
Orangevale, CA 916/961-1398
Booth 325

Raster/calligraphic deflection amp

The CD-100-6RS combines the best of two CRT beam-deflection techniques—energy-free resonance retrace and linear feedback control for line trace or calligraphic-mode presentation—all in one frame. This deflection amplifier can retrace a beam in less than 2 μ sec with a 30- μ H yoke at 30 APP. After retrace you can continue in the raster mode with precision geometrically corrected raster lines or switch to the calligraphic mode and stroke write high-resolution images with a closed loop bandwidth of up to 2 MHz.

Circle no. 5

CONNECTOR CORP.
Chicago, IL 312/539-3108
Booth 216

CRT sockets

Connector Corp. will exhibit its expanding line of sockets for CRTs. Socket families are available for most JEDEC-base configurations and those not so designated. Most sockets feature the new rugged tube-neck retaining clamp that secures the socket to the tube base to withstand shock and vibration during instrument operation and shipping. Most sockets also feature protective spark gaps, wrap-around contacts with tapered entries, and optional integral circuit components. They are available with flying wire leads, printed-circuit pins, or solder tail terminals.

Circle no. 6

CORNING GLASS WORKS
Corning, NY 607/974-4308
Booths 116, 118

High-temperature alkali-free glass

Corning Japan KK now supplies a new non-alkali boroaluminosilicate-glass substrate: Corning Code 1733. This new glass substrate has a high strain point, 640°C, and a coefficient of thermal expansion of $36 \times 10^{-7}/^{\circ}\text{C}$, which is close to that of silicon. This new substrate was developed in response to requests by display manufacturers for a commercial glass meeting the high-temperature requirements of advanced electroluminescent and polysilicon displays. The glass is manufactured in the United States and finished in Japan. Current production capacity is 300,000 m²/year. Corning 1733 is available in thicknesses of 0.5, 0.7, 0.9, and 1.1 mm. Maximum product size is 900 x 800 mm.

Circle no. 7

CR TECHNOLOGY, INC.
Laguna Hills, CA 714/859-4011
Booth 307

Automated CRT test system

The new CRT-480 test system uses machine vision to automate the CRT production line or incoming test station. CRT inspection, adjustment, and calibration tasks are conducted in a programmed sequence of test steps. All measurements, calculations, and controls are performed by the CR Technology PC-AT 80386-based Vision Test Controller, with interactive prompts for operator response. The test sequence includes tests for brightness, rotation/tilt, vertical/horizontal size, centering, and linearity. For color monitors, purity, focus, and convergence tests are optional.

Circle no. 8

CRAFT DATA, INC.
Mission Viejo, CA 714/582-8284
Booth 531

Gas plasma panel assemblies

Craft Data, Inc., now offers Dixy Corp. gas plasma panels with or without IR touch panel and RS232C, EGA, or composite video interface as an assembled, tested module complete with filter, bezel, cables, and software to get started. Finished dimensions using a 12-in. display and touch panel are 13 in. (L) x 8 1/2 in. (H) x 3 in. (W). The power supply is left unmounted.

Circle no. 9

MAKE FAST, COMPREHENSIVE, AUTOMATIC CRT MEASUREMENTS
WITH THE SUPERSPOT 100 FROM MICROVISION

CRT MEASUREMENT SYSTEM FROM MICROVISION

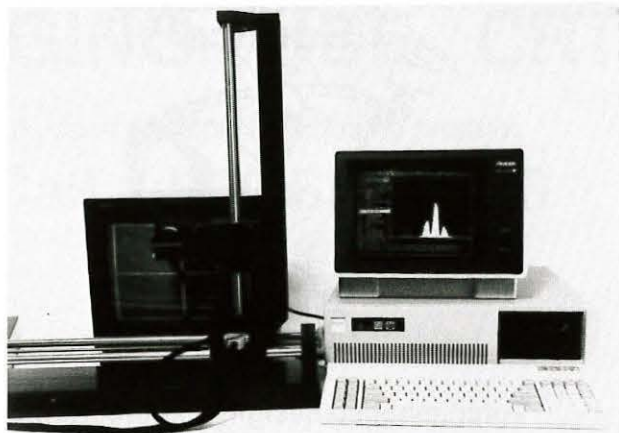
The **SUPERSPOT 100** System coupled with the **SPOTSEEKER II** Positioning System (with Automatic Focus) allows fully automatic characterization of Color and Monochrome CRT Displays without operator intervention.

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
- Real Time Display of Beam Intensity Profile (20 Frames/Second Display) • Disk Data Logging • MTF

Provides:

- Pattern Generation for Tests • Adjustable Cursors for Feature Analysis



MICROVISION • 591 West Hamilton Avenue, Suite 250, Campbell, CA 95008 • Tel: 408/374-3158 • FAX: 408/374-9394

Circle no. 55

Draw from a full line

Corning now offers more than 120 types of small special-purpose CRT bulbs, ranging in size from .5" to 17", in round, rectangular, and fiber optic designs.

Non-browning bulbs are also available for optimum performance displays in high-voltage applications.

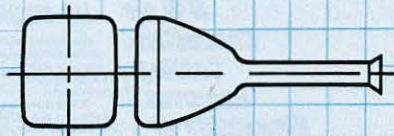
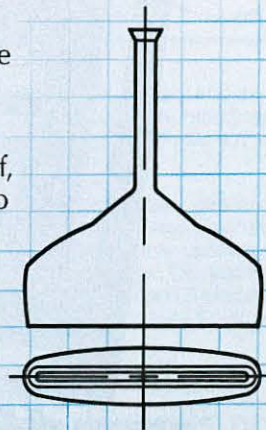
And the superior light transmission of Corning bulbs offers the brightness required for military applications, such as cockpit displays.

We can also deliver small bulbs with precision tolerances for high-resolution applications. Neck

diameters are consistently held to within 0.005", and alignment of centerface to neck varies no more than 0.040".

Call on Corning for all your bulb needs. You can order off-the-shelf, or we can custom design bulbs to your specs.

To get free technical information about Corning's CRT bulbs, circle the reader service number.



CORNING



Materials Business
Corning Glass Works
MP 21-3-4
Corning, NY 14831
(607) 974-4305

Circle no. 56

Information Display 5/88 29



Total in-house design, manufacturing,
and testing capabilities
Magnetic shielding and shielding grade alloys
of all types...

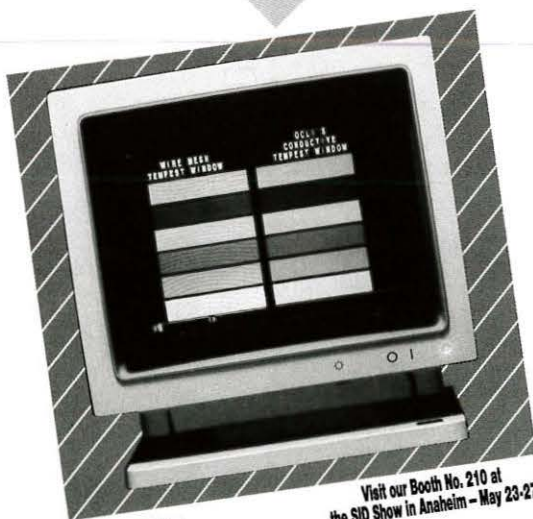
Send for our latest product literature

**Magnetic RADIATION
LABORATORIES, INC.**

92-A North Lively Boulevard • Elk Grove Village, Illinois 60007
Phone: 1-312-437-5200 • TWX 510-601-1013

Circle no. 57

TECHNOLOGICAL BREAKTHROUGH



Visit our Booth No. 210 at
the SID Show in Anaheim - May 23-27

New
Conductive
Coating
Improves
Viewability of
TEMPEST
Windows

NO MESH. NO MOIRE.

Now, achieve the level
of EMI/RFI suppression
you want without
sacrificing visual
performance.
OCLI's proprietary
coating has been tested
and proven to attenuate
unwanted radiation. Our
TEMPEST windows also
significantly reduce
glare, enhance contrast,
allow optical transmission
up to 80% and eliminate
moiré patterns.

All at a cost that
makes sense.
Make OCLI coatings
a part of your TEMPEST
shielding design solution.
Call today for complete
technical data and
independent test reports.

OCLI

Display Products
2789 Northpoint Parkway
Santa Rosa, CA 95407-7397
Tel. 707/525-7037
FAX 707/525-7841

SID 05/88

Circle no. 58

products on display

DAVID SARNOFF RESEARCH CENTER
Princeton, NJ 609/734-3017
Booth 426

CRT design, analysis, simulation

The David Sarnoff Research Center provides client-confidential contract services in the design, analysis, and simulation of non-consumer CRT systems, electron guns, and deflection yokes. Using its state-of-the-art 3D electron-optics software, The Sarnoff Center can optimize bipotential or multilens gun designs or saddle, toroidal, or stator-wound yokes with or without permeable pieces. Computer programs determine the part dimension and alignment tolerances necessary to maintain performance. Services include prototype construction and the measurement of yoke fields, spot contours, and convergence.

Circle no. 10

DIGITAL ELECTRONICS CORP.
Hayward, CA 415/471-4700
Booths 229, 231

Industrial touch-screen terminal

The new SealTouch Terminal from DeeCO is an extremely thin compact VT-220 compatible NEMA 4 & 12 rated touch-screen terminal that withstands harsh industrial environments. The electroluminescent 9-in.-diagonal flat-panel display with IR touch interaction is completely sealed in cast aluminum. There are no fans or filters, so contaminants don't get in or out. The small—10 1/2 in. (W) × 11 1/2 in. (H) × 3 in. (D)—lightweight unit can be mounted conveniently on walls, benches, desks, or equipment. VT-220, VT-100, and VT-52 emulations are standard.

Circle no. 11

DIXY CORP.
Yokokama, Japan 045-962-1717
Booths 524, 526

Plasma panel with gray scale

Dixy Corp. has developed a 640 × 480 pixel flat-panel plasma display capable of 16 levels of gray scale. Pixel pitch is 0.39 × 0.39 mm. Viewing angle is 115° up/down and viewing area is 256 × 195 mm. Input signal required is 4-bit parallel TTL. This display uses a unique capacitive coupled trigger, developed by Dixy, which allows the nondisplay areas to remain black for maximum contrast ratio.

Circle no. 12

DONTECH, INC.
Doylestown, PA 215/348-5010
Booth 205

EMI/TEMPEST windows

Dontech, Inc., manufactures EMI/TEMPEST windows and optical filters for CRTs, LEDs, EL, plasma, and touch-panel displays. Dontech also makes shielded structural windows to 5 x 12 ft., fleximeric shielding, narrow bandpass filters (P43, night-vision-compatible, etc.), and antireflection contrast-enhancement panels.

Circle no. 13

EG&G GAMMA SCIENTIFIC
San Diego, CA 619/279-8034
Booths 300, 401

Convergence measurements

EG&G Gamma Scientific's C-11CNV system was developed to quickly and accurately measure the spatial convergence of up to three different spectral components of stroke and raster color displays. For the first time, accurate and repeatable convergence measurements can be made without external connections to the monitor deflection amplifier circuits. The computer-controlled system is ideal for use in the manufacturing of color CRT displays, particularly those used in CAD/CAM and graphic art applications.

Circle no. 14

ELFORM, INC.
Reno, NV 702/356-1734
Booth 125

Anisotropic conductive tape

Anisotropic conductive tape, as a film or as part of a heat seal connector, makes it easy to attach flexible circuitry to rigid substrates without solder. Heat and pressure is all that's required. Gold particles up to 30 μ m in size are distributed in a 10- μ m layer of hot-melt thermoset resin with 30-40 particles/mm². As long as spaces are 0.002 in. or greater, this material will not create electrical shorts. The conductivity is then in the Z-axis only. Allow for about 5 Ω of contact resistance and 0.05 Ω/\square trace resistance. Elform also manufactures a vacuum-deposited anisotropic type of heat seal connector having a pitch of 0.20 mm.

Circle no. 15

LASER PMT X-RAY IMAGING TUBE CRT?

If you're developing a quality product,
Call 1-800 634-0740
to get the right high-voltage power supply.

We'll recommend the best, most cost-effective package with all the features you need. You can count on it.

IHVE has been manufacturing quality high-voltage power supply systems for display and medical applications in Danbury, Connecticut since 1977.

We are also exclusive North

American distributors for Bonar Wallis Hivolt, who have been manufacturing quality high-voltage devices in the UK since 1972. Some of the Bonar Wallis Hivolt packages are designed and approved for military and airborne environments.

Give us a call, and we'll do our best to make your system development succeed.

International High Voltage Electronics, Inc.

An affiliate of LORAD Medical Systems, Inc.

In Connecticut, 1-792-7820
FAX 1-203 743-3370

Circle no. 59

Finance Drive
Danbury, CT 06810

Hughes

Member of the Technical Staff

Hughes Research Laboratories, located in Malibu, CA, is seeking a versatile individual to join our team of top-notch research scientists in the development of advanced technology.

Our Image Transducers & Display Section is developing a new technology for adaptive optics and IR simulations. We are seeking an experienced scientist to ultimately assume project and technical leadership of the active matrix array development.

The successful candidate will have a demonstrated research background in electro-optics and IC design. Knowledge of active matrix liquid crystal displays and exposure to thin-film transistor design, materials, fabrication and analysis would be a plus. Excellent written and oral communications skills are required in order to deal effectively with all levels of management (both internal and external). A PhD in Physics or Electrical Engineering is desired.

We offer an attractive salary and an outstanding benefits package, including tax-deferred savings; medical, dental and vision care coverage.

For immediate consideration, please send your resume to: Lynn W. Ross, Hughes Aircraft Company, Research Laboratories, Dept. DI-588, 3011 Malibu Canyon Road, Malibu, CA 90265. Proof of U.S. citizenship required. Equal Opportunity Employer.

**Creativity
America depends on.**



RESEARCH LABORATORIES

Circle no. 60

Arconium is Indium

Arconium provides indium in all metal and oxide forms for applications including passive and active information displays, glass coatings and conductive films.

We are a producer of indium to 99.9999+% purity.

Indium for Glass Coatings

Arconium can provide you with the perfect indium metal or indium oxide sputtering targets for thin film, hard conductive coatings. Unlike many other conductive coatings, this hard coating allows flexibility for thin film glass coatings designed for deicing, defrosting and in solar applications to capture infrared light.

INDIUM BACKLIGHTING
FOR LCD'S

We can provide a wide variety of indium oxides and doped indium oxides to customer specifications for thick film applications such as backlighting for LCD's and in

electroluminescent panels. The powder form is available in various particle sizes for higher conductivity and maximum light output.



Indium Oxide Coatings help keep jet windows clear even under extreme temperature conditions.

Indium Forms:

Indium Oxide (In_2O_3)
Indium Tin Oxide (weight % or mole %). Powder, chunk and targets.

Indium Metal and Alloy
Ingot, targets, shot, pellets, preforms, foils, wire and powder.

Arconium Specialty Alloys,
400 Harris Avenue, Providence, RI
02909 USA, 401-456-0800,
telex 262987, fax 401-421-2419.

ARCONIUM
SPECIALTY ALLOYS

TOLL FREE 800-343-0282

Circle no. 61

FINLUX, INC.
Cupertino, CA 408/725-1972
Booth 214

High-resolution EL matrix display

The Finlux MD640.350 is a new high-resolution electroluminescent (EL) matrix display designed for high-end personal computers, instruments, factory terminals, and process controllers that will benefit from added resolution. The display is EGA-compatible and supports both high-quality text—from 25 lines of 80 characters—

and detailed high-resolution graphics. Crisp stable flicker-free images in a pleasing yellow color are Produced by means of a-sub-wavelength thin light-emitting EL phosphor layer. The display has a resolution of 13.8 mils (V) and 11 mils (H). Power consumption is typically less than 16 W. The EL panel and an electronic board containing the drive and controlling electronics are assembled into a package less than 0.5 in. thick.

Circle no. 17

products on display

GTE PRODUCTS CORP.

Greenland, NH 603/436-8900
Booth 518

Lightweight compact EL display

The Sylvania GTE DM512256-01 is a flat lightweight ac thin-film electroluminescent (EL) display module. Engineered to weigh 16 oz. and be only 0.530 in. thick, this display module can be the solution to many space-limited design problems. Its pleasing light-emitting yellow-orange color, flicker-free performance, 512 x 256 resolution, and individually addressed pixels all contribute to a less-tiring more-efficient work environment. In addition, the greater than 140° viewing angle allows more than one person to use the display at the same time.

Circle no. 18

HOYA ELECTRONICS CORP.

Woodcliff Lake, NJ 201/307-0003
Booth 330

Materials for flat-panel production

Hoya Electronics employs special substrate preparation, film-deposition techniques, and patterning methods to provide not only superior quality materials for flat panels but also products required to fabricate the panels. Products and materials to be exhibited include: large blanks, large masks, quartz wafers with thin-film ITO-on-glass plates, patterned ITO display panels, antireflection coatings on glass, a wide variety of electroconductive metal films on glass for electrocircuit application (Al, AlCu, Ti, Ta, W, MoSi, Cr), patterned electroconductive metal films, and display color filter information.

Circle no. 19

HOYA OPTICS, INC.

Fremont, CA 415/490-1880
Booth 328

Q-switch laser for LCD repair

Hoya Optics now offers a 10-mJ Q-switched laser for LCD micromachining. The compact laser head is easily interfaced directly to microscopes. The 1064-nm wavelength output is ideally suited for LCD and mask repair, resistor trimming, thin-film thermal-head trimming, and IC wafer-pattern cutting, including real-time circuit repair and diagnosis. LCD repair can double LCD screen yields leading to significant increases in profits of high-volume LCD devices.

Circle no. 20



Our smallest performer gives a brilliant display.

Among special purpose cathode ray tubes, the Hughes Model H-1401 one-half inch tube for helmet-mounted displays outclasses and outsells any similar tube in the industry. Its high brightness and fine resolution characterize our entire line. Hughes is the leader in the design and production of special purpose CRTs—a leadership position maintained by on-going research and development that sets industry standards for innovation and refinement in CRT technology.

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.



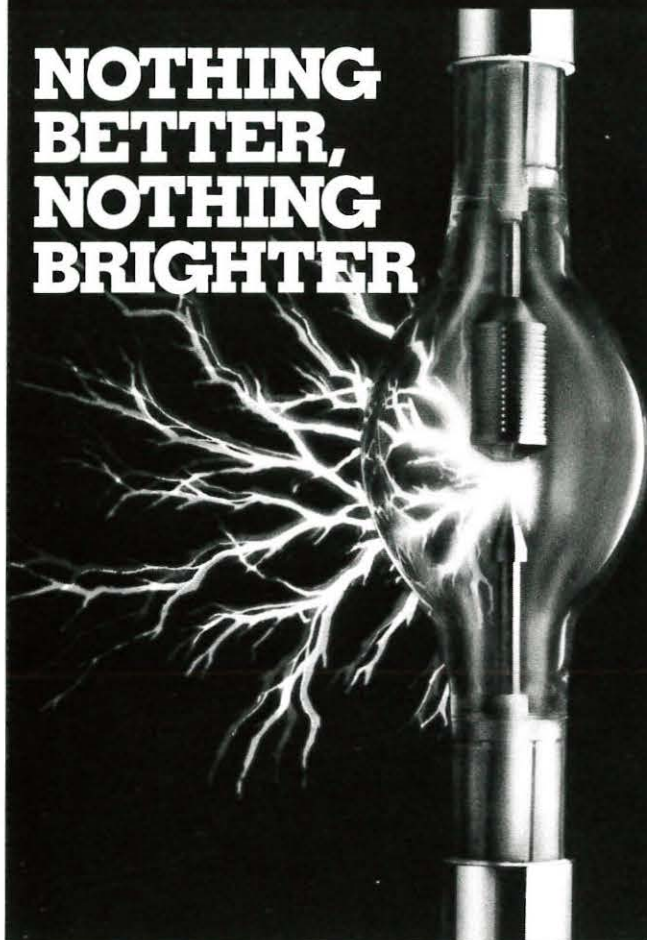
Model 1401, actual size.

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

**NOTHING
BETTER,
NOTHING
BRIGHTER**



ORC's Short Arc Lamps



ORC short arc xenon and mercury-xenon lamps are the best and brightest for point source illumination, extended life and high intensity. In addition ORC's lamp modules, which combine short arc lamps and electroformed reflectors, provide numerous other advantages to system manufacturers and end users. Call or write today for further information.

OPTICAL RADIATION CORPORATION

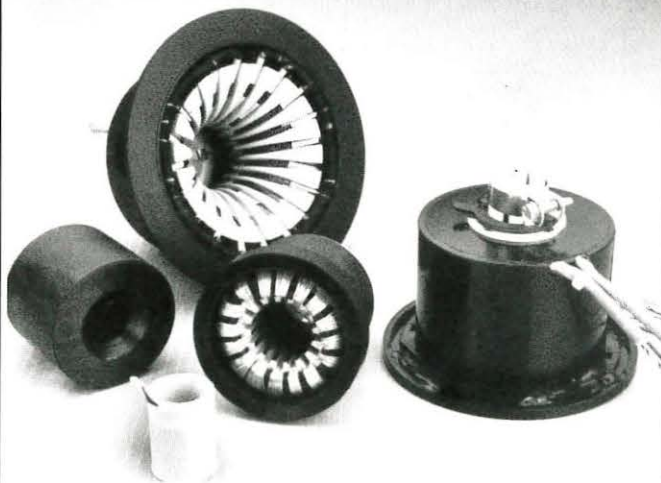
Lamp Division

1300 Optical Drive, Azusa, CA 91702
818 969 3344 • TWX 910 584 4851 • FACS 818 969 3681

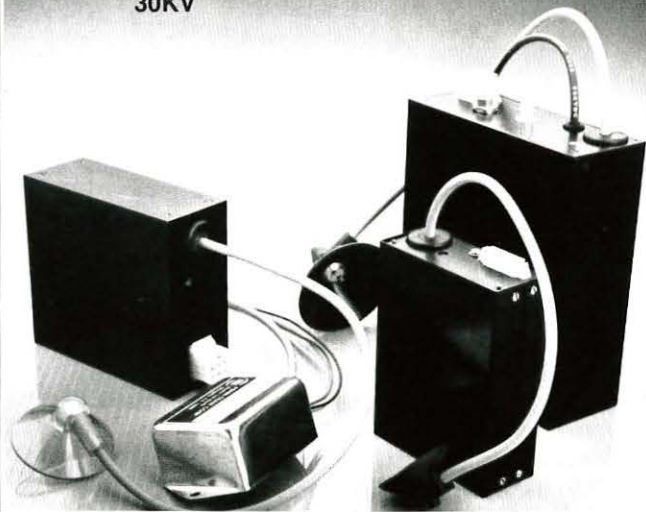
Circle no. 63

PENN-TRAN

Stator Yokes



High Voltage Power Supplies to
30KV



See us at SID '88—Booth 226

Penn-Tran Corporation, Route 144 North, P.O. Box 1321, Wingate, PA 16880
814-355-1521 Telex 706473 FAX 814-355-1524

Circle no. 64

products on display

HUGHES AIRCRAFT CO.

Carlsbad, CA 619/931-3000

Booths 408, 410, 509

High-brightness CRT

Significant improvements in brightness and resolution for 1-in. CRTs have been achieved by Hughes Aircraft Company's Industrial Products Division. Through the combined efforts of Hughes and the Armstrong Aerospace Research Laboratory at Wright-Patterson AFB, a new 1-in. tube type for helmet-mounted display has been developed. This new tube, designated the H1426, has twice the light output and one-half the line width of previous models: up to 5000 fL (peak) and 0.8 mils (scanned at 50%).

Circle no. 21

INTERNATIONAL PLANNING INFORMATION/STANFORD RESOURCES

Redwood City, CA 415/364-9040

Booth 510

Enhanced-LCD market study

Stanford Resources, in a new report, forecasts that the worldwide market for enhanced-LCD flat-panel displays will grow from \$450 million in 1988 to nearly \$2 billion in 1994. This sales growth will be driven by the use of these displays in new product applications. Two of the key uses for flat-panel displays will be pocket color television receivers and portable microcomputers. Other important 1994 market segments include application-specific computer terminals, automotive instruments, electronic typewriters, word processors, and industrial and medical equipment.

Circle no. 22

KELTRON CORP.

Waltham, MA 617/894-8700

Booth 430

Beam-penetration color power supply

Beam-penetration technology offers the CRT designer the ultimate in resolution for large bright high-contrast color displays, made possible by the elimination of the shadow mask. Four colors—red, orange, yellow, and green—selected by anode voltage, can be drawn with the resolution of a monochrome CRT. The Model HC17 power supply can switch through all four colors up to 120 times/sec for flicker-free display.

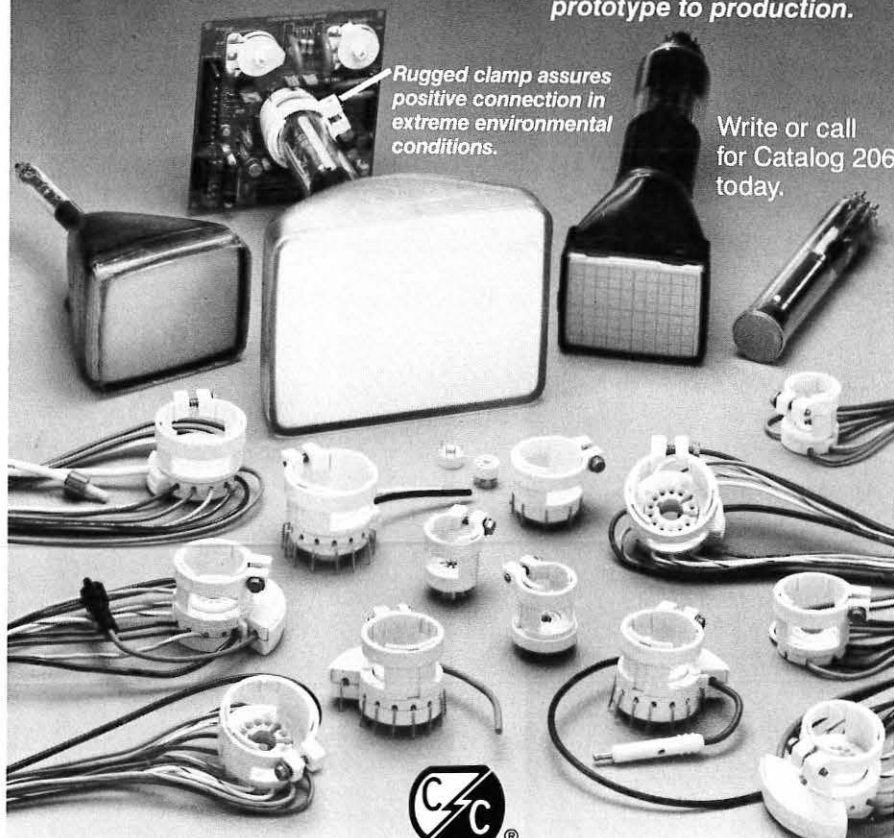
Circle no. 23

Avoid Shocking Disconnects!

Protect your CRTs from unexpected disconnects. Specify our **CRT SOCKETS** with exclusive Tube Neck Retaining Clamps.

Quality features make Quality CRT Sockets . . .

- **Non-conductive, 94V-0 Tube Neck Retaining Clamps.**
- **Rugged and resilient assembly.**
- **Protective Spark Gaps.**
- **In-line Components available.**
- **Tapered lead-ins for easy insertion.**
- **Wrap-around Contacts for low resistance.**
- **Quality sockets your way, prototype to production.**



Write or call for Catalog 206 today.



CONNECTOR CORPORATION

6025 N. Keystone Ave. • Chicago, IL 60646-5290 • 312/539-3108

TWX 910-221-6059 • FAX 312/539-3825

See us at SID '88—Booth 216

Circle no. 65

MICROVISION

Campbell, CA 408/374-3158

Booths 327, 329

Test system for CRT production

Microvision announces their latest product for high-volume production testing of both monochrome and color CRT systems. The PRD-1 will completely characterize a CRT in 10 sec, making simultaneous measurements at

up to 16 different locations on the CRT face. The PRD-1 makes high-resolution measurements of pincushion error, raster size and position, line width (focus), intensity, MTFr, and jitter. The PRD-2 makes similar measurements plus convergence. User-friendly displays assist in real-time adjustments of out-of-spec parameters.

Circle no. 24

The CRT is the User's First Impression of Your System.



Make it a Good One with Clinton CRTs

Let's face it, all the dramatic data processing innovations in a new product are worthless to your customer if the CRT screen doesn't perform.

That is why leading manufacturers have trusted Clinton CRTs for years. They know Clinton CRTs deliver reliability and performance every time.

Plus, Clinton's range of monochrome CRTs and phosphor types allow you to choose the most ergonomic end-user interface.

Clinton Responds to Market Demands.

Clinton is prepared to meet the ever changing demands of the computer and workstation industry. That means you'll get the high quality CRTs you need, and in the latest configurations that will give your product increased appeal.

Innovations like Flat Profile CRTs and Spectrum Segmented

Phosphor CRTs have contributed to Clinton's reputation as an industry leader.

And now Clinton has added a 17" and 20" CRT to their Flat Profile CRT Series. These new tubes are specially designed to meet the need for increased display area in workstation applications.



Clinton's 17" & 20" Flat Profile CRTs are ideal for Workstation Applications.

Team Up With Clinton.

Clinton is more than a CRT supplier. We are ready to team up with your company to provide a CRT that will enhance your new product design.

And with engineering and extensive manufacturing capabilities based in the United States, Clinton can accommodate the most stringent "Just-in-Time" delivery schedules with competitively priced CRTs.

When you are looking for a monochrome CRT and you want to ensure your new product's success, Clinton's the *only* choice.

Clinton Electronics Corporation
6701 Clinton Rd. • Rockford, IL 61111
815/633-1444
Telex: 687 1504 CECRK
Telefax: 815/633-8712



**CLINTON
ELECTRONICS
CORPORATION**

products on display

OPTICAL DEVICES, INC.

Camarillo, CA 805/987-8801
Booth 419

Contrast-enhancement and shielding

Optical Devices, Inc. (ODI) is a full-service contrast-enhancement and shielding filter manufacturer. ODI combines sophisticated coating technologies with bandpass elements and polarizers to provide filters for all display technologies, for both commercial and military applications. ODI's high-temperature polarizers and ANVIS filters are examples of recent announcements.

Circle no. 25

PHOTO RESEARCH SPECTRAMETRICS

Division of Kollmorgen
Chatsworth, CA 818/341-5151
Booths 211, 213, 215

Video photometer

The new PR-900 Video Photometer increases the speed and accuracy of displays analysis. It functions in a wide range of ATE environments, performing spatial, photometric, and colorimetric inspection of color and monochrome CRTs, flat-panel displays, and other image-producing systems. The system measures luminance, luminance profiles in two or three dimensions, display uniformity (including pseudocolor presentation), line width, and character size, at video frame rates. Chromaticity, misconvergence, and MTF measurement modules are optional, as is an autofocus capability for automatic measurement across curved or skewed surfaces. Prices begin at \$30,000.

Circle no. 26

PHOTONICS TECHNOLOGY, INC.

Northwood, OH 419/666-0762
Booths 309, 311

1.5-m dot-matrix display

Photonics Technology is the manufacturer of the world's largest (1.5 m) nonprojected fully populated dot-matrix display. Photonics produces ac plasma gas-discharge display terminals ranging in size from 256 × 256 (10 cm) to 2048 × 2048 (1.5 m).

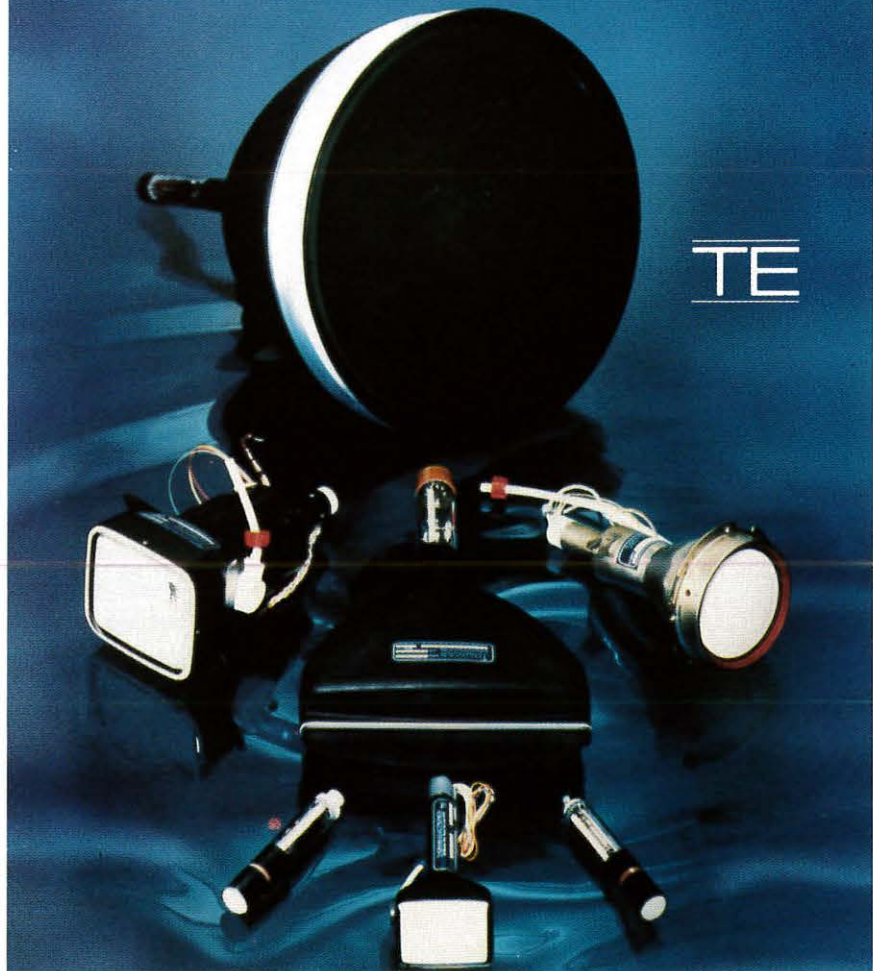
Circle no. 27

Cathode Ray Tubes

Thomas Electronics cathode ray tubes ... designed for Military, Commercial and Industrial applications ... from the most sophisticated avionics and photo-recording to the general computer terminal and medical display applications. Four production facilities to serve you best in Wayne, New Jersey — Los Angeles, California — and Clyde, New York. Send for our new full color catalog, or contact us with your specific requirements.

THOMAS ELECTRONICS

100 Riverview Drive, Wayne, NJ 07470 / 201-696-5200
TELEX: 310-685-3326 / FACSIMILE: 201-696-8298



Circle no. 67

PTK/RANTEK DIVISION

Emerson Electric Co.
Los Osos, CA 805/528-5858
Booths 306, 308

High-voltage power supplies

The LCC series commercial high-voltage power supplies (HVPS) for monochrome displays provide multiple outputs, tight regulation, low ripple, overvoltage protection, compact packaging, and reliable operation with MTBF in excess of 100,000 hours. The CDC series com-

mercial HVPS for color and very-high-resolution monochrome displays provide anode, focus, grids, and B+ outputs with DF input capability. Features include overvoltage protection, remote ON/OFF, low ripple, and tight regulation. High-volume manufacturing allows PTK to offer these HVPS at extremely low prices. The new LCM series HV lead assemblies and connectors are LGH-compatible, MIL-qualified, and low cost.

Circle no. 28

Gun Control.

At Southwest Vacuum Devices we solve gun control problems. Prototypes. Research. Design. Manufacturing.

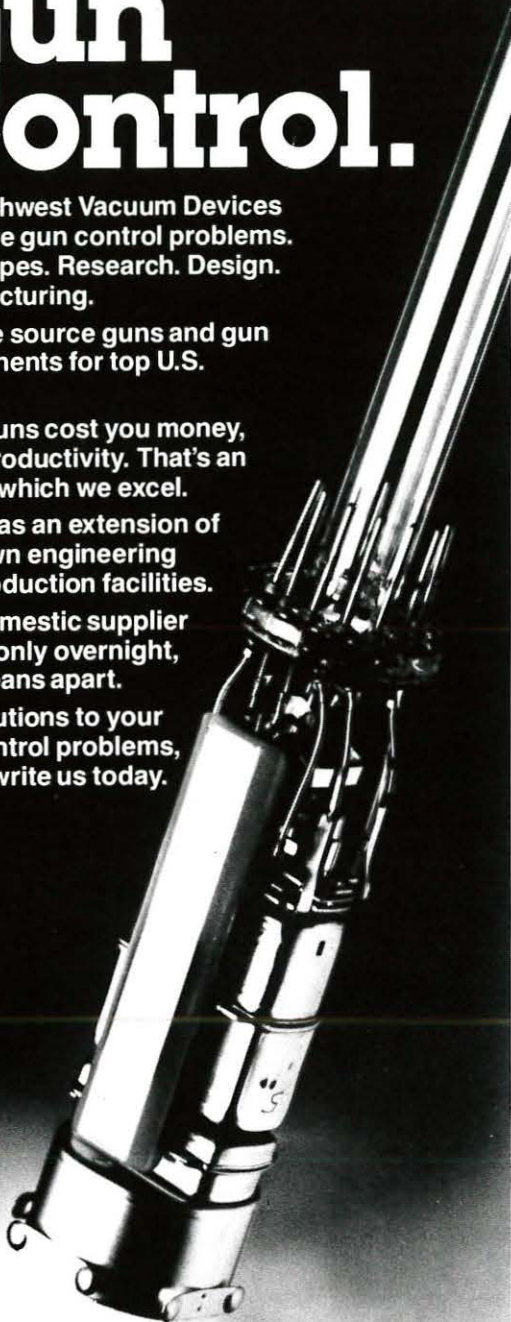
We sole source guns and gun components for top U.S. OEMs.

Short runs cost you money, time, productivity. That's an area in which we excel.

Use us as an extension of your own engineering and production facilities.

As a domestic supplier we are only overnight, not oceans apart.

For solutions to your gun control problems, call or write us today.



Complete Guns, Stems, Cathodes,
Other Components



SOUTHWEST VACUUM DEVICES, INC.

P.O. Box 50524/Tucson, Arizona 85703
(602) 887-7900 Telex 165-522

Circle no. 68

SINGLE SOURCE



Whether it is a prototype, broadcast, TV, medical, newspaper or data display CRT—Video Display is the Nation's largest full line supplier of replacement tubes.

SPECIALIZATION

VDC sells only CRTs, and has the most knowledgeable sales force in the industry. Supplying drop in replacements for any manufacturer's tube type is our specialty.

QUALITY

VDC stocks CRTs featuring the latest dark glass, direct etch options in colors ranging from Black and White to European Amber. VDC replacement tubes are often of higher quality than the original tubes.

INVENTORY

With over 70,000 units in stock, representing 3,000 tube types, VDC ships most orders the same day they are received.

PRICING

No one sells the same high quality tubes for less. Not the OEMs, not other tube manufacturers, not one.

1-800-241-5005

**VIDEO DISPLAY
CORPORATION**



5530 E Ponce De Leon Ave.
Stone Mountain, Georgia 30086
(404) 938-2080 or Your local VDC distributor

Circle no. 69

products on display

RANK BRIMAR, LTD.
Manchester, U.K. 061-681-7072
Booths 127, 129

Shadow-mask color tube for avionics

A new rugged shadow-mask color CRT specifically designed for military cockpit display is available from Rank Brimar. This 127-mm square flat-faced tube is the first of a range of color tubes being developed. The tube has a stretch mask, 0.2-mm resolution (dot triad pitch), and the high brightness needed for cockpit displays. The tube is fully encapsulated, with all coils, in a mumetal shield and is fitted with flying leads. A special optical filter with antireflective coating is optional.

Circle no. 29

SCHOTT AMERICA
Yonkers, NY 914/968-8900
Booths 317, 319

Contrast-enhancement filters

Schott Glass Technologies, Inc., has developed a high-contrast-enhancement filter for use in full-color displays: the S-8806 high-transmittance triple-notch contrast-enhancement filter. A 2.5-mm thickness has the following characteristics:

Wavelength (nm)	Transmittance
445	82.5 \pm 2.5%
555	69.5 \pm 2.5%
580	0.25 \pm 0.25%
618	80.0 \pm 2.5%

Circle no. 30

SONY CORP. OF AMERICA
San Diego, CA 619/487-8500
Booths 200, 201, 301

High-resolution color raster display

The DDM2801C from Sony Corp. is the largest super-high-resolution color raster display currently available. It provides 2048 \times 2048 resolution at a 60-Hz noninterlaced refresh rate on a 20 \times 20 in. flat screen, with a video bandwidth of up to 300 MHz. This color display uses Sony's Trinitron technology, which combines a single electron gun and an exclusive aperture grill to improve display quality over ordinary color raster display devices. The DDM2801C is virtually distortion free, allowing 0.1-in.-high characters to be easily read anywhere on the 400-in.² screen.

Circle no. 31

NEED THE COLOR FAST?

LMT CAN DO IT WITH ACCURACY !

- Virtually perfect tristimulus filter correction, no correction factors !
- Simultaneous measurement of x,y,Y or X,Y,Z. No time lag to introduce a time dependent error.
- Fast measurement rate. 2.5 per second (Model C 1200). 100 per second (Model C 3300).
- Simple front panel readout or microprocessor controlled models.
- Autoranging over six decades, or manual ranging.



C 1200 Colorimeter

What does "virtually perfect" filter correction mean? It means that you can now make production line measurements that are as accurate as you can get in the lab (your engineers will probably want a unit in the lab first!). It also means that it is unlikely that you will need any correction factors, regardless of the colors you are measuring. So if you are constantly changing between different colors, this is the way to go! Even if you don't change

colors often, wouldn't it be great to know that you have the right answer, the first time!

The key to the systems speed is the fact that the three tristimulus functions are being measured simultaneously by three filtered silicon detectors. And the fact that the detectors are very high quality silicon means that you can expect the same answer, year in and year out.

Systems are available that range in capability from just a front panel readout, to systems that have a built in microcomputer to enable the user to make decisions, print out measurement results and communicate with other computers. All use virtually perfect filter corrections to ensure that you always have the right answer, right from the start.

In North America:

LMT
P.O. Box 85666 MB 116
San Diego, CA 92138
Phone: 619-271-7474

All others:

LMT Lichtmesstechnik GmbH Berlin
Helmholtzstrasse 9
D 1000 Berlin 10, West Germany
Phone: 49-30-393-4028



Circle no. 70

TEAM SYSTEMS

Santa Clara, CA 408/720-8877
Booths 222, 224

High-resolution video printer

Test & Measurement Systems, Inc., in cooperation with Toyo Corp. of Tokyo, Japan, is now offering the new Model TP-6490 video printer for all high-resolution and very fine gray-scale applications. The TP-6490 provides 64 levels of gray scale per pixel or dot and a resolution of

up to 1280 dots/line and 1024 lines/frame. It incorporates the TEAM Systems TP-115 high-resolution video printer, a thermal printhead with 300 dots/in. resolution. It has a built-in frame memory to capture any black-and-white or gray-scale picture from today's high-resolution monitors. The printout is made from this fast memory in up to 40 sec/print. A redesigned video interface allows easy setup for different signal conditions. Price is \$6950 each.

Circle no. 32

AD-MU SHIELDING DOES ENHANCE EMI SENSITIVE COLOR DISPLAYS FOR



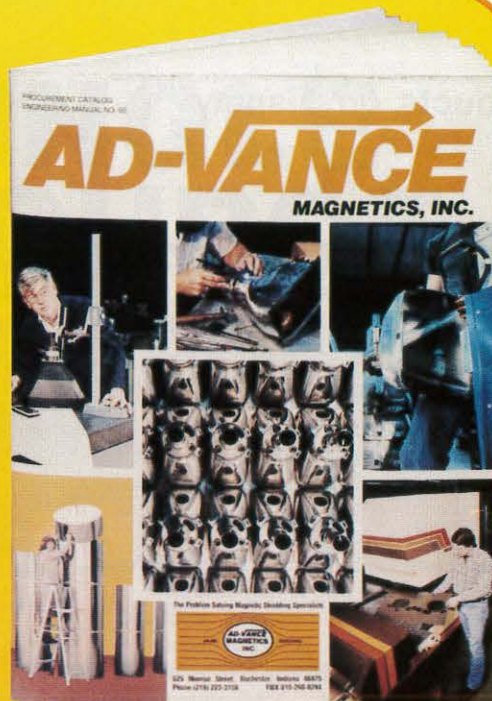
Achieve high quality hues and sharper color definition for avionics, computer graphics, medical instrumentation, military and other critical color image applications.

A properly selected shielding alloy... placed around or adjacent to a circuit component... suppresses radiated magnetic fields interfering with other nearby components, or vice versa.

That's how AD-MU shielding alloys solve your problem.

56 pages of this 84-page Procurement Catalog/Engineering Manual contains useful technical data covering the entire magnetic shielding field; 28 pages consist of usual catalog type data.

Just request this vital helpful data on your letterhead and it's yours.



AD-VANCE MAGNETICS, INC.



625 MONROE STREET, ROCHESTER, INDIANA 46975


(219) 223-ADMU

The Problem Solving Magnetic Shielding Specialists—4 Decades of Magnetic Shielding Leadership

Circle no. 71


The Color of Profits

The Brewer Science  products provide the highest quality multicolor process available... a process which uses a spin-on technique, can be integrated into any standard photolithography equipment, and results in fewer defects and higher yields. The  technology provides more precise color, and at the same time, increases your profits dramatically!

 is a polyimide color filter material for production of multicolor displays, color camera chips and color copiers.

Process Advantages

- Compatible with positive photoresists and developers
- Resolution to 6 microns
- All colors patterned onto one level
- Yields of 95% and higher
- Implementation in just two days
- Outstanding coating uniformity
- Excellent light and thermal stability

Achieve the ultimate in color filter technology and discover the color of profits with .



**Brewer
Science Inc.**

Supply Specialty Chemical Solutions

P.O. Box GG • Rolla, MO 65401 • USA • (314) 364-0300 • Telex 361471 • Fax (314) 364-7150

Circle no. 72

products on display

THOMSON ELECTRON TUBES & DEVICES CORP.

Dover, NJ 201/328-1400
Booths 312, 314

19-in. color shadow-mask CRT

Thomson's 19-in. color shadow-mask CRT has been ruggedized to meet full MIL-SPEC requirements and employs a specially developed and patented saddle-saddle shieldable deflection coil design. Instead of convergence magnets, convergence coils unitized with the deflection yoke make it possible to achieve stable purity and convergence in a wide operating temperature range.

Circle no. 33

TOSHIBA AMERICA, INC.
Deerfield, IL 312/945-1500
Booth 520

21-in. flat-square color tube

A 21-in. high-resolution flat and square color display tube from Toshiba's Electron Tubes & Devices Division uses a new electron gun design to achieve 30% better focus at the screen periphery. The DAC-QPF electron gun has six electrodes so that it can operate as a compensating four-pole lens for both horizontal and vertical astigmatism. A dynamic voltage of up to 800 V is applied to this quadrupole lens to control it according to the deflection value from the center to corners of the screen, which corrects the astigmatism of the electron-beam spot in the screen corner.

Circle no. 34

WELLS-GARDNER ELECTRONICS CORP.
Chicago, IL 312/252-8220
Booth 413

Industrial-grade touch screen

The Cyclops ES series, an optical touch screen with only one LED and one CCD detector, has recently been released in a ruggedized industrial version for outdoor harsh environments. This model has been tested to meet the following environmental requirements: -40°C to $+85^{\circ}\text{C}$ temperature range; operational in direct sunlight; and able to withstand high vibration, severe thermal shock, and rapid changes in temperature and humidity. The ruggedized version is available in 5- and 9-in. sizes for CRT applications and in 4×8 in., 4×9 in., and 5×8 in. sizes for flat-panel applications. ■

Circle no. 35

Celco YOKES

for
Best
CRT Displays



Mahwah, NJ 07430
201-327-1123

Circle no. 73

CRT-480

Machine Vision for Automated Inspection
and Alignment of CRT Displays

CRT TEST SYSTEM

- CRT Inspection/Alignment
 - Brightness
 - Rotation/Tilt
 - Vertical/Horizontal Size
 - Centering
 - Pincushion/Barrel Distortion
 - Linearity
- Easy to Use
- Interactive Graphics/Prompts
- Fast . . . Accurate
- Color CRTs (Optional)



Clear visual prompts guide operator to make adjustment.
Shown: Vertical Height.

*CR Technology has a proven system to save you time and money,
improve product quality and increase operator consistency, accuracy and productivity.
Call or write to have us study your needs.*

CR TECHNOLOGY

23062 La Cadena, Laguna Hills, CA 92653 Telephone: (714) 859-4011 Fax: (714) 859-3214

See us at SID '88—Booth 307

Circle no. 74



Don't
Miss
The
**Grand
Opening**
Of The
Brand
New...

at
**SID
'88**

The locks are opened...
the wraps come off...
Pattern Master is exposed.

Let us unlock the conven-
ience and capabilities of
Pattern Master for you...
you'll keep the keychain.

Vii is just inside the front door of
the exhibit hall, booth #104/106.

SID '88 - Disneyland Hotel,
Anaheim CA, May 24-26, 1988.

Vii® PO Box 33
Xenia OH 45385-0033
Phone: (513) 376-4361

© Visual Information Institute, Inc. 1988

Circle no. 75

Attention: OEMs, Developers, System Integrators
VuTek Systems is pleased to announce:

FREEZFRAME

FREEZFRAME is the *only* image capture & display board with the ability to superimpose (overlay) CGA/EGA text and graphics on captured video images in **32,768 colors** using a single multi-frequency monitor. This new and unique product, available *exclusively* from **VuTek**, includes software interfaces that can be used with virtually any new or existing programs/languages. Applications include interactive video instruction (IVI/CBT/CAI), photo database programs, desktop publishing, desktop presentations, and your own custom program development.



Technology with Vision

For complete information, call
619-587-2800

10855 Sorrento Valley Road
San Diego, California 92121

Circle no. 76

DRB TECHNOLOGIES, INC.

**Management and Technical Consulting
in
Display Technology and Electro-Optics**

DRB TECHNOLOGIES, INC. provides independent business assistance to companies like your own. We can assist you in the following ways:

- Perform feasibility studies
- Initiate and complete business planning tasks
- Improve manufacturing yield and efficiency
- Decrease time to market in product development
- Increase the accuracy of product specifications
- Restructure organizations for efficiency
- Improve organizational information flow
- Provide an independent forum for idea evaluation
- Spark creativity in problem solving

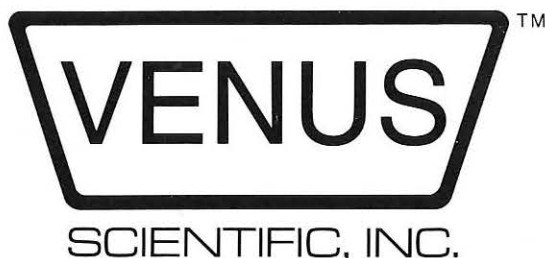
We have been effective in companies that manufacture high technology products which typically include one or more of the following components:

Microprocessor and memory
Sensors
Displays
Input devices

Thin film processing
Photolithography
Optical components
Packaging

DRB TECHNOLOGIES, INC.
630 Llewellyn Road
Berwyn, PA 19312
(215) 296-7589

Circle no. 77



Quality Price Availability

Venus Scientific offers over 400 power supply systems; from 5 to 30,000 volts, up to 2,500 watts. Venus has the power supply solution for:

- | | |
|------------------|-----------------------|
| ■ Lasers | ■ Aerospace |
| ■ Military | ■ Electronic Displays |
| ■ Communications | ■ Research Labs |

399 SMITH STREET, FARMINGDALE, N.Y. 11735
• (516) 293-4100 • TWX: 510-224-6492 • FAX: 516-752-7976

Circle no. 78

PRA

Princeton Research Associates

ACTIVE MATRIX LIQUID CRYSTAL DISPLAY MANUFACTURING TECHNOLOGY

Princeton Research Associates Inc. now has available for sale, the technology and specifications needed to assist you to begin manufacturing active matrix liquid crystal displays. This active matrix display, based on the proven and economical MIM Technology, has been manufactured at good yields in sizes ranging from 3" x 4" up to 5" x 9" and with resolutions as high as 640 by 200 addressable pixels.

Princeton Research Associates can provide detailed engineering specifications of processes, equipment and tooling required and can train engineers in the manufacturing techniques.

For more information contact:

Princeton Research Associates Inc.

P.O. Box 2069
Princeton
N.J. 08540

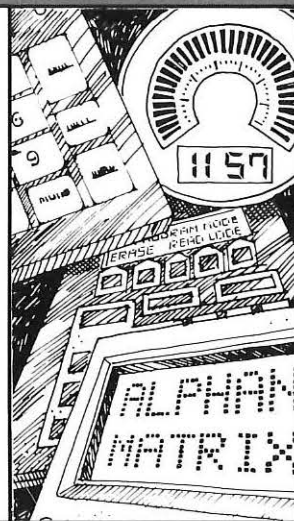
Telephone 609-890-7915
or 609-921-3192

Circle no. 79

POWER YOUR DISPLAYS FROM LOW DC VOLTAGE!

DC-DC Converters & Smart ForceTM DC-AC Inverters to power:

- Electroluminescent Lamps,
- Plasma Gas Discharge,
- Vacuum Fluorescent,
- TFEL Displays, and More!



FREE Data Packet includes:

- **CROSS REFERENCE INDEX** — matches ERG converters to various plasma and VF displays.
- **EL SOURCE LIST** — helps source EL Lamps, LCDs, membrane switches, etc.

Call today for complete product information and pricing:



Endicott Research Group, Inc.

2601 Wayne Street P.O. Box 269 Endicott, NY 13760
© 607-754-9187 TWX 510-252-0155

FAX: 607-754-9255

©1986 ERG, Inc.



Circle no. 80

HVCMOS[®] IMAGING



Supertex inc.

Leadership in CMOS/DMOS Technologies

Pushing the leading edge of display technology, the Supertex family of HVCMOS* drivers & multiplexers permit major breakthroughs in computer graphics, electroluminescent, gas plasma, LCD & vacuum fluorescent displays. This advanced technology also opens up a wide range of applications in ultrasound imaging, robotics, telecommunications, test systems and high performance printers.

High density HVCMOS drivers combine high speed with low power consumption to produce bright, high-resolution images. Investigate HVCMOS . . . a most attractive alternative to cumbersome boards or hybrids.

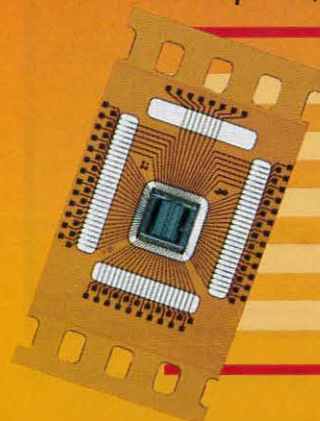
For complete specifications, application data or custom information, write or call:
Supertex, Inc., 1225 Bordeaux Drive, Sunnyvale, CA 94088 (408) 744-0100. Telex 6839143 SUPTX

PRODUCT	VOLTAGE	DESCRIPTION
AN01	160 to 400V	8 N-Channel Low Leakage Common Source Driver
AP01	160 to 400V	8 P-Channel Low Leakage Common Source Driver
HV01	60V	16 Channel, 16 Level Gray Shade Push-Pull Output Driver
HV02	250V	16 Channel, High Current Open-Drain Output Driver
HV03 & 05	200 & 300V	64 Channel Serial to Parallel Converter with Open-Drain Outputs
HV04 & 06	40, 60, & 80V	64 Channel Serial to Parallel Converter with Push-Pull Outputs
HV10-18	140 & 160V	4 or 8 Channel Bilateral Analog Switch
HV30	180V	7 Segment Decoder with Open-Drain Outputs
HV51 & 52	225 & 300V	32 Channel Serial to Parallel Converter with High Voltage Open-Drain Outputs
HV53 & 54	40, 60, & 80V	32 Channel Serial to Parallel Converter with High Voltage Push-Pull Outputs

Circle no. 81

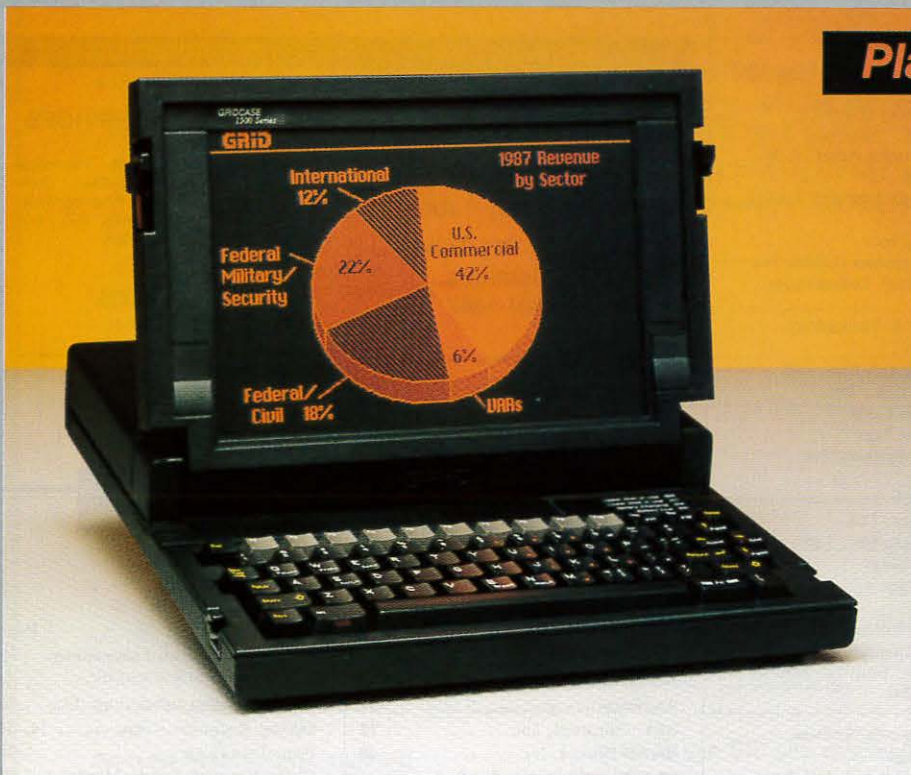
*HVCMOS is a registered trademark of Supertex, Inc.

See us at SID '88—Booth 217



NEC OUTSHINES THE COMPETITION.

Brilliant solutions to your display needs from World Products, Inc.



Plasma Display Panels



NEC plasma displays are lighter and brighter than ever before, with reduced power consumption and twice — even three times — the life.

- 9" through 26" displays
- High contrast, low power consumption
- 40,000-hour life with uniform brightness
- Many matrix choices: 512, 576, 640, 720 format with full graphic arrays

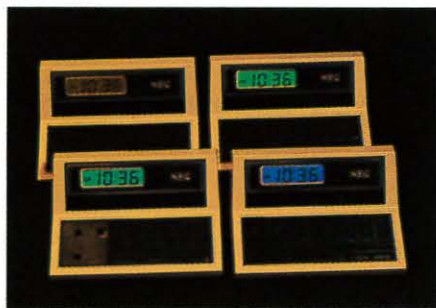
- Gray shades capability
- Wide viewing angle
- Easy interface, 5 & 12 volt operation
- Multimode EGA, CGA & Hercules Monochrome compatible



High Resolution Color CRT's

NEC's color CRT meets the demand for performance, reliability, and ergonomic efficiency.

- Choice of 9", 10", 12", 14", 15", 16", 20" diagonals
- Resolution: .21 through .39 dot pitch
- Conventional, flat-face, non-glare and anti-reflection types



Electroluminescent Lighting

NEC backlighting illuminates virtually any LCD.

- Custom configurations
- Sizes from 20 x 14 mm to 450 x 200 mm
- Uniform brightness and low power consumption

The Bright Side: Domestic Distribution

How can you get NEC performance and NEC quality, with domestic convenience? Call WPI's System Devices group. Our domestic distribution point assures you quick-response service and competitive turnaround schedules, with the industry's best product and technical service.

World Products Inc.

System Devices Group

P.O. Box 517 Sonoma, CA 95476

Telephone: (707) 996-5201

Fax: (707) 996-3380



**WORLD
PRODUCTS
INC.**

sustaining members

Ad-Vance Magnetics, Inc.
AEG Corp.
Alphasil, Inc.
Amuneal Manufacturing Corp.
Applied Films Lab, Inc.

Babcock Display Products
Ball Electronic Systems Div.
BDH Ltd.
Bendix Corp.
Brewer Science, Inc.

Canon, Inc.
Cardion Electronics
CELCO
Cherry Electrical Products Corp.
Clifton Precision/Special Devices
Clinton Electronics Corp.
Computing Devices Co.
Connector Corp.
Conrac Corp.
Corning Glass Works

Dale Electronics
Data Images
David Sarnoff Research Center, Inc.
Digital Electronics Corp.
Displays Inc.
DISCOM/Display Components, Inc.

EEV, Inc.
EG&G Gamma Scientific
Electronic Display Systems, Inc.
Electro-Plasma, Inc.
Endicott Research Group, Inc.

Ferranti-Packard Electronics, Ltd.
Futaba Corp.

GEC Avionics, Inc.
General Atomics Corp.
General Electric Co.
GML Information Services
GTE

George D. Harris Assoc., Inc.
Hartman Systems
Hazelton Corp.
Hewlett-Packard Co.
Hitachi, Ltd.
F. Hoffman La-Roche & Co., Ltd.
Hoya Optics, Inc.
Hughes Aircraft Co.
Hycom, Inc.

IBM Corp.
Imapro Corp./Imaprint Design, Inc.
Incom, Inc.
Industrial Electronic Engineers, Inc.
Infodex, Inc.
Interstate Electronics Corp.
Inter-technical Group, Inc.
ISE Electronics Corp.

K & R Engineering Sales Corp.
Kollmorgen Corp. Photo Research
Div.

Litton Panelvision Corp.
Litton Systems Canada Ltd.
Litton Systems, Inc. (2)
Los Alamos National Laboratory

Magnavox Government & Industrial
Electronics Co.
Magnetic Radiation Laboratories
Microfield Graphics, Inc.

Microphase Laboratories
Microvision
Minolta Corp.
Mitsubishi Chemical Industries
America, Inc.
Mitsubishi Electronics America, Inc.
Monitronix Corp.
Murata-Erie North America, Ltd.

NEC Electronics, Inc.
NEC Home Electronics (USA), Inc.
Norden Div. United Technologies
Corp.
NYNEX Science & Technology

OKI Electric Industry Co., Ltd.
Optical Coating Lab., Inc.
Optical Radiation Corp.
Orwin Associates, Inc.
Ovonic Imaging Systems, Inc.

Penn-Tran Corp.
Philips Electronics, Ltd.
Phosphor Products Co., Ltd.
Photonics Technology
Planar Systems, Inc.
Plasmaco, Inc.
Plessey Naval Systems
Precision Electronic Glass, Inc.
PTK/Rantec Div. Emerson Electric Co.
Quantum Data Inc.

Racal Microelectronic Systems
Rank-Brimar, Ltd.
Raytheon Co.
The Report Store
Ricoh Co., Ltd.
Rogerson Kratos Corp.

SAI Technology Co.
Sanders Associates, Inc.
Schott America—Glass & Scientific
Products, Inc.
Sigmatron Nova, Inc.
Singer-Librascope
Sony Corp.
Stanford Resources, Inc.
Supertex, Inc.
Syntronic Instruments, Inc.

Taliq Corp.
Tektronix, Inc.
Test & Measurement Systems, Inc.
Texas Instruments, Inc.
Thomas Electronics, Inc.
Thomson Electron Tubes & Devices
Corp.

UCE Liquid Crystal Displays
United Enclosures, Inc.

Venus Scientific, Inc.
Video Monitors, Inc.
Villa Precision, Inc.
Visual Information Institute, Inc.

Westinghouse Electric Corp.

Zenith Electronics Corp.

id classified

consultants

Howard W. Grossbohl
TROUBLE-SHOOTING
Cathode Ray Tubes
Cathode Ray Tube
Applications
805-581-1467

consultants

HAINES TECH SERVICES
Trained and Experienced Technical
Writer. Contract Administration. Com-
pany Representative. Photography
—Illustrations. John Haines, P.O. Box
6502, Silver Spring, MD 20906.
202-857-8006

index to advertisers

	Page
AEG Corp.	C2
Ad-Vance Magnetics, Inc.	40
Arconium	32
BKL Industries, Inc.	15
Brewer Science, Inc.	40
CELCO (Constantine Engineering Labs. Co.)	13, 41
CR Technology, Inc.	41
Citronix, Inc.	6
Clinton Electronics Corp.	36
Connector Corp.	35
Corning Glass Works	29
DRB Technologies, Inc.	42
Delco Electronics Corp.	C3
Digital Electronics Corp.	12
Endicott Research Group, Inc.	43
Hoya Electronics Corp.	48
Hoya Optics, Inc.	6
Hughes Aircraft Co.	5, 31, 33
International High Voltage Electronics, Inc.	31
LMT	39
Leader Instruments Corp.	4
Litton Electron Devices	47

	Page
Magnetic Radiation Laboratories	30
Microvision	29
Optical Coating Laboratory, Inc.	30
Optical Radiation Corp.	14, 34
Penn-Tran Corp.	34
Photo Research SpectraMetrics	C4
Plasmaco	8
Precision Electronic Glass, Inc.	27
Princeton Research Associates	43
Quantum Data	1
Rank Brimar, Ltd.	9
Raytheon Co.	10
Southwest Vacuum Devices, Inc.	38
Supertex, Inc.	44
Syntronic Instruments, Inc.	2
TEAM Systems	19, 21
Teledyne Kinetics	22
Tencor Instruments	23-26
Thomas Electronics, Inc.	37
Venus Scientific	43
Video Display Corp.	38
Visual Information Institute, Inc.	42
VuTek Systems, Inc.	42
World Products, Inc.	45

Business and Editorial Offices
Recruitment Advertising
Palisades Institute for Research
Services, Inc.
201 Varick Street
New York, NY 10014
Jay Morreale, Advertising Manager
212/620-3371

District Sales Office—Midwest
Stephen Steeves
The Patis Group
4761 West Touhy Avenue
Lincolnwood, IL 60646
312/679-1100

District Sales Office—West
Ted Lucas
P.O. Box 852
Cedar Glen, CA 92321
714/337-6627

District Sales Office—East
Becky Akers
The Patis Group
310 Madison Avenue, Suite 1804
New York, NY 10017
212/953-2121

Not all CRTs are created equal.

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.

Freedom from blemishes.

In medical imagery, a blemish or false shadow can be a life or death matter. To produce the most blemish-free screens available, we do all fabrication in a total clean room environment using exclusive phosphor deposition techniques.

Freedom from uneven color distribution. In color recording and film scanning, evenness of color is crucial. Litton is the only CRT manufacturer to develop a homogeneous, broad-band phosphor mix. This creates an absolutely even, full-color image without color hot spots.

Freedom from poor resolution. In typesetting, equipment has been built that can project an entire magazine page from a 7-inch tube onto a magazine-sized piece of film with razor sharp resolution. That's because our monochrome screens are finer grained than the typical CRT...

and because we offer the smallest spot size available.

We offer fiber optic face plate CRTs with high optical coupling efficiency.

And a real tour de force—a multi-beam gun technology capable of extremely high data recording rates and display density.

Our full line of recording CRTs ranges from a palm-sized 1-inch tube to a full 14 inches and more. We can

also design a CRT to your particular application.

All this together makes a powerful statement.

And it explains why so many builders of high-performance systems carry the torch for Litton CRTs.

If you have an application where resolution, cleanliness, throughput and uniformity of color are critical, contact Litton Electron Devices, 1215 South 52nd St., Tempe, AZ 85281. (602) 968-4471. TWX: 910-950-0149.



Litton

Electron Devices

Circle no. 83

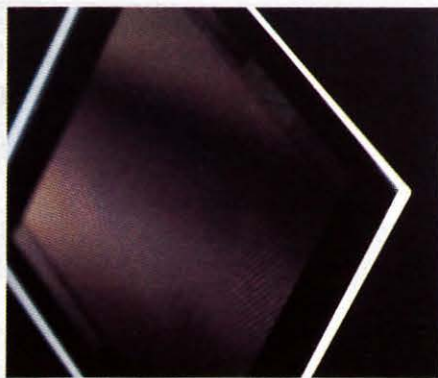


Highlight your Displays with HOYA's imaging.

The Hoya tradition of excellence continues with engineering for the emerging fields of flat panel Display, Information Processing and Electro-Optics. Our extensive new quality line of glass and thin-film materials incorporates the latest imaging and process technology services.

Integral to these new materials is Hoya's exclusive transparent and electro-conductive *ITO thin-film* on precision glass substrates. Major quality, yield and cost advantages include:

- Low defect Indium Tin Oxide: extreme surface cleanliness
- Optimized film uniformity: purity and stability
- Specialized film structure: precision etchability
- Flexible film character: resistivity vs. thickness
- Special SiO_2 undercoat and/or SnO_2 over coating
- To 14" x 14" size: volume thin-film deposition



Optimum product quality is ensured by virtue of Hoya's precision glass polishing and cleaning process, and our unique multicarrier packaging.

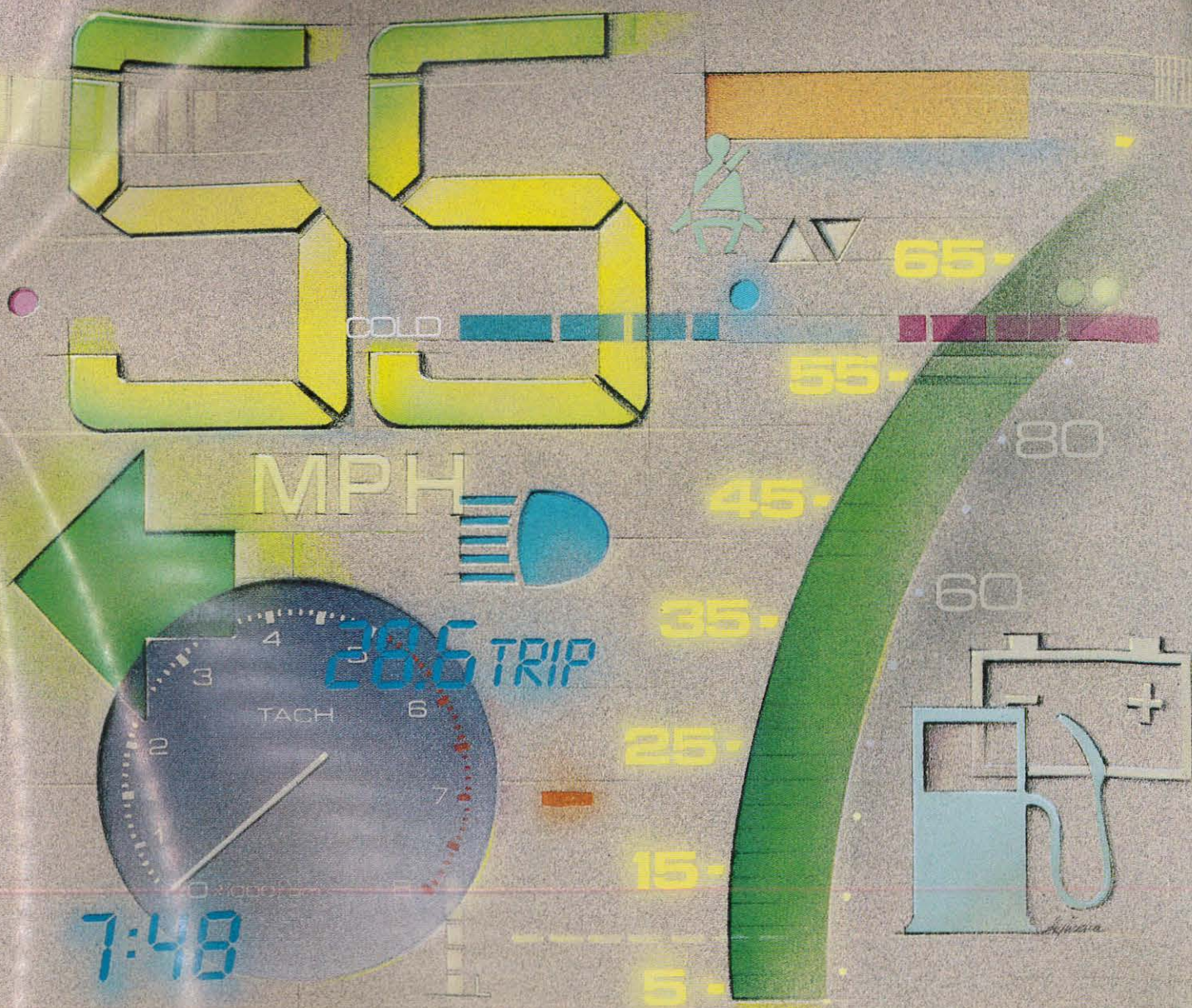
In precision glass, thin-film blanks, imaged panels, and large blanks/masks, Hoya's diversity meets the demanding requirements of; flat panel displays, electro-optic devices, large area electronic circuits, anti-reflection/polarizing films, and sensor/solar cell technology.

Look to Hoya as your complete source for all flat panel component design and imaging needs. We have the material and process know-how to support your end product success.

Contact us, we'll make it work for you. In CA: (408) 435-1450; in NJ: (201) 307-0003, in TX: (214) 450-4410.

HOYA

The image of tomorrow.



TRAVEL INFORMATION.

It's all there, right in front of your eyes. Travel information that reads fast, clear, accurately and reliably.

That's one of the benefits of electronics as applied to automotive design and engineering. And it's automotive electronics that Delco Electronics is all about.

From the numbers you see on our instrument panels, to the two million instructions per second our engine control modules process, to the

impressive sound you hear from our music systems.

We think it's our job to help make the cars and trucks you drive more dependable, more comfortable and enjoyable, and give you better value. And through our association with Hughes Aircraft, our partner in GM Hughes Electronics, we're applying the lessons learned in aerospace down here on the ground.

Delco Electronics. Keep your eye on us.

Delco Electronics

Subsidiary of GM Hughes Electronics

It's who we are.



Decisions. Decisions. Decisions. PR-900 makes them for you.

The world's leading light measurement people have done it again! They've developed a state-of-the-art Video Photometer that can make all your CRT and display test measurement pass/reject decisions for you. Automatically!

The PR-900 dramatically reduces measurement time, and improves the accuracy and repeatability over manual techniques. It virtually eliminates the possibility of operator error. And it provides NBS-traceable luminance measurements. Only Photo Research could have brought you this special combination of capabilities in a single instrument. The system is so flexible it can operate in the lab, the production line, as a stand-alone or in a complete ATE environment. And it is so easy to operate it requires almost no training. That's what leadership means.

The PR-900 Video Photometer embodies the latest advances in solid-state video technology and image processing techniques. Get all the facts today.



PHOTO RESEARCH®

The Light Measurement People®

Division of **KOLLMORGEN**

9330 DeSoto Avenue, PO Box 2192, Chatsworth, CA 91313-2192

(818) 341-5151 FAX: (818) 341-7070 TLX: 69-1427 Cable: SPECTRA

AUSTRALIA QUENTRON OPTICS PTY LTD., Ph: 08-223-6224 • CANADA OPTIKON CORPORATION, Ph: 519-885-2551 • FRANCE INSTRUMAT SA, Ph: 1-69 28 27 34 • HOLLAND INTECHMIJ BV, Ph: 020-56-96-611
WEST GERMANY OPTTEMA ENGINEERING GmbH, Ph: (0212) 67352 • JAPAN KYOKKO TRADING COMPANY, Ph: 03-586-5251 • U.K. MICRON TECHNIQUES LTD., Ph: 0202-841261 • INDIA PHOTONICS INTERNATIONAL, Ph: 366665
ISRAEL DELTA FILM LTD., Ph: 052-521874 • ITALY ELETTRONUCLEONICA, Ph: 2-4982451 • SWEDEN SAVEN AB, Ph: 08-7921100 • EUROPEAN HEADQUARTERS LUZERN, SWITZERLAND, PHOTO RESEARCH, Ph: 041-31-6194

Circle no. 86

See us at SID '88—Booths 211, 213, 215