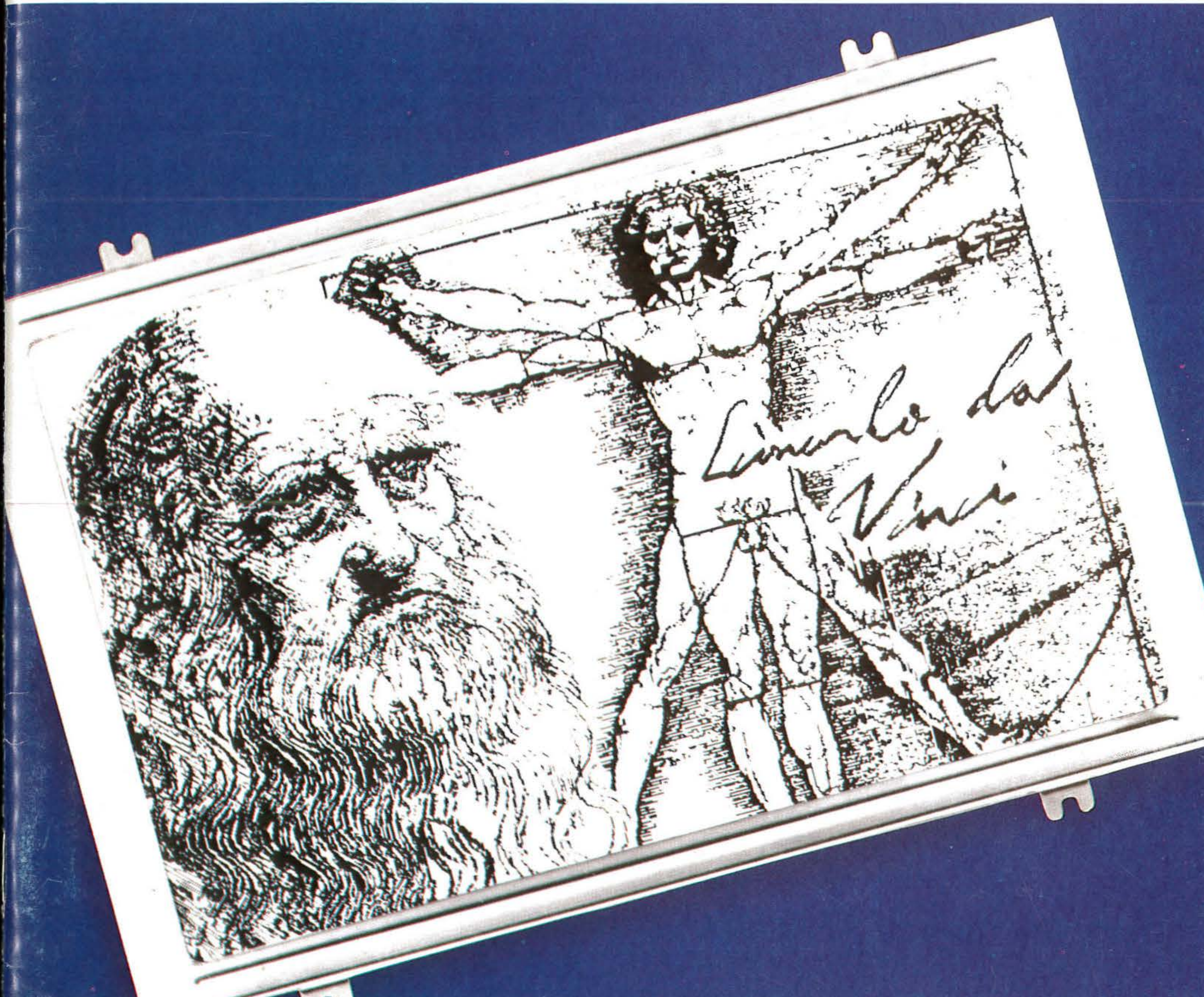
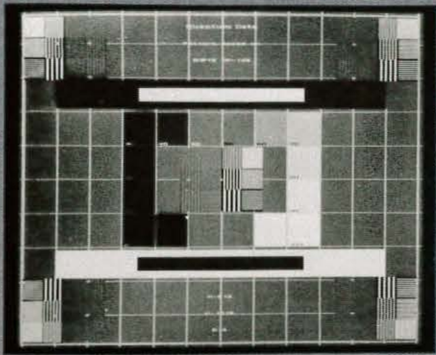
Official Monthly Publication of the Society for Information Display

INFORMATION DISPLAY

March 1987
Vol. 3, No. 3



Human factors for flat panels
SID '87 preview
Japan Display '86 r



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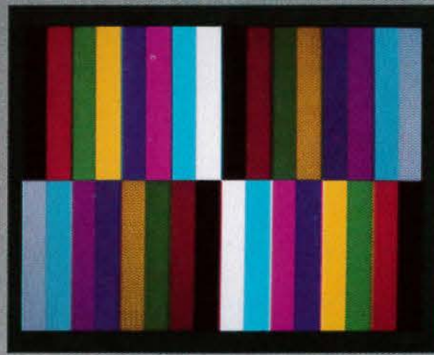

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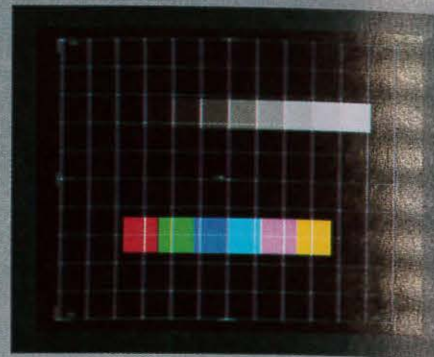

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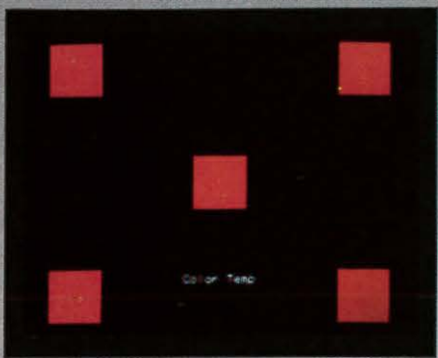

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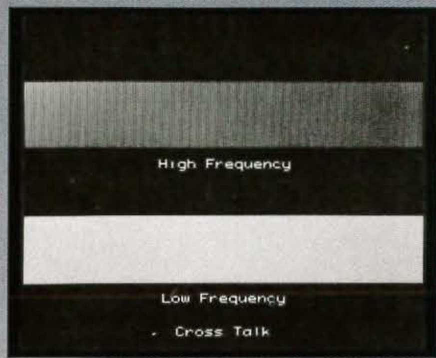

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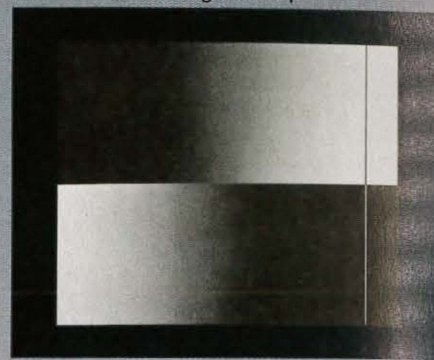

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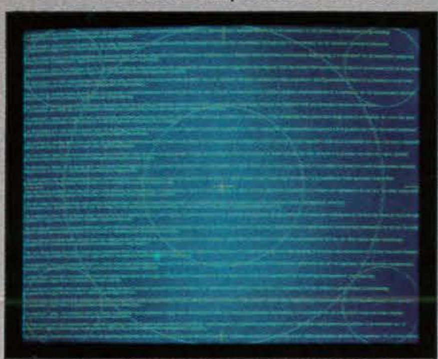

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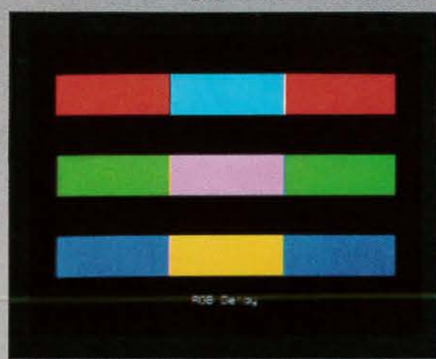

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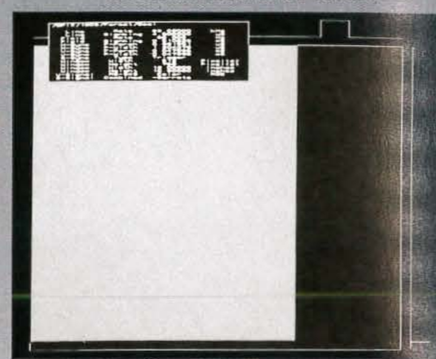

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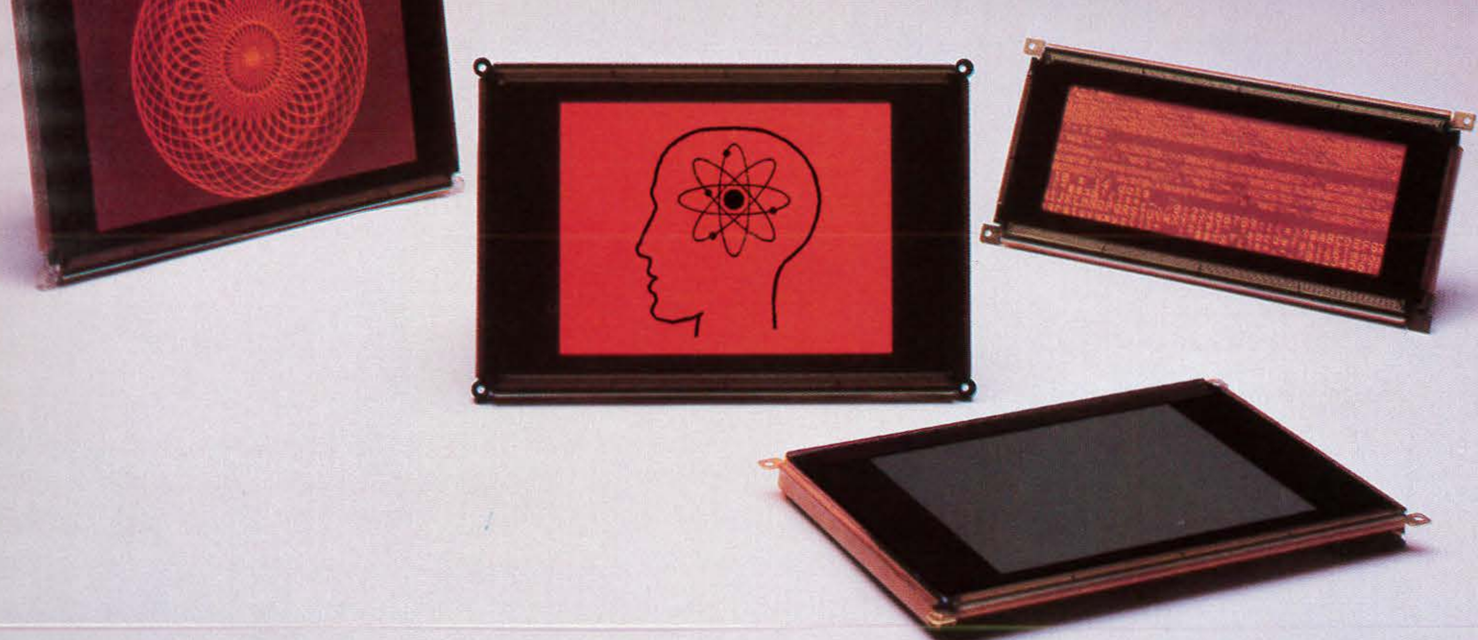

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Circle no. 3

≡ Official Monthly Publication of the Society for Information Display

INFORMATION DISPLAY

MARCH 1987
VOL. 3, NO. 3

Cover: self-portrait and "Proportions of Man" by Leonardo da Vinci displayed on a 640 × 400 pixel supertwist LCD from Sharp (page 8)

Next Month in Information Display

Silver Anniversary Issue

- Twenty-five years of display development
- SID: the first twenty-five years
- Twenty-five capsule interviews with display industry leaders
- Lewis Winner and SID

National art competition to include computer art

A major national art competition, including computer art, will be held in Los Angeles during the month of June 1987. Judges of the open, all-media competition include: Laura Rosenstock, Museum of Modern Art, New York; Susan Lubowsky, Whitney Museum, New York; Jacque Crist, Museum of Contemporary Art, Los Angeles; Victor Carlson, Los Angeles County Museum; and Nina Castelli, Lehman College Gallery, New York. Winners will exhibit at the Jerry Solomon Gallery, Los Angeles, with one work. $6000 in cash, purchase prizes, and awards. Deadline: April 2, 1987. For applications write to: Nora Smith, Director, Metro Art, P.O. Box 286-H, Scarsdale, NY 20583. 914/699-0969.

NCC registration half-price to SID members

SID members can register for the National Computer Conference in Chicago, IL, June 15–18, for $100 instead of $200 by using the specially marked advance registration form bound into this issue of *Information Display*. The discount applies only to advance registrations, and forms (or photocopies) must be postmarked by May 1. The American Federation of Information Processing Societies (AFIPS) is making this conference discount available to all its member societies.

Non-members can take advantage of the offer by first joining SID (annual dues are $35) for a net savings of $65. Use one of the membership cards in this magazine to request an application.

NCC '87 will cover a broad range of topics including: artificial intelligence and expert systems, local area networks, PC/micro/mainframe issues, and self-improvement sessions.

Student volunteers needed at NCGA conference

The National Computer Graphics Association is seeking college students interested in computer graphics who will help with registration at its annual conference in Philadelphia March 22–26 in return for free lunch and (depending on hours worked) free admission to the exhibits and technical sessions and free 15-month NCGA membership. Call Bob Scheller, volunteer coordinator, at 1-800/225-NCGA.

Computer Graphics '87 includes 129 conference sessions on topics ranging from the automated factory to the use of computer graphics in the arts, science, business, medicine, and education.

TRW launches mail-in subassembly repair program

TRW Information Systems Group, Fairfield, NJ, has introduced an extensive mail-in repair program for disk drives, monitors, microcomputers, peripherals, power supplies, printed circuit boards, printer mechanisms, and print heads. Called DEPOT DIRECT℠, the new program provides one source for repairs on a wide range of microcomputer equipment and subassembly products, including the following brand labels: Altos, Okidata, Taxan, TeleVideo, AT&T, Esprit, IBM, Wyse, Epson, Texas Instruments, and others to be added soon. For further information contact Customer Service Division, TRW Information Systems Group, 15 Law Drive, Fairfield, NJ 07006, 1-800/922-0897; in New Jersey: 201/575-7110, ext. 4231.

Static-dissipative film named "technology of the year"

STATICURE™, a static-dissipative packaging film developed by Metallized Products, Inc., Winchester, MA, has been named "The Most Significant Technology of 1986" by the Association of Industrial Metallizers, Coaters & Laminators.

STATICURE™ films provide permanent static-controlled packaging for highly sensitive devices. The films exceed industry requirements for surface resistivity, static decay, permanence, non-corrosivity, and sealability, and maintain static protection regardless of humidity. Unlike multi-layered, poly or carbon-impregnated films, the new STATICURE™ films incorporate a single plastic layer, in which the coating is driven through the film during the electron-beam radiation curing process. The protection is permanently impregnated, non-migratory, and allows full view of packaged items and printed identification. For further information contact Walter Gately, Vice President, Marketing, Static Control Group, Metallized Products, Inc., 37 East St., Winchester, MA 01890. 617/729-8300. Telex: 951992.

NEC MultiSync monitor wins *PC Magazine* award

The MultiSync multiple-scanning high-resolution color monitor developed by NEC Home Electronics (U.S.A.) Inc., Wood Dale, IL, was singled out as a winner during *PC Magazine*'s "Third Annual Awards for Technical Excellence," at last fall's COMDEX show. Cited for excellent design and performance in the graphics hardware category, the MultiSync was judged superior to seven other products nominated. Outstanding design features of the NEC Multisync monitor include an ultra-high-resolution display (640 × 480) and extensive color capabilities (16-color display from a palette of 64 colors). For further information contact Marion Black-Ruffin, NEC Home Electronics (U.S.A.) Inc., 1255 Michael Dr., Wood Dale, IL 60191. 312/860-9500, ext. 4244.

Executive changes

Carroll Touch, Inc., Round Rock, TX, has named **Lt. General David Doyle** (U.S. Army, retired) to serve in an advisory capacity for its Government Systems Division.

Paul E. Graf, president, **Conrac Corporation**, Stamford, CT, assumed the additional title of chief executive officer on January 1, 1987. Mr. Graf succeeded **Donald H. Putnam** who will continue as chairman.

Unisys Corporation, Blue Bell, PA, formed last year by the merger of Burroughs and Sperry, has announced the election of **Richard R. Shinn** to its board of directors.

Hartman Systems, Huntington Station, NY, has announced the following executive appointments: **Michael F. Canders**, product marketing manager, international markets; and **Howard S. Wortley, Jr.**, manager, business planning.

Official Monthly Publication of the Society for Information Display

INFORMATION DISPLAY

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editorial

Design inspiration can come from many sources: a newly available technology, a material now available at a lower cost, a recent discovery in experimental physics. With a display, the ultimate test is how people perceive it, so research into the factors that lead to visually effective displays can be a rich source of inspiration for display designers.

It's unfortunate that such a rich field of study should go under the dry name of "human factors." There is certainly little dryness evident in our lead article this month. Here, Gerald Murch indicates those areas in which flat-panel displays promise basic perceptual superiority over CRTs. His tone is far from the defensive one we often hear from flat-panel proponents, in which the CRT's visual superiority is acknowledged and the battle is then fought on the grounds of price, size, and power consumption. Jerry takes a much more assertive position, and his conclusions may indeed inspire some innovative designs by *ID*'s readers.

Inspiration may also come from a well-run symposium. Hearing stimulating papers and speaking with your peers often provides the broadened perspective that solves design and system integration problems. It is therefore not too early to plan your attendance at SID's Annual Symposium, Seminar, and Exhibition to be held this year from May 11–15 in New Orleans. To whet your appetite, we are including synopses of some papers that seem particularly interesting.

Like others who attended Japan Display '86 last fall, Derek Washington was astonished by the Japanese advances in color LCDs. He has summarized the major developments reported in Tokyo from the viewpoint of a CRT engineer who, for the first time, sees serious competition from other display technologies.

Two of three new features make their appearance this month. The first installment of an occasional book review column looks at a work that should be of interest to speakers preparing for the SID Symposium: *How to Prepare, Stage, and Deliver Winning Presentations* by Thomas Leech. If you are interested in reviewing for *ID*—for glory only, not cash—please drop us a line indicating your specialty.

Also premiering in this issue is the first of two alternating columns by Howard Funk. Howard never travels far without his laptop computer and modem, and he's using both to dip into his database and come up with a compilation of recent patents in the display field. This column will alternate with "Have You Read?," listing recent articles on display topics from other publications. Please use your reader response cards to let us know how you like these additions to *Information Display*.

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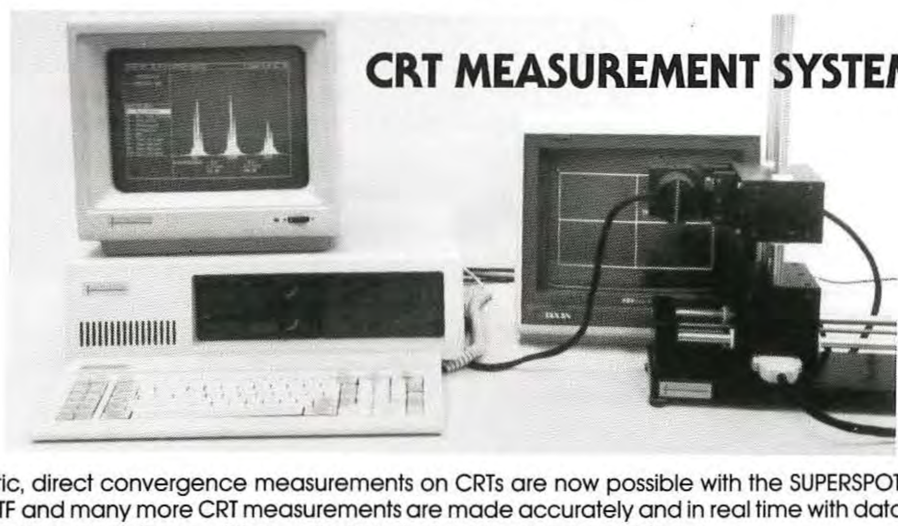

Automatic, direct convergence measurements on CRTs are now possible with the SUPERSPOT 100. Line width, MTF and many more CRT measurements are made accurately and in real time with data logging, profile plotting, as well as real time adjustment of convergence and focus.

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president's message

Last fall I discussed in this column the importance of recognizing and rewarding technical excellence, especially for a society such as ours that is committed to the dissemination of news and scientific breakthroughs in a broad field of technology. The task of identifying the important new developments is not an easy one but, fortunately, we have the experts in many areas who have the perspective and vision necessary to make the proper selection. As a society, I believe we have the obligation to identify important new developments, and the individuals who were responsible deserve our recognition for their achievements.

I was therefore delighted when IBM last spring announced that it would sponsor an annual SID prize for achievements in hard-copy technologies, a part of display technology that is growing very rapidly and is a cornerstone for our society. The new Johann Gutenberg Prize, which includes a $2000 cash award, will be presented for the first time at the SID '87 International Symposium in May; this year's recipient is Gary Starkweather, who will be honored for his pioneering efforts in the field of laser printing.

More recently RCA also announced that it would sponsor an annual SID prize "for outstanding achievements in display technologies." At its January meeting the Board of Directors decided to create a new SID award, the Karl Ferdinand Braun Prize, named after the inventor of the CRT (1897) and recipient of the Nobel Prize in physics (1909: for the coupled transmitter/receiver in wireless communications). The K. F. Braun prize will also include a $2000 award and will be presented for the first time at SID '87; this year's recipient is T. Peter Brody, who will be honored for his pioneering efforts in the development of thin-film-transistor active-matrix displays.

Together these two new prizes will take the place of the Frances Rice Darne Award which, until now, has been our most prestigious award for technical achievements in the field of information display. The selection of SID to administer these prizes and the decisions by IBM and RCA to thus honor outstanding achievements represents an important milestone: these events recognize SID's leadership role in all fields of information display and underscore the importance of innovation and excellence in our society. The two first recipients of these prizes have been carefully selected from many candidates and they set a high standard for future recipients to match. I am personally delighted with the recommendations of the SID Honors and Awards Committee and would like to acknowledge formally their hard work this year in soliciting the candidates, selecting the recipients, and creating the prizes themselves.

Sincerely,

Human factors and flat panels challenge the CRT

BY GERALD M. MURCH

EMERGING flat-panel technologies are faced with a powerful challenge to gain acceptance over the dominant display technology-the cathode ray tube (CRT). To succeed, a new display technology must be much more than price competitive: it must overcome one or more of the inherent weaknesses of the CRT.

Besides its relatively large size, weight, volume, and power consumption and its relative lack of ruggedness compared to flat panels, the CRT has specific weaknesses from a human visual perspective, particularly with regard to the uniformity, purity, and range of colors it produces and its spatial resolution. Herein lie opportunities for emerging flat-panel technologies to successfully compete against the CRT. To study such opportunities, display designers should consider the characteristics of human vision as a guideline against which specific technologies can be evaluated.

The database for evaluating display technologies from a human visual system viewpoint derives most heavily from sensory neurophysiology and from visual psychophysics. Sensory neurophysiology provides the basic understanding of how the human senses function. Any technology that is to interface to the human senses must be compatible with the needs of those senses. For example, a knowledge of the mechanism of visual accommodation allows the design of visual displays for which the lens of the eye is able to maintain a comfortable and accurate focal length.[1]

Gerald M. Murch directs the activities of the Human Factors Research Group at Tektronix, Inc., in Beaverton, Oregon. His current work emphasizes the effective use of color in displays.

Visual psychophysics provides both a database and a methodology for assessing the functional link between the display and the viewer. As an example, contrast sensitivity, a well-documented psychophysical function, provides an objective measure of the capability of the human visual system to process complex images in terms of the Fourier components of the image. Understanding this function allows the design of displays whose resolution matches the resolving powers of human vision.[2] The approach, then, is to treat the human eye and associated systems as a visual window into an electronic database. By calling upon the characteristics of this sensory system, designers can establish engineering goals for new technologies that will allow them to overcome the weaknesses of current technologies.

Resolution and addressability

Before considering specific resolution demands of the human sensory system let us try to overcome the confusion between two terms—resolution and addressability. Participants in last year's SID meeting in San Diego used (at least) these 11 expressions to describe the elusive concept of resolution: number of active lines, size of pixel or spot, beam cross section, line width, pixel frequency, addressable pixels, viewable triads, pixel pitch, mask pitch, raster frequency, and number of line pairs.

In the current context, resolution is the smallest detail which can be constituted on the display device. Practically, this detail represents the diameter of a single displayable pixel. Addressability, on the other hand, represents the number of displayed pixels per unit area, measured as the separation between the centers of adjacent pixels. Together, these physical parameters provide the basis for the visual impression of image sharpness that has long been known to be a key component of image quality. This overall image quality is a product of the significant physical attributes of the display, the visual capability of the observer and the environment in which the display is viewed.

The luminance of the light spot formed by an electron beam as it hits the phosphor in a CRT has a Gaussian or near-Gaussian profile. CRT technology precludes the production of a square profile—one in which the luminance rises at the edge of the pixel and goes from zero to its full value instantly. The weakness that results from this CRT characteristic relates to the mechanism by which the human eye focuses upon distal objects. Research indicates that a spot or line produces in the eye an image with a Gaussian energy distribution. The eye adjusts its focal length to produce a "perfect" Gaussian spot, which is interpreted by the visual system as an indicator of image sharpness. When the target itself has a Gaussian light distribution, the ideal focus can never be found.[3]

Thus, the square-profile luminance distribution offered by many flat-panel devices may represent a better match to the visual system than the Gaussian profile of the CRT. Unfortunately, this increase in focus and the resultant improvement in image sharpness carries a perceptual penalty. The disturbing quality of off-axis lines known as the jaggies is accentuated by a square pixel luminance distribution because of the human eye's hyperacuity for small offsets of square luminance distributions. Offsets as low as 8–10 seconds of arc are detectable in square-wave luminance distributions while only 20–30 seconds of arc can be detected with Gaussian luminance distributions.[4] This translates into a lower addressability requirement for Gaussian lines than for square profiles when the jaggies are to be rendered invisible. Once the diameter of a pixel is reduced below a specific level—probably about 7–10 mils—this advantage of the CRT dissolves because the visual system is unable to detect the higher spatial frequencies that define the edge of the square. Thus, the challenge for flat panels is to reduce pixel diameters to 7 mils or less.

A clear advantage for the CRT is the fact that individual pixels can be overlapped. Not only does this overlapping insure a flat field at full addressability, but pixels forming characters merge to produce smoother appearing lines. Several studies have shown that merged pixels in characters enhance display legibility;[5] that is, the ratio of the pixel diameter to pixel addressability, known as the resolution to addressability ratio (RAR),[4] can be greater than 1 [Fig. 1]. This means that an addressability can be selected for a given CRT resolution that renders individual pixels invisible when a full field raster is presented on the display. This is accomplished by selecting an addressability at which the variations in (or modulation of) luminance between adjacent pixels are below the human sensitivity to contrast [Fig. 2]. In the figure, the display has a spot size (diameter of the spot at 50% of the luminance maximum) of 0.254 mm (10 mils). As the addressability increases, denoted by an increasing value of the RAR, the luminance modulation between adjacent pixels falls. Where the luminance modulation intersects the human visual contrast sensitivity function, the luminance modulation is no longer detectable. In Fig. 2, this occurs with an RAR value of 0.92 at a luminance modulation of about 10%. This means that for a spot size of 0.254 mm, the maximum required addressability is 0.276 mm (0.254/0.92). For a display with a vertical height of 275 mm (10.8 in.) viewed from 500 mm, this translates to 996 lines. A greater addressability would be useless as it would be beyond the visual limit.

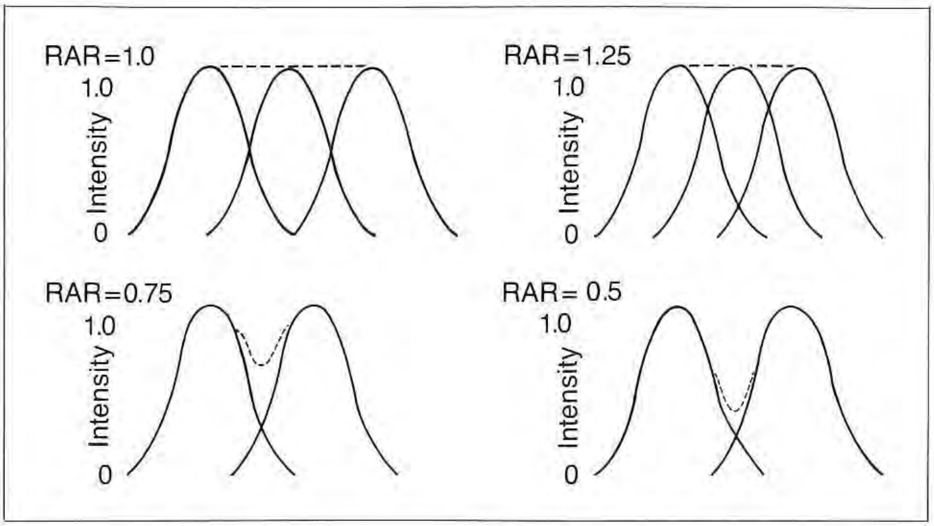

Fig. 1: A resolution-to-addressability ratio (RAR) of 1 or more (top left and top right curves) produces essentially no modulation between adjacent pixels while RAR values less than 1 (lower left and lower right curves) produce an increasing modulation between pixels as the RAR decreases. Discrete element flat panels have no pixel overlap so that the RAR is always less than 1 and the modulation between elements equals 100%.

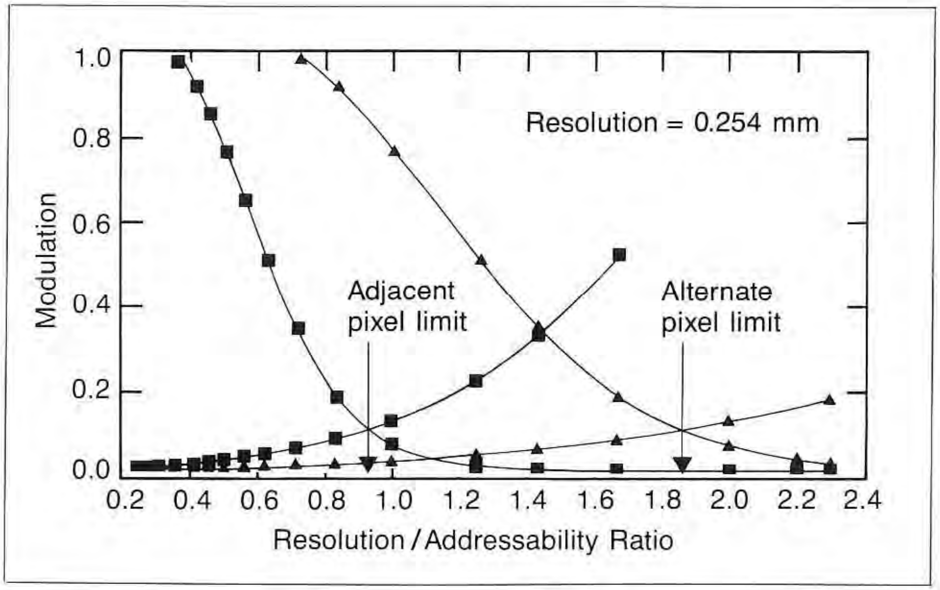

Fig. 2: The sloping curve starting in the upper left of the graph (squares) indicates the luminance modulation between adjacent pixels as the RAR increases. The lower curve indicates the human contrast sensitivity function (triangles). The intersect of these two curves indicates the visual limit for the detection of the luminance modulation between pixels. To insure that the viewer be able to distinguish between alternate pixels, the modulation between every other pixel is shown as well. The optimal ratio is a value just below the visual limit which allows alternate pixels to be distinguished.

For a flat-panel display with discrete non-overlapping pixels or elements, the RAR is always less than 1. For example, a panel with a display element size of 0.254 mm and an interelement spacing of 0.0508 mm would have an RAR of 0.91 (0.254/0.279). To achieve a flat field in which the individual elements are not visible when the luminance modulation between adjacent elements is 100%, the element density must be greater than the visual limit. This limit lies at a spatial frequency of about 50 cycles/degree of visual angle. In a panel with a vertical height of 275 mm (as in the preceeding

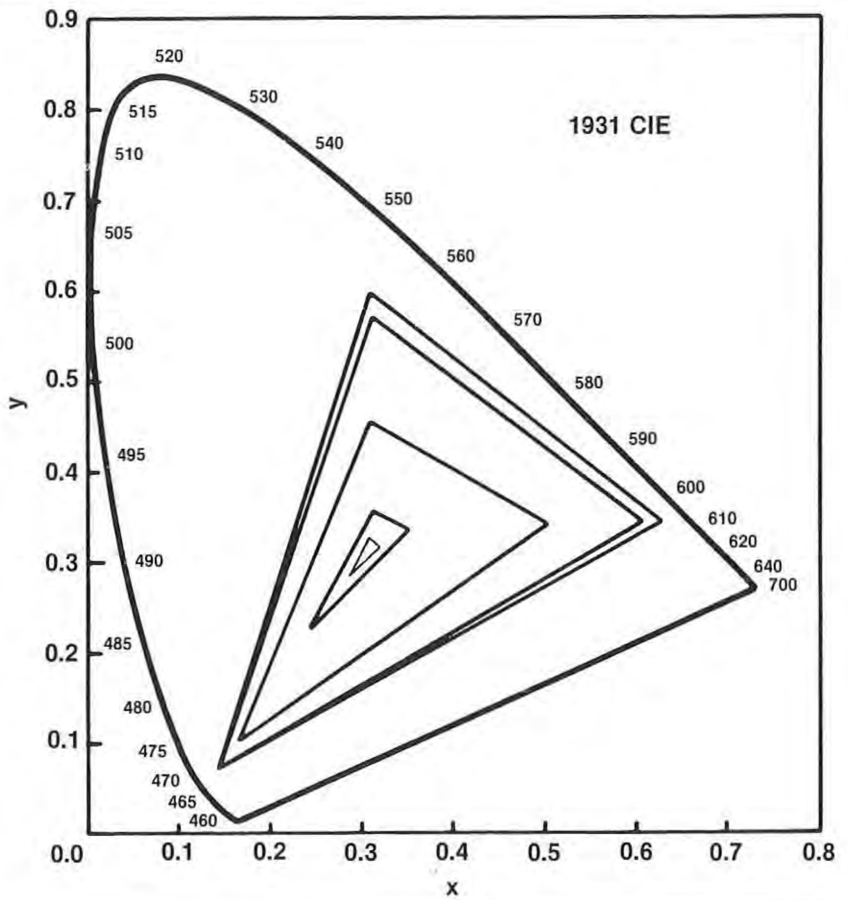

Fig. 3: The available color range on a typical shadow-mask CRT is indicated by the triangle in which the three primaries form the apices of the triangle. The smaller embedded triangles indicate the available color range with increasing levels of ambient sunlight.

example), 1670 lines would be required to produce a spatial frequency equivalent to 50 cycles/degree. This is a worst case, however, because the spacing between active display elements is assumed to be the same as the element width. With decreasing interelement spacing, the required addressability falls.[6]

Color range

Shadow-mask CRTs with typical phosphors produce a well-defined range of colors [Fig. 3]. Given electron guns with adequate intensities, these CRTs produce all the colors within the color triangle. While this range encompasses only one-half the colors the human eye can detect, it does provide a reasonable range of hues with acceptable brightness and saturation levels, as indicated by the images we have come to accept on home television. The range is not as good as can be obtained with film dyes, as is often seen when objects with colors lying outside the color triangle of the CRT are portrayed on film. The TV portrayal of colors such as emerald green and titian red are desaturated versions of the original.

Flat-panel technologies that do not rely upon phosphor emissions for color production have a significant opportunity to produce color renditions superior to those offered by CRTs. For one thing, dyes may be used for the production of colored filters that create primary colors well beyond the boundaries of CRT phosphors. Furthermore, the three-color primary system used in today's CRT is dictated more by engineering considerations of gun design than by colorimetric requirements. Primary systems of four or even five colors would increase the available range of colors and improve the saturation and brightness of mixed colors as well. These saturation improvements occur because colors produced through the mixture of pairs of primaries are generally less saturated than either of the component primaries. The loss of saturation increases as a function of the spectral difference between the primaries. By decreasing the spectral difference through an increased number of primaries, greater saturation of the mixtures is obtained. As for brightness, the luminance efficiency of the blue and, to some degree, red phosphors used in today's CRTs is disappointing. High luminance levels and improved brightness can be obtained with appropriate filters.

Another weakness noted in the CRT is the lack of color uniformity. A full-field color often varies in luminance by 50% from center to periphery and in color by 20-25 ΔE units.[7] While improvements in process control can reduce the nonuniformity resulting from uneven phosphor deposition, they increase the cost of tube assembly. Colors produced by filters placed over active elements, as is done in several flat-panel technologies, should show less variation in terms of luminance and purity due to the inherent stability of dye-coupled filters.

Although adequate data does not exist to predict the degree of improvement which can be expected, color uniformity and range of available colors appear to be two areas of potential superiority for some flat-panel technologies.

Convergence

In a typical CRT, electron beams can overlap each other. This is a desirable feature because it reduces the addressability requirements. Nevertheless, this very attribute produces misconvergence—a variation in placement of the electron beams produced by the different electron guns. This effect was demonstrated by data collected at Tektronix Inc. [Fig. 4] in conjunction with the design of the company's autoconvergence system.[8]
The graph indicates the percentage of observers able to perceive the misconvergence of the red or green gun relative to the blue gun when a pattern of white lines, characters, and panels was presented on the display. In this case the line width was 0.51 mm (20 mils). As the graph indicates, subjects could detect the misconvergence 75% of the time at 0.16 mm, which corresponds to about 30% of the line width. Current CRT systems have great difficulty in maintaining convergence limits within this range without the addition of autoconvergence devices or digital convergence systems that add to the system cost. As most flat-panel technologies emit or reflect light from a fixed element, misconvergence is not a problem in flat-panel displays.

Ambient light

The ambient light level on the CRT causes front-surface glare and contrast reduction among other problems.

All user surveys agree that front-surface glare represents the most disturbing attribute of today's CRT technology.[9] Although reflected light is an unfortunate property of glass, the applicaton of optical coatings can reduce the reflectivity from the normal 4.5% to 0.5% or less. But such coatings increase CRT cost. Other solutions, such as etching, serve only to redistribute the reflected light rather than reduce it. Additionally, etching reduces resolution by broadening the spot.[10]

Associated with glare and contrast reduction is the reflectivity of the CRT's phosphor layer. Typically 30% of the incoming light is reflected back to the operator by the phosphor layer. This produces glare and reduces the contrast on the screen. While most flat panels utilize a glass front surface and are therefore subject to the same reflectivity problem as the CRT, reflectivity from non-active areas of the screen can be reduced. Nonemissive displays already hold an edge over the CRT in high ambient light conditions because the contrast between written and unwritten screen areas increases with increasing ambient light. In general, incorporating a polarizing layer in a flat-panel display has the added benefit of enhancing contrast in high ambient light environments.

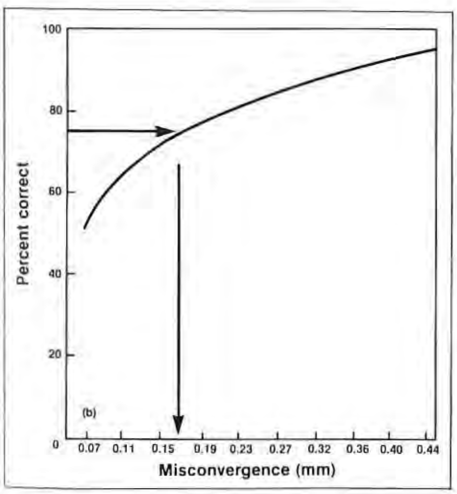

Fig. 4: Perceived misconvergence of a 50-mm-wide white line on a shadow-mask CRT, as measured at Tektronix, Inc., in Beaverton, Oregon. The graph indicates the percentage of observers able to perceive a given misconvergence of the red or green gun relative to the blue gun.

Distortion

While a piece of glass usually constitutes the first layer in most display technologies, the thickness and shape of the glass represent a further weakness in CRT technology. Because the outer envelope of a CRT must provide implosion protection, its front-surface glass must be relatively thick. For off-axis viewing, the light traveling through the glass is refracted and a distortion of the image results. The larger the screen, the higher the distortion created by the implosion shield. In most CRTs this distortion is aggravated further by the curvature of the screen.

Flicker and jitter

Also high on the list of user complaints with CRT technology is image flicker, or the inverse problem of image smearing.[9] Typically, display system designers strike a delicate balance between the display's refresh rate and the visibility of the temporal luminance modulation. If the phosphor responds to the impinging electron beam too quickly, full screen flicker is visible. If the phosphor reacts too slowly, noticeable smearing and ghosting occurs. For modern systems that are capable of animation, the problem is even more severe because the temporal limits over which smooth motion is perceived are fairly narrow.[11] Although system designers may select the appropriate decay rates for given phosphors to minimize flicker,[12] the number of phosphors with optimum rates is limited. Many flat-panel systems are less dependent upon the physical properties of an emissive phosphor; as a result, their temporal relations can be tailored to match the human visual capacity. Additionally, unlike CRTs, flat panels have their pixels' positions fixed. In CRTs, because this position may vary during successive screen references, the image occasionally suffers from jitter.

Conclusions

This review of a few CRT weaknesses indicates that opportunities exist for emerging flat-panel technologies to demonstrate advantages over the CRT in the visual as well as the physical domain. Those advantages will need to be extensive if the cost difference is to be justified. Of those weaknesses discussed in this review, those related to color uniformity, purity, and range, as well as the associated convergence, would appear to offer the most attractive opportunities for the flat-panel designer to demonstrate superiority over the dominant CRT technology. However, designers must also consider the potential disadvantages of flat-panel technologies relative to CRTs. From a visual perspective these include viewing angle limitations, contrast loss with increases in addressability, element drop-out, etc. Display system designs must surmount these inherent disadvantages in addition to overcoming the noted weaknesses of CRTs.

References

[1] G. Murch, "Visual Accommodation and Convergence to Multichromatic Display Terminals," *Proceedings of the SID*, Vol. 24 (1982), pp. 67–72.

[2] A. Ginsburg, "Perceptual Capabilities, Ambiguities and Artifacts in Man and Machine," *SPIE*, Vol. 283 (1981), pp. 78–82.

[3] G. Westheimer, "Spatial Interaction in Human Cone Vision," *J. Physiol.*, Vol. 190 (1967), pp. 139–148.

[4] G. Murch, L. Virgin, and R. Beaton, "Resolution and Addressability: How Much is Enough?," *Proceedings of the SID*, Vol. 26 (1985), pp. 305–308.

[5] H. Snyder, "Human Visual Performance and Flat-Panel Display Image Quality," *Virginia Polytechnic Institute and State University, Human Factors Laboratory Technical Report* HFL-80-1/ONR-80-1 (1980).

[6] Empirical research data on the visual requirements for discrete element flat panels will be presented at SID '87 by Robert Beaton of Tektronix, Inc.

[7] The metric ΔE is a measure of color difference. In general, values in excess of 10–15 units on a CRT produce clearly visible color differences.

[8] D. Denham, W. Meyer, and G. Murch, "Using Autoconvergence in a Color Display," *Mini-Micro Systems* (November, 1983).

[9] M. Smith, "An Investigation of Health Complaints and Job Stress in Video Display Operators," *Human Factors*, Vol. 23 (1981), pp. 387–400.

[10] R. Beaton and H. Snyder, "The Display Quality of Glare Filters for CRT Terminals," *Digest of SID*, Vol. 15 (1984), pp. 298–301.

[11] G. Murch, *Visual and Auditory Perception* (Indianapolis, Indiana: Bobbs Merrill, 1973).

[12] An empirically derived algorithm for determining flicker thresholds for CRT phosphors will be presented at SID '87 by Joyce Farrell of Hewlett Packard Laboratories. ■

SID '87 program highlights

THE LATEST developments in television, flat-panel technology, large-area displays, printing technology, and automotive displays will be among the topics covered at SID '87, the 1987 International Symposium, Seminar and Exhibition of the Society for Information Display, to be held May 11–15 at the Hyatt Regency New Orleans.

This year's Symposium will feature 19 technical sessions running concurrently on Tuesday, Wednesday, and Thursday (May 12–14), the largest exhibit of display manufacturers in SID's history (over 70 companies represented), and a two-day Seminar which, as usual, will be given on Monday and Friday of the conference week (May 11 and 15).

The SID '87 Seminar will begin with an overview by Larry E. Tannas, Jr. of Rockwell International, entitled "State of the Display Industry and Where It's Going."

On Monday and Friday industrial and academic experts from the U.S., Europe, and Japan will address the following topics in 14 separate tutorials: Visual Perception Basics; Electroluminescent Displays; Direct-Multiplexed LCDs; Active Matrices for LCDs; Display Measurement Technology; The Evolutionary CRT; Colorimetry of Displays; Tactical Fighter Display Requirements for the 1990's; Plasma Displays; Color Hard Copy; Advances in Image Processing for Art, Medicine, and Mapping; Image Synthesis and Computer-Generated Animation; Electronic Projection Displays; and Touch Input Technology.

The Symposium will feature two keynote addresses. Abel Farnoux of Electronics International Corp. will speak on "MINITEL and Its Applications" and Ralph V. Wilhelm, Jr. of Delco Electronics Corp. will speak on "The Automotive Instrumentation Explosion."

The SID '87 Symposium program of 95 contributed and 4 invited papers represents a cross section of new developments from around the world in display research, device characterization, fabrication, systems integration, human factors, printing and workstation technologies, as well as the emerging field of automotive displays, which will be highlighted this year. In addition to Ralph Wilhelm's keynote address, the Symposium will include, for the first time, an automotive display technology session and an evening discussion panel on future automotive display requirements. Two General Motors advanced concept cars will be on exhibit throughout the conference week.

Formal presentation of contributed papers will begin Tuesday afternoon and continue through Thursday afternoon. At the end of each day the audience will once again have an opportunity to talk informally with the authors and to view experimental prototypes at author interview sessions.

SID '87 features informal panel discussions on Tuesday evening. This year's panel topics are: Automotive Display Requirements for the 1990's; Failure Mechanisms in Displays and Display Systems; Advanced Television Systems; and Future Workstation Printers.

Papers were carefully screened by the SID Program Committee for technical quality and novelty, so it is risky to highlight only a few. Nevertheless the following papers can be expected to be particularly noteworthy because of their timeliness, novelty, or expected impact.

- *Professor Harry Snyder* of Virginia Polytechnic Institute chairs the American National Standard Institute (ANSI) Committee charged with preparing a national standard for human factors aspects of video display terminals. This draft standard will critically influence the nature of future display workstations, as evidenced by the fact that more responses to the proposed standard have been received by ANSI than to any other proposal in the institute's history. In an invited address, Dr. Snyder, a noted expert in display human factors, will review the history, content, and current status of the proposed ANSI standard, and will also acquaint members with the standard-making process and the level of technical conservatism inherent in it. (paper 4.1)
- *NTT Electrical Communication Labs* has developed a device structure and fabrication process to make full-color thin-film electroluminescent displays. The process can be used to make a patterned array of red-blue-green phosphor dots very much like that in a color shadow-mask CRT. This development paves the way for a new generation of color flat-panel displays for computer and TV applications. (paper 13.1)
- *Engineers from Seiko Instruments* have developed a full-color active-matrix liquid-crystal display using a newly developed "V^2" amorphous-silicon thin-film transistor. The 14-in.-diagonal panel has $440 \times 640 \times 3$ dots with color filters arranged in a RGB stripe pattern. (paper 9.1)

• *Researchers at F. Hoffman La Roche* will report their findings on the development of a new liquid-crystal electro-optic effect called optical mode interference (OMI). The OMI device is based on the strong interference of two normal optical modes similar to that which occurs in the supertwisted nematic (SBE) liquid-crystal configuration. The OMI device is black-and-white and represents an important advantage over the SBE device. It has a weaker cell-gap dependence, potentially resulting in a more flexible manufacturing process. (paper 20.1)

• *Seiko Epson* has optimized its liquid-crystal light valve for use in a high-resolution full-color TV projector. Optical properties of the twisted-nematic liquid crystal (TN-LC) have been studied in order to optimize the LC light valve. Three TN-LC light valves, each of which has 440 × 480 poly-Si thin-film transistor elements and an optimum $\Delta nd/\lambda$ for red, green, or blue, provide an excellent video image on a projection screen. (paper 6.5)

• *A full-color TFEL device* from Tottori University of Japan consists of two stacked electroluminescent devices of blue-green-emitting SrS:Ce,K and red-emitting CaS:Eu phosphors, and short- and long-wavelength pass filters. The configuration produces a full range of colors. (paper 13.2)

• *The largest ac plasma panel yet built* is also the largest single-unit flat-panel display yet built. The active area of the Photonics Technology display is 59-in. diagonal. It has 2048 × 2048 elements (over 4 million pixels) at a resolution of 48.8 pixels/in. The panel can display computer or TV images at 30 frames/sec with area luminance of 15 fL. The panel is transparent, so maps or other data can be projected from the rear, with the electronic information superimposed. (paper 7.4)

• *An active-diode-matrix LCD* from Seiko with 640 × 400 pixels (9.8-in. diagonal) uses an off-stoichiometric SiNx layer. Since the LCD is fabricated by a process with only two masks, it promises low-cost production. (paper 9.5)

• *NEC Corporation* has developed a fast linear-array liquid-crystal light-valve designed for high-speed printing. The print head employs a newly developed ferroelectric liquid crystal and 1/8 duty-ratio multiplexing. It has 400-dots/in. resolution and can print 10 B4-size pages/min. The print head has applications in facsimile, electronic editing, and publishing systems. (paper 19.2)

Student Papers at SID '87

This is the second year that SID has provided travel funds to student authors of accepted papers and their professors to attend the SID Symposium.

This year's student authors come from universities in the United States, Canada, Japan, and West Germany. They are:

• *Stephen T. Knox of Portland State University*: "Resolution and Addressability Requirements for Digital CRTs" (paper 4.4)

• *Ralph C. McArthur of Oregon State University*: "Efficiency Improvements in ZnS:Mn TFEL Devices Driven by a Stepped Pulse Train" (paper 16.6)

• *Marc Hunter, R. G. Pigion, and V. A. Bowers of Virginia Polytechnic Institute and State University*: "MTF and Perceived Image Quality for Three Glare-Reduction Techniques" (paper 4.5)

• *James J. Reger of Virginia Polytechnic Institute and State University*: "Performance and Preference for Cursor-Key Control Configurations in Editing Tasks" (paper 4.3) and "Visually Displayed Force Feedback in Delayed and Non-Delayed Bilateral Teleoperation" (paper 8.6)

• *W. H. Miller of the University of Windsor*: "A New Optical Method of Paper Roughness Measurement for Thermal Transfer Printing" (paper 15.3)

• *Tetsuya Miyashita of Tohoku University*: "Stereoscopic Display Using Double Guest-Host Liquid-Crystal Cells" (paper 20.5)

• *Wolfram Runge of Technische Universität München*: "One-Dimensional Simulation of a Phase-Change Cycle in Thermal Ink-Jet Printers" (paper 11.2)

• *An A4-size thermal-dye transfer printer* from Hitachi with a high-speed drive produces 6-dots/mm resolution and 64 gradations of three colors for each dot. A full-color near-photo-quality print is obtained from a high-definition TV signal within approximately 2 min. (paper 22.2)

• *A silverless, dry color print paper* based upon microencapsulation and photopolymerization technologies has been developed by Mead Imaging. Researchers from Mead Imaging and Landmark Technology have used this paper in a color printer to produce high-quality high-resolution images from digital data sources. Electronic printing of full-color halftone images is made possible by the use of a laser-addressed liquid-crystal light modulator to optically project a sequence of color-separated images onto the Mead color paper. Images with resolution of up to 3000 × 3000 dots have been written with a laser power of 7 mW. (paper 19.5)

• *AT&T Bell Laboratories* has developed a hardware device, the Image Prism, for accelerating bit-map image mirroring, 90° rotation, and transpose operations. With this device, images can be reoriented in place without additional buffer memory and at speeds and memory activity equivalent to moving the image (BitBlt). An 8 × 4 Mbit image, the size of a laser printer bit-map, can be rotated in under 1 sec. (paper 21.2)

• *An analytical technique* for predicting whether or not a display will flicker has been developed by Hewlett Packard. Only knowledge of phosphor persistence, refresh frequency, observer distance, and luminance is required to make this prediction. This is particularly significant at this time since VDT requirements for flicker-free displays are being invoked but no uniform measures to determine what is flicker free have been embraced by the standards groups. (paper 4.2)

• *RCA Laboratories* presents new insights into the perennial problem of minimizing moiré effects in color CRT displays. This paper demonstrates that moiré cannot be eliminated by judicious choice of the vertical aperture period or of the aperture pattern. Only by making the raster illumination pattern more uniform can moiré visibility be reduced. (paper 18.5)

• *Colors that match in luminance* often do not match in brightness. This discrepancy between brightness and luminance poses significant problems for designers of electronic color displays. Researchers at the Univeristy of New Brunswick have developed a simple method to correct the discrepancy. The method utilizes a polynomial equation that yields a luminance correction factor as a function of a color's CIE 1931 chromaticity coordinates. This equation provides a significant improvement in our ability to accurately specify the visual characteristics of color displays (paper 17.1) ■

Conference report: Japan Display '86

BY DEREK WASHINGTON

JAPAN DISPLAY '86, a meeting jointly sponsored by the Society for Information Display and the Institute of Television Engineers of Japan, took place in Tokyo September 30–October 2, 1986. It covered a wide range of device and system research dealing with the display of information from electronic sources. As expected, the subject matter showed a strong bias towards LCDs (60 papers); next came CRTs (18) followed by EL (16), electrochromic (9), plasma (7), VFDs (5), with just a single paper on LEDs. The attendance was 550, of whom 400 were from Japan.

This report is presented largely from a CRT engineer's viewpoint from where, for the first time, competition between technologies seems to be serious.

The main highlights undoubtedly came from the LCD area. One of the most significant was the large area achievable with active-matrix color LCDs. Seiko demonstrated a 14-in. panel; the colors were not brilliant and there were many line and pixel defects, but it was 14-in. and that was very impressive.

Two color LCDs from Hosiden were also impressive. One was a 5-in. television panel. Brightness, contrast, and color saturation were outstanding, and it seemed to have a respectably large viewing angle. The other was a 130 × 130 mm square datagraphics display. It showed a restricted range of colors and no halftones but, like its smaller cousin, it was a pleasure to look at and had that sparkling quality which hitherto has been restricted to CRTs. Both of these displays showed pixel defects at normal viewing distance, and there were rumors that yield was a problem. Some lag was also apparent in the larger panel. These displays, together with some of the smaller TV panels which were demonstrated at the nearby Japan Electronics Show (notably from Sharp and Matsushita), are setting new performance standards by which all small color displays are going to be judged in future.

Boeing reported that they are seeking LCDs for aircraft flightdeck applications, where 8-in.-square color is required. The staircasing associated with dot-matrix addressing will have to be eliminated, and poor viewing-angle performance is also a problem (there must be simultaneous viewing capability by pilot and co-pilot). Boeing is also going to introduce seat-back displays for entertainment in their next generation of passenger aircraft; these are most likely to be LCDs in the 4-6-in. range.

Moving on to emissive technologies, the quest for color EL continues, but there is much still to do. Luminance matching seems to be a problem; one group reported 5000 nits green, 650 nits red, and 10 nits blue. Among the plasma and vacuum fluorescent papers there was one challenger to the CRT for datagraphics, but still no serious rival for TV. The datagraphics display was Futaba's flat VF panel which was also demonstrated at the author interviews. Performance was impressive, with good color and contrast, reasonable brightness for normal room use, 8-level gray scale, and resolution of 320 × 200 three-color pixels on a 0.56-mm triplet pitch (180 × 100 mm display area.)

The achievement of a practical cold-emitter is an objective of the French group, LETI, who claimed to have overcome uniformity and life problems (usually associated with this technology) by averaging the emission of 1000 emitters/pixel in their microtips fluorescent display. The tips were fabricated by first creating etched cavities in a substrate using photolithographic methods, and then building up the emitting points by evaporating molybdenum into the cavities. They have made a 32 × 32 pixel array, but thus far have only demonstrated good life in very high vacuum.

The use of plasma technology for color TV is still being investigated by NHK, who reported a new 5-in. display which is of simpler construction than their previous panel. However, quoted brightness and efficiency were poorer than before—137 nits down to 58 and 0.34 lumens/W down to 0.11. Nevertheless, NHK still predicts that plasma technology will produce an acceptable HDTV display in the near future. It seems appropriate to refer here to Hitachi's color plasma panel which was not in the program. This conference would have provided an ideal venue for a home-based demonstration of the 8-in. panel (with 40 in. predicted) which was announced last May, so one wonders why it did not appear.

CRTs ranged in size from a massive (85 kg) 43-in. shadow mask down to tiny tubes for viewfinder use. The 43-in. tube was from Matsushita; it was said to pro-

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vide the optimum picture size to represent reality in the most commonly used TV scenes, which consist of one or two people shown head and shoulders. Super-real, i.e., larger than life, was said to present an unpleasing viewing experience. This tube was also demonstrated at the Japan Electronics Show.

There were three contributions on flat (thin) CRTs. The Kanazawa Institute of Technology gave an update on their small box-like tube which uses a single line cathode. This was first described in Kobe three years ago; since then they have improved the resolution to achieve 192 vertically deflected beams into a 3-in. display. Improved brightness was claimed (240 nits) and non-working tubes were shown at the author interviews.

Hitachi demonstrated a flat 4-in. beam-index CRT similar in concept to the Sony Watchman tube. Color and brightness were reasonable, but contrast did not seem quite up to shadow-mask standards. It is interesting to note that both Sony and Sanyo are working on similar color tubes for TV, and seem to think there will be a sufficient market life, while the LCD people are sorting out their yield problems.

The third paper on flat CRTs was an update of the Philips channel multiplier CRT. Having demonstrated the feasibility of the approach with 12-in. monochrome tubes, the research is concentrating on adding color. TV-quality results have been demonstrated on a 2.8-in. display in a demountable vacuum unit using a line-sequential color selection system.

Finally a few impressions of the Japan Electronics Show might be appropriate as some of the items described in papers were being demonstrated there. This event was held in Tokyo immediately after the conference. It was a large exhibition with seven major sections housed in five different buildings. The most interesting new displays were the active-matrix LCDs. All were good, with the Sharp 3-in. TV display looking the best. It had excellent color saturation and contrast, a low flicker level, and good viewing angle. The launch date is said to be in the spring of 1987.

Going to the other extreme of the size range, 37-in. shadow-mask tubes were common and tubes of 42 and 43 in. were being shown. The stimulus behind these huge tube sizes appears to be partly fostered in Japan by trendy young consumers who want large colorful displays for their pop videos.

The overall impression gained from attending these events is that the Japanese attitude to the displays market is largely consumer driven. In the next five years or so, differing technologies will dominate various sectors with TV displays organized along the following lines: small-area displays (up to about 10 in.) will be LCD; thin flat CRTs will take over the medium sizes; the large sizes will stay with shadow masks; and very large displays will remain the province of projection systems. ■

Free Commemorative Pin If You Register for SID '87 before April 27, 1987

Everyone who registers for SID '87 before the advance registration deadline of April 27, 1987, will receive a free 25-year pin commemorating SID's silver anniversary. For a program and registration form, call 212/620-3388.

books

How to Prepare, Stage, and Deliver Winning Presentations

by Thomas Leech
417 pp. New York: American Management Association. $39.95 cloth; $14.95 paper.

Too many books on public speaking follow a predictable formula. There are treasuries of podium jokes, books of famous quotations, and collections of great speeches, all doing their best to put someone else's words in your mouth. A few books offer more practical advice, but in a form best suited to the business or financial speaker. The engineer who has been called upon to give a research paper at a technical conference, or to brief top management on a current project, has until now been left to his own devices.

This new book by Thomas Leech fills the need for a comprehensive guide to preparing technical presentations. While not written exclusively for scientists—sales and advertising presentations are also covered—the book draws many of its illustrations from the author's own background in aeronautical engineering, giving it special relevance for scientists and engineers. Comprehensive, readable, organized for easy reference, the book delivers sound advice on everything from overcoming stage fright to preparing slides to handling audience questions.

Thomas Leech spent 20 years at General Dynamics before becoming a teacher and consultant in business communications. An accomplished speaker himself, Mr. Leech has helped many others to become more effective presenters. He has heard and countered all the excuses of the people who feel they can never be good speakers. He has met the shy scientist who is happiest behind his bench and who wishes "they" would leave him alone and "let the showboats do the talking." Like it or not, public speaking is a fact of life in today's corporate world, where the ability to speak effectively before a group is often a prerequisite for career advancement. Knowing this, Mr. Leech is not content to make better speakers out of us: he wants us to enjoy the process.

In an early chapter, the author examines the psychological barriers to public speaking. The gist of his advice is that good speakers are made not born; that preparation and practice can ensure those small successes that pave the way for the larger ones. Declaim in the shower. Read aloud to your children. Everything helps. It may be comforting to learn that many great actors never fully overcame their stage fright. The butterflies may never go away, but they can learn to fly in formation.

The author devotes a long chapter to the organization of ideas. He explores the standard formulas for structuring a presentation, and describes the tools—outlines, doodles, and story-boards—that can help to clarify thought. Since a well-organized presentation is the one most likely to hold the audience's attention and get its message across, the time spent on these preliminaries is well worth it. This interesting material is as relevant to writing as to speaking. The same can be said for the author's section on the effective use of language, which can stand beside the best writing manuals.

The preparation of audio-visual materials receives a complete treatment. One of the biggest complaints at conferences concerns visuals that cannot be read by the audience. We all know that slides and viewgraphs should not be too crowded, but how much information is too much? What is the optimum type size? Which colors work best? What kinds of things should never be included on a slide?

Two other chapters have special relevance for conference presenters. The one on speaking from a manuscript tells how to do it without putting your audience to sleep. The chapter on audience feedback gives techniques for dealing with hostile questioners, frequent interruptions, and even a complete lack of questions. The author also includes some thoughts on judging the mood and interest level of your audience.

Other chapters cover team presentations, speaking in foreign countries, and the role of the emcee. A bibliography lists books for further reading.

Throughout, Mr. Leech follows his own advice to "tell 'em what you're gonna say, say it, then tell 'em what you said," so that the book is very easy to use for study and reference. His style is a model of what writing should be; illustrations and examples abound on every page, making the book a delight for browsing. We'll conclude with a sample, taken from the chapter on delivery.

"Even puns have a place. David Goodstein, chairman of the faculty at California Institute of Technology, likes to end his lectures with puns because, he said, they bring forth a loud and exquisitely predictable groan, waking up everyone for lunch. Example: 'Heroes in the history of science come and go, but Ampère's name will always be current.' You may now groan." ■

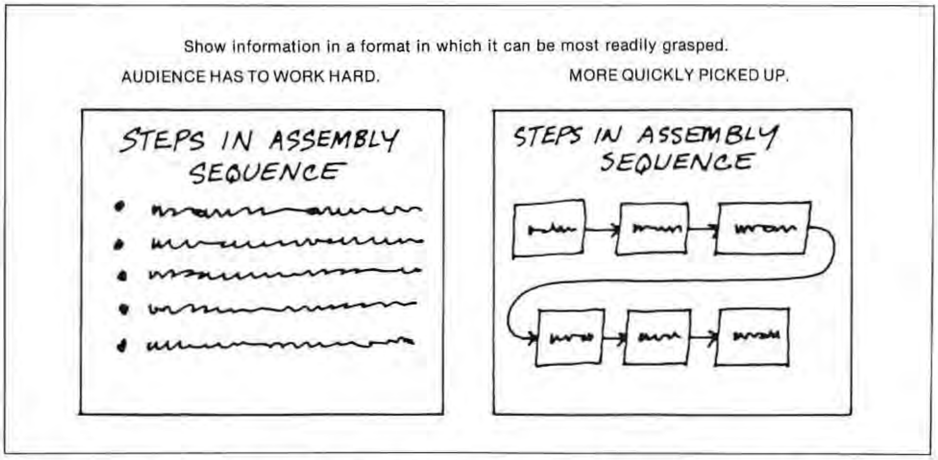


Illustration adapted from "How to Prepare, Stage, and Deliver Winning Presentations"

recent patents

Compiled by Howard L. Funk
IBM Corp.

U.S. Pat. No. 4,635,051; Issued 1/6/87
High-Speed Electro-Optical Light Gate and Field Sequential Full Color Display System Incorporating Same
Inventor: PHILIP J. BOS
Assigned to: TEKTRONIX, INC.

A high-speed electro-optical light gate includes a pair of matched variable optical retarders positioned between a pair of light polarizing filters to promote rapid switching between optical transmission states for light rays of the wavelength to which the variable optical retarders are tuned. The projections of the optic axes of the variable optical retarders are orthogonally aligned so that the response time characteristics of the transitions between optical transmission states of the light gate reflect only the turn-on time response characteristic of the variable optical retarders. A field sequential color display system incorporates a switchable color filter which utilizes the alignment configuration of the variable optical retarders of the light gate to provide light output states of white light and light of three different colors to form an image in full color.

U.S. Pat. No. 4,635,107; Issued 1/6/87
Electron Beam Position Control for Color Display
Inventor: JOHN A. TURNER
Assigned to: IBM CORP.

An electron beam position control arrangement for a color CRT includes a series of spaced apart, parallel conductive strips on the faceplate or phosphor cooling of the CRT, the spaces between the strips defining a path along which an electron beam produced in the CRT is to be scanned. The electron beam is modulated with a pilot signal and, in the event the beam deviates along the predetermined path between the conductive strips, the pilot signal is detected as a result of the electron beam impinging on one of the strips by an amount greater than the beam impinges on an adjacent strip along the predetermined path, and the beam is returned to the predetermined path by position correction circuitry connected to beam deflection circuitry associated with the CRT. Such beam control arrangement allows for phosphors of different colors to lie between successive sets of the conductive strips, and for one or more electron beams to scan color phosphors to produce a color picture, without the use of a shadow mask or aperture grill in the CRT.

U.S. Pat. No. 4,636,866; Issued 1/13/87
Personal Liquid Crystal Image Display
Inventor: NOBORU HATTORI
Assigned to: SEIKO EPSON

A personal liquid crystal image display includes a housing to be worn on a user's head, a light-transmission-type liquid crystal display panel for displaying video signals and a lens positioned between the display panel and a user's eye to enlarge the image. The housing may include earphones. The display and earphones are coupled to a tuner for receiving signal and driving the display and earphones. A portion of the drive circuit for driving the display may be disposed in the housing.

U.S. Pat. No. 4,635,127; Issued 1/6/87
Drive Method for Active Matrix Display Device
Inventor: SEIGO TOGASHI
Assigned to: CITIZEN WATCH CO., LTD.

A method is disclosed of driving an active matrix display device by scanning signals to sequentially store and display image signal data by successive rows of picture elements (incorporating for example liquid crystal display elements), whereby the image signal data applied to successive picture element rows (or successive groups of rows) is alternately inverted in polarity about a fixed reference potential. Image-dependent leakage current effects caused by non-ideal characteristics of the matrix switching elements are thereby effectively reduced due to the elimination of low-frequency components other than the reference potential from the image signals applied to each column of display elements.

U.S. Pat. No. 4,636,632; Issued 1/13/87
Photoelectric Input Apparatus for Display System
Inventor: NORIYOSHI ANDO
Assigned to: NIPPONDENSO CO., LTD.

A photoelectric touch input apparatus comprises a frame placed in front of the display surface of a display device, a plurality of light-emitting elements mounted on the frame in a row along one side of a central opening of the frame to produce a plurality of light beams in parallel spaced relationship, a plurality of photosensitive elements mounted on the frame in a row along the opposite side of the opening and aligned with the light-emitting elements to receive the light beams, a transparent flat plate arranged between the display surface and the light beams and resiliently supported on the frame to be moved toward the display surface by pressure of an object touched thereto, a comparison circuit associated with the photosensitive elements to produce a first output signal indicative of the position of the object when it interrupts one of the light beams, a plurality of switches mounted on the frame and associated with the flat plate to produce a plurality of second output signals therefrom in response to movement of the flat plate toward the display surface, and a switching circuit responsive to the first output signal and at least one of the second output signals to produce a control signal for switching over an indication or picture on the display surface to another indication or picture defined by the first output signal.

U.S. Pat. No. 4,634,934; Issued 1/6/87
Electroluminescent Display Device
Inventors: ATSUSHI ABE, YOSUKE FUJITA, TOMIZO MATSUUKA, TSUNEHARU NITTA, TAKEO TOHDA
Assigned to: MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.

Electroluminescent display device suitable for ac and unipolar pulse voltage operation, and ensuring an increased luminescent brightness and a low driving voltage, comprises a transparent electrically insulating substrate; an electroluminescent layer comprised of zinc sulfide (ZnS) and at least one luminescingly active material; an electrically insulating layer formed on one surface of said electroluminescent layer; and first and second energizing means for applying signal voltages across said electroluminescent layer and said insulating layer corresponding to information to be displayed, wherein said first energizing means is interposed between said transparent substrate and said electroluminescent layer, and includes at least one semiconductive electrode which contacts said electroluminescent layer and is comprised of a semiconductive material containing at least one chemical compound selected from the group consisting of the chemical compounds of groups II–VI, and wherein said second energizing means is arranged on said insulating layer on the surface thereof opposite said electroluminescent layer.

U.S. Pat. No. 4,630,122; Issued 12/16/86
Television Receiver with Liquid Crystal Matrix Display Panel
Inventors: SHIGERU MOROKAWA
Assigned to: CITIZEN WATCH CO., LTD.

A television receiver is equipped with a liquid crystal matrix display panel having the drive electrodes arranged such as to form a plurality of regions, with the regions each successively entering a drive phase of operation in which selection and bias drive signals are applied to the display element electrodes and a rest phase of operation in which a voltage level substantially equal to zero is applied between the display element electrodes, with only one region operating in the drive phase at a time and the remaining regions operating in the rest phase. The display contrast attainable with a given number of rows of picture elements in the display can thereby be substantially increased, e.g. can be effectively doubled for the case of a display divided into two regions, without the need to utilize large-capacity video memory circuits.

U.S. Pat. No. 4,645,229; Issued 1/6/87

Liquid Crystal Display

Inventors: HERMANN AMSTUTZ, DIETER HEIMGARTNER, MEINOLPH KAUFMANN, TERRY J. SCHEFFER

Assigned to: BROWN BOVERI & CO., LTD.

A liquid crystal display based on the bistability effect is disclosed, wherein the distance between the support plates is smaller than 10 μm and the total twist of the liquid crystal is between 180° and 360°, preferably about 270°. Over the entire viewing area of the display, randomly distributed spacers are provided. Because of these measures, the range of the bistable action is so narrowed that the display can be driven with operating voltages outside this range, using conventional multiplexing techniques. A high degree of multiplexing with short switching times and excellent contrast is obtained. The range of viewing angles is very large and independent of the direction of illumination.

U.S. Pat. No. 4,633,415; Issued 12/30/86

Windowing and Scrolling for a Cathode Ray Tube Display

Inventors: EDWARD F. ASAM, DEWAYNE J. FERRIS, ANTHONY B. VINK

Assigned to: NORTHERN TELECOM LTD.

A method and a circuit for producing an independent scrollable display region (sometimes referred to as a window) on the face of a CRT in a bit-mapped data display system is disclosed. Circuitry is provided to detect the presence of the window along a vertical axis and to detect the presence of the window along a horizontal axis. When both a vertical and a horizontal presence are detected simultaneously, a window is deemed to be present. When the window is deemed to be present a memory address selection circuit selects memory addresses from one memory address circuit, and when the window is deemed to be not present the memory address selection circuit selects memory addresses from another memory address circuit.

U.S. Pat. No. 4,634,225; Issued 1/6/87

Transflective Liquid Crystal Display with Integral Heating Unit and Temperature Sensor

Inventors: ELIAS S. HAIM, JOHN E. SUMINSBY

Assigned to: GENERAL ELECTRIC CO.

A heated transflective liquid crystal display device has the heating element positioned behind the transflector to keep the heater out of the reflective light path. This construction significantly improves brightness of the display in the reflective mode. The heating element is positioned between the cell transflector and a temperature sensing thermistor. The thermal gradient of the path between the heating element and the thermistor matches that of the path between the heating element and the liquid crystal cell. As a result, the trip point of the heating element can be set much closer to the minimum cell operating temperature than hitherto possible thereby reducing the power consumption of the display. This invention relates to liquid crystal display devices, and more particularly to liquid crystal displays incorporating a heating unit. While the invention is described in the context of a cell of the guest-host variety, it is by no means limited thereto. The invention is equally applicable in a liquid crystal display utilizing a liquid crystal solution of the twisted nematic type.

U.S. Pat. No. 4,633,244; Issued 12/30/86

Multiple Beam High Definition Page Display

Inventors: THOMAS O. HOLTEY, J. NATHANIEL MARSHALL

Assigned to: HONEYWELL INFORMATION SYSTEMS, INC.

A high definition page display system for graphics and text utilizing multiple beams in a CRT is disclosed. Information for the several lines which are written simultaneously is made available in parallel. The invention is described in terms of a character set and text generation, but the same principles apply to any other graphic or bit map and to storage in ROMS or loadable RAMS. Each beam of a multiple CRT tube is biased to generate a portion of a character or graphic as it scans across the tube. It takes 12 lines to scan a character with a n-beam tube; 12 over n character scans are therefore required. With the same scanning speed as with a single beam, this factor can be used to increase definition (i.e. number of lines). Also the advantage of multiple beams can be used to reduce scanning speed, if this is useful to improve brightness or spot definition, or to increase the number of dots per line. Reduced scanning speed can also reduce costs, particularly if it brings the scan rate in line with standard components available commercially. Another way to use the advantages would be higher refresh rates.

U.S. Pat. No. 4,632,514; Issued 12/30/86

Color Liquid Crystal Display Apparatus

Inventors: SADAYOSHI HOTTA, SEIICHI NAGATA, TETSU OGAWA

Assigned to: MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.

In a color liquid crystal display apparatus of twisted nematic type, thicknesses of the liquid crystal layer is made different for different color picture elements, thereby optical rotatory dispersion, which has been the cause of undesirable light transmittance at 0 voltage input, is minimized, so that contrast, range of reproduced color, view angle dependency, etc. are improved, and a color liquid crystal display apparatus capable of displaying improved picture quality is provided.

U.S. Pat. No. 4,631,584; Issued 12/23/86

Transmission of Reduced Resolution Picture Edge Information Using Horizontal Blanking Period

Inventor: GLENN A. REITMEIER

Assigned to: RCA

A television system generates a composite video signal for an image having extended aspect ratio such as 5:3, and displays such composite video signal in a television image area having the same extended aspect ratio. The horizontal blanking interval of an NTSC composite video signal is utilized for the transmission of video information characterizing either the right or the left edge of a display line of the picture; whereas, the remaining portion of the NTSC signal is utilized for the transmission of video information characterizing the inner portion of the display line between the edges. The video information for the missing edge in each display line is derived in the receiver from video edge information of adjacent display lines.

recent patents

U.S. Pat. No. 4,630,894; Issued 12/23/86
Multi-Colored Liquid Crystal Display with Color Transflector and Color Filter
Inventor: ROLF A. CREMERS
Assigned to: BORG INSTRUMENTS GMBH

A multi-colored liquid crystal display arrangement, especially for motor vehicle instruments, including colored foils with different colorings spatially associated with a plurality of mutually offset and differing information areas of the display, intermediates a liquid crystal cell and a large-surfaced illuminating arrangement. The multi-colored liquid display arrangement is additionally equipped with a transflector which is positioned between the color foils and the liquid crystal cell, and wherein the transflector incorporates differently colored areas which are spatially associated with predetermined color foils.

U.S. Pat. No. 4,630,115; Issued 12/16/86
Cathode Ray Tube Display Device
Inventor: CYRIL HILSUM
Assigned to: GENERAL ELECTRIC CO. (UK)

A display device is disclosed which corrects for vibration, for example between the screen and the electron gun in a CRT. The device comprises an optical system on the observer side of the screen for directing the light from a small part of the screen, onto which the electron beam is directed at intervals, onto a photocell which detects the position of the light spot. The output signal from the photocell is processed in a circuit to provide a correction signal which is applied to the deflection system of the CRT to reduce the deviation of the light spot from the position it would have in a vibration-free environment.

U.S. Pat. No. 4,627,676 (4,508,402); Issued 12/9/86
Electronic Assembly Including Integrated Circuit Package and Liquid Crystal Display Panel
Inventors: MASAYUKI HIGUCHI, TADASHI TOMINO
Assigned to: SHARP CORP.

An electronic assembly for use in calculators, watches, and so forth is disclosed. The assembly includes an integrated circuit element having a plurality of positioning apertures at the periphery thereof and a circuit board (preferably, a flexible circuit film) having a plurality of terminals to be electrically connected to the respective terminals of the integrated circuit element and also having a plurality of positioning apertures. The assembly further includes an upper casing and a lower casing, one of which has a plurality of positioning projections to be received within the positioning apertures in the circuit element and a plurality of positioning projections to be received within the positioning apertures in the circuit board, for determining relative position of the integrated circuit element and the circuit board with respect to the casing. Preferably, the integrated circuit element has a plurality of signal terminals extending from one side and one or more power terminals extending from a second side thereof and in a direction different from that of the signal terminals, with the latter in direct contact with battery terminals when the assembly is completed. The package of the integrated circuit element may be of a polygonal configuration including a pentagon or more and the whole of the integrated circuit element including the power terminals shaped substantially into a rectangle.

U.S. Pat. No. 4,636,841; Issued 12/2/86
Method of Driving Matrix Display Device
Inventor: SEIGO TOGASHI
Assigned to: CITIZEN WATCH CO., LTD.

A method of driving a matrix display device in which each display element (e.g., a liquid crystal display element) is connected in series with a non-linear resistance element, utilizes row scanning signals which vary periodically between four different potentials, the potentials being selected such that an alternating bias potential is applied to each display element both in the non-activated and in the activated state thereof, and such that satisfactory operation can be attained using non-linear resistance elements having a threshold voltage which is considerably lower than has been practicable in the prior art, e.g. With the threshold voltage of a single pn junction being utilizable.

U.S. Pat. No. 4,626,073; Issued 12/2/86
Liquid Crystal Display Cell with Elastic Cell Spacers
Inventors: HERMANN AMSTUTZ, MEINOLPH KAUFMANN
Assigned to: BROWN BOVERI & CO., LTD.

A liquid crystal display cell includes a liquid crystal layer contained between two plane-parallel support plates provided with electrode layers on their mutually inward facing surfaces as well as a border. The support plates are held apart within a predetermined separation range by means of spacers. Those spacers distributed in the border are electrically conductive and serve as contact bridges between through-contact points on the support plates. Rubber-like elastic particles, e.g. from a silicone elastomer, are used as spacers to prevent low pressure bubbles in the liquid crystal layer at temperatures of $-30°$ C as well as to prevent loss of contact between the through-contact points. The rubber-like elastic particles, between the through-contact points, are electrically conductive.

U.S. Pat. No. 4,631,585; Issued 12/23/86
Apparatus for Synchronizing the Operation of a Microprocessor with a Television Synchronization Signal Useful in Generating an On-Screen Character Display
Inventor: CHARLES M. WINE
Assigned to: RCA

A microprocessor embodied in an integrated circuit has a clock signal generator comprising an inverter in the integrated circuit and a frequency determining network external to the integrated circuit connected to the inverter through terminals. The clock signal generator generates a clock signal which determines the frequency of the instruction cycles of the microprocessor. The operation of the microprocessor is synchronized with a television horizontal rate signal by programming it to generate a comparison signal each time a predetermined number of instruction cycles, selected so that the comparison signal has the same nominal frequency as the horizontal rate signal, have occurred. The simple wire and gate serves as coincidence detector for the horizontal rate signal and the comparison signal and generates a pulse error signal representing the phase and frequency deviations between its two input signals. The error signal is filtered and coupled to the inverter to control the phase and frequency of the clock signal. This microprocessor synchronization arrangement is used to form characters on the screen of a picture tube without the need of an additional character generator. ■

Low-priced image-scanner option kit

Epson America has introduced an image scanner which it claims is the lowest priced of any IBM PC-compatible image scanner on the market. The Epson Image Scanner Option Kit retails for under $300.

An optional accessory for Epson's EX-800, EX-1000, and LQ-2500 dot-matrix printers, the Epson Image Scanner is designed for entry-level desktop publishing and advanced word-processing applications.

The scanner reads and converts hard-copy images such as photographs, logos, maps, clip art, and other text or graphic documents into bit image data. The images are then transmitted through a serial interface to a host computer where they are stored. The user can then manipulate the images and integrate them into most advanced word processing and spreadsheet packages available today using American Programmer's Guide bundled INSET software package. The images can be printed at any time. The Image Scanner Option Kit includes the scanner mechanism, an identity cartridge, a diskette containing Epson's scanner utility and INSET software, and a user's manual.

The scanner offers a resolution of 180 × 180 dots/in. on the LQ-2500 and 144 × 144 dots/in. on the EX-series printers. It can scan small-to-large areas—11 × 8 in. on wide-carriage models and 6 × 8 in. on narrow-carriage printers. A page of graphics can be scanned or digitized at 27 in./sec on the LQ-2500 and 25-in./sec on the EX-800 and EX-1000. An Epson-designed image-processing utility program, which comes standard with the scanner kit, adjusts for size, darkness, brightness and contrast. It also provides up to 64 levels of halftone as well as erasing and editing capabilities. The scanner will work with IBM PC, XT and AT, or compatible computers with a CGA, EGA, or HERCULES display adaptor installed, and comes with Epson's limited 1-year warranty.

For further information contact Epson America's Computer Products Division, 2780 Lomita Blvd., Torrance, CA 90505. 213/539-9140 or 1-800/421-5426.
Circle no. 10

Ruggedized 5-in. monitor for avionics surveillance

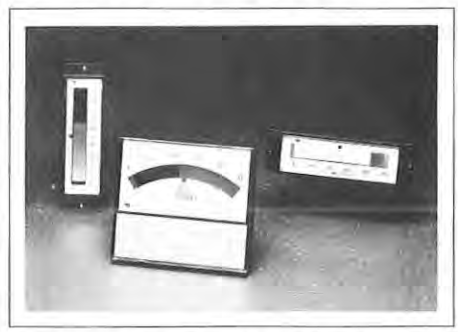
A new 5-in. high-resolution monochrome monitor from Lenco, Inc. is designed for avionics surveillance applications. Model PHP-105-20 has standard broadcast resolution of 525 lines and provides a sharp ultra-stable video image that is viewable in a sunlit cockpit or under the dim night-ambient conditions of a surveillance patrol. Originally designed and customized for forward looking infrared (FLIR) applications, the PHP-105-20 is ruggedized to withstand vehicular, maritime, or aircraft environments.

For further information contact Mark A. Hill, Lenco, Inc., 300 North Maryland St., P.O. Box 348, Jackson, MO 63755. 314/243-3141.
Circle no. 11

Multicolor LCD bargraphs

A new LCD bargraph panel meter from the Triplett Corporation comes in 16 styles, including eight models with back-lit color displays. The devices fit a wide variety of industrial, commercial, and laboratory panel instrumentation applications.

The back-lit models are reported to be the first bargraph meters to incorporate multiple colors in a single LCD display. This feature enables the user to color code measurements for high visibility and instant identification of trouble spots. The displays come in single or multiple colors, including red, green, amber, yellow, blue, or combinations thereof, and can be read easily at a distance of up to 20 ft.



The eight non-back-lit models feature black-on-gray LCD displays, and have all the advantages of traditional non-back-lit meters, such as low power consumption. They are particularly well suited to field use due to their high visibility in direct sunlight and their ability to run off a battery.

Both the back-lit and the non-back-lit models were designed with Triplett's advanced custom chip. This allows them to monitor data in 13 modes, including data, high set point, low set point, both high and low set points, peak, valley, and both peak and valley. In addition, the panel meters have the ability to alternate between data and the six display modes. The 103-segment bargraph also provides over-range, under-range, low power, and loss of power indicators.

Available in 3.5- and 4.5-in. rectangular and square sizes, Triplett's new LCD bargraph can also be customized to fit the end user's specific needs. All models have

100-mV dc meters and are capable of accepting the majority of standard voltage and current inputs. Conversion to ac is easily accommodated with the Triplett Model 12766 rectifier kit. Triplett's bargraph receives its power off a 5-V power supply at 500 μA. The back-lit models require an additional 6.3-V 200-mA per bulb. Additional specifications include: accuracy of $\pm 1\%$ of scale, a maximum response time of 200 msec, linearity of $\pm 1/2$ segment, input impedance of 1 MΩ, and operating temperature of 0–+50°. The user net on Triplett's new LCD bargraph ranges from $135 to $195. Quantity discounts are available, and delivery is approximately two weeks ARO.

For further information contact Triplett Corporation, One Triplett Dr., Bluffton, OH 45817. 1-800/TRI-PLET, ext. 30.
Circle no. 12

Add-on scanner plotter accessory

Houston Instrument has introduced a scanning input device as an option for its DMP-50 Series of pen plotters. The SCAN-CAD Plotter Accessory, an add-on alternative to expensive stand-alone scanning equipment, is priced under $3000. It can be used with an IBM PC.

The SCAN-CAD option features a 200-dots/in. scan head that can accurately detect lines as fine as 0.007 in. Capable of automatically scanning detailed architectural, engineering, or other computer-aided design (CAD) drawings from paper, vellum, acetate film, or blueline, the SCAN-CAD option can input a D-size (22 × 34 in. or 24 × 36 in.) drawing in 12 min and an E-size (36 × 48 in.) drawing in 24 min.

The SCAN-CAD includes the snap-on scan head, cable and cable support assembly, scanner controller expansion card, scanning software, document carrier, and operation manual. Other items the user will need are an IBM PC, AT or XT, with 10 Mbyte or larger hard disk and 640K, and a Houston Instrument DMP-50 Series drafting plotter. Priced at $2995, the SCAN-CAD is available through Houston Instrument's distribution network.

For further information contact Marty McConnell, Houston Instrument, 8500 Cameron Rd., Austin, TX 78753, 512/835-0900, ext. 443; outside Texas, 1-800/531-5205. In Europe, contact Houston Instrument, Belgium NV., Rochesterlaan 6, 8240 Gistel, Belgium. 32-(0)59-277445.
Circle no. 13

Modular multicolor LED display

Display-Tech Inc. has released a multicolor LED display to complement its line of single-color LED displays. The fully programmable sign can generate fully animated graphics and text in any combination of red, green, and yellow. The

new display unit follows Display-Tech's concept of modular block building and is fully stackable in both the vertical and horizontal directions. This modular technique allows Display-Tech to offer more than 50 different shapes and sizes of LED displays. Display-Tech products carry a 1-year limited warranty and range in price from $325 a unit and up. For further information contact Larry D. Bridges, Display-Tech Inc., 2179 S. State St., Ann Arbor, MI 48104. 313/994-3460.
Circle no. 15

Electronic typewriter word processor converter

A word processor from Britain, for use with most electronic typewriters with RS 232 interfaces or as a dedicated stand-alone unit with its own keyboard and printer, is said to be as effective as others costing twice the price. The CITY TYPERSCREEN, a twin floppy-disk add-on module with 64K RAM memory, can

be extended to include 20-Mbyte hard disk and telex capability. As an add-on, the system makes use of all typewriter keys, and on-screen help is available, even during editing. A spelling-checker with a 50,000 word dictionary proofreads 100 pages in 6 min. The system will produce personalized letters, print labels, and perform automatic invoice extension and calculation. Files may be of any length to disk capacity and text can be manipulated in all modes—character, word, sentence, line, paragraph, and block.

For further information contact A. L. Daltrey, Houndsditch Business Machines, Ltd., HBM House, 32 Bethnal Green Road, London E1 6HZ England. 729 5088.
Circle no. 16

Circle no. 18

Custom LCDs ready in 3 hours

UCE, Inc. reports that it can now supply custom LCD prototypes in as little as 3 hours. UCE's capability is based on a fast photolithographic etching system to transfer film positive artwork directly to glass.

For 3-hours service, customers must supply 1:1 film positives. If not available, UCE can typically generate artwork within days for simple designs, or within 1-3 weeks for complicated ones. There is a 100% premium for these services.

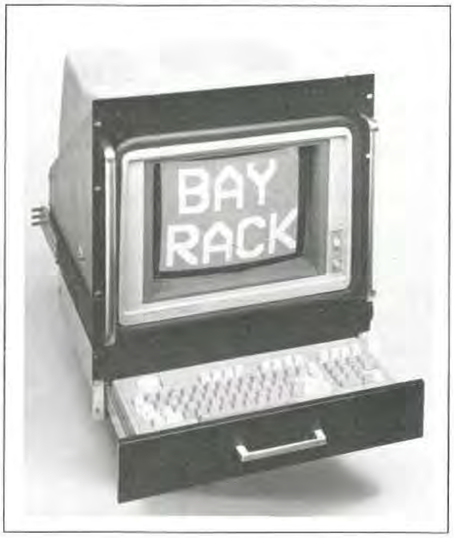
For further information contact Dick Borstelman, UCE, Inc., 24 Fitch St., Norwalk, CT 06855. 203/838-7509.
Circle no. 17

new products

Shop-floor color graphics displays

BAY R&D announces a series of new products for system designers who require industrial shop-floor color graphics displays. The BAYRACK series adapts Tektronix color graphics terminals to EIA compatible rackmount equipment. Originally developed for shipboard instrumentation, the rackmount adapter augments the environmental specifications of TEK color graphics terminals including the new Tektronix 4200 series.

The aluminum rackmount adapter requires no modification to the TEK terminal, provides tilt adjustment, and fits standard EIA front-panel dimensions of 19 × 17.5 in. with 22 in. of minimum rack depth. The keyboard drawer requires 35 in. of rack height and is mounted below the adapter. Standard finish for the front panel is black hard-coat anodize, which may be painted to match existing rack colors. Several options are available, including chassis slides, a keyboard drawer, and an enclosure for applications where an instrumentation rack is not required. BAY R&D can produce custom designs, and can also supply the rackmount adapter with the TEK terminal already installed.



Typical applications for the BAYRACK adapter include manufacturing, medical instrumentation, process control, plus shipboard and other industrial sites where airborne contamination or environmental extremes may exist. A complete test report covering specifications and performance is available upon request. The BAYRACK adapter and optional enclosure are priced at $495 each, with the optional keyboard drawer and slides priced at $195 and $89, respectively. Availability is stock to six weeks.

For further information contact Sandy MacKellar, BAY R&D, P.O. Box 2517, Santa Barbara, CA 93102. 805/965-4913.
Circle no. 19

Enhanced color graphics display with text mode

Magnavox has introduced a new model to its Magnavox professional line of computer monitors, which is fully compatible with the IBM enhanced graphics display adapter (or equivalent).

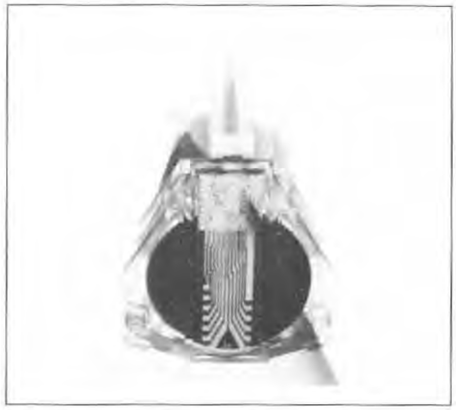
Model 8CM540 utilizes a 14-in. 0.31-mm-dot-pitch CRT to produce a resolution of up to 720 dots (horizontal) and 350 lines (vertical). The 64-color display has a non-glare CRT and a green and amber text mode capability, and is backed by a 1-year warranty. The suggested retail price is $750.

For further information contact Deborah L. Fee, NAP Consumer Electronics Corp., Interstate 40 and Straw Plains Pike, P.O. Box 14810, Knoxville, TN 37914-1810. 615/521-4494.

Circle no. 38

Thermal ink-jet print cartridges

Hewlett-Packard Company's thermal ink-jet print cartridges, used in the HP Think-



Jet and HP QuietJet printers, now are available to original equipment manufacturers (OEMs). The HP thermal ink-jet print cartridge is a low-priced disposable ink-jet print head suitable for a broad range of industrial and commercial applications. It has an average life of 10 million dots, or approximately 500 pages of text.

Circle no. 21

Its small size (1.5 in. long) and low power consumption make the HP ink-jet cartridge appropriate for compact or portable printers. It also allows designs where several cartridges are combined for larger print zones or higher throughput speeds. Designed for high-speed use, the cartridges fire 1,250 dots/sec or about 150 characters/sec at a 96-dots/in. printing density. These cartridges can print up to 2,000 dots/sec under certain printing conditions.

The print cartridges are available in four colors: black, HP 92261A; blue, HP 51605B; red, HP 51605R; and green, HP 51605G. Single-unit pricing is $9.95 for the HP 92261A black print cartridge. The blue, green, and red print cartridges are $12.95 each and are available immediately. OEM pricing also is available. Cartridges are available at HP authorized components distributors.

For further information contact Inquiries Manager, Hewlett-Packard Company, 1820 Embarcadero Road, Palo Alto, CA 94303. 1-800/367-4772
Circle no. 22

Vacuum fluorescent power converter

The E800VF modification of the E800 Series DC-DC/AC Converter powers vacuum fluorescent displays requiring up to 6 W total output power. Endicott Research Group's Vacuum Fluorescent Converters provide two outputs: a dc voltage for the anode and a center-tapped ac output voltage at oscillator frequency for the filament. Both can be tailored to the user's display. The E800VF is suitable for powering vacuum fluorescent displays from Futaba, NEC, and others. The size of the E800VF is 1.43 in. (L) × 1.5 in. (W) × 1.03 in. (H). Price is $14.84

@ 1000 pieces.

For further information contact Michael Foldes, Endicott Research Group, Inc., P.O. Box 269, Endicott, NY 13760. 607/754-9187. ■
Circle no. 23

Circle no. 24

Circle no. 25

Guide to R&D limited partnerships

Research and Development Limited Partnerships: Funding Your R&D Programs, 3rd ed., revised to take into account the 1986 Tax Code changes, is now available from Market Intelligence Research Co., Palo Alto, CA. In an R&D limited partnership, a corporation conducts product development research that is financed by a limited partner. The corporation retains the rights to manufacture and distribute the product developed under the R&D partnership program. The limited partner is paid from the profits of the product, but if the research produces nothing, the limited partner—not the corporation—takes the loss. This guide for managers covers the managerial, financial, and legal aspects of these partnerships, which have been a major source of R&D funds in the 1980's. The report is supplemented by charts and figures, sample forms, a bibliography, and eight appendices on topics such as "How to prepare a research and development proposal." Report no. A004 is $125.00 per copy. For more information, contact Evelyn Boykan, Market Intelligence Research Company, 4000 Middlefield Rd., Palo Alto, CA 94303. 415/856-8200. **Circle no. 26**

Educational literature on VDT ergonomics

An assortment of teaching aids—slide presentations, videotapes, brochures, books, and government reports—is available from the Center for Office Technology (COT) on the subject of video display terminals (VDTs) in the workplace, especially the purported health and safety hazards of VDT use. Since COT is a coalition of VDT manufacturers and employers, you are not likely to find here any negative views on VDT health questions, but the Center produces a variety of informative publications and visual aids on terminal design, seating, lighting, furniture, and management issues, as well as rebuttals to the health and safety hazard arguments.

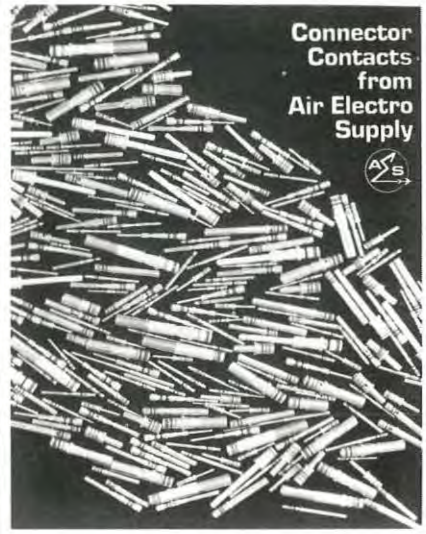
For example, *Improving VDT Work: Causes and Control of Health Concerns in VDT Use* by Steven L. Sauter, L. John Chapman, and Sheri J. Knutson ($12.00), a 96-page report originally prepared in 1984 for the Wisconsin State Department of Administration, provides guidelines for reducing health risks and discomforts in the modern office. For each specific site of bodily stress (back, neck, and shoulders, arms and hands, legs, eyes), the authors examine the physiology involved, the problems that may develop, the solutions to those problems, and the impact of personal differences in age, habit, and pre-existing conditions. Appendices provide checklists for chairs and worktables, simple exercises to relieve eyestrain and postural discomfort, and a stress management relaxation technique.

Prices range from $75.00 to $125.00 for the videotapes and slide presentations to no charge (in small quantities) for some of the fact sheets and slim, attractively illustrated brochures (which, by the way, show at least as many men as women seated at VDTs). For a publication price list, contact VDT Educational Materials, The Center for Office Technology, 1801 K St., N.W., Suite 905, Washington, DC 20006. 202/452-9060.
Circle no. 28

Connector contact brochure from Air Electro Supply

A new 6-page color brochure from Air Electro Supply, Inc. features Tri-Star Electronic's extensive line of MIL-Spec connector contacts, including power, crimp, thermocouple, wire-wrap, and coaxial types. Air Electro Supply, distributor of connectors and related accessories, handles the product lines of Amphenol, Bendix, Burndy, Cannon, Cinch, Deutsch, Electro-Adapter, ESC, Flight Connector, Kings, Matrix Science, Souriau, and T. J. Electronics in addition to Tri-Star.

For a free copy of the connector contacts brochure, contact Lorraine Apolito, Air Electro Supply, 7700 Gloria Ave., Van Nuys, CA 91406. 818/988-4400. ■
Circle no. 29



Circle no. 30

Bay Area Chapter

The Bay Area Chapter's January 15 meeting hosted a presentation by **Paul Breen** of **The MITRE Corp.** on "Display Technology in the Military." Mr. Breen reviewed the CRT, flat-panel, and large-screen display technologies currently used by the military, and discussed future trends.

On February 17, the Chapter welcomed **Steven M. Jarrett** of **Uniphase Corp.** as guest speaker. Dr. Jarrett's talk on "Liquid Crystal Light Valves" described the fabrication techniques and performance parameters of these devices, which are used in full-color high-brightness video display systems.

Canadian Chapter

Chapter Chairman **Andrew Moffatt** reports that the Canadian Chapter has had a good inaugural year with four well attended technical meetings and very few problems. In order to sustain a high level of interest and to establish SID firmly in the fabric of the Canadian scientific/engineering community, he has launched a major effort to expand membership and to solicit financial support from the display industry to offset the costs of bringing in guest speakers of exceptional merit. With an executive committee of six officers, three in Toronto and three in Ottawa, and four technical meetings planned per year with the site alternating between the two cities, the machinery is in place for a period of consolidation and growth throughout 1987.

Japan Chapter

The Technical Group on Image Processing and Display of the Institute of Television Engineers of Japan and SID's Japan Chapter held a joint meeting December 18 to hear a report on Japan Display '86. An overview by **Shunsuke Kobayashi** of **Tokyo University of Agriculture and Technology** was followed by presentations from **Matsushita**, **Hitachi**, **Toshiba**, and **Seiko** on developments reported at the conference.

One hundred forty-two people attended the October 3 International Workshop on Information Display, a satellite meeting of Japan Display '86 in Tokyo. Speakers included **Larry F. Weber** of the **University of Illinois** on "Plasma Displays," **Terry J. Scheffer** of **Tektronix** on "Direct-Multiplexed LCDs," **Joseph A. Castellano** of **Stanford Resources** on "Display Applications in Communications," **Dr. F. Morin** of **CNET** on "MINITEL: The French Videotext System," and **Sol Sherr** of **Westland Electronics**, who presented "An Overview of Information Display." The workshop was held jointly with the Institute of Television Engineers of Japan, the Institute of Electronics and Communication Engineers of Japan, and the Japan Technology Transfer Association.

Mid-Atlantic Chapter

At the January 15 Mid-Atlantic Chapter meeting **Allan R. Kmetz** of **AT&T Bell Laboratories** spoke on "Flat Panel Displays." Using the CRT as a benchmark, Dr. Kmetz compared flat display work in plasma, EL, and LCDs and noted that while traditional CRTs account for three-quarters of the $6.4 billion annual world display market, an overwhelming majority of research papers address the flat panel. Perhaps the most promising candidates for eventual competition to CRTs are the active-matrix thin-film transistor LCDs, which alone can rival the CRT in full color and brightness. The process equipment needed to scale them to CRT size is only a matter of time. Cost reductions will be needed, too, to make them competitive with the CRT. But the same was true of shadowmask technology when it first appeared. No one could have guessed at the time that a technology that seemed so impossibly cumbersome would one day become so inexpensive—and pervasive. Since at present flat panels are unprofitable as direct replacements for CRTs, system designers are faced with the challenge of defining new product concepts for flat panels in areas where CRTs are impractical.

Minneapolis-St. Paul Chapter

At its December 12 meeting, the Minneapolis-St. Paul Chapter heard **Richard Jamieson** of **Jamieson and Associates** speak on "Audio-Video Programmable Infrared Remote Control Systems." Mr. Jamieson's presentation focused on the General Electric programmable remote controller with LCD display, which he described as "an evolving technology for reducing the clutter of remote controls on your coffee table."

On January 24, the Chapter welcomed **William Wurster** of the **Federal Reserve Bank of Minneapolis** as guest speaker. Mr. Wurster, bank data security supervisor, gave a presentation on "Computer Display Telecommunications."

New England Chapter

On Wednesday, April 15, the New England Chapter will sponsor a Display Workshop featuring presentations on "CRT Displays" by **Carl Machover**, "Flat Panel Displays" by **Larry E. Tannas, Jr.**, and "Touch Entry Technology" by **Arthur Carroll**. The workshop will be held at the Raytheon Company, 548 Boston Post Road, Sudbury, MA, from 2:00–9:30 p.m. and dinner will be served. During dinner, **Tom Holzel** will speak about his 1986 Mount Everest expedition. SID members: $25; non-members: $40, of which $15 can be applied to new SID membership. Space is limited. For information and reservations contact Melvin Silverstein, New England Chapter Chairman, at 617/359-6063.

UK & Ireland Chapter

Neil Bartlett, Vice Chairman of the UK & Ireland Chapter, reports that "the first year of our existence has met with a success that has exceeded our wildest dreams." It was a year of well attended meetings, growing membership, a thriving newsletter, and an invitation from the Department of Trade and Industry to organize a technology fact-finding mission to Japan. For his work in organizing the

chapter notes

UK & Ireland Chapter and his many contributions to SID, **Alfred Woodhead** has been awarded a citation by SID National.

The theme of the 19 September meeting at RSRE in Malvern was "Military Displays." **Alan Cox** and **Dennis Hind** of **RARDE, Chertsey**, spoke on displays for fighting vehicles. Small high-resolution displays with minimum depth are required for the cramped crew space and indirect viewing angle of the modern tank. For the next five years, there appears no alternative to the CRT, preferably with some color capability provided by an LC shutter. The next talk, by **Andrew Smith** of **RARDE, Fort Halstead**, described military command and control requirements for electronic map displays in the field environment. **Paul Beatty** of **Ferranti** gave a talk on head-down displays for aircraft cockpits, which must display detailed moving map information in a 6-in.-sq. area. **David Cochrane** of **Plessey** discussed the new NAUTIS family of integrated systems for naval command and control. The fully modular system uses customized standard monochrome CRT consoles and a powerful graphics interface language that is device independent. The final talk by **Alan Pritchard** of **Plessey** described a device intended to simulate the input to a thermal imager, which is needed both for testing of thermal imagers and for scenario simulation. The 32 × 32 array is matrix addressed by means of a diode at each pixel; it is fabricated using thick-film hybrid technology and achieves a response time of 100 msec.

On November 12 the Chapter met at British Telecom Research in Martlesham for a technical program on "Interactive Displays." **Morgan Potter** of **British Telecom** gave a presentation on displays for video-conferencing. He revealed tentative specifications for two future Telecom terminal displays: 10-cm diagonal, 40 lines/cm, 320 × 240 elements; and 20-cm diagonal, 50 lines/cm, 800 × 600 elements (both with a 16-level gray scale). **Tony Cox** of **Phosphor Products** spoke on touch systems for flat displays. He described a 2000-character EL panel with touch capability achieved by means of capacitive sensing through a 1.5-mm-thick glass overlay, which is said to work well in applications which involve high operator stress. **Nick Milner** of **British Telecom** spoke on human factors for displays in office automation environments. The last speaker was **Simon Turner** of **Philips** on the interactive uses of compact disks. These very cheap, large data stores provide tremendous storage capacity. Audio can be mixed with text and video, making this an ideal medium for dictionary-type applications where pronunciation as well as meaning can be defined.

Los Angeles Chapter

At the January 14 meeting of the Los Angeles Chapter, **Paul Breen** of **The MITRE Corp.** spoke on "Trends and Outlook in C^3 Data Processing and Display," providing members with an insight into the design of military display systems for command, control, and communications (C^3). Mr. Breen praised hybrid systems (part commercial and part military) as cost-saving and reliability-improving for such products as workstations, and presented results of a survey of popular Air Force display systems. Future trends are toward 1500 pixels/line, refresh rates of 60 Hz, and imbedded pixel manipulation. Research on large-screen systems is aimed at 2000 pixels/line and 2000 lumens. As to flat screen displays, the military wants portable units with limited graphics, the ability to identify "hostiles" vs. "frendlies," self-test capability, and survival in harsh environments. ■

March

Office Automation Conference. AFIPS, 1899 Preston White Dr., Reston, VA 22091. 703/620-8900.
Mar. 9–11 Dallas, TX

Three-Dimensional Display Techniques—Short Course. Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
Mar. 22–24 Bedford, MA

Computer Graphics '87. Craig Stewart, National Computer Graphics Association, 2722 Merrilee Dr., Suite 200, Fairfax, VA 22031. 1-800/225-NCGA.
Mar. 22–26 Philadelphia, PA

Ink-Jet Printing—Short Course. Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
Mar. 23–25 Amsterdam, Netherlands

Advances in Semiconductors and Semiconductor Structures. SPIE, P.O. Box 10, Bellingham, WA 98227-0010. 206/676-3290. Telex: 46-7053.
Mar. 23–27 Bay Point, FL

SOUTHCON '87. Dale Litherland, Electronic Conventions, Inc., 8110 Airport Blvd., Los Angeles, CA 90045. 213/772-2965.
Mar. 24–26 Atlanta, GA

12th Annual West Coast Computer Faire. Keith Westerman, The Interface Group, 300 First Ave., Needham, MA 02194. 617/449-6600.
Mar. 26–29 San Francisco, CA

Update on Ion Deposition Printing—Short Course. Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
Mar. 29–31 Monterey, CA

4th International Symposium on Optical and Optoelectronic Applied Science and Engineering. SPIE, P.O. Box 10, Bellingham, WA 98227-0010. 206/676-3290. Telex: 46-7053.
Mar. 30–Apr. 3 The Hague, Netherlands

1987 IEEE International Conference on Robotics and Automation. Harry Hayman, Exeter C3037, Boca Raton, FL 33434. 305/483-3037.
Mar. 30–Apr. 3 Raleigh, NC

ADEE WEST: Automated Design and Engineering for Electronics West. Wendy Geller, ADEE WEST, Cahners Exposition Group, 1350 Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017-5060. 312/299-9311, ext. 2486.
Mar. 31–Apr. 2 Anaheim, CA

April

CHI&GI 1987: Special Combined Conference on Human Factors in Computing Systems (CHI '87) and Graphics Interface (GI '87). Wendy Walker, Computer Systems Research Institute, University of Toronto, 10 Kings College Rd., Rm. 2002, Toronto, Ontario, Canada M5S 1A4. 416/978-5184.
Apr. 5–9 Toronto, Canada

ELECTRO '87. Dale Litherland, Electronic Conventions, Inc., 8110 Airport Blvd., Los Angeles, CA 90045. 213/772-2965.
Apr. 7–9 New York, NY

Third Photoreceptor Industry Conference. Diamond Research Corp., P.O. Box 128, Oak View, CA 93022. 805/649-2209.
Apr. 12–14 Santa Barbara, CA

Display Workshop on CRTs, Flat Panels, and Touch Entry. (Sponsored by SID, New England Chapter.) Melvin Silverstein, Chairman, SID N.E. Chapter, 19 Whichita Rd., Medfield, MA 02052. 617/359-6063.
Apr. 15 Sudbury, MA

CD-ROM vs. Micrographics—Short Course. Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
Apr. 20–22 Monterey, CA

Electronic Newspaper Production—Short Course. Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
Apr. 22–24 Amsterdam, Netherlands

3rd Annual Artificial Intelligence and Advanced Computer Technology Conference and Exhibition. Tower Conference Management Co., 331 W. Wesley St., Wheaton, IL 60187. 312/668-8100.
Apr. 22–24 Long Beach, CA

Fiberoptic Venture '87. June Warren, Kessler Marketing Intelligence, America's Cup Ave. at 31 Bridge St., Newport, RI 02840. 401/849-6771.
Apr. 23 Boston, MA

Integration of Text and Graphics—Short Course. Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
Apr. 27–29 Bedford, MA

IEEE Computer Society Symposium on Office Automation. Vincent Lum, Dept. of Computer Science, Naval Postgraduate School, Monterey, CA 90045. 408/646-2449.
Apr. 27–29 Gaithersburg, MD

CLEO '87: Conference on Lasers and Electro-Optics. Optical Society of America, 1816 Jefferson Pl. N.W., Washington, DC 20036. 202/223-8130.
Apr. 27–May 1 Baltimore, MD

IQEC '87: International Quantum Electronics Conference. Optical Society of America, 1816 Jefferson Pl. N.W., Washington, DC 20036. 202/223-8130.
Apr. 27–May 1 Baltimore, MD

May

37th Electronic Components Conference. Doug Loerscher, Sandia National Labs., Div. 2123, P.O. Box 5800, Albuquerque, NM 87185. 317/261-1306.
May 11–13 Boston, MA

EICO '87: 4th European Conference on Integrated Optics, Electro-Optics, and Sensors. SPIE, P.O. Box 10, Bellingham, WA 98227-0010. 206/676-3290.
May 11–13 Glasgow, Scotland

New Opportunities for Video Publishing—Short Course. Institute for Graphic Communications, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
May 11–13 Monterey, CA

calendar

SID '87: Society for Information Display International Symposium, Seminar and Exhibition. Palisades Institute for Research Services, Inc., 201 Varick St., Suite 1140, New York, NY 10014. 212/620-3388.
May 11–15 New Orleans, LA

Interface '87: Fifth Symposium on Human Factors and Industrial Design in Consumer Product Design. James Wilson, Eastman Kodak Co., Human Factors Dept., Bldg. 320, 2nd Fl., Rochester, NY 14650. 716/722-6627.
May 13–15 Rochester, NY

Thermal Printing—Short Course. Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
May 13–15 Amsterdam, Netherlands

1987 Technical Symposium Southeast on Optics, Optoelectronics. SPIE, P.O. Box 10, Bellingham, WA 98227-0010. 206/676-3290.
May 17–22 Orlando, FL

SPSE '87: 40th Annual SPSE Conference and Symposium on Hybrid Imaging Systems. Pam Fornas, SPSE, 7003 Kilworth Lane, Springfield, VA 22151. 703/642-9090.
May 17–22 Rochester, NY

Digital Facsimile—Short Course. Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
May 18–20 Bedford, MA

NAECON '87: A National Forum for the Exchange of Aerospace Electronics Information. Cindy Porubcansky, Wright-Patterson AFB, OH 45433. 513/255-4848.
May 18–22 Dayton, OH

Hard Copy Processes for the Future—Short Course. Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. 617/267-9425.
May 20–22 Bedford, MA

CG Int'l '87: Conference on Computer Graphics in Japan. Prof. Tosiyasu L. Kunii, Kunii Laboratory of Computer Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-Hu, Tokyo 113, Japan. (03) 812-2111.
May 25–28 Karuizawa, Japan

Call for Papers

Robotics '87 & IECON '87: Advances in Intelligent Robotics Systems and 13th Annual IEEE Industrial Electronics Society Conference. Nov. 1–6, Cambridge, MA. Papers are solicited on the following topics among others: controls and simulation (including graphics for control and monitoring); small computer applications; CAD/CAM; instrumentation; optics and image sensing for machine vision; space station automation; and high-speed vision architectures. Late submissions will be considered. For a joint Call for Papers for the two conferences contact SPIE, P.O. Box 10, Bellingham, WA 98227-0010. 206/676-3290. Telex: 46-7053. Deadline for abstracts: Mar. 30

2nd Pan Pacific Computer Conference on Information Technology. Aug. 26–29, Singapore. Papers are solicited on the following topics: personal computers, office systems, communications technology, database management systems, and applications development languages; and also on the applications of these technologies to banking, manufacturing, electronic publishing, trade facilitation, transportation, government, and natural resources exploitation. Authors should submit three copies of a 5000-word (maximum) double-spaced summary in English to Herbert B. Safford, GTE Data Services, 4750 Lincoln Blvd., Marina del Rey, CA 90252, 213/821-0511, ext. 355 (U.S. authors only); or to Dr. Juzar Motiwalla, Director, Institute of Systems Sciences, National University of Singapore, Heng Mui Keng Terrace, Singapore 0511. Late submissions will be considered.
Deadline for abstracts: Mar. 15

Eurodisplay '87: 7th International Display Research Conference. Sept. 15–17, London, England. Original papers on the following themes are sought: concepts for light generation and modulation; electro-optic materials and phenomena; display devices and technology including print heads; display systems, addressing, and applications; man-machine interfaces, human factors, and I/O. Both oral and poster presentations will be included. Authors should submit a four-page (maximum) summary including objective, background, and a clear statement of new and significant results to: Clive Jones, Meetings Officer, The Institute of Physics, 47 Belgrave Sq., London SW1X 80X, U.K. 01-235-6111. Telex: 918453.
Deadline for abstracts: Mar. 31 ■

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