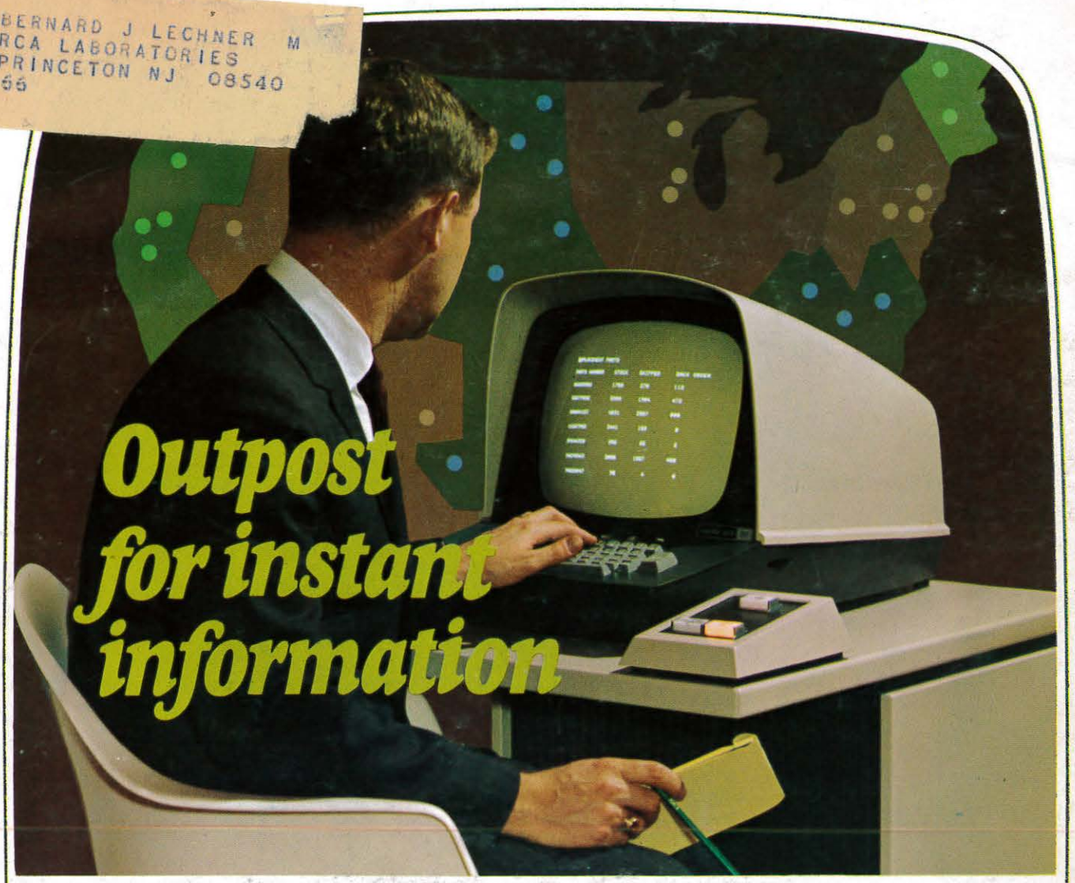

Volume 4 Number 2 *March/April 1967*

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Martin H. Waldman
FEATURE EDITOR .....John Lathourakis
EDITORIAL ASSISTANTS .....J. Trachtenberg
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Volume 4 Number 2 March/April, 1967

Information Display

Journal of the Society for Information Display

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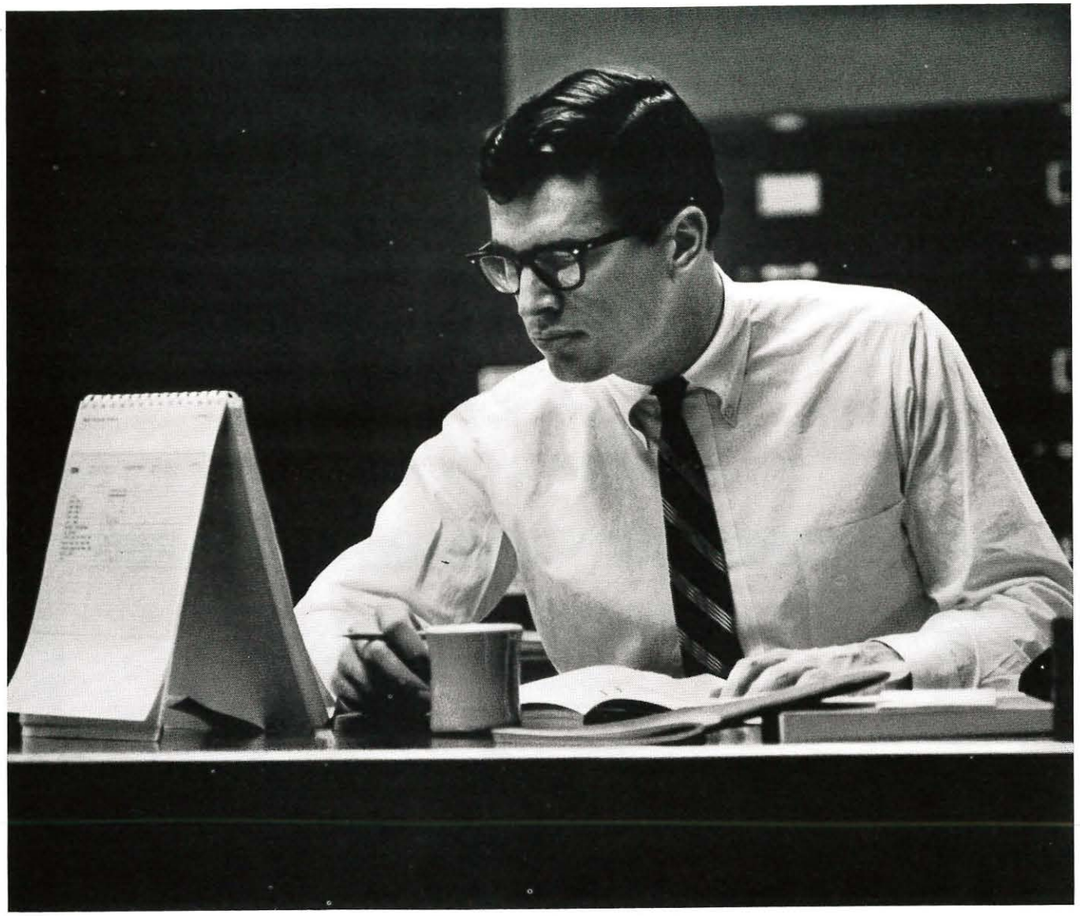
the cover

Exotic new modes of communication, surveillance, and detection may be provided by crystals — a key to the optical range of the spectrum. This statement is strikingly illustrated by the cover art provided to ID *by the Martin Co., Orlando Div., Orlando, Florida.*



The 20-minute education break.

For busy people who need to know.
Maybe you have a programmer who needs to brush up on COBOL, or a tab operator who needs to know about the IBM 85 Collator. Or you may know a junior executive who just wants to learn a little bit about data processing. IBM has an easy way to teach them.

It's called programmed instruction—P.I. for short.

P.I. is an approach to self-study that guides a student through the required material at the student's own pace, a step at a time. He can breeze through five or ten pages whenever there's some time to spare—at home or on the job.

Last year, some 100,000 students took IBM programmed instruction courses. And the results were gratifying. Students learned faster—27% faster on the average—and scored higher than did those in conventional lecture-discussion classes.

Right now there are 29 P.I. courses available to IBM customers covering punched card systems, computer fundamentals and computer programming. More are being developed.

But programmed instruction won't replace your local IBM Education Center. Some subjects are just too complex or too specialized to be taught by P.I. So we'll continue to operate our school system—providing a comprehensive curriculum for everyone from key punch operators to board chairmen.

Either way—sending the student to school or the school to the student—IBM education helps you and your people learn how to get the most productive work from your IBM system.

IBM Education: it's there when you need it. Just like the rest of IBM's services.

IBM®

RESOLUTION

Typical high-resolution cathode-ray tubes, including a completely packaged 1-inch tube.

To get that extra bit of resolution from every cathode-ray tube, call on Fairchild-DuMont engineers.

Of course, resolution in any particular tube depends upon many factors: screen diameter, type of focus and deflection, screen material, post acceleration, beam current and deflection angle to name a few. Here are some of our accomplishments in the area of excellent resolution characteristics.

- *A 5-inch tube with a resolution of 0.3 mil.*
- *The "Clean Beam" tube (excellent edge to edge focus).*
- *Fiber optics tubes for direct contact photography.*
- *High resolution in multi-gun tubes.*
- *Pinpoint resolution on flying-spot scanner tubes.*
- *Fine grain phosphors.*
- *Sharp character display.*
- *The finest resolution in tubes from 1 to 22 inches in diameter.*
- *Complete CRT packaged assemblies.*

Add the experience of DuMont engineers to your own technology.
Write or call Fairchild-DuMont for your specific CRT requirements and for our own complete technical catalog.

WORLD'S LEADING MANUFACTURER OF DISPLAY TUBES

FAIRCHILD
DUMONT ELECTRON TUBES
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION
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ON-LINE 305

CARD INPUT DELTA

NEW 8000 SERIES

DIGITAL DRAFTING SYSTEM

B-L 120

NEW B-L 180

THE EXPANDING WORLD OF Benson-Lehner COMPUTER GRAPHICS

To get 3 discrete levels of dynamic information integrated on one display — depend on Stromberg-Carlson

Each advance in information management brings a new set of pressing demands. For some time, the big question has been how to get more different types of intelligible data on one display —and at rates that represent real-time events. As an early leader in display engineering, Stromberg-Carlson has the experience to produce working hardware that does the job now.

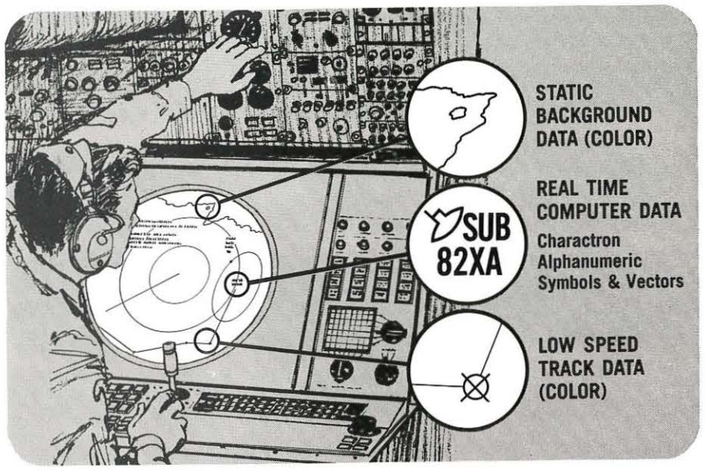
The new possibilities in S-C Multipurpose Displays are legion, offering quality, flexibility and convenience that permit really efficient interaction between man and machine—particularly in military situations.

Now S-C makes it feasible to integrate 3 levels of information efficiently on one display—effectively covering the entire dynamic range encountered in real-time tactical problems. An S-C display with a rear-ported tube, employing the new scribe-projection technique, presents a variety of data, all at rates appropriate to real-time events. Here's a true situation display that helps the decision-maker.

The principle is illustrated at the right. Let's take a military application as an example, though the approach and hardware would be equally valid for commercial use. Through a rear-port, a projector is used to present a slide of static information, such as a tactical map. At the same time, the scribe technique is used to generate the display of relatively low speed vehicles —such as ships—or slowly changing situations—such as weather. This data appears in dynamic form and can include lines, curves, symbols and characters.

The scribe system is essentially an x-y plotter fitted with a stylus which etches a moving trace on the opaque surface of a slide. Slides can be changed as fast as data become obsolete. Finally, the versatile CHARACTRON® Shaped Beam Tube generates alphanumeric, graphical and raster data of highest quality at computer speeds.

Or how about this for a genuine advance—an airborne display which presents multiple, time shared inputs of both digital and analog information from a variety of surveillance sensors? That's the S-C Multipurpose Display, developed for the A-NEW program as a key element in an ASW system. This



display has been operationally employed for some time, and Stromberg-Carlson was recently awarded a contract by the Naval Air Systems Command to begin pilot production of the equipment.

The key to much of the flexibility of S-C Displays rests in the versatile CHARACTRON Shaped Beam Tube. S-C alphanumerics and symbols are generated entirely with one pulse of the electron gun through the matrix, rather than being generated piece-meal. S-C symbols offer definition and clarity of the highest order. Symbol resolution in excess of 5000 lines is achieved, providing such definition and sharpness that data appears to stand out from the display surface.

The spot-writing mode is used to generate vectors, curves and lines on a time-shared basis. Thus, with the addition of the rear-port a single S-C display can combine optical data with unexcelled alphanumerics and graphics, plus highest-quality images of raster data from television, radar and scan converted information from other detectors.

Since the use of CRT displays first began to assume its current importance, S-C has been a leader in development and in producing finished hardware. S-C supplied special displays for the SAGE air defense system, the U.S. Army War Room, the Navy's Sea Surveillance tactical system.

One of the most widely used direct view display consoles is the S-C 1090. Current equipment includes small-screen interrogator displays, for multiple station use, giving many operators access to the same data.

S-C scientists and engineers are now probing the future – working on new pin-matrix light-valves and projection systems with an eye to improving reliability, resolution and flow of dynamic information to large-screen displays in sizes up to 20 feet square.

Whatever your needs in displays, count on Stromberg-Carlson experience for real here-and-now hardware. For information, write: Dept. ID-100, Stromberg-Carlson, Data Products Division, P.O. Box 2449, San Diego, California 92112.

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HOW CAN YOU BEAT ODDS LIKE THESE IN FINDING THE DISPLAY LIGHT YOU WANT?

You're looking for one very special display light or switchlite. Control Switch makes over 2,900...the broadest line you can tap at any one manufacturer. Check the items below for an idea of our diversification. Then . . . get a real reference file by sending for all the literature listed.

Goof-proof Switchlites

One to four lamps and colors. Four-lamp Quadlite* monitors up to nine conditions by combining flashing and steady lights. All re-lamping from front. Extra compact designs. Round lenses from ⅝" diam.; square units from ⅞". Over 1,800 styles in all.

See literature offer—Bulletin 54-A, 55-C, 63.

World's tiniest indicator lights

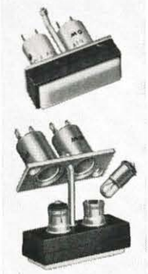
Type L10,500 (top), only .200" diam. L10,600 (center), only .383" diam. and L10,400 (bottom) only .219" diam. Operating life, 16,000 hours at 28 v; 60,000 hours at 5 v. All with 100% moisture-proof integral lamp and lens assembly molded to stainless steel assembly. Available with RFI radiation shielding. (See RFI item at right).

See literature offer—Bulletin 60

Multi-color indicator lights

From two to four lamps and colors. Four-lamp Quadlite* monitors up to nine conditions by combining flashing and steady lights. Twinlite* monitors two conditions simultaneously in different colors. All re-lamp from front. Choice of five colors, plus clear. Compact for tight, symmetrical stacking.

See literature offer—Catalog 120



See-able billboards

Over-sized. Two lamps for extra clarity. Operators get the message for sure. Captive lens housing can't be reversed or interchanged. Single or split lens. Split lens can be any of six colors, lighted independently. Choice of 6, 14, or 28 v incandescent or 115 v neon. Press-to-test types included.

See literature offer—Catalog 120

* Trademarks

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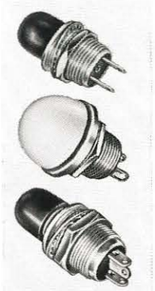

Single lamp/color indicator lights

Virtually every size and type you could want. Subminiatures with lenses as small as 0.200" diam. and cases to fit holes as small as 13/32" diam. Types include edge-lit, water-tight, moisture-proof, back or front panel mounting, press-to-test and others . . . even lighted legends and numerical read-outs!

See literature offer—Catalog 120

RFI-shielded indicator lights

New! Especially designed to reduce RFI and EMI emission from filaments of lamps in otherwise well-shielded panels. Metal mesh in lens attenuates emissions in the important 0.15 to 1,000 mc range. Special conductive gasket provides electrical conductivity between shield and case in removable lens types. Standard sizes with 115 v neon lamps, subminiatures with long life 5 or 28 v incandescent lamps.

See literature offer—Bulletin 62

Human engineering advances for extra safety

Control Switch designers are deep into human engineering for the development of switch and light features that take the guesswork out of panel equipment operation. Advances include a broad range of toggle, pushbutton and special-actuator switches as well as switchlites and indicator lights. Write us about your specific needs.

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- integrated field support to keep your system operating at top efficiency.

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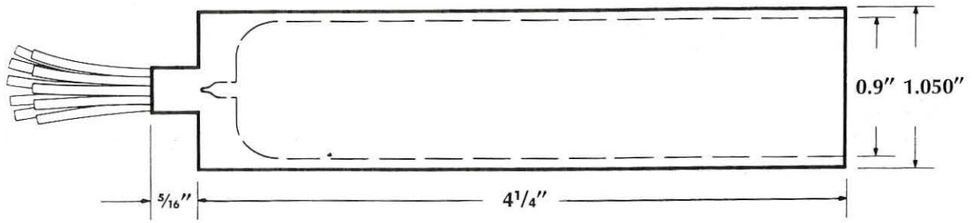
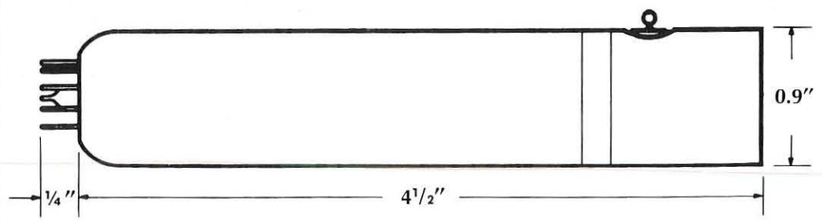


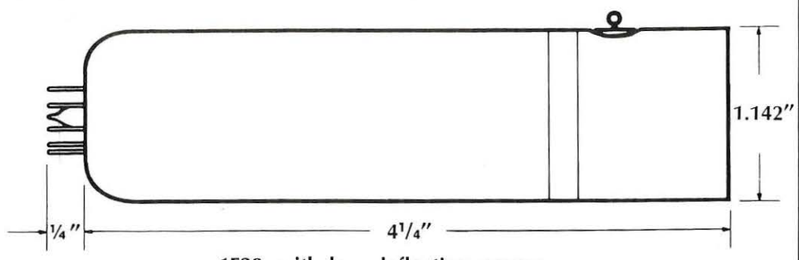
Developed for a head-mounted high resolution television display, the Type 1E29P20 can provide well over 1,000 resolution elements across the useful screen diameter. Supplied encapsulated within a magnetic shield with ruggedized electron gun and potted leads, the 1E29 is off-the-shelf for application in the visual, recording, or flying spot scanner fields.

Our family of miniature electrostatic CRTs now includes over 30 designs which are diversely employed in data annotation systems for aerial and bubble chamber photography, as high speed light sources, in manned spacecraft photo recording, in "personal" computer terminal displays, and in various character recognition and scanning systems. All of these tubes can be supplied with fiber optics face plates.

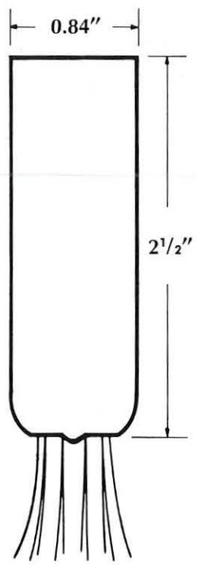
Outlined below are three other interesting types:



1E27, combining high resolution and high brightness.



1E28, with low deflection power.



1E30, only 2½ inches long for minimum size and weight.

Thomas Electronics can fill your requirements for many other types of CRTs . . . including projection, dark trace storage, rear view and bright display tubes. Write for more detailed information or call for prompt technical guidance or quotations.

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This fine line drawing of the masterpiece was actually made by a computer and a CalComp Plotter to demonstrate that a CalComp Plotter can draw anything. Automatically.

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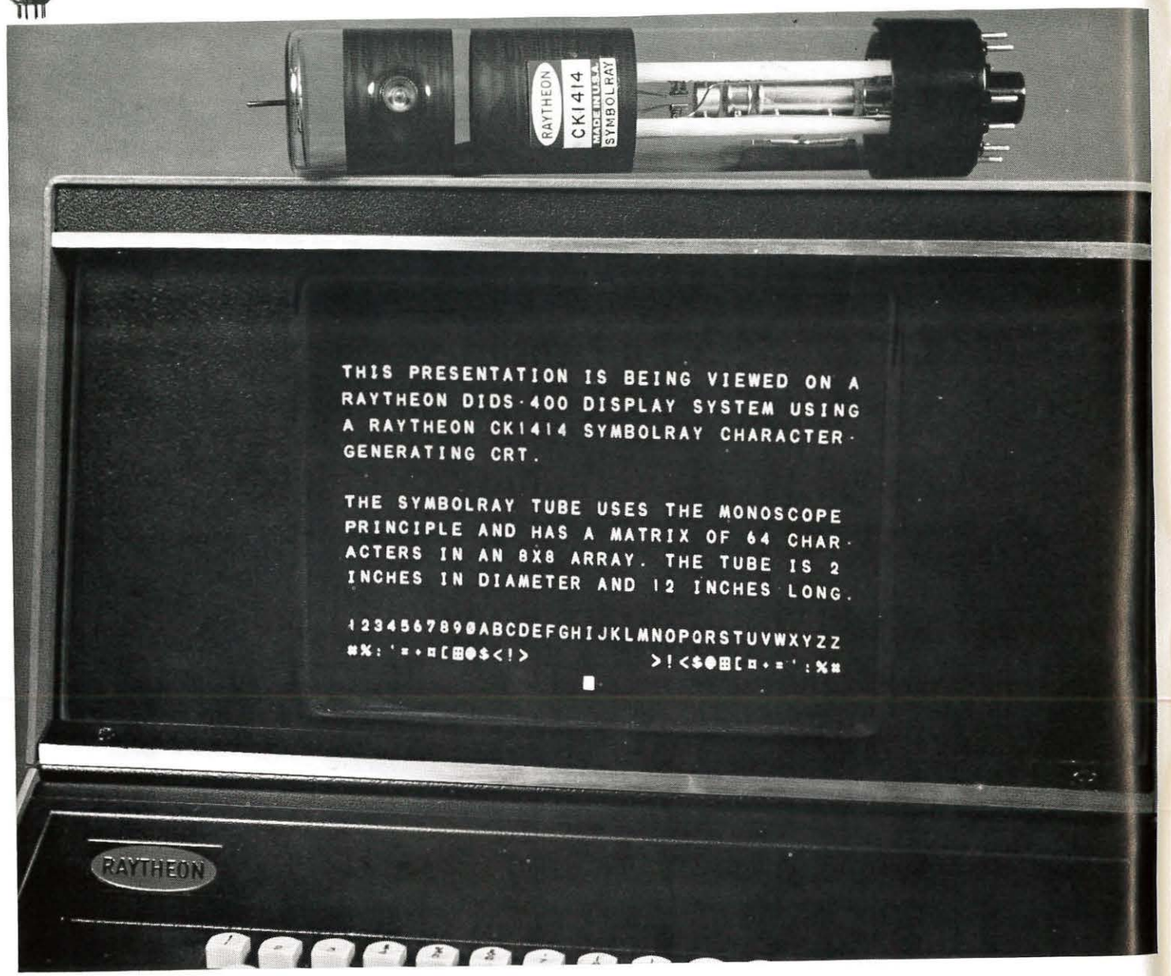


The presentation you see above was generated by a Symbolray* Cathode Ray Tube identical to the one lying on the console. A new type of monoscope, the Symbolray can generate alphanumerics from electrical signals for cathode-ray display or for hard copy print-out. The presentation here is shown on a Raytheon tube (CK1415) used in a Raytheon DIDS-400 display system.

An economical method of generating characters. Priced at less than $100 in quantities of 1,000, the Symbolray provides a more economical method of generating electronic displays than using large numbers of circuit cards.

The output of the Symbolray operating as a monoscope is obtained by electrically deflecting the electron beam to desired characters on the target and scanning them sequentially with small raster. The display cathode ray tube on which this output is viewed is scanned in synchronism. When the Symbolray method is used in conjunction with buffer-memory techniques, full messages can be displayed—as shown above. The Symbolray tube uses electrostatic deflection and focus, and is available in designs with 64 and 96 character matrices.

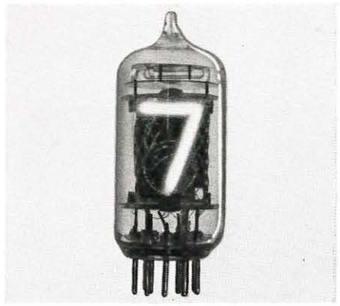
Raytheon's wide range of Dataray* CRTs cover the screen sizes from 7 to 24". Electrostatic, magnetic and combination deflection types are available for writing alphanumeric characters while raster scanning. Raytheon also offers combination deflection or "diddle plate" types and all standard phosphors. Or, Raytheon can meet your special CRT design requirements.

For more information—or a demonstration—call or write your Raytheon regional sales office.

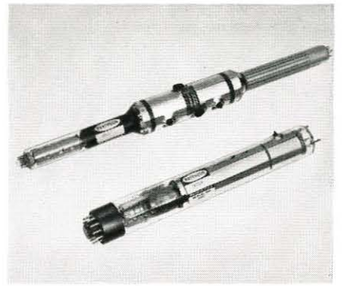
New Raytheon Projectoray* Tube produces more than double the light output of standard projection-type cathode ray tubes. The tube's light output is 30,000 foot lamberts, which results in a light level of 15-foot lamberts on a 3′ x 4′ lenticular screen.

The tube's expected minimum operating life is 500 hours—20 times the life of a standard projection tube.

The Projectoray's high light output and long life are due to its novel design. The design incorporates liquid cooling of the phosphor backplate. This allows the phosphor to be energized with a very intense electron beam. At high beam levels, very high peak light output is obtained. The light image is projected through a 5" optical window in the face of the tube. The electron gun is set at an angle to the phosphor and the deflection system compensates for keystone effects.



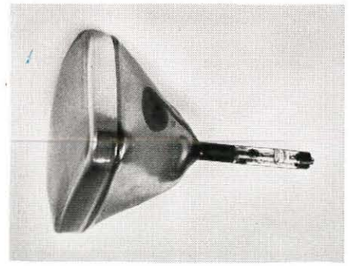
Datavue* Side-View Tubes. New Type CK8650, with numerals close to the front, permits wide-angle viewing. These side-view, in-line visual readout tubes display single numerals 0 through 9 or preselected symbols such as + and − signs. Their 5/8"-high characters are easily read from a distance of 30 feet. Less than $5 each in 500 lots, they also cost less to use because the bezel and filter assembly can be eliminated and because their mating sockets are inexpensive.



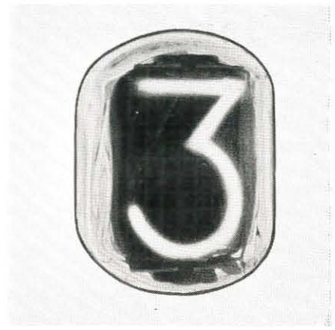
Recording Storage Tubes. The miniature tubes shown here are Raytheon's single-gun (CK1516) and dual-gun (CK1519). They provide high resolution, long storage, and fast erase capability.

Raytheon electronic input-output storage devices feature the above capabilities and immediate readout. Information can be written and stored by sequential techniques or by random-access writing. Complete, gradual or selective erasure is possible.

Raytheon storage tubes are readily available for applications in radar scan conversion, slow-down video, signal processing, signal enhancement, time delay, and stop motion.



Dataray* Cathode Ray Tubes. Raytheon makes a wide range of industrial CRTs—including special types—in screen sizes from 7" to 24". Electrostatic, magnetic, and combination deflection types are available for writing alphanumeric characters while raster scanning. All standard phosphors are available and specific design requirements can be met. Combination deflection or "diddle plate" types include CK1395P (24" rectangular tube), CK1400P (21" rectangular), and CK1406P (17" rectangular).



Datavue* End-View Tubes. These tubes are easily read in high ambient light—do not wash out like other displays. Erroneous readings due to segment failure do **not** occur because the characters are fully formed. Raytheon Datavue End-View Tubes fit existing sockets and conform to EIA ratings. Models include round (CK8421) and rectangular (CK8422). Ultra-long-life types are designed for 200,000 hours or more of dynamic operation.

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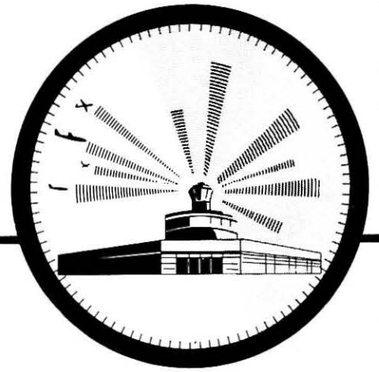

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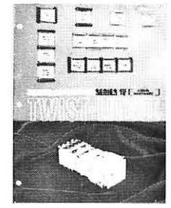

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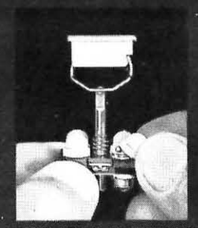

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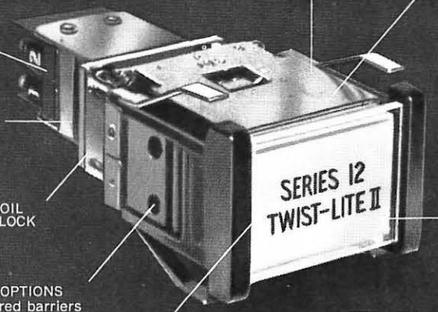

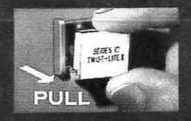

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25 YEARS IN INFORMATION DISPLAY

Happy New (Fiscal) Year!

This editorial was invited as a message from your outgoing Treasurer. The financial report will be given at the Annual General Meeting scheduled for this period, but I will say here that the financial report will show that we are soundly solvent and growing. Our policies, procedures and organizational structure are developing and firming. We have already established a central office in our own quarters to carry out the many activities necessary to keep our organization viable. Now that we have developed the means to permit us to function more efficiently, greater attention can be given to the nature of that functioning. *SID* was founded because of our need to be in contact with others working in this vital technological area to share problems, approaches, information, and findings. Its phenomenal growth attests to the fact that *SID* is meeting our requirements in this respect. The increase in membership and the diversity of affiliations of our members is concrete evidence that the need for information about our rapidly evolving technology is being felt more and more widely across the entire economic spectrum.

As we pause for assessment at our fifth anniversary time, I would like to examine with you the thought that the need *SID* fills for its members is also known and felt by other areas of business, government and society. It is important that *SID* members be cognizant of and responsive to that need.

Our world is changing profoundly in a manner that reaches every aspect of life. As new concepts emerge and new technology develops, each adds to requirements for communication of information and for appropriate means of presentation to the user. There is a growing demand for greater understanding of technologies available and for means of evaluating these technologies in terms of present and future requirements. For example, in areas such as science, industry, government, medicine or education, there is expressed more and more frequently a need for definition and interpretation of technologies for information handling and display. This is because the outer limits of information handling and display capabilities represent a significant restraint on ability to take advantage of other new technological advances.

It is from *SID*'s membership that authoritative response to this need can be expected. *SID* represents the preponderance of talent and skill in the information display field. It is principally within our membership rolls that the individuals who developed the present state of the art and who will shape its future are to be found. It is from this group that assessment of present capabilities and suggestions for future trends should emanate. Would-be users are seeking syntheses of findings and recommendations for development in anticipation of the demands for sophisticated information display of the future. We in *SID* should be keenly aware of this need and move to meet it.

EDITH BAIRDAIN, PhD
Treasurer
Society for Information Display

Dr. Edith Bairdain, Treasurer, Society for Information Display, *is a Fellow and Charter Member of the society. She is also active in the American Psychological Association, the American Association for the Advancement of Science, and the Human Factors Society. Principally engaged in systems engineering and design of large electronic communication systems, her contributions to the field are well known and widely respected. She is a member of the staff at Communications Systems Inc., a Division of Computer Sciences Corp.*

Hardware for Bimat processing

by ROBERT P. MASON
Photomechanisms Inc.
Huntington Station
Long Island, New York

ABSTRACT

The use of Kodak Bimat for processing of transient data is described in an article currently available from Photomechanisms, Inc. Photomechanisms' Robert Mason discusses the design of hardware and systems employing Bimat for the recording and processing of CRT-displayed transient data generated by telemetry or computer outputs. Bimat, which contains its own processing chemicals and requires no free liquids offers some distinct advantages to the designer of data handling equipment and imposes certain limitations. These are set forth and evaluated.

[The following paper was first published in SPSE News, Vol. 9, No. 3, May/June 1966, and is reprinted here with the permission of the SPSE editor, and the author.]

INTRODUCTION

Much has been presented about the properties of the well known Kodak Bimat Transfer Film since its announcement[1] and availability for experimental use four years ago. Equipment designed to exploit its unique properties has been under development in the interim. Some of the considerations and constraints on such equipment imposed by the distinguishing features of the Bimat Transfer Processing System are described, citing for illustration a few of the devices which have emerged on the scene.

The Eastman Kodak Company has recently published a data sheet on the Bimat Transfer Processing System[2] which outlines the essential features and properties of the various materials which are produced under the Bimat label.

THE BIMAT PROCESS

For the reader not already acquainted with Bimat, the following is a quick review. The Bimat prcoess is diffusion transfer in nature. This involves two materials, an exposed silver halide film and a positive image receiver or print material. Bimat is the unique positive receiver, soaked in solutions which are absorbed in a gelatin layer carried on a film base material. Thus the Bimat is a film which carries in an absorbent coating the necessary wet chemicals for processing a separate negative film.

The film and Bimat are pressed together in intimate surface contact for a time long enough for the process to take place.

As the dry negative film emulsion contacts the wet Bimat coating, the chemicals enter the layer, developing exposed silver grains and dissolving the silver halide which is not exposed. As the dissolved silver halide diffuses into the Bimat layer, it encounters development centers which result in development of the dissolved silver in the Bimat. Thus the film turns black where it is exposed and the Bimat turns black where the film is not exposed. Given sufficient time, the process goes to completion leaving no undeveloped silver and results in two separate transparent images, one negative and one positive. The materials are separated and may be dried and used as is or washed and dried for full permanence.

UNIQUE FEATURES

In Figure 1, the fundamentally unique features possessed by Bimat over conventional processing means are listed. The use of Bimat and the generation of equipment in which it is employed is always justified over conventional methods by one or more of those listed.

Containment of Free Liquids is the property which results in the misnomer "dry process". It is, of course, not dry, since water must be and is present in any development process for silver halide films. No free drops exist, and the presoaked Bimat may be handled in roll form without danger of spilling. The process is completely insensitive to magnitude or direction of gravity.

[1] *Tregillus—"A Diffusion Transfer Wet Process", SPSE Annual Meeting May, 1962.*
[2] *"An Introduction to Kodak Bimat Transfer Processing System", Kodak Pamphlet No. P-65.*

Inherent Advantages of Bimat Over Conventional Processing:

1. Containment of Free Liquids
2. Simplified Equipment
3. Controlled Sensitometry
4. Simultaneous Positive
5. Quick Access
6. Strong Image Base

FIGURE 1: The use of Bimat is usually justified by one or more of these features.

Simplified Equipment is possible where the two materials are rolled up together for the duration of the process. This involves only a box, a film supply spindle, a Bimat supply spindle, and a take-up core for the sandwiched materials with a spring loaded builder roller in contact with the materials at the mating point. This roller excludes air entrapment between the layers and assures a uniform and firm contact between the materials. At room temperature, the complete process takes 15 to 20 minutes.

Controlled Sensitometry results from the process since it is self limiting, and relatively temperature insensitive. The negative D log E curve shifts upward slightly as a whole when the temperature is increased, resulting from a simple fog level rise. The D log E curve of the positive shifts somewhat in relative speed with temperature but is not otherwise significantly affected. The basic performance is determined by the materials used.

Simultaneous Positive generation results in a considerable saving of time when compared with the time required for the production of a proof print for analysis from a master negative. In many instances, a quick look at a positive record is required to assess the value of information recorded without risking damage to the master negative. The positive transparency by-product often represents an important capability of the process.

Quick Access can be achieved at elevated temperature. A complete positive and negative image are available in one to two minutes at 120°F depending on materials used. A quite excellent positive image is available in the order of 10 seconds after lamination at a like temperature.

Strong Image Base material is used. The Bimat base stock is Estar polyester film, an extremely strong and durable material. It permits the use of Bimat in conditions where high acceleration and shock loads are encountered, such as in rapid frame advance mechanisms or high speed winding equipment.

Film suitable for processing with Bimat are restricted to those types which possess relatively thin and hardened coatings. The Eastman Kodak Company will recommend any of a number of different film and Bimat imbibant types depending on the application. While some degree of development and fixation reactions would undoubtedly occur between Bimat and any film, satisfactory image formation, negative clearing, gel stability, and so on, will be present only when the film emulsion and Bimat solution formula are matched at the time of manufacture.

CAPABILITIES

A dramatic example of the capabilities of Bimat for reduction in complexity of processing equipment is manifested in the portable windup type processing unit shown in Figure 2. This simple box, not more than 1 ft. high, can process

FIGURE 2: A complete Bimat film processor. Roll on left is Bimat.

short lengths of certain films in either 35 mm or 70 mm width, can produce sensitometrically controlled images, can yield a positive transparent print along with the negative film, has a total capacity of 100 ft., and requires no darkroom, sink or other accessory facility or materials. Negative film, withdrawn from a standard 35 or 70 mm cassette, is wound tightly with Bimat drawn from a 100 ft. supply spool onto a take-up spindle equipped with a spring loaded builder roller. The materials are left for 15 to 20 minutes for the process to take place. The film and Bimat are cut and separated as they are pulled from the core, and hung up to dry. Both will dry in low relative humidity air and will remain quite stable. The Bimat image surface, however, is hygroscopic in air above 30% RH unless washed.

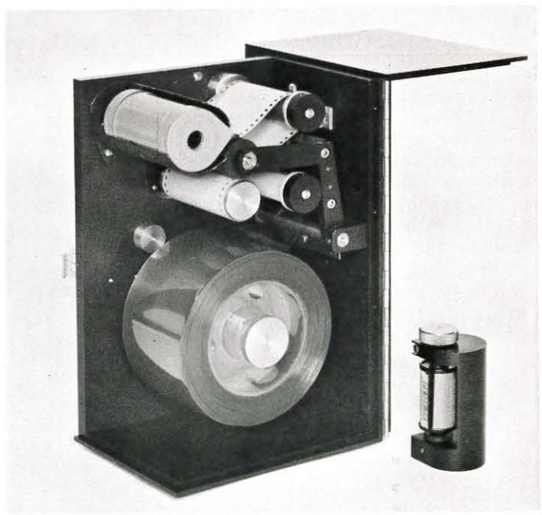

FIGURE 3: Details inside the Bimat processor.

DESIGN CONSIDERATIONS

Even in such a simple device a number of design considerations are important. As can be seen in Figure 3, there

are two flanged guide rollers around one of which each of the materials passes to assure alignment prior to lamination and to produce a proper entrance angle of the two materials to the laminating point. Care in selecting the location of the builder roller must be exercised to avoid the possibility of the materials either contacting before being squeezed together by the laminating roller, or the sandwich being bent over a different radius after it is formed. Violation of the latter would cause relative slippage of the two materials which could degrade the positive image severely or physically damage the emulsion. In the former case, the entrapment of air between the layers must be avoided by causing the materials to be pressed firmly and uniformly together at the time of first contact. These conditions must hold over the range of radius change on the take-up core as the materials are wound up.

Additionally, some provision for convenient threading and starting of the unit must be made. For example, tape will not stick to active Bimat. In this case, the Bimat is started on the core with a full turn to lock it on, and the film is then stuck to the Bimat carefully placed in alignment at the edges.

Protection of the Bimat on the supply core is desirable if the materials will not be completely consumed within a few hours after opening the package. This can be accomplished by providing spool flanges with resilient foam plastice inner surfaces to seal the edges of the supply roll of Bimat and thus retard the rate of drying out before use.

When such a device is put to serious use, it is found that hanging the materials up to dry presents a number of problems. First, there are two strips, both tacky. One must hold them up high to prevent them from dragging on the floor. Since both hands are occupied, one may have difficulty in getting either one over a suitable hook or clothes line without damaging it, provided a suitable one can be prepared. If either are rolled loosely, they will almost immediately stick to themselves and tear when they are unrolled.

This dilemma can be solved nicely by equipment design. Kodak offers a material known as Dry Cover Sheet which consists of a 2.5 mil Estar film with a gel coating on one side. If it is firmly laminated to the Bimat Film after separation from the processed negative, it will adhere and protect the tacky image surface. The sandwich thus formed is capable of being handled almost immediately and may be spooled and run through readout equipment without difficulty. The entrapped chemicals do stain in 10 to 12 days, however, and so the cover-sheeted positive must be considered as a temporary or short term proof.

The negative must be washed and dried for permanence. It may be protected from adhering to itself by winding tightly, carefully excluding air with a builder roller. A hand operated unit with a capacity of 100 ft. which rewinds the negative and laminates the cover sheet to the positive after processing is now being completed. Other similar equipment in various forms are available on the market.

AUTOMATIC PROGRAMMED-DATA RECORDING

Another class of equipment is that for automatic recording of programmed data with short access time to the processed image. Some of this equipment, built by Photomechanisms, Inc., has been used for recording of pictorial data telemetered over long distances and displayed on a cathode ray tube (CRT). In these machines, the exposed film is laminated continuously with Bimat and the sandwich is passed at a constant rate through an oven to maintain the elevated temperature for about 90 seconds. The materials are then separated and passed through washing or other protecting treatments and onto spools. These

FIGURE 4: Nimbus weather satellite ground station equipment.

units provide complete dry-to-dry processing, give access in the order of 5 minutes, and yield both an archival negative and an expendable quick-look positive. In some cases, viewing of the images immediately after development is provided for monitoring purposes.

Certainly this type of equipment is not justified by its small size or low cost. In one case a 6 foot diameter wheel was used to convey the laminated sandwich over a 16 ft. portion of its circumference before separation and washing. It is justified by the simplified handling of processing materials, there being no separate developer or fixer involved; the high degree of sensitometric control imparted to the negative, it being necessary to gain subject data from film density measurements; the simultaneous generation of a

FIGURE 5: Upper section of Nimbus processor showing Bimat supply container (center), laminating rollers (to left of container), negative film viewer (top left), and camera section (right).

proof-type positive record for quick analysis; and the relatively quick access available through elevated temperature Bimat processing.

Figure 4 shows a front view of equipment generated for the Nimbus weather satellite ground station equipment at NASA's Goddard Space Flight Center. Figures 5 and 6 show the upper and lower sections respectively with the front doors open. The film is exposed in a camera section located in the right hand half of the upper unit. The lens projects the CRT display onto 70 mm film along with the separate image of an identifying caption. The film is advanced regularly, one frame at a time and forms a loop below the pulldown sprocket. The film is then metered continuously into the Bimat processing section and laminated with the Bimat at the entrance to a 30 inch long straight path oven. At a rate of 20 in. per minute, this provides the full 90 seconds of processing time required at a temperature of 120°F.

FIGURE 6: Lower section of Nimbus processor showing processing tunnel, wash tank (lower left), cover sheet supply spool (black), and positive image takeup (right).

At the exit of the heated tunnel, the two materials are separated. The Bimat is relaminated with cover sheet, moved across a light table for magnified viewing, and spooled up. The negative film takes a double pass through wash water and moves through a warm air dryer and a magnified viewer on its way to the take-up spool.

The number of important design considerations in the manufacture of this type of equipment is, of course, very much higher than in the small portable unit. Many are related to the use of the materials at elevated temperature. Some are related to the greater number of functions performed, the straight path form of the processing section, and the continuous drive nature of film movement. A few of the more important factors are described for the benefit of those interested.

Protection of the Bimat supply roll was necessary due to the intermittent intended use of the equipment. It is operated for about 10 minutes during each orbit of the satellite and placed on standby for the remaining one hour and 20 minutes. A closed container with roll edge seals was used, providing only a slit exit for the Bimat.

Because the positive and negative materials will "bake together" or dry out and adhere at elevated temperature if allowed to remain stationary too long, a low speed "creep" transport drive is maintained active at all times. This brings fresh Bimat constantly into readiness for lamination and avoids creating the adhering condition. Rates for creep as low as 0.5 in. per minute can be used.

Temperature limits must be observed to assure completion of the process in the available 90 seconds on the low end and to avoid exceeding the gel melting point or elevating the fog level too much at the high end. A solid state thermister temperature sensor and regulator of our own design was utilized very successfully.

Care to avoid bending the sandwich after lamination was taken as well as to assure the proper entrance angles. The laminating roller was gimbaled on one axis to assure uniform pressure across the line of contact. Careful alignment and stiff design of the rollers were necessary to assure proper tracking of the materials.

Tensions in the two bands were carefully controlled to avoid shear stresses in the sandwiches and to prevent excess force on the film metering sprocket teeth. Separate film takeup drives were used, one of which was completely isolated by a closed drive loop which started and ended with synchronized sprockets.

Simple and rapid threading of the unit is important. Considerable attention was given to this and alignment aids for use during threading were included.

The use of Bimat in this system was intended to provide an on-line photographic processing system which would fit into the electronic equipment or computer environment. There is evidence that electronic technicians are finding the servicing and operating requirements of the Bimat system within their capabilities. This may, in time, prove to be a strong asset to the process.

CONCLUSION

Bimat is gradually carving a place for itself in the overall film processing picture. Certainly there is little competition for this type of processing in airborne or satellite environments where the direction and magnitude of gravity is unpredictable. It offers great potential in field portable processing equipment where the supply of fresh materials can be maintained. The high quality and rapid access capability of the positive image alone presents very interesting possibilities. Where both positive and negative images are necessary, especially where access time is important, Bimat should also be given serious consideration. There remains a fertile area for imagination and skill in the development of new hardware to exploit this modern and unique processing technique.

THE AUTHOR

ROBERT P. MASON is Vice President for Research and Development at Photomechanisms Inc., Huntington Station, Long Island, N.Y. He is a graduate of Amherst College (1954) with a BA/Physics, and of MIT (1954) BS/Physics. He joined Photomechanisms in 1959 and is responsible for R&D direction and planning, technical proposal direction, and company security and personnel. Prior employment included classified R&D with the federal government in the field of electro-optical instrumentation; Physicist with Eastman Kodak Co., and Laboratory Assistant at MIT. He has published several papers and has a patent pending. He is a member of OSA, IEEE, SPIE, and APS.

The relative legibility of Leroy and Lincoln/Mitre alphanumeric symbols

by DIANA J. SHOWMAN
The Mitre Corporation
Bedford, Massachusetts

[This paper is based on the author's recent report, entitled, "Studies in Display Symbol Legibility: X. The Relative Legibility of Leroy and Lincoln/Mitre Alphanumeric Symbols". The full reference is cited under Reference 1, at the end of the paper.]

ABSTRACT

The legibility of standard Leroy alphanumeric symbols was compared with that of a new font, the Lincoln/Mitre (L/M) font. Legibility was tested by having human subjects attempt to identify the symbols when shown one at a time for a brief exposure period. The L/M font was found to be more legible than the Leroy. It is recommended that the L/M font be used in solid-stroke displays, and that it be tested for different types of displays.

INTRODUCTION

A set of alphanumeric symbols (letters and numerals) which is known to be legible in different kinds of visual displays would be useful in many systems. Such a symbol font, or style, would retain good legibility whether being displayed on a television monitor, a beam-writing cathode ray tube, a printer, or a large board display. The font's legibility is best tested by having human subjects attempt to identify

the symbols, or otherwise read something printed with the symbols. One way of determining the legibility of a set of alphanumerics is to expose the symbols briefly to subjects one at a time, and to record the errors made for each symbol shown. The font's legibility is shown by the total errors made, and specific confusions of one symbol with another suggest design changes to improve symbol clarity. At Mitre, many legibility tests have been made of several different fonts,[2, 3, 4, and 5] and an attempt is being made to develop a font of more universal application.

In this attempt, a font which has been successively modified in earlier work has been tested by comparing it with standard Leroy, a font known to have good legibility (Figure 1). The font tested (hereafter referred to as the Lincoln/Mitre, or L/M, font; see Figure 1) is similar to that designed by Harris, *et al.*, at M.I.T.'s Lincoln Laboratory for the Charactron tube[6]. Design changes in the Q, 8, I, C, 2, and Ø, which were suggested by other work at Lincoln Laboratory and at Mitre, were included in the L/M font.

In an earlier experiment at Mitre[3], eleven letters and numbers (B, C, G, I, O, Q, S, 1, 5, 8, and Ø) and the dollar sign from the Leroy and the L/M fonts were tested under conditions similar to those of the experiment reported in this paper; many more errors were made with the Leroy than

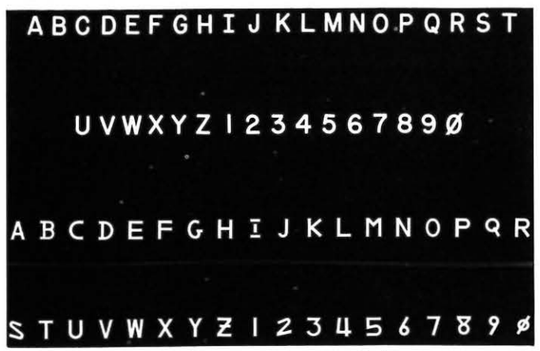

FIGURE 1: The Leroy alphanumerics (top) and the Lincoln/Mitre alphanumerics (bottom) shown in the experiment.

with the Lincoln/Mitre symbols. This result suggested comparing the two fonts using all 36 alphanumerics, and indicated that the Lincoln/Mitre font would be a good choice to begin with in designing a font legible in many kinds of displays. The details of the experiment comparing the 36 alphanumerics (capital letters and numerals) of the Leroy font with those of the L/M font are reported below.

APPARATUS

Each set of alphanumerics was photographed on a 35 mm strip of high contrast film, with one symbol per frame. One film strip with 180 symbols was made for each font. The symbols had a height to stroke-width ratio of approximately 6 to 1, and a height-to-width ratio of approximately 4 to 3. Symbols were clear with the rest of each frame opaque.

The symbols were shown in a tachistoscope (Figure 2). At one end of the tachistoscope, the film passed from one reel to another behind an opening just large enough to expose one symbol. A mechanical shutter was mounted between the film and a battery operated, incandescent light. The shutter was activated when the subject pressed a button, and allowed a 10 millisecond exposure of the symbol. The height of each symbol subtended approximately 16 minutes of arc at the subject's eyes. The image of the background (which was a rectangle of white styrofoam) was reflected by a beam-splitter through which the subject could see the symbol; the symbol thus appeared to be superimposed on the background. The background brightness was held constant at 1 ft-L, and the brightness of the symbol was either 10, 8, 6, or 4 ft-L. The symbol brightness was held constant throughout each session. The brightness of symbol and background were measured through the eye

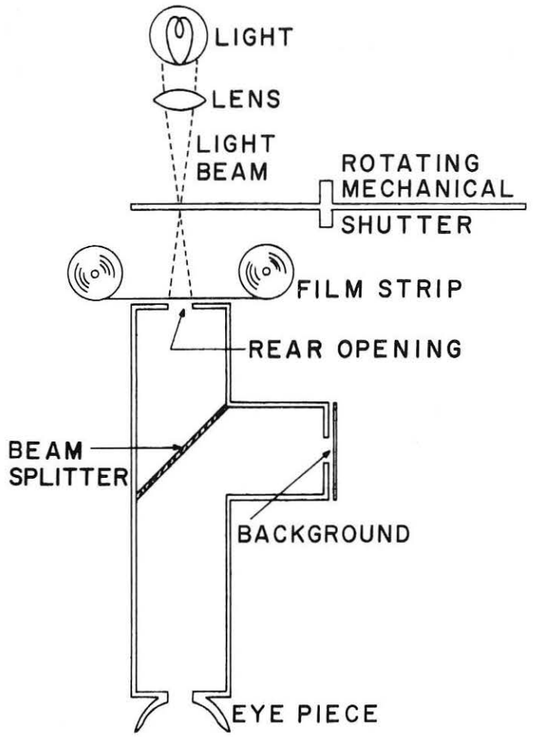

FIGURE 2: The tachistoscope used to expose the symbols to the subjects.

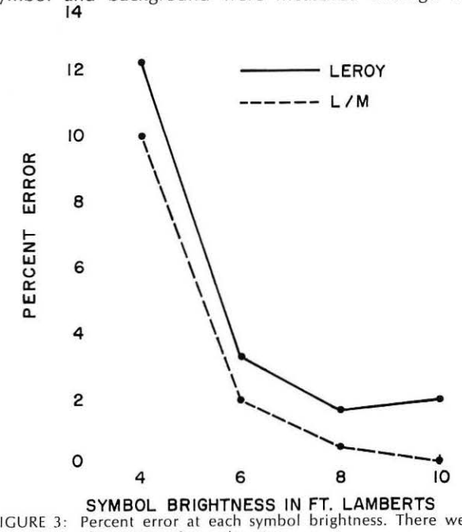

FIGURE 3: Percent error at each symbol brightness. There were 1620 observations for each point.

piece of the tachistoscope with a calibrated Spectra Brightness Spot Meter before and after each experimental session. Symbol brightness did not vary more than ±.4 ft-L, nor the background brightness more than ±.1 ft-L, from the stated values.

PROCEDURE

The subjects were nine Mitre employees who scored at least 20/20 for both near and far acuity, either corrected or uncorrected, in the Bausch and Lomb Ortho-Rater. No subject had an extreme phoria score or was color blind.

Symbols were shown one at a time to each subject. Each of the 36 symbols appeared 5 times at random with respect to alphabetic or numeric order on each film strip. In each experimental session, the subject saw all of the 180 symbols on one film strip. By advancing the film either one or two frames at a time, and by beginning at either end of the film strip, the experimenter showed the symbols of each font in four different random sequences in the four sessions with that font. The subject was given a photograph of the alphanumerics to be seen in each session, and could refer to it at any time during the session. The subject pressed his button when his eyes were fixated on the background and he was ready to see each symbol. After each symbol exposure he was required to identify the symbol shown, guessing if he was not sure, and his errors were recorded. Three short rests were given in each session, dividing the session into quarters. Four subjects saw the L/M font at 10, 8, 6, and 4 ft-L in four successive sessions, and then the Leroy at 10, 8, 6, and 4 ft-L; five subjects saw Leroy first, and then L/M. Each subject, therefore, was tested in eight experimental sessions, with no more than two sessions for each subject per day. For each font at each symbol brightness value, there were 1620 symbol exposures (one session with each of nine subjects, and 180 symbols per subject per session).

RESULTS AND CONCLUSIONS

Figure 3 shows the percent error as a function of symbol brightness for both fonts. At each value of brightness, fewer errors were made with the Lincoln/Mitre font than with the Leroy font. At each brightness value, each subject's error score on L/M was subtracted from his score on Leroy, and for each brightness value, a one-tailed, correlated *t* test of the difference in errors between fonts was done. At 4 ft-L, the difference in errors between Leroy and L/M was not statistically significant. At 6 and 8 ft-L, the differences were significant at the 5% level. At 10 ft-L, the difference was significant at the 1% level.

The distributions of errors for both fonts at 4 ft-L are shown in Tables 1 and 2. The errors at each brightness level are discussed in greater detail in the earlier paper[1].

In summary, the results were as follows:

1. Fewer errors were made at each symbol brightness value with L/M than with Leroy. This finding agrees with that of the 12 symbol study described earlier.[3]
2. At 8 and 10 ft-L, the error rate with L/M was very low; with Leroy it was higher, and was no better at 10 than at 8 ft-L.

Character Called

Character Shown	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	1	2	3	4	5	6	7	8	9	Ø	Σ
A																		1										1										2
B							1										2														2		5		1	11
C							21								2		2											1									26
D			1												4		2				1															1	9
E																													1		1						2
F																																					0
G			4												1																						5
H																		3			2																5
I																				1				1		1										1	4
J																												1									1
K																		2						1													3
L																																					0
M										2				1								1	2													1	7
N								1									1	1			1		1														5
O			4				3										10																				17
P						1																													1		2
Q			1	1			1								4													1							1	9
R					1																																1
S							1																								6						7
T								2																	1		1										4
U			1																																		1
V																									2												2
W																					1																1
X											1																										1
Y																				1												1					2
Z																												3									3
1								2																										1			3
2																										1						1				1	3
3															1			1													1					1	4
4																													1								1
5		3																1											2			2				2	10
6			4				7										1									1									1	14
7																																					0
8		12					1								1			2														6			1	23
9							2		1						1		1												1						1	7
Ø																												2				1					3
Σ	0	15	15	1	0	2	37	1	5	0	3	0	0	1	14	0	19	7	4	2	5	1	3	2	3	2	2	7	7	0	7	12	3	5	1	12	198

TABLE 1: Confusion matrix showing errors with Leroy at 4 ft-L for nine subjects, one session each. Each symbol was shown 45 times (five times to each of nine subjects).

Character Called

Character Shown

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	1	2	3	4	5	6	7	8	9	Ø	Σ
A																	1							1							1						3
B				1														2	1															2		1	7
C															1																							1
D		1					1																															1	3
E																															2							2
F																4																						4
G			1																																			1
H														1			1	3													1							6
I				1												1										2	2	1			1	1		1				10
J									2																	3												5
K																		1						1										1				3
L			1																																			1
M																																						0
N											1																											1
O							5										6																					11
P						3							1																									4
Q																1		1																				2
R																																						0
S																								1		2		2			1			1		1		8
T						1			4																	1												6
U																														1								1
V																									1													1
W							1				2						1																				1	5
X											1														1													2
Y																																	3				1	4
Z																											9											9
1									2																												1	3
2																										7			3								3	13
3									1	2																											1	4
4							1				1			1			3			2																		8
5		1			1														4													1		1				8
6																	1														1			2		3	7
7																										1												1
8		1																1	2							2						1					3	10
9																																	3	2			3	8
Ø																																						0
Σ	0	3	2	2	1	4	8	0	9	2	5	0	1	2	1	6	13	8	7	0	2	0	0	3	2	12	6	13	4	1	5	4	7	9	1	19	162

TABLE 2: Confusion matrix showing errors with L/M at 4 ft-L for nine subjects, one session each. Each symbol was shown 45 times (five times to each of nine subjects).

3. The differences in number of errors between fonts were statistically significant (according to *t* tests) at 6, 8, and 10 ft-L.
4. A higher proportion of the error was concentrated in fewer confusions with Leroy than with L/M.

The conclusions are as follows:

1. The L/M font is more legible than the Leroy font, and
2. The L/M symbols, Z, 2, F, P, O, Q, G, S, and 5 may need to be modified if errors are to be further reduced.

RECOMMENDATIONS

The lower error rate and the greater scattering of errors suggest that, for different displays, the L/M font is a better choice than a standard font similar to Leroy. At the same time, the concentrations of errors found for L/M indicate that the font may be improved further by changing the symbols most often confused. It may not be necessary to change all of these symbols in order to reduce confusions among them. A test of the improved font can be made, but before any symbols are modified, it seems wise to collect more data on inter-symbol confusions when the font is tested under conditions that occur in different types of displays.

It is recommended that the L/M font be used when improved legibility is desired in displays using solid-stroke numerals and capital letters.

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1. The present paper is based on a report by Showman, D. J., *Studies in Display Symbol Legibility*, X. "The Relative Legibility of Leroy and Lincoln/Mitre Alphanumeric Symbols", *ESD-TR-66-115*, August 1966.
2. Kinney, G. C., "Studies in Display Legibility. A Talk Given at the Tri-National Symposium on Information Transfer, October 1965, and the Text of the Paper Submitted", *Mitre Technical Paper 21*, 1965.
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4. Shurtleff, D., and Owen, D., *Studies of Display Symbol Legibility*, VI. "A Comparison of the Legibility of Televised Leroy and Courtney Symbols", *ESD-TR-65-136*, May 1966.
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6. Harris, W. P., Green, B. F., Wilson, E. A., and Liaudansky, L. H., "The Design of Characters for the Charactron", *M.I.T. Lincoln Laboratory Technical Report No. 117*, May 1956.

DIANA J. SHOWMAN received her B.A. degree in Psychology from Cornell University, Ithaca, N.Y., in 1963. Since that time, she has been employed as a Technical Assistant in the Computer and Display Department at The MITRE Corporation, Bedford, Massachusetts. Her work at MITRE has included testing the legibility of several sets of alphanumeric symbols and conducting experiments in visual perception.

INTRODUCTION

Energy transfer in illumination and electronic viewing or imaging systems takes place from the light source to the scene or object to the photosensitive surface of the imaging device, while the light is reflected from the object and finally through the photosensor and imaging device electro optical process to the output electrode, amplifier and display. The performance of this last leg of the electronic imaging process by the variety of available photosensitive devices is limited primarily by the finite number of light quanta and the quantum efficiency or absorption coefficient of the primary photoprocess. Any structural or electro-optical defects are more or less removable and are not fundamental limitations.

A particular photosensor device surveying a scene with a certain scene brightness through an optical system and during a given exposure time is irradiated by a finite number of light quanta. A number of discrete bits of information is furnished during the exposure time through the sensing device in form of light quanta, counted and determined in number and distribution. The conversion of this light quanta into bits is accomplished with a certain arithmetic.

Characteristics of photosensors

by G. T. NAGY
Nortronics Division
Northrop Corporation

Most visual or imaging processes whether electrical like in TV pick-up tubes, chemical like photographic film or biological like the human eye are simple counting processes. Although those electrical, chemical or biological imaging concepts operate on different principles, they do possess one concept in common, some means of counting the incident of light quanta. Electro optical photosensor devices convert the light quanta into photoelectrons and count the number of electrons in measuring output voltage or current. Photographic or chemical process converts light quanta into granules of silver on emulsion of photographic plates forming a pattern of opaqueness. The number and density of those silver granules corresponds to the incident light quanta. The human eye produces nerve pulses by converting a small portion of the incident light quanta. The brain does the counting by estimating the original light quanta, their arrival frequency and their distribution.

This paper concerns the electronic imaging processes, electro optical photosensitive devices and wherein this process differs from other visual systems by the arrangement of the received information. It uses the scanning process for accepting the bits of information and distributes

them one at a time into their proper sequence to reconstruct the image.

The particular electro optical imaging devices in mind are the two well-known TV tubes, the photoconductive vidicon tube and the photoemissive orthicon tube, and a relatively new device which utilizes the advantages of both the vidicon and orthicon tubes, the French CSF-developed TIAM* tube, and the Westinghouse-developed SEC** tube.

IMAGING DEVICES

Vidicon Tube

The vidicon tube photosensitive faceplate consists of a thin layer of photoconductive material. The construction of the well-known camera tube is shown in Figure 1. The tube sensitivity is a function of the photoconductive coating characteristic as well as the signal electrode voltage. Dark current increases with signal electrode voltage and presents problems in normal operation if it is not uniform across the photoconductive surface. Since it is temperature sensitive the tube transfer characteristic is also temperature dependent. Light transfer characteristic signal output current as a function of faceplate illumination is shown in Figure 2. The slope of the curve gives the average gamma of the tube (gamma = 0.65). Other characteristics are the following:

Spectral response characteristic is shown in Figure 3.
Signal to noise ratio = 300
Medium sensitivity
Maximum output current = 0.35 μamp.

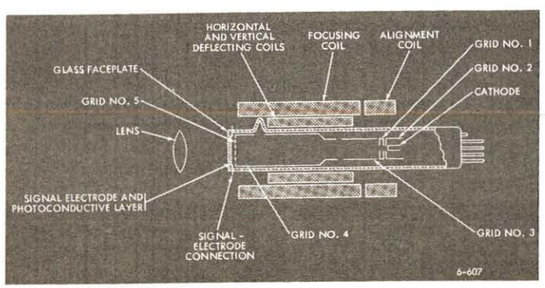

FIGURE 1: Vidicon tube.

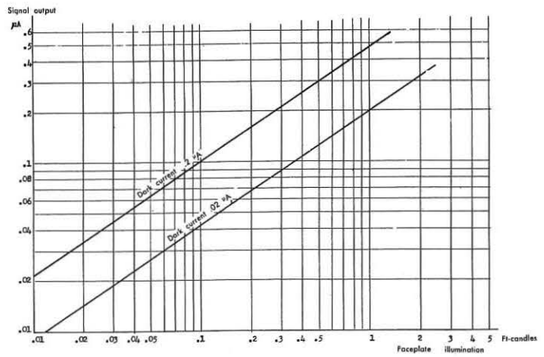

FIGURE 2: Vidicon tube transfer characteristic.

*Tube Image Analiseur Memoire (CSF, France, and Warnecke, Chicago)
**Secondary Electron Conduction (Westinghouse)

Image Orthicon Tube

The image orthicon tube is a photoemissive device with a photocathode at the photosensitive faceplate, with a single or multiple image intensifier at the primary photo-

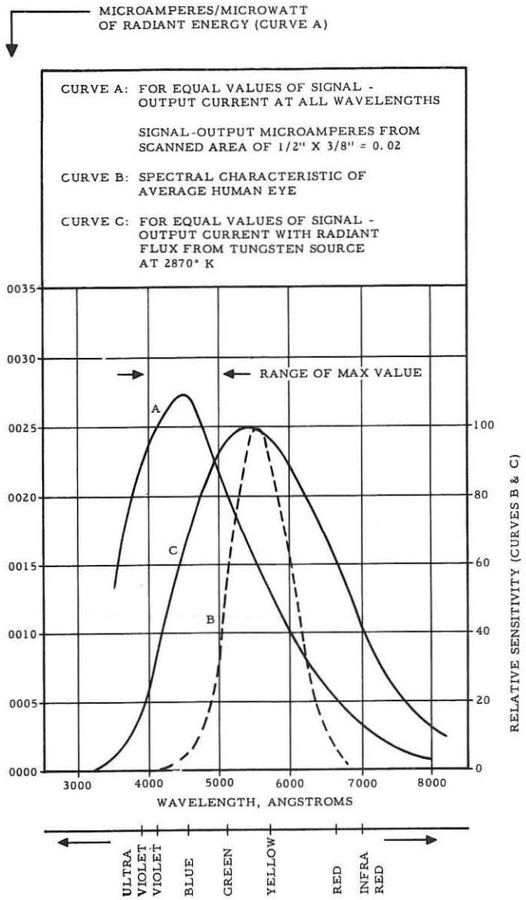

FIGURE 3: Spectral sensitivity characteristics of a typical vidicon.

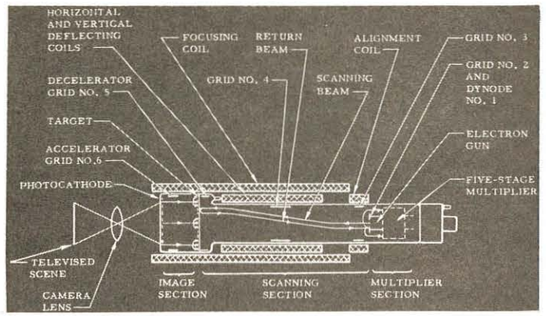

FIGURE 4: Image orthicon tube.

process and a photomultiplier for amplification of the output signal. The construction of a simple image orthicon tube is shown in Figure 4. The transfer characteristic is linear below saturation level without multiple image intensifier and nonlinear with multiple photomultiplier. Figures 5 and 6.) The advantage of the photomultiplier is the high gain of the output signal however it increases the internal noise and the signal to noise ratio is a function of the faceplate illumination light level.

The tube is very sensitive to operating position. According to the manufacturers specifications, the tube should never be operated in a vertical position nor in any other position where the axis of the tube with the base up makes an angle of less than 20 degrees with the vertical.

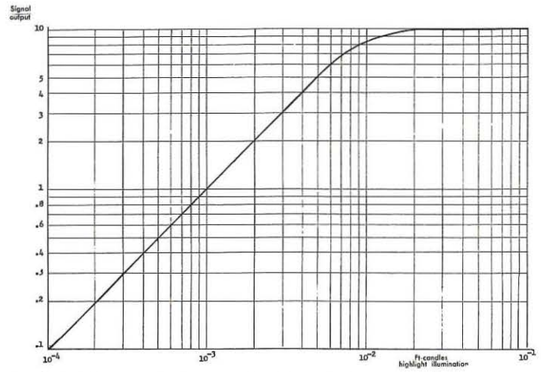

FIGURE 5: Image orthicon transfer characteristic.

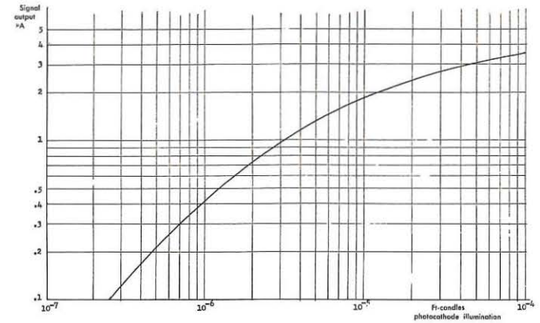

FIGURE 6: Transfer characteristic, image intensifier orthicon RCA C74003.

Other characteristics are:
Maximum signal output current = 5-10 μamp
Signal to noise ratio = 35
Very high sensitivity

TIAM or SEC Tubes

These new types of photoemissive devices are a combination of the image orthicon and the vidicon tubes with an EBIC or SEC target. Because of this combination, it combines the sensitivity of the image orthicon, the size of the vidicon, and the noise-free signal amplification of the target system. The transfer characteristic (Fig. 9) is linear from the detectable signal level to saturation and has a unity gamma value.

The construction of the TIAM tube is shown in Figure 7, and the SEC tube, in Figure 8.

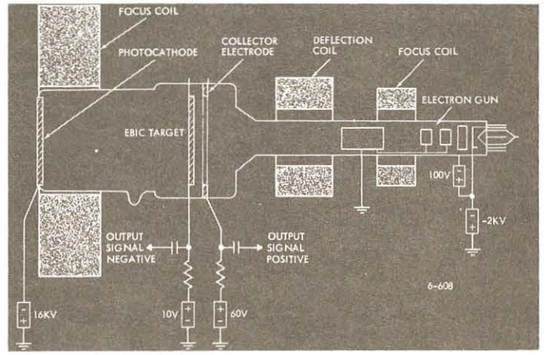

FIGURE 7: TIAM tube 8061.

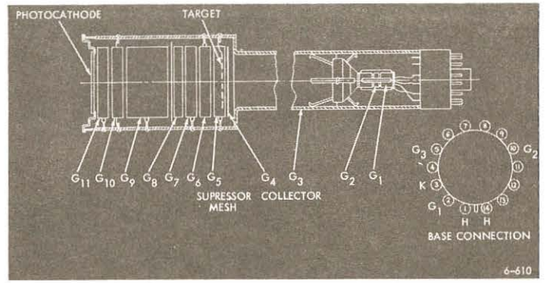

FIGURE 8: SEC tube WX-5419.

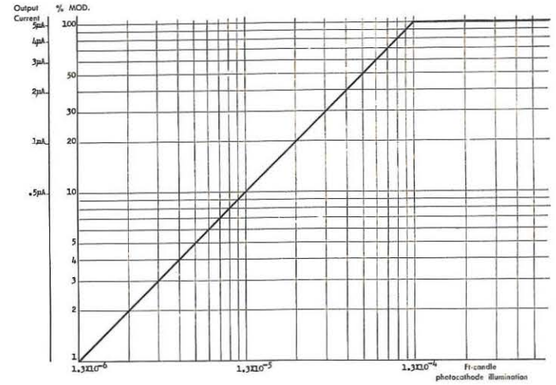

FIGURE 9: TIAM tube transfer characteristic.

This photosensor device has a number of characteristics giving performance superior to those of the orthicon and vidicon tubes. The most significant difference besides the high sensitivity is the signal-to-noise ratio.

For the image orthicon tube the signal-to-noise ratio is

$$\frac{S}{N_{IO}} = K\sqrt{i_{ph}(\delta-1)}\sqrt{\frac{M}{1-M}} \qquad (1)$$

where K is a constant relative to the photocathode characteristic

i_{ph} is photoelectric current
δ is secondary emission ratio
M is modulation ratio (ratio of beam current incident to photomultiplier to beam current from electron gun)

For the TIAM tube

$$\frac{S}{N_{Tiam}} = K\sqrt{i_c}\sqrt{\frac{M^2}{1-M}} \qquad (2)$$

where K and M are essentially the same as for the image orthicon

i_e is electron beam current

Since the K constant is the same in both relations and M is usually quite small, these terms cancel each other. Normally, at image orthicon, $i_{ph} = 10^{-14}$ amp and at the TIAM, $i_e = 10^{-6}$ amp. The secondary emission ratio, δ, has the value 4.

Also,

$$\frac{\frac{S}{N_{Tiam}}}{\frac{S}{N_{IO}}} = \sqrt{\frac{i_c}{i_{ph}(\delta-1)}} \approx 5000 \qquad (3)$$

This is a rough theoretical calculation but, considering the way in which gain is achieved in the TIAM tube, it has realistic value. The experimental results received from the manufacturer shows a minimum signal-to-noise ratio factor of 1000 — that of the image orthicon tube at the same sensitivity level. Other characteristics are:

Signal-to-noise ratio = 2000-5000
Sensitivity is very high
Maximum output current is 1-5 μamp

THE IDEAL PHOTOSENSOR

In the following derivations, ideal performance is assumed in the sense that the photosensing device is able to count each absorbed light quantum.

Consider a photosensor with a side dimension d, or a square element of a photosensor surface of a pick-up tube device with side length d. Consider also an average light quanta N, which the d^2 area absorbs during exposure time t. This absorption is a random process and the deviation from the average is the rms value $\sqrt{N}$. Because of this deviation, the N average value accuracy is limited to the smallest detectable increment of N, which is denoted by $\triangle N$. Because the deviation as a value $\sqrt{N}$, the increment is also of the order of $\sqrt{N}$.

The geometric relation between object, sensor and optics is shown in Fig. 10. In this arrangement the scene brightness is B, the threshold contrast is C, the elemental area of the photosensor is d^2, and the angle subtended by d at the lens is α.

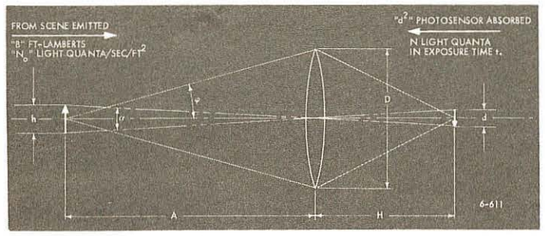

FIGURE 10: Geometric relations.

The light quanta arriving from the scene constitute the scene brightness, given by

$$B \approx \frac{N}{d^2} \qquad (4)$$

The threshold contrast in terms of the light quantum deviation is

$$C = \frac{\Delta B}{B} = \frac{\Delta N}{N} \sim \frac{1}{\sqrt{N}} \qquad (5)$$

From Equations 4 and 5,

$$B \sim \frac{1}{C^2 d^2} \qquad (6)$$

or

$$B C^2 d^2 = B C^2 \alpha^2 = \text{constant} \qquad (7)$$

With evaluation of the constant, Eq. 7 is already a characteristic equation for the ideal photosensor. It can be seen that the smallest angular size that can be resolved, is α, and that the threshold contrast or half-tone discrimination is proportional to the square root of the brightness. Furthermore, with two of the three parameters specified, the threshold value of the third is determined, For example, knowing the scene brightness B and the contrast C gives the smallest angular size α which can be resolved or, given angular size and contrast, the minimum scene brightness is determined. The only condition attached to the validity of Eq. 7 is the assumption that all of the light quanta be counted, or in other words that the absorption coefficient be unity and the distribution function of the random process known. This basic function is then equally applicable to the eye, photographic film, or electro-optical sensors.

One fact has to be set straight. Whatever happens subsequent to the primary photoprocess can only deteriorate or, at best, maintain the performance set by the basic terms of Eq. 7. Subsequent elements can not improve performance. This can be seen also if one considers that the performance is limited only by the statistical fluctuation in the rate of absorption of light quanta — or, in other words, by the signal-to-noise ratio.

From Figure 10, the rate at which light quanta are radiated from the scene is $N_o/ft^2/sec$, which gives a total number of light quanta radiated $N_o h^2$ from the element area of the scene h^2 per second. With a Lambert distribution the number of light quanta passing through the lens per second is $N_o h^2 \sin^2\phi$. Since from geometry the same light quanta is incident on the d^2 area of the photosensor, the number of light quanta absorbed by the photosurface is

$$N = \theta t N_o h^2 \sin^2\phi \qquad (8)$$

where O is the absorption coefficient or quantum efficiency of the photosensitive surface and t is the exposure time.

Again, from geometric relations, $h = \frac{A}{H}d$, $\sin\phi \approx \frac{D}{2A}$ and $\alpha = \frac{d}{H}$. Substituting these values in Eq. 7, the absorbed light quanta are

$$N = 1.4 N_o h^2 t \theta \alpha^2 \times 10^{-10} \qquad (9)$$

if α is in minutes of arc and D in inches. For the light quantum one lumen of visible light equals 1.3×10^{16} quanta/sec, the radiated scene brightness, $B = \frac{N_o}{1.3 \times 10^{16}}$ ft-lamberts. Substituting these values in Eq. 9 yields

$$N = 2B d^2 t \theta \alpha^2 \times 10^6 \qquad (10)$$

and

$$B = 5\frac{N}{D^2 t \theta \alpha^2} \times 10^{-7} \text{ ft-lambert} \qquad (11)$$

Now may be determined one of the basic limitations of the photoprocess, the signal-to-noise ratio. From Eq. 5, this is a constant which relates the thereshold contrast to $\frac{1}{\sqrt{N}}$. Let's denote for this constant "r". From experimental data the useful low value of constant "r" is 5. Substituting Eq. 5 the value of the light quantum $N = \frac{r^2}{C^2}$ into Eq. 11 and transposing yields

$$B C^2 \alpha^2 = 5\frac{r^2}{D^2 t \theta} \times 10^{-7} \qquad (12)$$

which completes the form of the characteristic equation. The contrast expressed in percent values $C = \frac{\triangle B}{B} \times 100$ the Eq. 12 can be written

$$B C^2 \alpha^2 = 5\frac{r^2}{D^2 + \theta} \times 10^{-3} \qquad (13)$$

It is obvious that the ideal and real photosensing device performances can be differentiated by one parameter only — the quantum efficiency. For this statement Eq. 13 has been rewritten as

$$\frac{5r^2}{B C^2 \alpha^2 D^2 t} \times 10^{-3} = \theta \qquad (14)$$

If it is an ideal photosensor device (i.e., if all the incident and absorbed light quanta are counted), the value of the quantum efficiency Ø as determined by Eq. 14 is the actual quantum efficiency of the primary photoprocess. A non-ideal device, however, which can not count all the absorbed light quanta by the primary photoprocess, will have a quantum efficiency lower than the primary photoprocess.

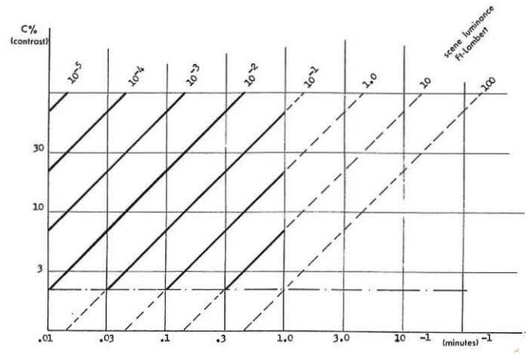

FIGURE 11: Performance curves with parameter values of the human eye.

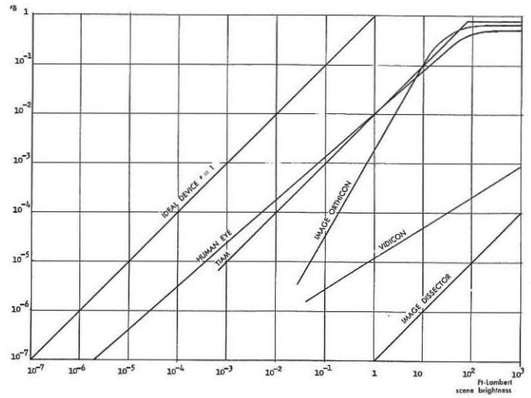

FIGURE 12: Performance curves of photosensor devices.

Equation 14 defines an absolute performance scale for evaluating a photosensor. The quantum efficiency "Ø" extends from Ø = 0 to Ø =1, where the value zero means no picture transmitted and the value 1 means ideal operation. In Eq. 14 are five parameters:

1. Scene brightness B (ft.-lambert)
2. Contrast of the object, $C = \frac{\triangle B}{B} \times 100$ percent
3. Angular size of the object or scene element, α (minutes of arc)
4. Lens diameter, D (inches)
5. Exposure time, t (sec)

When four of these are specified, the threshold value of the fifth is given by Eq. 14. If all five parameters are given, the Ø quantum efficiency is determined. As an example, a performance curve is shown in Fig. 11 with the parameter values of the human eye, where the quantum efficiency is 1 percent, storage time 0.2 sec, and lens diameter 0.3 in. For signal-to-noise ratio a value 5 was assumed. The dash-dot line shows the contrast and smallest angular size that can be detected.

For selected photosensor devices in comparison with an ideal device and the human eye, performance curves are illustrated in Fig. 12. The horizontol line indicates equal picture quality for all the presented photosensor devices.

EFFICIENCY AND VOICE

The efficiency which converts a photon current into electron current at the photosurface is the quantum efficiency Ø, which is a function of the photon wavelength. Another commonly used measure of the photosensors is the sensitivity S measured in amp/watts. This differs from Ø only by use of photon energy rather than a number: i.e.,

$$\theta(\lambda) = \frac{h\lambda}{eC} S(\lambda) \qquad (15)$$

where h is the Planck constant and λ the wavelength.

Rewriting Equation 15,

$$\theta(\lambda) = \theta_D \eta(\lambda) \qquad (16)$$

where θ_D is the peak quantum efficiency of the photosensor and $\eta(\lambda)$ describes the variation in wavelength. The function $\eta(\lambda)$ is plotted for three photocathode materials and a silicon photodetector in Fig. 13.

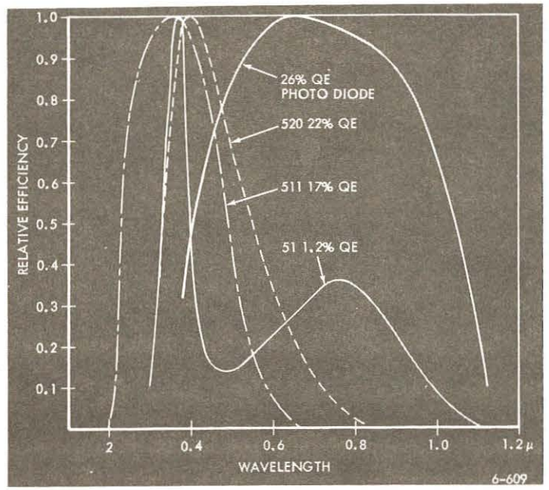

FIGURE 13: Quantum efficiency of photocathodes.

Besides the inherent operational speed of a photosensor and the speed limitation relating to the incident signal power, there is also a speed limitation relating to the noise. Photosensor noise arises from three sources:

1. Dark current (leakage)
2. Johnson noise
3. Shot noise or statistical noise

Dark Current

If an e_d electron flow per second causes dark current in a detector, then during a bit time T an average of $e_d T = E_d$ electrons are detected. Associated with this dark current is an rms noise current

$$i_{nd} = \frac{e}{r}\sqrt{E_d} \qquad (17)$$

since the noise current can be assumed to be random process.

Johnson Noise

This noise is associated mainly with conventional light sources. The current from a photosensor at the output flows through a load resistor, R_L, either directly or after after amplification at the target or photomultiplier. This resistor develops noise current depending on photosensor bandwidth, resistor value, and such environmental factors temperature. A theoretical value of noise current in a low-noise resistor is

$$i_{nj} = \sqrt{\frac{2KT}{R_L r}} \qquad (18)$$

where K is the Boltzmann constant and T one bit time.

Shot Noise

Shot noise or statistical noise is associated with the signal itself and the random arrival of the photons which compose the signal. Furthermore, it is associated with laser light sources. With a signal current i_s, the average collected electrons per bit is

$$E_s = i_s \frac{r}{e} .$$

The actual number of electrons, however, varies from bit to bit with the rms deviation of E_s. This fluctuation is the noise current

$$i_{ns} = \frac{e}{r}\sqrt{E_s} \qquad (19)$$

The total rms noise current at the load resistor is

$$I_n = G(i_{ns} + i_{nd}) + i_{nj} \qquad (20)$$

where G is the gain of the photosensor processing system photomultiplier, target, or photodiode. For the photodiode, $G = 1$. The signal at the output is, of course, $I_s = i_s G$ and the signal-to-noise ratio

$$\frac{S}{N} = \frac{1}{\left(\frac{i_{ns}}{i_s} + \frac{i_{nd}}{i_s}\right) + \frac{1}{G}\left(\frac{i_{nj}}{i_s}\right)} \qquad (21)$$

It is apparent from Eq. 21 that the major value of a photomultiplier lies in reducing the noise contributed to the load resistance.

Substituting the expressions of Eq. 17, 18, and 19 into Eq. 21,

$$\frac{S}{N} = \left[\sqrt{\frac{e}{r i_s}} + \sqrt{\frac{e\, i_d}{r\, i_s^2}} + \frac{1}{G}\left(\sqrt{\frac{2KT}{R_L r\, i_s^2}}\right)\right]^{-1} \qquad (22)$$

For a high-quality video signal readout, the $\frac{S}{N} = 1$ limit detectibility is not a useful definition. An acceptable minimum value is $\frac{S}{N} = 10^2$, which gives an expression

$$\sqrt{\frac{e}{r i_s}}\left[\left(1 + \sqrt{\frac{i_d}{i_s}}\right) + \frac{1}{G}\sqrt{\frac{2KT}{R_L e\, i_s}}\right] = 10^{-2} \qquad (23)$$

The maximum bit reading rate, $\frac{1}{T}$, can be determined from Eq. 23. This requires the answer to three questions:

1. What is the maximum available signal with a given light source-sensor combination?
2. Is the signal current larger than the dark current ($i_s > i_d$)?
3. Is $2KT/eR_L < G^2 i_s$?

The primary noise source (shot, leakage, or Johnson) is determined by answers to questions 2 and 3. The bit time T can be calculated with Eq. 23 and the determined noise source combined with i_s signal current. The i_s signal current for a light source-photosensor combination is a product of light radiance versus wavelength and the photosensor quantum efficiency versus wavelength.

THE AUTHOR

G. T. NAGY is presently engaged in Automation System Engineering with Nortronics, a Division of Northrop Corp. He has had extensive R&E experience since receiving his MS/EE from the University of Technical Sciences, Budapest, Hungary. He served in the University's Research Institute (1950-57), and since coming to this country has been associated with several major ID projects. He holds two patents.

Basic EL designs for space and military applications

by R. W. CHRISTENSEN
Section Head
EL Development Group

and W. R. McKEIRNAN
Senior Chemist
Materials Department

Electronic Tube Division
Sylvania Electric Products Inc.
Emporium, Pennsylvania

ABSTRACT

The advent of electroluminescence (EL) made possible a new dimension of visual data presentation. As a display medium, EL readout devices offer almost limitless flexibility in customized presentation as well as those of the standard numeric, alphanumeric and solid area variety (Figure 1). Design advantages of the new all-glass EL readout panel are manifold both from a manufacturing and a user viewpoint.

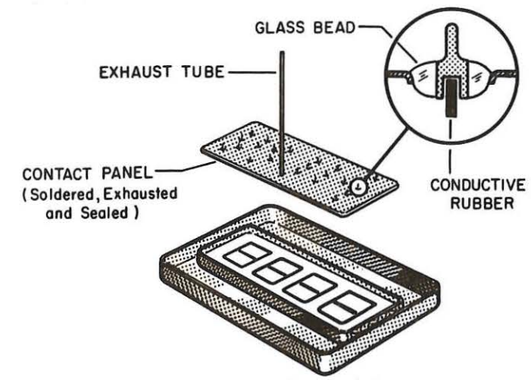

FIGURE 1: Typical metal-glass EL readout panel designs.

INTRODUCTION

In recent years interest in EL has risen sharply, particularly by military and space agencies. By their inherent properties, EL readouts are particularly suited for military and aerospace type display applications. Their solid state nature and construction features assure stable performance under conditions of temperature and pressure extremes and, where suitably mounted, to severe shock and vibration. With its sandwich panel-type compactness, the EL readout panel takes up only a minimum of valuable space. Besides consuming very little power, the units are relatively light which is an important factor in airborne applications where total weight is critical.

EL readouts can be fashioned to provide most any type of display in various sizes and shapes. Also, they are not inherently subject to catastrophic failure as end-of-life is determined by the permissible decrease in light output in relationship to ambient illumination and other viewing considerations.

Sylvania, as one of the participants in the EL display field, has engaged in numerous programs to design, develop, and manufacture ruggedized hermetic units for stringent applications. For example, the units shown in Figure 2 were designed to MIL-STD 202 and 810 specifications for moisture resistance, shock, vibration fatigue, vibration, thermal vacuum, saline atmosphere, temperature cycling and altitude. These units were used in such extra-terrestrial applications as the Lunar Excursion Module.

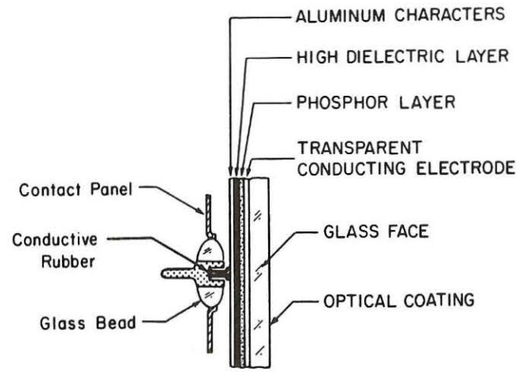

FIGURE 2: Basic construction of metal-glass EL readout panel.

This paper presents two basic EL readout designs: e.g., the hermetically sealed metal-glass variety and the recently developed hermetically sealed all-glass unit. They are discussed along the lines of design, fabrication, development, in-house evaluation, and quality testing.

METAL-GLASS DESIGN

The metal-glass design utilizes an EL plastic matrix type of display stratum. This material offers the advantage of increased brightness over the conventional ceramic matrix structure. Basically, manufacture of the unit involves essen-

tially a three-step process consisting of the fabrication and sealing of the faceplate and contact panel subassemblies.

The use of the plastic embedment material makes it essential to provide complete environmental protection. The hermetic seal assures maximum protection against any degradation from atmospheric contact. The specific steps involved in the construction and subsequent sealing of a typical metal-glass unit are illustrated in Figure 2.

Construction

To fabricate the faceplate, an optically coated glass plate is cut to size, shaped and coated with a transparent conducting electrode of tin oxide. It is then joined to the faceplate sealing frame by a glass frit furnace sealing operation.

For the unit of Figure 2, in order to permit accommodation to an instrument panel, the faceplate assembly is soldered to a mounting frame. The display stratum is then fabricated with successive deposition and curing of the electroluminescent and dielectric layers onto the transparent conductive electrode. Thickness, density and curing of these layers are controlled to provide an optimum compromise of life, brightness, and breakdown voltage. The device shown was designed for 115 volts RMS, 400 Hz operation with a peak voltage rating of 300 volts over the temperature range of —55 to 85°C.

The next step in fabricating the faceplate assembly is to deposit a segmented top electrode in a configuration corresponding to the display pattern desired; i.e., 7 segment numeric, 9 segment alphanumeric, solid areas, and special symbols.

To construct the contact panel subassembly, a metal back panel (a glass sealing alloy amenable to plating, soldering, and glass sealing operations) is cut and punched out for the necessary leads and shaped into the required configuration. After an oxidizing step, leads are glassed into the appropriate holes. This operation is then followed with suitable cleaning and plating to optimize sealing. The upper portions of the leads, which are hollow, are then fitted with conductive rubber cylinders. These cylinders effect segment

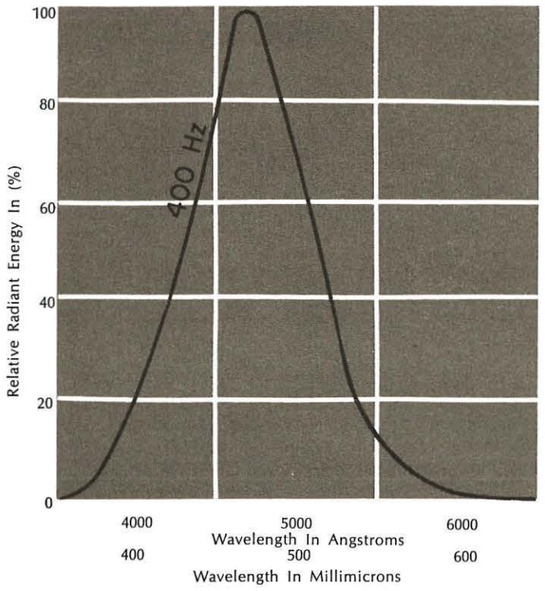

FIGURE 3: Brightness vs. voltage at various frequencies for metal-glass EL readout panel design.

to lead compression type contact when the faceplate and contact panels are mated together.

The final operation in fabricating the metal-glass unit is the joining and sealing of the two subassemblies. Prior to sealing, the panel is energized to assure proper registry of the conducting rubbers with corresponding electrode segments of the display. Once proper registry is assured the unit is then hermetically solder sealed, baked out, and burned in. The baking process provides added assurance against any presence of moisture, while the burn-in is a stabilizing procedure.

Specifications and Characteristics

Performance of an EL readout panel is judged by such criteria as brightness, spectral emission, contrast and life. Also, additional testing may be required to meet specific customer requirements.

Brightness is a function of field strength across the dielectric layer, and thus dependent upon voltage and frequency. Brightness of the metal-glass unit as a function of voltage and frequency is shown in Figure 3.

Spectral emission is a property of the phosphors that are used in the construction of the display stratum. The phosphors used will exhibit a peak emission of 5000 angstroms with an envelope as shown in Figure 6.

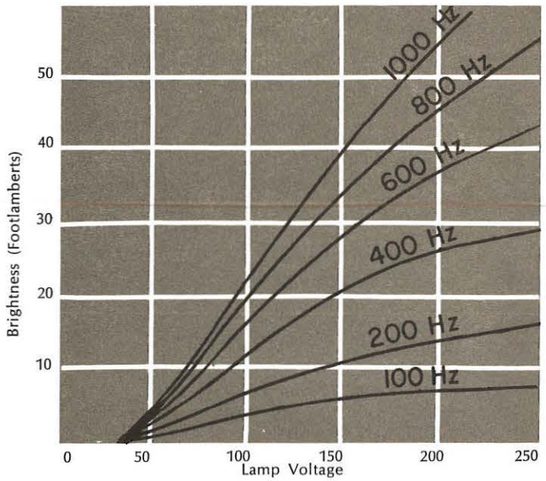

FIGURE 4: Typical spectral energy emission characteristics for metal-glass EL readout panels.

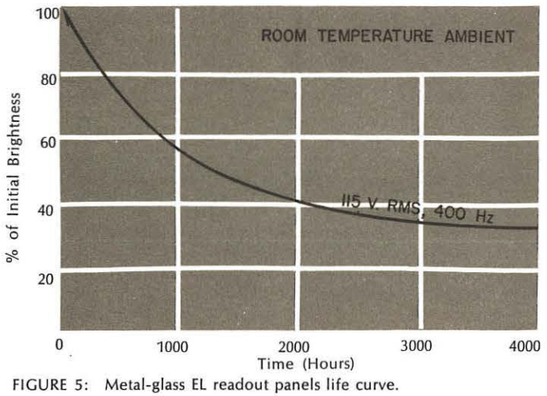

FIGURE 5: Metal-glass EL readout panels life curve.

An optimum contrast ratio of approximately 0.20 at 100 FC ambient and 0.06 at 300 FC ambient for the metal-glass design is achieved using 60-70% transmission neutral density gray glass for the faceplate. Greater contrast is obtained through the use of lower transmission glass or other appropriate techniques; however, light output is proportionately reduced. To minimize reflection, an anti-reflection coating is applied to the front surface of the faceplate.

Life of an EL readout panel is spelled out generally in terms of half life or the number of hours on life until half the initial brightness is reached. Figure 5 depicts life of the metal-glass design at room temperature operation. The life curve is extended out to 4000 hours where the brightness is approximately 30% of the original value. Half life is reached at approximately 1200 hours when operated at typical conditions of 115 volts MS, 400 Hz. Tests show that the acceptable minimal viewing limits of EL readouts, in subdued ambient lighting, vary from 15-20% of initial light output for most applications. Since the drop-off curve for light output is relatively flat, a slight reduction in output requirements will substantially prolong useful life.

Testing

The extensiveness of qualification testing is based primarily on application requirements. Typical environmental test criteria for EL readouts as dictated by space and military agencies are as follows:

Shock — in accordance with MIL-E-1, Method 1041 (311 g acceleration; impulse duration approximately 0.5 msec).

Vibration Fatigue — in accordance with MIL-E-1, Method 1031, Subparagraph 7 (96 hours total, 32 hours in each of three (3) positions with frequency of 25 ±2 Hz at approximately 2½ g).

Vibration -— in accordance with MIL-E-1, Method 1031 (panels vibrated at 15 g, 40 Hz).

Thermal Vacuum — 10^{-5} mm Hg. pressure (−25°C to +100°C at face of panel and 1 atmosphere at rear of panel).

Saline Atmosphere — in accordance with MIL-STD-202C, Method 101, Condition B (5% salt solution).

Moisture Resistance — in accordance with MIL-STD-202C, Method 106 (moisture free at 100% relative humidity with condensation).

Temperature Cycling — in accordance with MIL-STD-202C, Method 102A, Condition B.

Altitude (Barometric Pressure) — in accordance with MIL-STD-202C, Method 105C, Condition D.

The hermetically sealed metal-glass concept is a fully developed technique of EL readout panel design that has spawned qualified units for space agency and military applications. However, fabrication of this design, while amenable to glass sealing techniques has several shortcomings that have dictated the need for a new concept.

With the metal-glass design the user is limited to small enclosures on the order of 1" x 5", 2" x 3", etc. This is due primarily to the problem of oil canning of the contact panel in large displays when operated at high altitudes. This problem can result in loss of contact and/or fracture of the faceplate. One solution was to use several smaller panels instead of a large one; however, a new design concept, permitting the use of single, larger size diplay would be a more desirable solution.

Digit size with the metal-glass design is limited to ½" or more. Sizes less than ½" are extremely difficult to achieve due to the area requirements in sealing the pins into the contact panel. Misregistry (misalignment of conducting rubbers with contacts), although to a much lesser degree, can also be a problem in the metal-glass unit. It may occur periodically during the final sealing operation due to slight displacements of the contact panel.

ALL-GLASS DESIGN

The all-glass design developed by Sylvania is an entirely new method of constructing an EL readout panel. With this new design, the undesirable short comings of the metal-glass configuration have been eliminated.

While the metal-glass units used metal contact pins and metal sealing frames, the new design is a complete glass construction with the connector pins being the only metal present. Also eliminated are the conductive rubber contacts which provide a definite improvement in lamp reliability.

The new all-glass design is illustrated in Figure 6. As with the metal-glass unit, it incorporates a plastic embedded phosphor layer. The entire lamp is constructed on the contact panel and becomes an integral part of it.

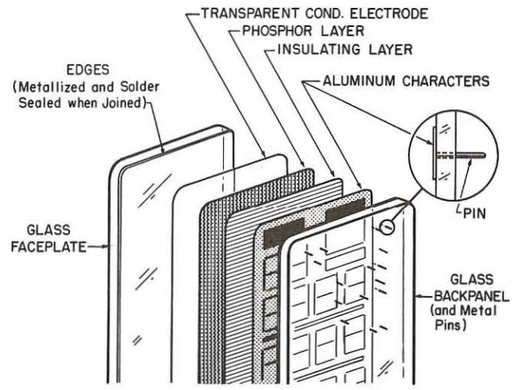

FIGURE 6: Prototype all-glass EL readout panel.

Construction

With the all-glass design concept, the glass contact panel, with connector pins in place, is molded as one piece (Figure 7). The inner glass surface, including the pins is ground

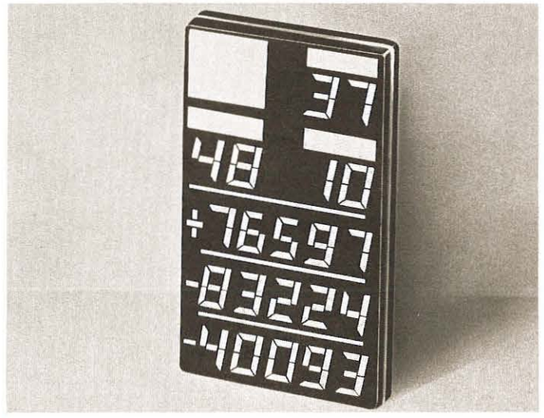

FIGURE 7: Basic construction of all-glass EL readout panel design.

flat and polished to simultaneously expose the pins and optimize flatness of the surface. The inside edges are shaped and metallized to facilitate subsequent sealing. The exposed pins of the base are metallized (evaporation with aluminum) with the desired segmented electrode pattern. This process results in each active area becoming an integral part of its own connector pin, eliminating any registration problem that could occur as when the back electrode and contact panels are separate entities and must be fitted together.

The next step is to deposite a high dielectric layer onto the base, covering the metallized segments. This dielectric or insulating layer is then overlayed with the EL stratum which is in turn fixed with a top transparent conducting electrode to simultaneously permit viewing and energizing of the panel.

As for the metal-glass design, complete environmental protection is essential. To protect the whole assembly, a glass front panel with any required legends is placed on the transparent conductor and sealed to the contact panel using a metal-solder technique. In less stringent display applications, then the majority for space agencies and the military, a plastic seal may be used instead of metal-solder.

Specifications and Characteristics

To provide maximum reliability for the demanding environmental and operational conditions that may be encountered in space craft or other space agency or military applications, the all-glass hermetically sealed EL readout panels are designed to rigid specifications. Performance of the all-glass units is judged by the same criteria as the metal-glass devices; e.g., brightness, spectral emission, contrast, and life.

To date evaluation of prototype units reveal initial brightness to be on the order of 25-30 FL at normal room ambient conditions when operated at 250 volts RMS, 400 Hz. Spectral emission is essentially the same as for the metal-glass design; e.g., 5000 angstroms peak. However, the top electrodes filter out some of the wavelengths at the short wavelength end of the spectrum, thus altering the shape of the envelope somewhat. Contrast, life and half life are also comparable to the metal-glass design. The all-glass design is amenable to 115 volts RMS operation as well as 250 volts RMS. The permissible lower operating level is achieved by appropriate reduction in thickness of the EL and dielectric strata.

Testing

The extensiveness of testing is based primarily on application requirements. Various prototypes have been subjected to test criteria quite similar to that used for most of the metal-glass units. In all areas the new design proved fully satisfactory.

For example, the hermetic seal was tested at simulated altitudes of approximately 200,000 feet. Also, units were subjected to thermal cycling to note the effect of gradual and large temperature excursion. Determination of the effects of the thermal cycling were then ascertained via the previous altitude test. The metallized solder type seal withstood these tests successfully.

The test criteria of thermal shock resistance of both seal and lamp strata was determined under conditions of exposure to extremes in temperature ranging from —55°C upward to 85°C simulating actual usage in space. Reaction of the seal and panel to these thermal excursions was then determined via humidity and altitude tests. Thermally cycled units were subjected to 95% relative humidity in the following manner. They are brought up from a room ambient environment to 71°C and maintained at 95% relative humidity over a two-hour period. They were subjected to these conditions for six hours. Then the temperature was gradually reduced to between 20°C to 38°C. The units remained at this temperature for 16 hours with the relative humidity still held at 95%. This sequence constituted one cycle of ten cycles called for in MIL-STD-810. The final test in this sequence was that of altitude testing where the all-glass units were subjected to the previous thermal cycling humidity tests and then subjected to simulated 100,000 foot altitudes.

CONCLUSION

The all-glass design offers certain distinct advantages over the metal-glass EL readout panel. The prime advantage is the capability of larger area displays with one unit. This is due to the elimination of the faceplate-frame sealing, oil canning problem peculiar to the metal-glass design. Secondly, higher density arrays and smaller digit sizes are feasible since the leads can be stacked closer together.

With the elimination of the numerous conducting rubber contacts, any possibility of misregistry is eliminated. In the new design, each active area becomes an integral part of its own connector pin and not separate entities as with the metal-glass methods. Also, there is an excellent match of the expansion characteristics of the faceplate and contact panel assemblies which minimizes the possibilities of unit failure during temperature excursions.

The development of the all-glass EL readout panel has reached the stage where it is being offered for field use. The advantages of the design are manifold both from a manufacturing and user standpoint.

THE AUTHORS

R. W. CHRISTENSEN is Enginer-in-Charge, Polycrystalline and Electroluminescent Devices, New Products Development, Sylvania Electronic Tube Division, Emporium, Pa. He was graduated from the University of Miami with a BS in Physics (1950) and has done graduate work at Franklin and Marshall in electron optics, solid state physics and quantum mechanics. Prior to joining Sylvania, he was engaged in new product development activities with RCA, in the areas of electroluminescence, photoconductors, ir and solar cells. He also conducted active research in the field of solid state devices at the David Sarnoff Research Center under Dr. A. Rose. He holds several patents and has authored technical articles in the solid state device field. He is a member of *SID*, and is a senior member of IEEE.

W. R. McKEIRNAN is Group Leader, EL Engineering, New Products Development and Manufacturing of Sylvania's Electronic Tube Division, Emporium, Pa. He is a graduate of St. Bonaventure University (1954) with a BS in Chemistry. He joined Sylvania in 1954 as an engineer in the Analytical Section of the Electronic Tube Division where his main responsibility was the inorganic quantitative analysis of cathode nickel by spectrophotometric methods. Other analytical work was in the organic field, such as analysis of oils, identification of units, and organic solvents. After additional work in strong emission films, and as Group Leader in the RTO Chemistry Department, he assumed responsibility for production of el display devices in 1966. He holds several patents for materials and processes involving thin, porous films. He is a member of the ACS.

Visual simulation

by PAUL T. KAESTNER
Photomechanisms Inc.
Huntington Station
Long Island, New York

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ABSTRACT

When generating a display from a scale model for the realistic presentation of a view as seen from an aircraft or spacecraft, compromises with the real life situation are inevitable. These occur both in the initial imaging lens and in the final display. Factors such as resolution, light intensity and true perspective influence the imaging characteristics, while problems of parallax and image brightness limit the realism of the display. Fortunately, the choice of the compromises provides acceptable performance for most simulation systems. A typical simulation system is described and illustrated.

INTRODUCTION

In the simulation of the view seen from a spacecraft during a docking operation or from a low flying or landing aircraft, the use of reduced scale models of three dimensional form has proven to be a direct and useful means of generating the display associated with the simulation system. The basic elements of a visual display produced by this means are a model, an articulated image forming lens system, a closed circuit TV link and a display.

The method is also useful in situations where close proximity to the model is not required in which case a two dimensional model with appropriate art work often suffices for the simulation of a terrain.

MODEL SCALE

A reduced scale model and an optical system to form a true perspective image, as seen by the observer in a real situation, requires that the entrance pupil of the optical system be located at the point corresponding to the observer's eye position relative to the reduced scale model. Thus the point of perspective or lookpoint of the image forming optical system may move to a position quite close to the model in the case of a docking or touchdown maneuver. With a reduced scale model, the size of the optical system entrance pupil, when scaled back up to the real life display, can cause problems of perspective and depth of field that detract from the effectiveness of the visual simulation. The display generated from such a camera image may be compared to the view seen by a one eyed giant with an eye pupil of several feet in diameter. Fortunately the problems of perspective and depth of field can be reduced to tolerable proportions for most applications without seriously detracting from the realism of the simulation.

OBLIQUE VIEWING

In order to produce an image forming optical system in which the six degrees of freedom, three linear and three angular, are generated, the optical device and TV camera are provided with the means for translating in three orthogonal directions and the optical system is designed to incorporate prisms to produce yaw or heading, pitch and roll motions relative to the model. Within practical limits, these motions or combinations of these motions could also be introduced by oblique optical techniques utilizing the Scheimpflug effect, which is a technique commonly used in rectifying oblique aerial photographs, or electronically in TV link. However, a true undistorted perspective view is only obtained with a two dimensional model by these techniques.

In addition to the realism required by the presentation with respect to perspective, the demands on the image forming optical system include such factors as wide angular fields of view, adequate light gathering capability, uniformity of image brightness, good resolution and depth of field.

OPTICAL PICK-UPS

Optical systems used to produce images for simulation have run the range from pin holes on one extreme to bug eye lenses on the other. Between these extremes an optical system is described which provides an entrance pupil external to the lens to permit the use of articulation prisms ahead of its objective lens at the point of perspective or lookpoint.

While the pinhole provides infinite depth of field and a truly rectilinear image, its poor light gathering capability, illumination fall off at the edges and limited resolution restrict its satisfactory utilization. At the opposite extreme, the bug eye lens provides an extremely wide field of view at the expense of considerable barrel distortion but its entrance pupil is ill-defined and physically inside the lens envelope so that true perspective close to the model cannot be obtained. As a compromise between the two extremes, a telecentric lens system has provided a satisfactory solution for a number of simulation problems. In addition to providing a well defined and relatively small entrance pupil forward of the first lens element, a choice of reasonably wide field angles may be obtained with resolutions substantially better than can be effectively utilized in current closed circuit TV systems. A moderate amount of barrel distortion tends to enhance edge of field illumination and may either be tolerated in certain situations or may be rectified either in the TV link or optically in the display system.

Figure 1 shows such an optical system. The scanning prism is servo driven to provide pitch motion at the entrance pupil. The head end of the system is rotated to produce yaw. The telecentric objective serves to maintain a constant size field of fixed cone angle at all object distances. A pair of rhomb prisms centers the yaw axis with the line of sight and pitch axis. A servo driven focus lens maintains optimum image focus at all target distances. Corrector lenses are provided to compensate for accumulated optical aberrations. An iris diaphragm provides an adjustable pupil which can be regulated to provide best imagery under prevailing light levels. A delta prism, servo driven in roll, introduces the third angular degree of freedom. An image forming lens forms an image at the face of the vidicon or image orthicon TV camera tube.

DEPTH OF FIELD

The speed or F/number of the optical system will determine the level of illumination needed on the model. On the other hand, the depth of field of a system having

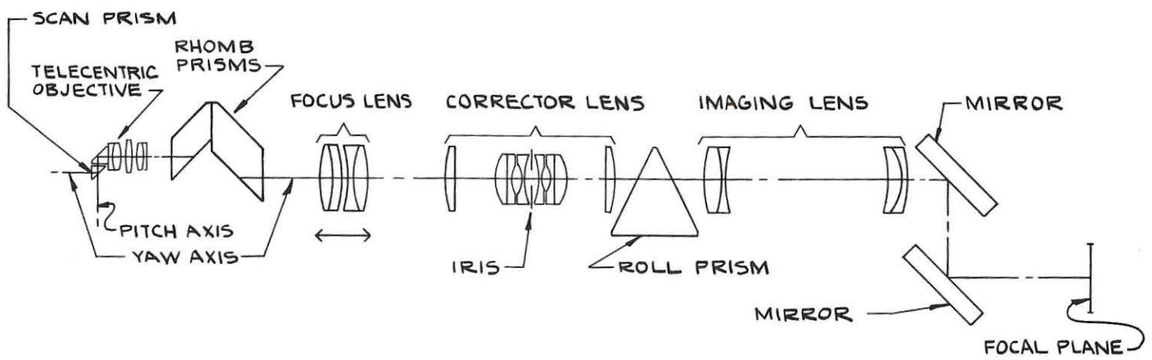


FIGURE 1: Optical system.

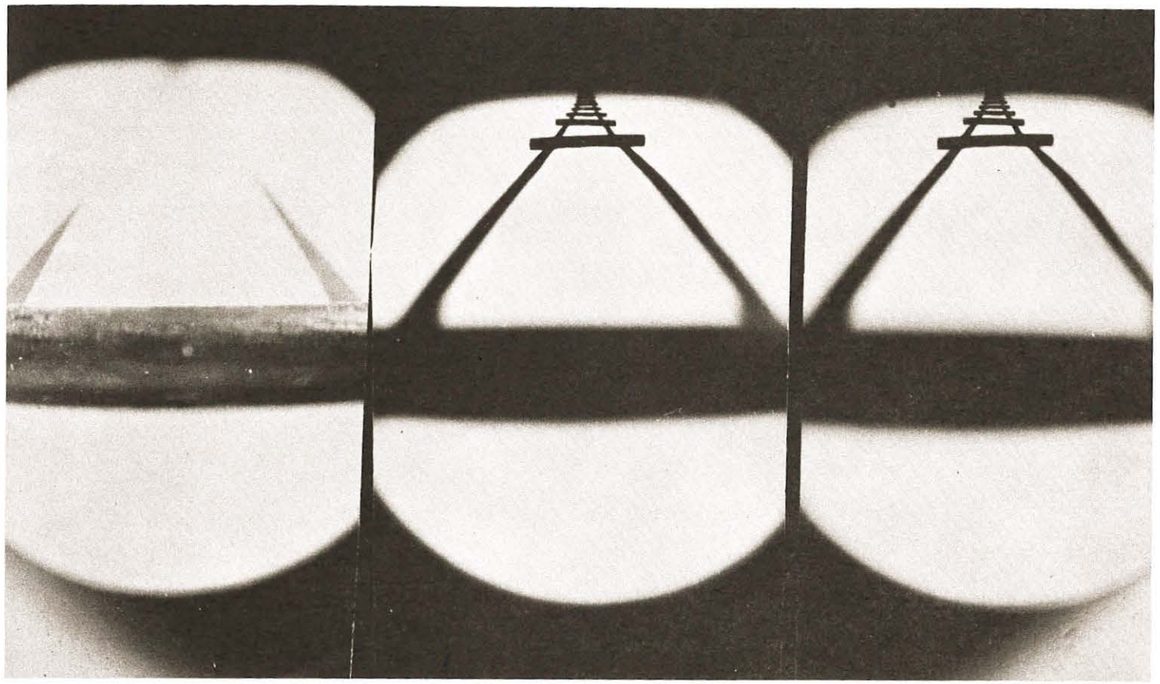


FIGURE 2: (l-r) Half-inch focus, three-inch focus, infinity focus. 1.2 mm pupil.

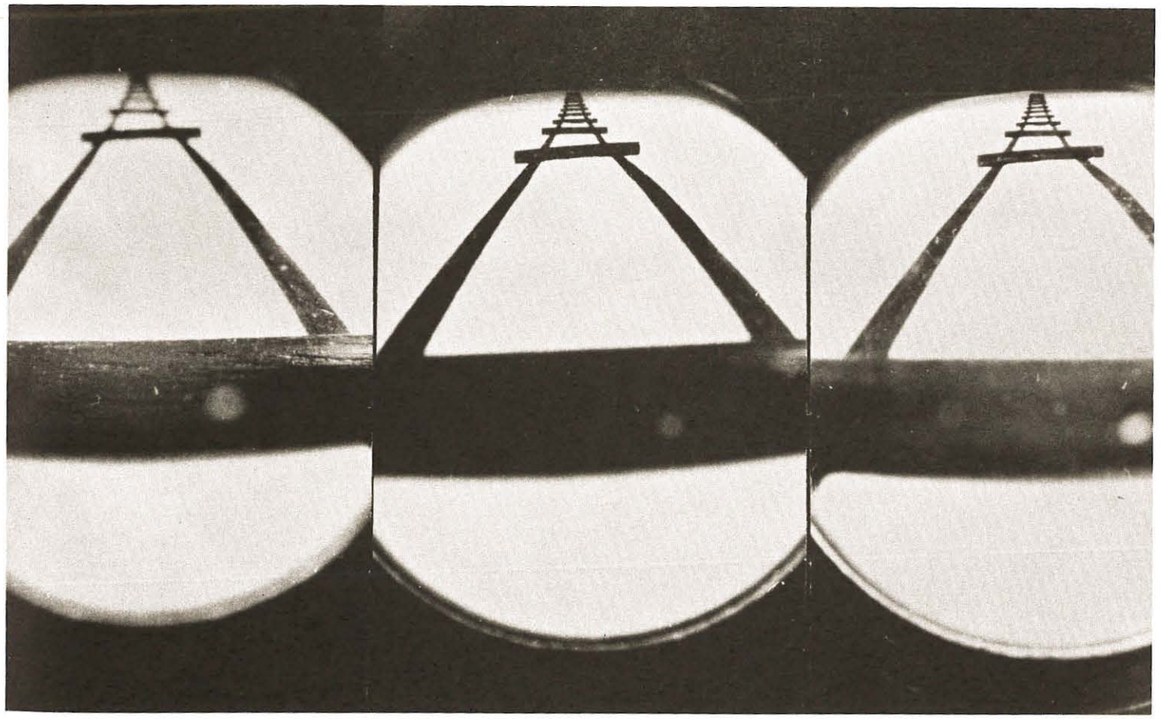


FIGURE 3: (l-r) Half-inch focus, three-inch focus, infinity focus. 0.5 mm pupil

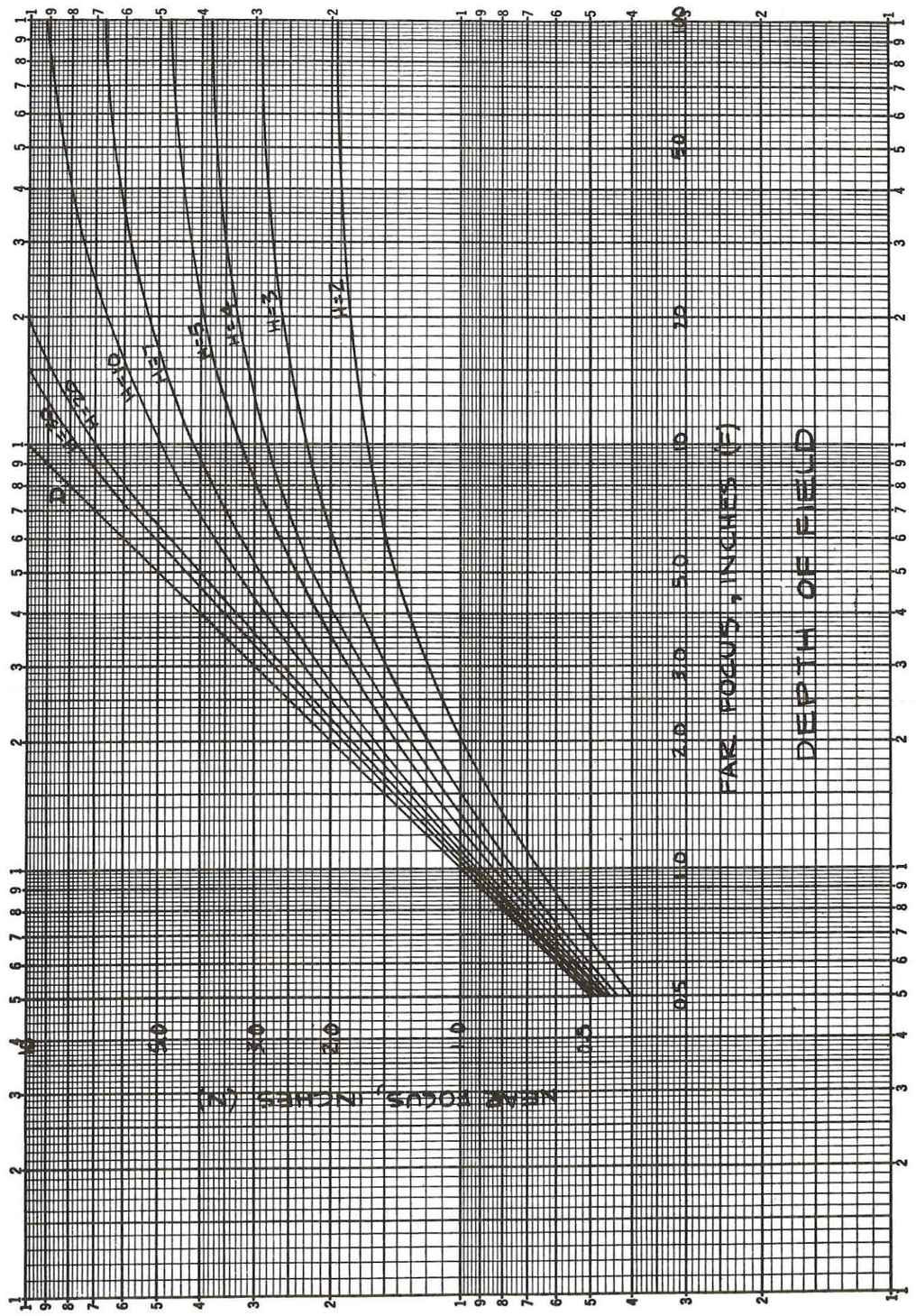


FIGURE 4: Depth of field.

a large entrance pupil is limited at close proximity to the model. Figure 2 shows photographs taken through an optical system as described with an entrance pupil of about 1.2 millimeters at focus settings to optimize near, intermediate and far lines on an oblique flat target made up of two parallel lines 1 inch apart and a series of cross rungs made from wood dowels at 3-inch intervals. The nearest rung on the target is about half an inch from the entrance pupil. Figure 3 shows the same series of photographs taken with an entrance pupil of about 0.5 millimeters. These photographs were taken with film positioned normal to the optical axis at the image plane of the optical system without a TV link.

It is apparent from the photographs that depth of field becomes a serious problem only at close proximity to a model and with large entrance pupils. For an aircraft landing or low level flight simulation, the effect of this defocus of the very near objects is hidden in the TV scan smear that is produced by the very rapid image movement and by the inability of the observer to discriminate lack of clarity at the extreme rates of motion of the near objects. In other specialized simulation problems, quantitative depth of field information may be useful to the system designer, however.

In evaluating depth of field, a basic dimension from which calculations can be made involves the hyperfocal distance of the optical pickup. Hyperfocal distance is defined as the object distance at which an optical system is focused to obtain equivalent circles of confusion at infinity, and at half hyperfocal distance. The circle of confusion or blur circle for a simulation system can best be expressed as a ratio of the circle of confusion with respect to the raster height.

Where the circle of confusion is small with respect to the optical pupil, hyperfocal distance can be expressed by the following equation:

$$H = \frac{F}{b/p}$$

Where H = hyperfocal distance
F = focal length of the optical system
b = circle of confusion or blur circle
p = diameter of the system entrance pupil

The above equation can also be expressed in terms of the numerical aperture of the system rather than in terms of entrance pupil size since $p = F/N$ where N is numerical aperture (F number).

$$H = \frac{F^2}{Nb}$$

For a distortionless optical system (rectilinear), the focal length can be expressed as follows:

$$F = \frac{y}{\tan \omega}$$

Where y = half image size (radius)
ω = the equivalent angular object half angle

By combining equations, the ratio of y/b is obtained.

$$H = y/b \times \frac{p}{\tan \omega}$$

The above equation indicates that the hyperfocal distance for a given ratio of raster height to circle of confusion is directly proportional to the pupil size and inversely proportional to a function of angular object coverage. This function will vary depending on the distortion characteristics.

The hyperfocal distance is useful in arriving at the focal setting that produces maximum depth of field with tolerable image degradation at infinity object distance.

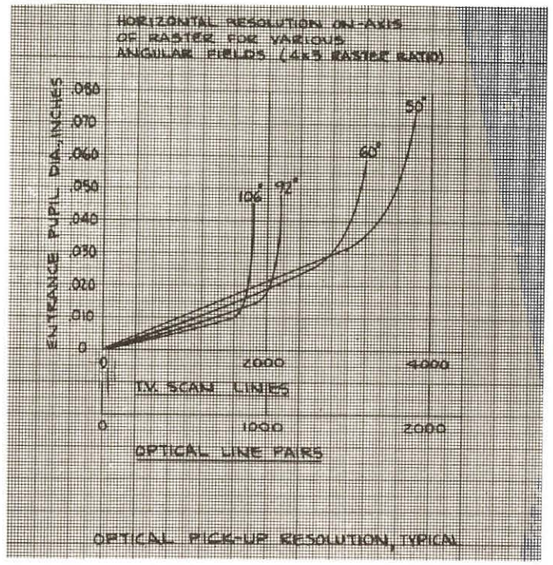


FIGURE 5: Optical pick-up resolution, typical.

However, the depth of field when viewing objects at finite distances is of paramount interest. For any focal distance, D, the tolerable near and far object distances can be derived from the computed tolerable hyperfocal distance.

$$A = \frac{HD}{H+D}$$

$$B = \frac{HD}{H-D}$$

Where A = near object distance
B = far object distance

For convenience in obtaining values for A and B for various values of D and H, the graph in Figure 4 serves as a reference. A chosen value for D may be read from either the abscissa or ordinate. From this point, movement horizontally to intersect the line representing the desired hyperfocal distance can be read to provide the abscissa reading of far focus distance. Movement vertically from the same point provides an ordinate reading for near focus distance.

IMAGE TILT

For simulators in which the model is basically two dimensional, large depth of field due to an oblique viewing angle actually results in an image plane that is tilted. The TV camera could be tilted or, more practically, two or more articulated mirrors could correct for the image plane tilt. However in such a case image distortion in the form of keystoning is introduced so that near points on the model appear magnified and distant points diminished in size. The false perspective generated by this device could be cancelled by translating the position of the point of perspective and varying the image magnification to offset this effect and provide a corrected perspective. However, the use of the tilted image causes all vertical objects on a horizontal surface to lean at an angle. The magnitude of this effect may be tolerable for certain applications; however, the additional complexity of the optical drive system to produce this oblique focus correction has not made its application particularly attractive to date. Another approach that has been frequently suggested is the use of

image rectification using the Scheimpflug effect mentioned earlier as a device for producing an oblique view. Limited tilt compensation at the expense of substantial complexity is obtained by this approach.

OPTICAL RESOLUTION

The optical resolution of the image at the focal plane of the lens system is affected by factors other than those resulting from depth of field. These include basic limitations imposed by the compromises in the optical design which include such factors as aberration corrections, flat image plane and wide field angle. The alignment tolerances and cumulative effects produced by the large number of optical elements in the system provide an additional constraint on the achievement of a high resolution image. In addition, as the entrance pupil size is reduced, the system becomes diffraction limited although under this condition, its depth of field is increased. Based on known system parameters for a series of actual instruments, it is of interest to examine some of the effects of these image resolution restrictions. Figure 5 shows a family of curves which relate the resolution of the optical system in total horizontal optical line pairs per raster, based on a 3 x 4 raster ratio, with diagonals which represent the field of view angles indicated. Since two TV line scans are needed to resolve an optical line pair, it is seen that even for the widest field angle of 106°, resolution compatible to TV state of the art resolution is obtained. Note the equivalent pinhole performance based on an .008 inch diameter pupil.

Because of the opposing requirements for high image resolution and moderate lighting requirements on one hand and for depth of field on the other, the instruments are provided with adjustable iris diaphragms so that the user may set up the best optical compromise for the particular problem.

TYPICAL EQUIPMENTS

Figure 6 shows a complete optical system with its servo drive motors geared to produce, on external command, the three angular motions and a fourth drive which establishes an average best focus which is generally driven as a function of slant range so that the center of the image is held at best focus. Gear differentials are employed to neutralize mechanical and optical cross coupling effects.

Figure 7 shows the optical system mounted on a carriage structure with a vidicon TV camera. The carriage provides vertical linear motion under servo command. Transverse and range rails provide two orthagonal linear horizontal motions. The device shown is a space docking simulator which also includes a spacecraft model mounted in a gimbal designed to provide yaw, pitch and roll motions to the model. A 1/50th scale LEM model is mounted on the gimbal pictured in Figure 7.

The 1029 line TV link consists of a 1½ inch vidicon camera at the scanner together with a second similar camera (which can be used for insetting background scenes), monitoring and instructor's displays and 21 inch monitors. The

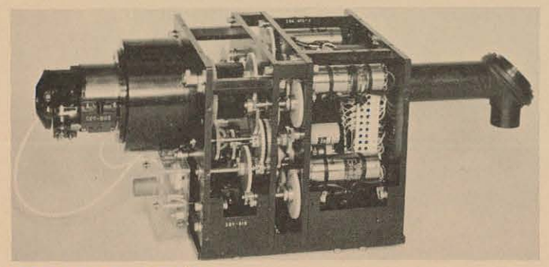


FIGURE 6: Optical pick-up.

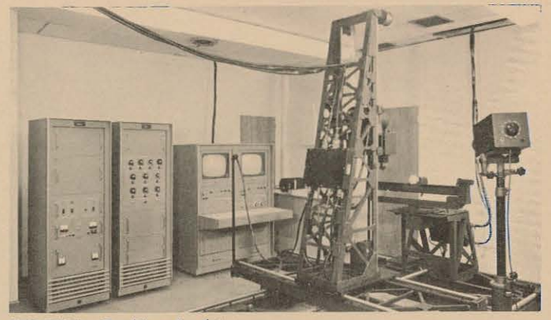


FIGURE 7: Docking simulator.

monitors provide adjustable distortion, partially to compensate the barrel distortion in the camera optics and partially to offset that produced in the optical viewing system used in this application.

IMAGE DISPLAYS

Display of the simulation to the observer or trainee generally falls into one of two basic types. These are screen displays and virtual image displays.

Screen displays employ projection systems to produce an image on a screen at a finite distance from the observer. Generally limited by the luminous output of a high intensity TV picture tube, the use of a front or rear projection screen offers a relatively inexpensive display method in which the image may be viewed from a range of observer eye locations. Projection TV systems employ efficient Schmidt corrector optical systems. Control layer high intensity projection systems have also been utilized for large screen projection systems.

Virtual image display systems provide a more efficient light gathering system by optically bringing a larger portion of the TV monitor illumination to the eye of the observer but substantially reducing his head freedom. An image of the pupil of the optical system is formed at the observer eye location with this system which offers the advantage of providing an image at infinity eye focus.

The use of color generally enhances the realism of a display, particularly for near viewing daylight simulations and for colored lights during night simulation as, for example, the lights on an airport runway. Color, however, is not essential for producing satisfactory displays in many instances. Where the display does not provide a high illumination level, color saturation, as seen by the eye, is substantially degraded.

THE AUTHOR

PAUL T. KAESTNER is Vice President and General Manager of Photomechanisms Inc., Huntington Station, Long Island, N.Y. He is a graduate of Stevens Institute of Technology (1935) in ME, and of New York University (1939) in accounting and business management. He joined Photomechanisms in 1962 and is presently responsible for operations, including engineering design and manufacturing, and detailed guidance in all phases of engineering and design. Earlier positions included Project Manager with Kollsman Instrument Corp., Chief Engineer with J. W. Fecker Div. of American Optical Co., Senior Engineer with Perkin-Elmer, and Project Engineer with Farrand Optical Co. He has published several technical works and holds six patents, with five others pending.

Eighth National SID Symposium

San Francisco to Host Meeting May 24-26

The Eighth National Symposium will be held May 24 through 26 at the Jack Tar Hotel, San Francisco, California.

A full program, organized into six technical sessions, is being planned by the Bay Area Chapter of *SID*. These sessions will cover Display Materials, Devices, Techniques, Systems and Applications and Display Evaluation. The complete symposium program, together with registration information, will be mailed to *SID* members in the near future and will also appear in the May/June issue of *Information Display*, which will be distributed, additionally, to all Symposium attendees.

Exhibit space is still available. For information, contact W. D. Fuller, 1420 Hamilton Avenue, Palo Alto, California 94303.

For registration information contact: Jerry T. Lewis, registration chairman, Eighth National *SID* Symposium, Stanford Research Institute, Menlo Park, Calif. 94025 (415) 326-6200 Ext. 3851.

The following program represents a preliminary list of the papers scheduled for presentation.

Session I — Display Materials

ORGANIZER: James E. Wurtz, Litton Industries

Surface Deformable Media as Applied to the Generation of Projection Command and Control Displays — G. J. Chafaris, Electronic Laboratories, General Electric Company.

Improvement of Photochromic Film for Data Display — J. H. Fletcher, G. H. Dorian, American Cyanamid Corp.

Dry Silver Recording Materials For Display Purposes — D. A. Morgan, T. J. Werner, W. H. Libby, Duplicating Products Division, Minnesota Mining & Manufacturing Co.

The Application of Photochromics to Color Display — W. A. Stein, Electronics Division, National Cash Register Co.

Session II — Display Devices

ORGANIZER: Robert J. Wohl, IBM Corporation

The Plasma Display Panel — A New Device for Information Display and Storage — B. M. Arora, D. L. Bitzer, H. G. Flottow, R. H. Willson, Coordinated Science Lab, University of Illinois.

A Low Cost Alphanumeric Display Device Requiring Negligible Switching Power — R. DuBois, Tungsol Division, Wagner Electric Corporation.

A Novel Application of Magnetic Technology to Electronic Display Devices — R. C. Sinnott, Consulting Engineer.

A Versatile High Performance Scan Converter Storage Tube — L. S. Yagy, Vacuum Tube Products Division, Hughes Aircraft Company.

Session III — Display Techniques

ORGANIZER: Philip Rice, Stanford Research Institute.

Grey Scale Reproduction on a Line Scan Electrostatic Printer — L. D. Emmons, Ampex Corporation.

An Inexpensive Color Technique for Color Electroluminescent Display — J. S. Frost, Autonetics Division, North American Aviation.

Automated Display Chart for Program Management — D. J. Hilt, Boeing Company.

Sixteen Earth Orbit Film for the Apollo Mission Simulator — R. C. LaFrance, North American Aviation.

Experimental Multi-Color, Real-Time Laser Display System — S. M. Stone, Bayside Laboratories, General Telephone and Electronics Laboratories Inc.

Anaglyph Stereoscopic CRT Display System — J. Wolvin, Chicago Aerial Industries, Inc.

Session IV — Display Systems and Applications, Part I

Session V — Display Systems and Applications, Part II

ORGANIZER: Robert A. Miner, Ampex Corporation

An Instructional Display Terminal — R. A. Aziz, Advanced Systems Development Div., IBM Corporation.

Graphic Approach to Numerical Informaton Processing — C. G. Beatty, Systems Development Division, IBM Corporation.

Physician-Machine Interface in a Hospital Information System — W. O. Fuller, Information Systems Organization, Lockheed Missile & Space Company.

The Link Automated Microfilm Aperture Cord Updating System — D. F. Jackson, D. Jackson, Link Group, General Precision Incorporated.

Customized Graphic Output Adapter for Remote Plotting — E. T. Johnson, System Development Division, IBM Corporation.

A Low-Cost Graphic Display for Computer Time-Sharing Console — R. H. Stotz, T. B. Sheek, Project MAC, Massachusetts Institute of Technology.

A Computer-Controlled Multi-Channel CRT Television Symbol Generator — R. Winfield, Information & Communication Division, Sperry Gyroscope Co., Sperry Rand Corporation.

A Simplified Direct View Bi-Stable Storage Tube in Computer-Output Applications — C. N. Winningstead, Tektronix, Inc.

Session VI — Display Evaluation

ORGANIZER: C. K. Clauer, IBM Corporation

Development and Evaluation of a Two-Color, Solid-State VSTOL Hover Display — P. R. Fuller, Instrument Division, Lear Siegler, Inc.

Flight Evaluation of Windshield Displays for All-Weather Landing — T. Gold, Information & Communication Division, Sperry Gyroscope Co., Sperry Rand Corporation.

Analysis of Saturation and Reliability in a Shared Display System — A. S. Goldstein, G. B. Hawthorne, Jr., MITRE Corporation.

The Effect of High Background Luminance Adaptation Levels on the Visibility of Electronic Displays — G. M. Ketchal, Kaiser Aerospace & Electronics Corporation.

Design and Development of a Prototype Photo-Optical Display Data Analyzer — D. A. Naureth, Laboratory Department, U.S. Naval Missile Center.

ID Readout

BUSINESS NEWS

The BOEING CO., Airplane Division, Renton, Wash., has purchased a Model 223 dual-gun Electrostore from Image Instruments. The unit will be used by Boeing in company-supported studies of radar terrain following . . . An $86,000 contract for an airborne radar signal processor has been awarded GENERAL ATRONICS CORP. by the Naval Air Development Center, Johnsville, Pa. . . . Selection of the OPTICAL SCANNING CORP. of Fairless Hills, Pa., for installation of an optical mark reader at Air Force Headquarters has been announced by the Electronic Systems Div., Air Force Systems Command. Approximate cost of the mark reader, scheduled to be operational by the end of April 1967, is $51,000 . . . A new GENERAL ELECTRIC computer complex has gone to work for the American Stock Exchange. First assignment of the two GE-415 systems is to launch a compared clearance in the Exchange's Clearing Corp. . . . Point-of-purchase color film commercials in 41 south Florida supermarkets have started as a result of a long-term pact between the Florida Div. of the GRAND UNION CO. and SPOT ADVERTISERS INC. of Hialeah. Automated equipment will activate the Project-O-Vision unit each morning and de-activate it at closing time . . . A contract for $467,000 has been awarded to the BUNKER-RAMO CORP. for the Naval Electronics Systems Command by the Navy Purchasing Office, Washington, D.C. The contract provides for the fabrication of a remote query display system consisting of a modified AN/FYQ-37 (Bunker-Ramo Model 90) visual analysis console, a special buffer unit, and a BR-189 hard copy typewriter . . . ADAGE INC. has received $2 million from the sale of common stock and 10-year debentures. Proceeds from the sale are being used to retire all short-term borrowings and to strengthen working capital. The company is building up to meet a growing volume of computer orders.

FMA INC. recently announced receipt of a $1.8 million program to build image interpretation systems for the US Marine Corps. The system is designed for field deployment to support RF4B type aircraft in analysis of photographic reconnaissance materials, and the entire shelter can be transported by land or air to a field site and be operational within one and a half hours . . . MILGO ELECTRONIC CORP., Miami, Fla., recently announced a two-year agreement to supply WESTERN UNION with its new data transmission device, Modem 4400, which will transmit digital data from computers and related devices at high speed over Western Union's communications network . . . Stockholders of TASKER INSTRUMENTS CORP. recently voted approval of a change in name to TASKER INDUSTRIES. W. E. Tranthem, Jr., new president of the company, said the new corporate identity was in keeping with the broad scope of activities of the organization. The firm, producer of electronics systems for the US military and NASA, released its audited financial statement showing that the company is operating on a profitable basis.

DASA CORP., Andover, Mass., has announced the acquisition of IMAGE INSTRUMENTS, INC. As an operating division of Dasa, Image will continue its work in the technology of information processing through use of electronic storage tubes.

Your society has recently acquired a national office and full time secretary. The office is located at 654 N. Sepulveda Blvd., Bel Air, Los Angeles, Calif. 90049, Suite 5. The telephone number is (213) 472-3550. The secretary is Mrs. Sharon Satterfield who maintains a welcome mat outside her door on Monday through Friday, from 8:30 to 5:00. Sharon works under the direction of *SID* National Executive Secretary, Dr. H. R. Luxenberg; she is there to help answer questions, and serve your needs.

"INSTANT REPLAY" FOR ASTRONAUTS

Videotape recording is helping North American Aviation to analyze reactions of pilots and astronauts to various mission situations. Enginers use an Ampex VR-660B compact closed circuit videotape recorder to record the actions of pilots in the laboratory's flight simulators. Results of the tests are used in the development of more efficient aircraft systems. The tape may be used instantly or delayed as a television picture. Of particular value is the VR-660B's capacity to play back in slow motion, thus allowing detailed examination of pilot's reactions to simulated mission problems.

LARGE SCREEN RADAR DISPLAY

A large-screen TV projector used to project radar displays has been found acceptable for air traffic centers by the Federal Aviation Agency. Radar data displayed by the projector compares favorably with conventional bright "tube" type display (RBDE-5) in use today. On tests, the display, which resembles a movie screen, was operated 24-hours a day, seven days a week, for 56 days. Modifications to assure better operation and improved interface with existing equipments have been recommended, and lighting for viewing areas was recommended.

LIGHT MODULATORS

New light modulators developed at Bell Telephone Laboratories reportedly make it possible to impress broadband communications signals onto laser beams using modulating powers of less than one watt. Most earlier modulators required too much power or had insufficient bandwidth. The gallium phosphide modulator consists of a semiconductor p-n junction, together with a suitable mounting and input and output lenses. Phase modulation of light in gallium phosphide diodes is due to a phenomenon — the linear electro-optic effect — which takes place in the diode p-n junction region when a reverse bias is applied.

SPECTRAL SLEUTH AT WORK

A "spectral sleuth," the ST-701 spectral contour plotter, is at work at Northrop Nortronics, Needham Heights, Mass. Tiny differences between virtually identical electronic signals, important in diagnosing heart ailments, radar returns, etc., are spotted and displayed in a manner reported to be twice as clear as a home television picture. More than 100 heart sounds have been analyzed, showing dramatic differences between abnormalities. The "sleuth's" findings are presented as charts similar to topographic maps of the earth's terrain.

EMULSION AIDS ASTRO-PHOTOGRAPHY

A new photographic emulsion has enabled the world's largest telescope, the 200-in. Hale instrument at Palomar, to reach much farther into space and to record celestial objects three times fainter than any ever photographed, the Mt. Wilson and Palomar Observatories disclosed recently. "The emulsion not only will make possible the study of very faint and very distant objects heretofore beyond reach, it also will enable astronomers to see nearby objects in greater detail than before," says William C. Miller, research photographer for the Observatories. The new photographic material, created at the research Laboratories of the Eastman Kodak Co., Rochester, N.Y., was tested by Miller on the Hale telescope and its companion, the 48-in. Schmidt telescope. These instruments are located on Palomar Mountain and are operated by the California Institute of Technology and the Carnegie Institution of Washington.

FJCC CALL FOR PAPERS

A call for papers has been issued by the program committee of the 1967 Fall Joint Computer Conference to be held Nov. 14-16, 1967, at the new Convention Center, Anaheim, Calif. A deadline has been set for April 17, 1967; complete manuscript is requested in addition to a 100-word abstract. Five copies should be sent to Harry T. Larson, (technical program committee chairman), P.O. Box 457, Costa Mesa, Calif. 92627. Papers should deal with significant advances in any aspect of the information processing field, including hardware, software, systems, applications and analog/hybrid systems. A $500 prize will be awarded by the American Federation for Information Processing Societies, FJCC sponsor.

VIDEO MATRIX FOR HOSPITAL SYSTEMS

Development of a remote computer terminal, a kind of far-flung input-output station, which can greatly increase the speed and efficiency of hospital administration, has been announced by Lockheed Missiles and Space Co., Sunnyvale, Calif. Known as the Lockheed Video Matrix, the new terminal will permit doctors, nurses and other hospital personnel to sidestep long series of paperwork operations. The terminal will have its first extensive use at the Mayo Clinic in Rochester, Minn. Besides speeding exect ion of doctors' orders, the video matrix will bring faster communication among nurses and other hospital personnel and store information on hospital operations for use by administrators. The terminal consists of a video screen, keyboard, printer and "light pen," a photosensing device. In a normal situation, a number of terminals located throughout a hospital would be linked to a central computer containing millions of characters of information about patients and ways of treating them. A doctor wishing to issue a medical order takes a seat before the video screen. He inserts a magnetically coded card — his personal property — into a slot on the console; this identifies him, by name, as an authorized user.

DECISION FOR KOLLSMAN

By a unanimous decision of the US Court of Appeals, 2nd Circuit in New York, Kollsman Instrument Corporation's Data Projector was cleared of infringement of any claim of the Ling-Temco-Vought Fenske Patent. Data plotting devices of the type involved in this action have been utilized primarily for air defense and tactical command center purposes to provide a projected, graphic, visual, real time display of movement and location of aircraft, missiles and other high speed devices.

AIRBORNE DISPLAY SYSTEMS CONTRACTS

Two contracts for development of airborne computer display systems used in anti-submarine warfare, and aerial early warning and control systems, have been awarded by the Naval Air Development Center to The Data Products Division of Stromberg-Carlson. The first contract calls for construction of two tactical display consoles for laboratory simulation and for possible airborne applications. Each will display computer-processed information on a 12-in. cathode ray tube. The second contract is for two similar consoles for use in a Navy in-house laboratory program.

FIRM RECOVERS AFTER FIRE

Despite a plant fire a year ago which leveled a major portion of its production facility, the Electronic Tube Division of General Atronics Corporation reports it has achieved a 10% increase in shipments over the prior year. The Division supplies special purpose cathode ray tubes to government and industry, and made most of its recovery during the second half of the year. It was the hardest hit of the firm's four divisions by the fire which gutted 5000 sq. ft. of the plant.

FLIGHT INDICATOR

Apollo Astronauts will get their bearings in space from a nine lb. cockpit instrument called a flight director attitude indicator. Honeywell is producing the instrument for North American aviation, which is prime contractor for the NASA spacecraft. The electronic ball in the indicator displays the spacecraft's attitude, attitude error and attitude rate in each of three axes: roll, pitch, and yaw. The model has been built for lunar mission some time before 1970.

EXPERIMENTAL LASER SYSTEM

An experimental TV picture display system using a laser beam scanned by ultrasonic waves to produce large-size pictures for projection has been developed by Zenith Radio Corporation scientists. Sharpness and detail are said to approach that of a conventional TV picture. The system is the result of four years of research by the company's light amplification and electron device research teams, and is one of a number of new approaches to TV picture displays of the future. The system is still in an early stage; more efficient lasers or other light sources must be developed before large scale commercial application is possible.

NATIONAL AEROSPACE ELECTRONICS CONFERENCE

Banquet speaker for the 19th National Aerospace Electronics Conference (NAECON), May 15-17, 1967 at the Sheraton Hotel, Dayton, Ohio, will be Maj. Gen. David M. Jones, Deputy Associate Administrator for Manned Space Flight (Programs) NASA Headquarters, Washington, D.C. A special classified session will be sponsored by the Aeronautical Systems Division, the Air Force Laboratories, and the Systems Engineering Group of the Research and Technology Division, AFSC. Theme for the classified session will be Technology Impacts the Military Mission. NAECON attendees desiring to attend will be required to submit no later than May 5, 1967 pertinent information in strict compliance with Pars. 40a and 40d of DOD Directive 5220, 22M. Visit notification must be approved in writing by an administrative contracting officer and forwarded to the Aeronautical Systems Division, attention: ASI (J. M. Kelly), Wright-Patterson Air Force Base, Ohio 45433.

NATIONAL MICROFILM ASSOCIATION CONVENTION

The National Microfilm Association will hold its 16th Annual Convention from April 26-28 at the Americana Hotel, Bal Harbor, Miami, Beach, Fla. Featured will be varied microfilm applications and systems development information. NMA will also host the second meeting of the International Micrographic Congress.

SYMPOSIUM ON AUTOMATIC PHOTOINTERPRETATION

A Symposium on Automatic Photointerpretation is scheduled for May 31 - June 2, 1967 at the Washington Hilton Hotel, Washington D.C. Sponsored jointly by the Office of Naval Research, the Pattern Recognition Society, and the University of Maryland, the symposium will review recent advances in the automatic analysis and interpretation of pictures. Further information may be obtained from: George C. Cheng, Pattern Recognition Society, P.O. Box 692, Silver Spring, Maryland 20901.

HIGH-PERFORMANCE A/C MONITORING

Litton Industries' Westrex Communications Div. is building a closed-circuit TV and distributive system for use in continuous, real-time visual monitoring of high-performance aircraft. Designated "Flitovision", the system is to be installed for the Air Force at Edwards AFB, where it will collect, transmit, process, record and distribute flight test data. Equipment will be located at 16 fixed locations, in two mobile vans, two C-130 aircraft, and in eight supersonic chase and data aircraft. Approximately 87 TV cameras and monitors will be connected by cable and mcw links.

AUTOMATIC CLASSIFICATION/RETRIEVAL

An economical method of automatic classification and retrieval for large document collections has been designed by System Development Corp., Santa Monica, Calif., the firm has announced. The computer-based system, called Automatic List Classification and Profile Production, allows low-cost computerized classification in large collections which range from one to ten million document, according to Lauren Doyle and Don Blankenship of SDC's Language Processing and Retrieval Staff. The program's initial success was demonstrated in experiments that involved 400 documents. Direct cost projections indicate that high-quality classification can be made for document collections of any size, including one as large as the Library of Congress, for a net cost of only a few cents per document. ("Net cost" presumes that document text has been key-punched or otherwise placed in machine-readable form.) The SDC researchers point out that when other classification methods are used, the cost per document goes up as the size of the library increases. Using ALCAPP, the cost per document remains substantially the same, no matter how much the collection grows. It was also noted that when computer costs in general decrease, the cost per document decreases proportionately.

ACM TECHNICAL SYMPOSIUM

TRW Systems of Redondo Beach, Calif., is sponsoring a one-day Technical Symposium for the Los Angeles Chapter, Association for Computing Machinery, on May 18 at the Century Plaza Hotel in Los Angeles. B. G. Dexter, Jr. is handling arrangements for TRW.

The National Annual Business Meeting of the Society for Information Display will be held in New York City on March 22, 1967. The meeting, which will be hosted by the Mid Atlantic Chapter, will be held at CBS Studios, 524 W. 57th Street, Rehearsal Room No. 2 at 8 P.M. The guest speaker for the meeting will be Dr. Edward Kennedy of RADC. Dr. Kennedy will talk on the impact of changing requirements on new display technology. The Board of Directors meeting of SID will be held on the same day at 10 A.M. at the CBS Broadcasting Center, 530 W. 57th Street.

CHAPTER NEWS

The *Los Angeles Chapter*, headed by Erwin Ulbrich, was host to William Bethke, National President, and Carlo Crocetti, Chairman of Definitions and Standards, at its February 9th dinner meeting. The meeting was held in the Engineer's Club at the Biltmore Hotel in downtown Los Angeles. Forty-three enthusiastic members heard Bill Bethke give an interesting summary of papers presented earlier that week in his Display Session at the IEEE, Wincon Symposium. Dr. Crocetti gave a thorough run-down on the efforts of the Definitions and Standards Committee over the past several years. The March 28th meeting, preceded by a period of fellowship and dinner, will feature a tour of the System Development Corp.'s Time Shared Computer Facility. Operation of four different CRT type systems in an iterative computer time shared mode will be demonstrated. A unique application of the Rand Tablet will also be demonstrated. — Fred E. Smith, *Publicity*, Los Angeles Chapter.

ID Products

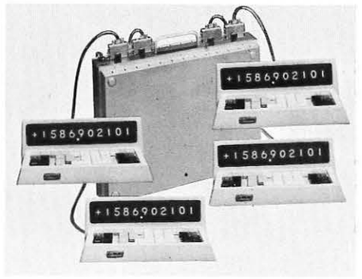
STEP-SERVO MOTORS. IMC Magnetics Corp., Westbury, N.Y. is offering three new step-servo motors: Tormax Size 11 PM, Size 8 VR and Size 15VR. A 4-phase, bidirectional unit, the Tormax Size 11 PM is said to be ideally suited for computer, X-Y plotter and similar digital systems applications. The Tormax Size 8 VR, with its small size (¾ in. dia.), light weight (50 gm), and precision high-speed performance is claimed to be suitable for a wide variety of computer, integrator, tape recorder or digital control systems applications. Tormax Size 15 VR is intended as a digital actuator for X-Y plotters, switch and valve positioning, and similar systems requirements.

Circle Reader Service Card No. 38

FLEXIBLE TUBING. Shieldflex is a high nickel iron flexible tubing now available with an ID of two inches and an OD of 2-19/64 in., according to the manufacturer, Russell Industries Inc., Lynbrook, N.Y. Providing both electrostatic and electromagnetic shielding of current-carying conductors, the tubing material has a thickness of 0.020. Nominal weight per 100 ft is 70 lb; nominal bend ID is 10 in. Space economy is said to be effected by close routing of conductors around components or other conductors.

Circle Reader Service Card No. 39

ELECTRONIC CALCULATOR. Declaring a significant breakthrough in electronic calculator design, Wang Laboratories Inc., Tewksbury, Mass., has announced its new calculator system in which as many as four relatively low cost keyboard/display console units may be operated simultaneously from a single control unit. The Wang Model



300 console is a small, lightweight desk-top unit providing three separate sets of input keys for a variety of arithmetic operations, together with a panel on which input and output figures are displayed instantly in large, lighted number numerals ⅝-in. in height.

Circle Reader Service Card No. 40

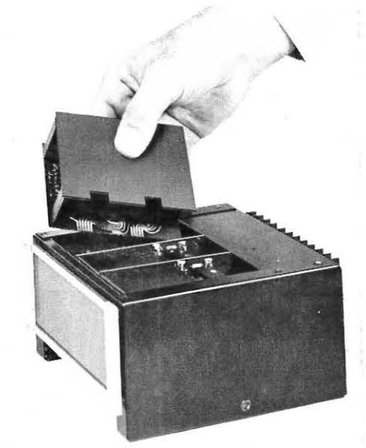
READOUT WITH NEONS. A transistorized segmented digital readout (TSR Series) with neon lamps is available from Transistor Electronics Corp. of Minneapolis. Solid-state decoder/driver circuitry of the TSR Series, designed for use in discrete or integrated circuit systems, controls neon lamps with signals as small as 0.5 ma. Rugged, long-life neons, which are not subject to catastrophic failure, make this readout far more reliable than incandescent lamped types, the firm states. Supply voltage required is ±50 volts RMS, rectified, unfiltered. The bright readout which remains distinctly visible at wide viewing angles and in high ambient light is designed for conventional thru-panel mounting with bezel or for use behind the glass panels of Tec-Lite Data Panel display systems. "No-gap," 1.200-in. high characters are said to produce easily-read numerals.

Circle Reader Service Card No. 41

ENCODER/DRIVER MODULES. Discon Corp. of Fort Lauderdale, Fla., is offering new miniaturized encoder/driver modules in its DiGiCATOR line of numeric readouts and input converters. DiGiCATOR readouts are said to provide maximum character height for the amount of panel space occupied. The modules are available in plug-in style or as chassis-mounted units.

Circle Reader Service Card No. 42

READOUT MODULE. Numex, Inc., Waltham, Mass., has developed a readout module for visually displaying numerals 0-thru-9 in response to coded electrical input signals. The new readout, according to



the firm, has the inherent ability to accept and decode BCD input signals, and can be supplied in side-by-side assemblies complete with bezel, frame, and common electronic circuits, to make multi-decade readouts for digital instruments, systems, computers, etc. The principle of Numex (patent applied for) operation is that of a digital servo. The stepping motor is pulsed continually when a fresh numeral is called for, and in this way, "tries different numerals for size," until the right one is found. Photocells are used to stop the motor when the displayed numeral matches the numeral specified by the BCD data-input.

Circle Reader Service Card No. 52

SUBMINIATURE INDICATOR. Designed for installation in equipment and systems where space is at a critical premium, the Bowmar-Fort Wayne Div. subminiature elapsed time indicator (DC-3215) is said to occupy little more than a quarter cu. in., and to provide easy readability at 48 in. or more with the unaided eye. The self-contained and hermetically-sealed unit displays four 0.078-in. white-on-black digits through a glass faceplate for presentation of elapsed hours from 0000 to 9999. Readings in tenths of hours, 000.0 to 999.9 can also be specified, it is claimed. The indicator is unitized and ruggedized to meet environmental requirements of Mil-M-7793C, and appears on the Bureau of Weapons qualified products list.

Circle Reader Service Card No. 53

INDICATOR LIGHTS. Ultra-miniature Datalite indicator lights which mount in a ⅜-in. clearance hole have been announced by the Dialight Corp., Brooklyn, N.Y. Datalites consist of three parts: the Datalamp holder, adapted for permanent mounting on the panel; the Datalamp cartridge which telescopes into the holder and makes electrical contact as the pins enter the receptacle in the holder; and the screw-on Data Cap. The Data Cap lens controls the light emission. A choice of transparent lenses, with or without internal diffusing rings, is available in short or long cylindrical shape. Translucent Data Caps, for use with engraved or hot-stamped legend markings, are also available in short or long cylindrical lens shape.

Circle Reader Service Card No. 54

MARKING SYSTEM. California Computer Products, Anaheim, Calif., has announced development of an automated marking system for use with the computerized grading system which Cal Comp and Catalina, Inc., have been developing for the past year. The marker reportedly automatically reduces patterns to one-fifth scale and back again, plots a ready-to-cut marker up to 88 in. in width and 120 ft. in length, and provides for pattern identification, cutting instructions, and garment number annotation. According to the firm, digital information from the grading and marking machinery can be adapted to equipment of the eight largest computer firms.

Circle Reader Service Card No. 55

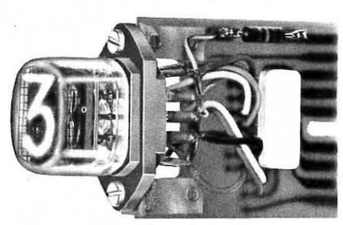
RECTANGULAR TV PICTURE TUBE. The Electronic Tube Div. of Sylvania Electric Products Inc., New York, N.Y., has announced its rare earth color TV picture tube, a 22-in., 90-deg rectangular model. The tube features a "pre-stabilized" screen panel said to minimize glass shifting during the manufacturing process and to result in a more precisely aligned picture. The firm claims added precision is guaranteed through the use of computer-controlled equipment to determine the exact spacing between the glass panel and the dome-shaped shadow mask through which the electron beams must pass to create a color TV picture. The tube is approximately six in. shorter than the 21-in. 70-deg round tube which it replaces.

Circle Reader Service Card No. 56

MAGNETIC PARTICLE CLUTCH. A line of Fastep magnetic particle clutches has been introduced by Lear Siegler Inc., Power Equipment Division, Cleveland, Ohio. Originally designed to meet the requirements of business machine mechanisms, the clutch reportedly offers fast response and long life. The identical unit can also be used as a brake, the firm states. A magnetic particle mixture, patented by LSI, is contained between the input and output members. When current is applied, the particles become magnetized and span the gap in a seemingly solid mass, resulting in an "extremely smooth" clutching and braking action. The rate of acceleration or deceleration is controlled by the rate of current applied.

Circle Reader Service Card No. 57

READOUT TUBE DRIVERS. National Electronics, Inc., Geneva, Ill., has announced its third readout tube driver series, NL-M300, decimal counter/driver with latching memory, a 15 MHz decimal counter, and a display device. The count is



stored in a quad latch memory and displayed on a readout tube. Display is updated upon application of gating signal to quad latch memory. BCD output is also available from the counter to drive printers and remote display devices. TTL monolithic integrated circuits and modular construction are used for maximum reliability and small overall size.

Circle Reader Service Card No. 58

COMPUTER-DRAWN LAYOUTS. An architectural service which will provide computer-drawn perspective layouts within 24 hours has been introduced by design systems inc., Boston, Mass. The firm states it has developed a computer graphics program which permits perspective layouts at any scale and any given vertical or horizontal displacement from 0 to 360 deg. Because the building plan is stored in the computer, any number of drawings, each from a different vantage point, is said to be possible to obtain. Afterwards the building plan is permanently stored on punch cards. This permits the architect to order a new perspective of his building if he want to change a detail or view it from a different angle.

Circle Reader Service Card No. 59

PUSHBUTTON ROTARY SWITCH. The Digitran Co., Pasadena, Calif., has introduced the Series 12000 miniature Pushbutton rotary switch which is said to permit complete panel sealing to prevent contamination of switch and panel interior. Individual modules can be sealed from dust and moisture. The firm recommends the product for military communications equipment and hostile environments where panel sealing is required. It is designed to meet the requirements of MIL-S-22710, and is available in all 8-and-10 position standard octal and BCD codes including complement and "true, not-true" functions. Width is 0.480 in., height 1.30 in.; weight less than 0.4 oz per module; low profile with button extending 3/16 in. beyond the panel. No supplemental panel covers, boots or other enclosures are required behind the panel.

Circle Reader Service Card No. 60

MICROFLASH STROBE SYSTEM. EG&G Inc. of Boston, Mass. has a stroboscopic light system (Model 502 Multiple Microflash) which reportedly provides up to 15 one-microsecond light pulses at controlled pulse intervals. It is designed for use in photographic instrumentation systems for ballistic studies, velocity acceleration instrumentation, fatigue studies and stress/strain instrumentation. The system provides peak light of 200,000 horizontal-candle-power, a flash repetition rate from 25 to 100,000 cycles, and a flashtube life of 100,000 flashes, the company asserts. Energy input per flash is 1.5 watt-seconds, time delay between flashes ranges from 10 microseconds to 40 milliseconds. Triggering is by microphone, electrical signal or manual contact.

Circle Reader Service Card No. 61

MOTION-PICTURE CAMERA. Red Lake Labs, Santa Clara, Calif., recently announced a new 2,000 ft capacity 16-mm high speed motion picture camera which uses the advanced Hycam rotating-prism principle and operates from 10 to 20,000 pictures per second. The 2,000 ft rating is based on conventional 6 mil acetate color film, but the camera also accepts 2400 or 2800 ft rolls of Estar or Cronar 4-mil black and white film. Camera specifications listed provide a range from 16 seconds at 5,000 pictures per second to 3 hours 20 minutes at 10 frames per second. The camera is based on the development of a new low inertia film transport system utilizing daylight loading casettes identical and interchangeable between film supply and takeup functions. As a result, it can be utilized in start-stop operations throughout the entire speed range, according to the firm.

Circle Reader Service Card No. 62

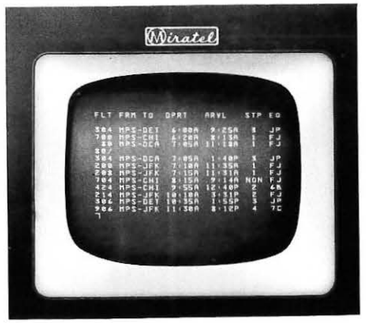
DATA PLOTTER. Multi-purposed three-dimensional graphs can now be produced from electronic processing equipment, automatically, with new Spatial data plotter, according to Spatial Data Systems, Inc., Goleta, Calif. The desk-height console system, Model 501, is said to be a true, first-of-kind three-dimensional plotter. Used with a digital computer, a physical likeness of three-dimensional data is constructed. Resolution is 1/100 in. Plotting is limited only by the size of X-Y positioning mechanism. Surface of plotting board can be annotated before/after plot is made, with ink or pencil. According to the firm, the Model 501 will plot (with correct buffer electronics) 3-D data from electronic processors, magnetic and paper tape, punched cards.

Circle Reader Service Card No. 65

COMPUTER. Control Data Corporation, Minneapolis, Minn., has announced it is now marketing a new medium-scale data processing system, the Control Data 3150 computer system. This latest addition to the firm's 3000 Series computers is said to be a complete, self-contained, mass storage oriented computing configuration, designed to satisfy data processing requirements of business, sciences, and engineering. It includes: a central processor with desk console, I/O typewriter, 16K memory (1.75 microsecond cycle time), two twelve-bit data channels, one twenty-four-bit data channel, peripheral controller electronics, one Control Data 405 card reader (1200 cpm) two Control Data 854 disk storage drives with two Control Data 850 disk packs, and one Control Data 3254 line printer (300 lpm).

Circle Reader Service Card No. 66

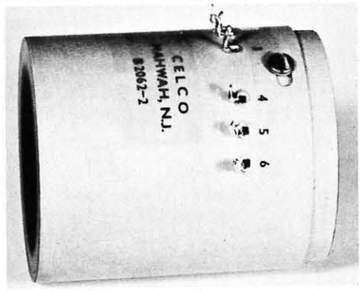
HIGH RESOLUTION MONITOR. Miratel Electronics Co., Mineapolis, is announcing an all solid-state high resolution television video monitor which uses plug-in modular card construction and has



30 MHz video bandwidth. The transistor high resolution series (TH Series) is said to be capable of 200 graphic lines per in. on a 17-in. kinescope. The unit will operate on any of the popular scanned raster line rates from 15 KHz to 35 KHz horizontal and 15 Hz to 180 Hz vertical. Geometric and deflection distortion is less than one percent. Both high voltage and low voltage power supplies are regulated, and the unit has been specially stabilized for long term drift, it is claimed. The monitor is intended for computer readout of alphanumeric data and to provide photo copy characteristics for data as well as pictorial displays.

Circle Reader Service Card No. 67

POSITION-WRITE DEFLECTION YOKE. A low-cost, high-performance positioning deflection yoke with a character writing or "diddle" yoke in a single housing has been announced by CELCO, of Mawah, N.J. (Model PW626). The writing yoke is said to be adjustable ±5 deg relative to the positioning yoke. Built-in speed



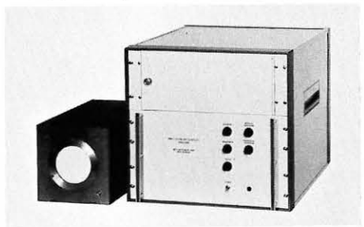
and accuracy are claimed to provide optimum performance for on-line sequential scan read-outs, airline schedule displays, ticker tape, facsimile and other alphanumeric transistorized display applications. The product is designed for CRT with 1-7/16-in. necks and up to 66 deg deflection angle.

Circle Reader Service Card No. 68

SLIDE PROJECTOR. A new random access slide projector, Model 723-1, has been developed by Giannini Scientific Corp., Santa Ana, Calif. Designed for simulators and high performance displays, it is said to feature precise registration of large image formats and random access to 100 slides. The 3¼ x 4 in. slide frame assembly has integral locating pins that register the chip in a glass sandwich without the use of cement or adhesives. Specifications include image format: 2.10 x 3 in., lens: 6 in. or longer efl, lamp: 500 or 750 w incandescent, registration: 0.001 in., access time: 6 seconds from position 00 to 99. All electronic circuits are modular and integral with the projector structure.

Circle Reader Service Card No. 69

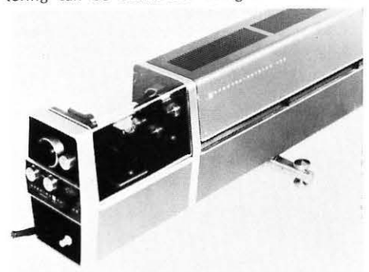
PRECISION DISPLAYS. A new family of precision CRT displays, Model Series PD1000, PD1100, and PD1200 is being offered by Beta Instrument Corp., Newton Upper Falls, Mass. Utilizing 5-in., flat-face,



magnetically-deflected cathode ray tubes, the displays feature all solid-state circuitry for application in film and hard copy printing recorders, flying spot scanners, film readers, radar displays, or any application requiring a precision programmable light source. Spot sizes available include 0.0015, 0.001, and 0.005. The basic displays include deflection, blanking and linearity correction circuits. Circuit options include video amplifiers, phosphor protection circuits, X-Y sawtooth generators, and resolved sweep generating circuitry.

Circle Reader Service Card No. 70

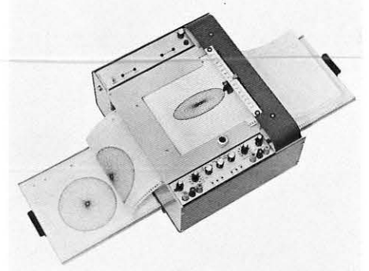
CAVITY EXTENSION. A laser extension to permit intra-cavity experiments is being manufactured and marketed by Spectra-Physics Inc., Mountain View, Calif. The extension is said to provide for easy insertion of samples into the cavity of the laser. Various experiments in the areas of supermode techniques, harmonic generation and light scattering can be conducted using the extension.



For single pass sample loss of five percent, typical power through sample is 1.5 watts; typical power outside laser cavity is 5 mw, according to the firm. The Model 325 Cavity Extension is an accessory which can be specified when ordering the Stabilite Model 125 50 mW gas laser. In addition, existing Model 125 lasers can be retro-fitted with the extension at either of Spectra-Physics' Service Centers in Mountain View, Calif. or in Cranford, N.J.

Circle Reader Service Card No. 71

X-Y RECORDER. A new concept in X-Y recording is claimed by Houston Omnigraphic Corp., Houston, Tex., for its Model 6420 Omnigraphic™ X-Y recorder



which uses fan-fold paper and allows a series of consecutive records without individual hand-loading of sheets. The paper may be loaded or unloaded in mid-record and each record can be torn out as an individual sheet at the perforations, the firm states. Both forward and reverse advance is inherent and can be controlled automatically by programming, it is reported; each record is capable of automatic advance when the extreme margin is reached. The unit has a reported slewing speed of 15 in./sec. with 18 calibrated dc voltage ranges (continuously variable in between) for each axis.

Circle Reader Service Card No. 72

VIDEO CABLE. Dynair Electronics, Inc., San Diego, Calif., has announced a new system designed to compensate for high-frequency losses encountered in the cable transmission of video information. The Equa-Dyn system features silicon solid-state circuitry and a 16-MHz bandwidth. A single system, consisting of a line-driving terminal and a receiver terminal, is said to transmit video over 124-ohm balanced cable for distances up to 10,000 feet. Video may be passed through several systems with negligible signal deterioration. Three basic Equa-Dyn systems are provided: an unbalanced system for use with 75-ohm unbalanced cable to 5,000 feet; a balanced system for use with 124-ohm balanced cable to 5,000 feet, and another for use with balanced cable to 10,000 feet.

Circle Reader Service Card No. 73

MEDIUM PERFORMANCE COUNTER. Hecon Corp., New Shrewsbury, N.J., has introduced the 6-digit Series F 051 industrial totalizer, featuring escapement drive for counting accuracy and life expectancy, positive rotary reset, and interchangeable mounting configurations. Base mounted 5 and 6 digits reset are standard. Figures white on black, 7/32 in. high, with optional frame for panel mounting and non-reset version with up to 7 digits also available; 110 v ac continuous duty coil with 2 va consumption is standard. Maximum counting speed is 1000 counts per minute with 30 ms each minimum on and off time. The base plate measures 3.661 x 1.654 in. with mounting holes to match dimensions of similar models. Overall height is 2.618 in.

Circle Reader Service Card No. 74

PULSE GENERATOR. Adar Associates, Inc., Somerville, Mass., have introduced their new SQ-200 Programmable Pulse Generator, which features solid state integrated circuit logic and has a 16 x 12 program matrix board. Programming is accomplished by inserting diode pins. The sixteen time steps make a single pass through the program, operating at stepping rates from 1 kps to 10 mps. Any step may be repeated, with the number of repeats controlled by an analog timer. Trigger pulses constitute the 12 parallel channel outputs, while an "Endless" position on the repeat duration controls is said to allow very long repeat periods under the operator's manual control.

Circle Reader Service Card No. 75

TUBE SHIELD ASSEMBLY. The Magnetic Shield Div., Perfection Mica Co. of Chicago, Ill. offers a twin photomultiplier tube shield assembly called Netic Co-Netic which reportedly permits compact positioning of individually shielded photomultiplier tubes and prevents amplification capability degradation from magnetic fields. The

structurally self-supporting assembly has an outer layer of Netic S3-5 alloy and an inner layer of Co-Netic AA. Dual layer construction is said to enhance the shielding capability over a wide range of external field situations because Netic diverts high-level magnetic fields and Co-Netic attenuates low-level magnetic fields. Photomultiplier tubes can be shock-mounted within the shield, using resilient pads or foam potting, the firm states.

Circle Reader Service Card No. 76

WORD INDICATOR LIGHT. Master Specialties Co., Costa Mesa, Calif., has announced availability of word indicator lights that feature a ¼ x 1 or 1⅜ in. wide rectangular front lens and a rotatable lamp capsule for front-of-panel relamping, as well as legend or color change without requiring use of tools. Designated the Series 6000 and 7000 Roto-tellite, the units are two-lamp indicator lights that mount flush with the panel front and may be grouped for mounting in many different configurations providing for vertical stacks, horizontal rows or matrices. Relamping is said to be accomplished without tools by depressing either side of the lens face, which causes the lamp capsule to rotate 180 deg., exposing the lamps for replacement. The capsule is permanently connected to the basic unit, preventing it from becoming detached during the operation.

Circle Reader Service Card No. 79

GAS LASER. Electro Optics, Palo Alto, Calif., has announced a new gas laser for OEM and other applications requiring maximum performance. The LAS-2000 makes one half milliwatt of 5328 A TEM mode output available from a hermetically sealed adjustment and service free package 9 x 1.5-in. dia. The ruggedized plasma tube is shock mounted within a protective metal envelope, terminating on one end into a conventional 8-pin tube socket, and delivering a collimated pencil beam of red laser light from the other end. The unit plugs in like a radio and operates from 1,000 volts dc at 10 ma, with 6.3 ac or dc required for the heated cathode. The LAS-2000 is completely self-contained and service free, requiring no adjustments during the entire life of the tube, according to the firm.

Circle Reader Service Card No. 80

G-D INPUT SYSTEM. A two-dimensional graphic-to-digital input system for use with general purpose digital computers has been announced by Data Equipment Div., Bolt Beranek and Newman Inc.,

Santa Ana, Calif. Designated the Grafacon Model 1010A, the system (based on the Rand Tablet) consists of a "writing" surface, electronic pen, and associated control circuitry. While providing man-computer communication, it is said to permit the plotting of a wide range of graphical input information directly on an integral screen. The printed-circuit screen, with capacitive-coupled encoding, is the hub of the system. The 10 x 10-in. writing surface accommodates 10^6 input locations with "excellent" linearity and 100 lines/in. resolution in both x and y.

Circle Reader Service Card No. 81

New Literature

TUBE MANUAL. An updated RCA Receiving Tube Manual (RC-25) is available from RCA tube distributors or for $1.25 from the company in Harrison, N.J. The 608-page manual presents the complete RCA line of home-entertainment type receiving tubes, voltage-regulator and voltage-reference tubes. New text material is given on basic system functions, tuned amplifiers, wideband (video) amplifiers, television scanning, sync, and deflection circuits.

Circle Reader Service Card No. 84

READOUT CATALOG. Burroughs Corp., Electronic Components Div., Plainfield, N.J., manufacturers of Nixie® tubes and related assemblies, offers a 32-p catalog containing a guide to readout tube selection, listings of all standard Nixie tubes with electrical, mechanical and environmental characteristics and detailed specifications of their operation and application. In addition, it includes descriptions of special readout tubes, alphanumeric displays, and associated driver modules.

Circle Reader Service Card No. 85

NUMERIC READOUTS. Dialight Corp., Brooklyn, N.Y., has announced the availability of a Dialco Numeric Readout catalog which includes descriptive data, drawings and specs for readout and caption modules with: Incandescent or neon light sources for operation on 14-16 v and 24-28 v ac-dc; and 150-160 v dc or 110-125 v ac, respectively. Designated Catalog L-181, it also covers translator drivers for binary input; 10- to 7-line converters; assembly of modules; and mounting on panels and accessories.

Circle Reader Service Card No. 86

SPECIAL PURPOSE CRT. Video Color Corp., El Segundo, Calif., a subsidiary of NORAMCO Inc., produces a special folder on its unusual cathode ray tubes for varied purposes, including character generators, projection, readouts, printers, oscilloscopes, radar, monitors, video recorders, view finders, computers, flying spot scanners, backported devices, etc. Included is a complete phosphor screen chart providing color, persistance, and general application data.

Circle Reader Service Card No. 87

IC QUICK REFERENCE. A 8-p quick-reference guide that presents schematic diagrams, design features, and complete model designations of more than 60 digital and linear integrated circuits is available from the Westinghouse Molecular Electronics Div., Elkridge, Md. The digital circuit line includes a wide range of devices, such as NAND gates, flip-flops, pulse binary counters, line drivers, level-detectors/Schmitt triggers, diode arrays, monostable multivibrators, AND or NAND gates, interface circuits, level shifters, and destructive readout bit drivers. Many are available with numerous combinations of inputs, nodes, and collector resistors.

Circle Reader Service Card No. 88

FIBER OPTICS. Fiber optic magnifiers that magnify or reduce information through light transmission pathways considerably shorter than conventional lens systems are described in a data sheet available from Corning Glass Works, Corning, N.Y. According to the folder, magnifiers are ideal for film enlargers, photoelectric systems, and other display systems that require minimum optical degradation.

Circle Reader Service Card No. 89

VOLTAGE TESTERS. Test lamps ruggedized for toolbox use and test accessories are shown in a four-page catalog produced by Industrial Devices Inc., Edgewater, N.J. Included are neon pilot lights and Mini-Slide pilot light assemblies which are said to incorporate long life miniature incandescent slide base lamps. Other electromechanical devices, all stock items, are presented.

Circle Reader Service Card No. 90

IMAGING SYSTEMS. A six-page brochure on photo-optical imaging systems has been released by Giannini Scientific Corp., Santa Ana, Calif. The brochure features the firm's new random access slide projector, Model 723-1. Designed for simulators and high performance displays, it is claimed to offer precise registration of large image formats and random access to 100 slides. Specifications and options are detailed.

Circle Reader Service Card No. 91

DIGITAL READOUT. Tung-Sol Div. of Wagner Electric Corp., Newark, N.J. has announced publication of a booklet describing its line of optimum contrast illuminated digital readouts. The units are discussed as to their display and equipment features. Included also is a presentation of the operating principles of the seven segmented bar readout, and a chart of the characters produced.

Circle Reader Service Card No. 92

VIDEO SWITCHING. Dynair Electronics Inc., San Diego, has published a new informative book called "Video Switching Techniques". It describes the most commonly used methods of switching video and audio information. (High-speed data can be switched utilizing the same techniques.) Pictorial diagrams, supported by easy-to-understand text, charts and tables, make system design simple.

Circle Reader Service Card No. 93

LOW RFI PRINTER. Shepard Labs, Summit, N.J., has published a brochure describing technical details of the firm's new high-speed line printer Model 400. It describes in detail the special design features by which the Model 400 achieves a low RFI factor, and develops printing speeds to 1200 lines/min (alphanumeric) and 2400 lines/min (numeric) with column capacities from 1 to 200 characters/line.

Circle Reader Service Card No. 94

SHAFT ENCODERS. An 8-p bulletin issued monthly by Theta Instrument Corp., Saddle Brook, N.J., describes many applications of shaft encoders in scientific instruments, automation, and control systems. Amply illustrated, the publication covers the use of 2-digit to 6-digit encoders as well as electronic accessories.

Circle Reader Service Card No. 95

ROTARY SWITCH. The Digitran Co., Pasadena, Calif., introduces its new Series 12000 pushbutton rotary switch in a recent issue of its monthly bulletin, *Digitrends*. The low profile switch is designed to meet Mil-S-22710/17 and to permit complete panel sealing to eliminate possible contamination of the switch and panel interior.

Circle Reader Service Card No. 96

Circle Reader Service Card No. 97

BUTTON-LIGHTS. An indicator light and electrically isolated momentary switch combined within a 1/2-in. dia. by 0.770-in. long body is described in Data Sheet No. 69 by Transistor Electronics Corp., Minneapolis, Minn. The Tec-Lite MBL series indicator-switch mounts from the rear in a 3/8-in. hole on 9/16-in. centers, conserving panel space.

Circle Reader Service Card No. 98

PRECISION OPTICS. Spectra-Physics Inc., Mountain View, Calif. has listed its precision optics and coating services in a 20-page illustrated catalog. Specific optical components are reflectors, prisms, spatial filters, and laser telescopes and accessories. Coating services include high reflection, anti-reflection, and transmission coatings designed to customer specification.

Circle Reader Service Card No. 99

DISPLAY SYSTEM. Technical details on a 16-in.-CRT display system that reportedly provides instantaneous visual presentation of several computer variables simultaneously are now available in an engineering data sheet from Electronic Associates Inc., West Long Branch, N.J. The EAI 8880 unit is said to provide a graphic presentation of faster-than-real-time solutions to analog computer simulations.

Circle Reader Service Card No. 100

3-D TV SCREEN. A simplified method of displaying stereoscopic TV is described in new NASA Tech Brief No. 66-10086, released earlier this year. It may be obtained for 15¢ from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va., 22151.

Circle Reader Service Card No. 101

TUBE ASSEMBLY. Data Sheet 186 is now being offered by Magnetic Shield Div., Perfection Mica Co. of Chicago, Ill. It describes the Netic Co-Netic twin photomultiplier tube assembly which reportedly permits compact positioning of individually shielded photomultiplier tubes and prevents amplification capability degradation from magnetic fields.

Circle Reader Service Card No. 102

OSCILLOSCOPES. Data Instruments Div., Pennsauken, N.J., has published a catalog on its two types of oscilloscopes: plug-in amplifiers and built-in amplifiers. Dual and single beam oscilloscopes are available in both classes, and rack mounting versions are included as well as a rack-mounted main frame with plug-in amplifiers. The catalog contains an introduction which discusses the design, production, and specification philosophy of the manufacturer.

Circle Reader Service Card No. 103

TABLE-TOP SYSTEM. A 16-page application guide is available from Field Emission Corp., McMinnville, Ore., on its Faxitron 804 table-top radiographic system which is claimed to provide prints of prototype and experimental components with "quick, accurate" detail for master film drawings.

Circle Reader Service Card No. 104

WIRE MEMORIES. A high-speed magnetic memory that is woven like cloth on a loom is described in a brochure, "Woven Plated Wire Memories," published by General Precision Inc., Librascope Group, Glendale, Calif. The 16-page illustrated brochure provides technical information on the new type of memory and describes how it is adaptable to virtually any computer system.

Circle Reader Service Card No. 105

SLIDE PROJECTORS. Spindler & Sauppe Inc., Glendale, Calif., describes its complete line of Selectroslide professional slide projectors in a new condensed catalog. Publication covers all models from basic manual projectors through sophisticated speed-dissolve systems and patented random access projectors.

Circle Reader Service Card No. 106

VISUAL CONTROL. A full-color brochure describing Rol-a-Chart visual control boards, offered by the W. A. Steward Co., Mill Valley, Calif., features a sample chart section and guide to visual control. To assist the planner, the sample chart section offers a typical scheduling system.

Circle Reader Service Card No. 107

ILLUMINATION DATA. An illumination system capable of projecting 3000 lumens is described and illustrated in a catalog sheet released by the manufacturer, Spindler & Sauppe Inc., Glendale, Calif. The unit is designed for use with automated SL Selectroslide projectors and speed dissolve system made by the company. Named "Ultra-bright," the system employs a standard 1200-watt incandescent projectroron lamp operating at 120 volts.

Circle Reader Service Card No. 108

POINT PLOTTER. Six applications where high-speed point plotting saves time in gathering information in chart form are described in a bulletin prepared by Houston Omnigraphic Corp., Bellaire, Tex. The Model 6550 omnigraphic™ high speed point plotter is said to eliminate hand plotting, manual chart replacement and roll chart inconvenience with the Z-fold paper approach.

Circle Reader Service Card No. 109

NAVAL LAB GRAPHICS. A recent issue of IBM's "Computing Report" (April 1966, Vol. 2 No. 1) includes an interesting feature on Naval Weapons Laboratory's scientific analysis utilizing Analyst-Assisiant Program (AAP-1).

Circle Reader Service Card No. 111

KEYBOARD DISPLAY. The SDS Model 7550 multipurpose keyboard display, a combination keyboard input and CRT display device for use with Sigma computers, is described and illustrated in a publication offered by Scientific Data Systems, Santa Monica, Calif. The new unit is designed to replace the teleprinter and to provide "greater flexibility" for SDS Sigma time-sharing, text-editing, and inquiry/response systems. It is said to feature high-speed character generation and the ability to display both upper- and lower-case characters.

Circle Reader Service Card No. 112

MANUAL SWITCHES. Catalog 51, a purchasing guide for manual switches, has been announced by Micro Switch, a Division of Honeywell, Freeport, Ill. The 44-page publication contains ordering information on modular and integral types of push-button switches (with or without light display color) and toggle switches. Detailed specifications, mounting instructions and applications are covered, together with circuitry data.

Circle Reader Service Card No. 113

FASTENING SYSTEMS. Briles Manufacturing, El Segundo, Calif., details its patented Taper-Lok fastening systems in an 8-page brochure currently available. Illustrations and technical language present the system and its components, describe performance, installation advantages, tools available, quality control and maintenance advantages.

Circle Reader Service Card No. 114

LIGHT PEN. Principles for the characterization of light pen sensitivity are developed in an 11-page application note published by Abacus Div., Information Control Corp., El Segundo, Calif. The paper reviews phosphor luminescent action and light pen performance; it develops basic equations for the calculation of light pen response for various phosphors, display programs, spot characteristics and light pen sensitivities.

Circle Reader Service Card No. 115

OUTPUT DISPLAY. An application note called "Displaying Computer Output" has been prepared by Image Instruments Inc., Waltham, Mass. The paper describes the coupling of the Electrostore® scan converter to the computer and visual display. Advantages of the system for remote displays and multiple-access computers are covered. Two typical arrangements are shown in block diagram form.

Circle Reader Service Card No. 116

ILLUMINATED SWITCHES. Master Specialties Co., Costa Mesa, Calif., has prepared a 20-page catalog on its 10E Series Twist-Lite illuminated pushbutton switches and accessories for aircraft, aerospace and ground support as well as industrial and commercial equipment. Illustrated are the three basic unit types, colored lamp filters, display screen arrangements, optional features and accessories. Specifications and ordering information are provided.

Circle Reader Service Card No. 117

ELECTRONICS EQUIPMENT. Quindar Electronics Inc., Springfield, N.J., offers an illustrated catalog of its equipment line, including specifications, tables, charts and technical articles on application of the type of components it manufactures.

Circle Reader Service Card No. 118

SPSE VOLUME. A tutorial text of 10 basic photo-optical subjects has been published by the Society of Photographic Scientists and Engineers, Washington, D.C. Priced at $5 with a 10 percent discount for SPSE members, the book is intended for people who have backgrounds in other fields and can serve as a review book for photo-optically trained personnel. The 216-page volume is titled *Photographic Systems for Engineers.*

Circle Reader Service Card No. 119

FLASHING LIGHT. Dialight Corp., Brooklyn, N.Y., has prepared a catalog sheet on its flashing indicator light. The unit accommodates a seasoned NE-2J neon lamp which is the T-2 midget flanged base, high brightness type, according to the firm.

Circle Reader Service Card No. 120

REED PUSHBUTTON SWITCH. Recently released Bulletin 7A1H, by Micro Switch, Freeport, Ill., a division of Honeywell, describes new reed push-button switches for use with the KB Switch/Display Matrix System of modular components for lighted input keyboards and control panels. The bulletin provides complete electrical data, photographs, operating characteristics, mounting dimensions, performance test data, and ordering information.

Circle Reader Service Card No. 121

Sustaining Members

AEROSPACE CORPORATION
SAN BERNARDINO, CALIFORNIA

BURROUGHS CORPORATION
DEFENSE, SPACE & SPECIAL SYSTEMS GROUP
PAOLI, PENNSYLVANIA

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(CONSTANTINE ENGINEERING LABS. CO.)
MAHWAH, NEW JERSEY

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CONRAC DIVISION
GIANNINI CONTROLS CORP.
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VACUUM TUBE PRODUCTS DIV.
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RADIATION, INC.
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STROMBERG CARLSON CORP.
DATA PRODUCTS
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SYLVANIA ELECTRONIC TUBES
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SENECA FALLS, NEW YORK

SYNTRONIC INSTRUMENTS INC.
100 INDUSTRIAL ROAD
ADDISON, ILLINOIS

TELEVISO ELECTRONICS DIVISION
DOUGHBOY INDUSTRIES
WHEELING, ILLINOIS

ID Advertisers

on the move

WILLIAM R. DIXON has been appointed marketing services manager of the Electronic Components Group of Sylvania Electric Products Inc., N.Y., according to WILLIAM T. BUSCHMANN, vice president, marketing. Dixon will be responsible for market research, sales forecasting and analysis, technical publications, advertising, and marketing plans.


DIXON


RAUTH

WILLIAM R. RAUTH, JR. has been named general sales manager of a new sales force consisting of dealers and manufacturers' representatives to market products to industry complementary to products in Control Data Corp's standard electronic data processing systems. Rauth has held several key positions at Control Data since 1963.

Arcon Corp., Boston, announced the appointment of two senior scientists, GEORGE H. CONANT, JR. and ROBERT L. CUSHMAN. Conant has been an independent consultant in scientific and systems programming since 1962.

LOUIS M. NUCCI has been appointed general manager of General Applied Science Laboratories (GASL), Westbury, N.Y., a subsidiary of the Marquardt Corp. Nucci has been with the company for the past 11 years.

The appointment of CARL TEPEL as manager of materials has been announced by general manager FRED WALZER, of Fairchild Du Mont Electron Tubes, Clifton, New Jersey. Tepel will be responsible for procurement and materials control, including storage and distribution of incoming materials. His previous position was as manager of purchasing.

ROBERT W. BRUCE, executive vice president of the First National Bank of Miami was elected director of Milgo Electronic Corp., Miami, Fla. Bruce has over 30 years banking experience behind him.

Memorex Corp., Santa Clara, Calif., has opened a new district office in Syracuse, N.Y. and has named IRVING H. HAMLIN as sales engineer for the upper N.Y. area.

The board of directors of Texas Instruments Inc., Dallas, has elected DR. MARK SMITH JR. a vice president of the company. He continues as manager of the Science Services division and as president of Geophysical Service Inc., a wholly owned T.I. subsidiary.

S. THOMAS WORKMAN has been named by Giannini Controls Corp., Duarte, Calif., to the post of marketing manager, Scientific/Industrial Instruments Department, Datex Division, it was announced by vice president and general manager ROBERT J. MARMORSTONE. Workman will be responsible for marketing a broad range of instruments for science and industrial research.

Photomechanisms Inc., Huntington Station, N.Y. has named PAUL T. KAESTNER to its board of directors, according to FORDYCE M. BROWN, president. Kaestner joined the firm in 1962 as VP and general mgr.

Mark Systems Inc., Santa Clara, Calif. has appointed GEORGE C. MACDERMUT sales rep for Ohio, with emphasis on the Dayton area. MacDermut was previously senior district rep for Nortronics Div., Northrop Corp.


MACDERMUT


SCHREIDER

Fairchild Space and Defense Systems Div. has named FRANKLIN BOLNICK dir. of engrg. at its Paramus, N.J., facility, and JEROME M. SCHREIDER has been named sls. mgr. of electro-visual systems.

DR. JAY BURNS has joined the Rauland Corp., a wholly-owned subsidiary of Zenith Radio Corp., Chicago, Ill., as associate director of research, special tubes. Announcement was made by DR. CONSTANTIN S. SZEGHO, Rauland VP and dir/research.

REAR ADMIRAL SADAO CHIGUSA (Ret.) has been appointed consultant for Argus Ltd., in Japan, according to MALCOLM N. SMITH, pres. of the U.S.-based manufacturer of amateur photographic equipment and optical devices.

SHELDON O. NEWMAN has been appointed mgr., Information & Communications Div., Sperry Gyroscope Co., a division of Sperry Rand Corp., according to an announcement by VP PERCY HALPERT.

ALLEN A. ANDREWS, advertising and public relations executive, of Holden, Mass., has been appointed mgr. of public information at LFE Electronics, Boston, a division of Laboratory For Electronics Inc.

KOSTAS KARAYANNIS, Athens, Greece, has been appointed by Milgo Electronic Corp. as exclusive sls representative in Greece.

DR. DONAL B. DUNCAN has been appointed pres. and gen. mgr. of Litton Industries' Guidance and Control Systems Div., and GEORGE F. BREITWIESER has been named VP/asst. gen. mgr. of the division. Litton has also announced the appointment of JOHN H. WENZEL as mgr., Systems Engineering Dept., in its Amecom Div., Silver Spring, Md

JOSEPH E. HARDMAN has been appointed asst. mgr. of the Magnet Wire Div. of Anaconda Wire and Cable Co. He succeeds NORMAN A. LORIMER, recently appointed mgr., Communications Products Div.

Comtel Engineering Inc., Redwood City, Calif., has been acquired by PAUL S. BYRNE, taking over as president. Byrne was formerly mgr/distribution and planning for Ampex Corp., Redwood City.

New Members

The Society for Information Display wishes to welcome the following new members to its expanding ranks:

Aziz, Rahmat A., IBM Corp.; *Brown, Caroll Jae,* IBM Corp.; *Chambers, George P.,* Autonetics; *Davies, A. D.,* Educational Systems, Ltd., Middlesex, United King.; *Doering, John W.,* Northrop Nortronics; *Feuer, Robert,* Giannini Controls Corp.; *Groner, Paul S.,* Corning Glass Works; *Holmquist, John A.,* ITT Industrial Labs; *Jesty, Leslie C.,* Westinghouse Research and Development; *Jones, Wynne H.; Kaase, Frederick C.,* Link Group, GPI; *Latta, John N.,* Midwest Research Inst.; *McFadden, Joseph M.,* Data Proc. Div., AETD; *Rutherford, Robert E., Jr.,* CBS Laboratories; *Saenz, Norman Elliot,* Lockheed-Georgia Co.; *Schott, John C.,* Burroughs Corp.; *Segar, Thomas E.,* Litton Industries; *Snyder, Joel B.,* Snyder Associates; *Spanier, Gerard,* Federal Aviation Admin.; *Springer, Allen,* IBM Corp.; *Vaughan, Norman C.,* IBM Corp.; *Wilson, Constance A.,* Tektronix Inc.; *Wines, Warren R.,* Remington Office Mach.; *Zinman, Manfred,* Effective Presentations Ltd., Johannesburg, So. Africa; *Osborn, Daniel C.,* General Electric Co.

Beach, Frank J., Braun, Richard J., Carville, Fred J., Gruen, Wolf J., and *Muoio, Anthony W.,* Bunker-Ramo Corp.

The Atlantic City site of the SJCC '67 — Convention Hall

Spring Joint Computer Conference 1967

Atlantic City, N.J., host to almost two million convention visitors yearly, is the site of the 1967 Spring Joint Computer Conference, April 18-20.

The event, sponsored twice yearly by the American Federation of Information Processing Societies, (AFIPS), will be attended by more than 5,000 computer scientists and over 100 exhibitors.

There is hardly a major convention, trade show or exposition held in the United States which hasn't convened in the famed seashore city. And, although Atlantic City has been a leading convention center since the turn of the century, recent years have been marked by an acceleration in construction which has given the island city a new, modern face.

Thirty-five thousand square feet of floor space in Atlantic City's Convention Hall will bristle with an estimated $35 million worth of advanced computer equipment — the largest ever assembled and displayed under one roof.

Conference Chairman Brian W. Pollard of RCA said the projected record attendance at the Spring Joint Computer Conference "is an indication of the tremendous growth of the computer industry." When the first conference of this type was held just 16 years ago, he said, it attracted only 200 people.

THE TECHNICAL PROGRAM

Rep. Cornelius E. Gallagher (D-NJ) and Maj. Gen. John W. O'Neill, chief of the Air Force Electronic Systems Division at L. G. Hanscom Field, Mass., will be the featured speakers.

The SJCC '67 technical program consists of thirty-four sessions treating four areas of broad interest: hardware devices, logic design and computer organization, programming and applications, and analog/hybrid systems. The Program Committee will present a balanced program with sessions on both theory and practice. Many sessions, especially those on logic and organization, will be of interest to both engineers and programmers. The seven sessions devoted to these subjects of dual interest are an important advantage of joint computer conferences.

Those familiar with past conferences will notice the significant increase in the number of sessions scheduled. This is mainly due to the large number of panel discussion sessions. It is felt that a conference should not only be a means for presenting quality technical papers, but should also provide a forum for discussion and debate. Seven sessions are devoted exclusively to this purpose.

The subjects selected for panel sessions are ones which may have a major effect on future developments in the computer art, but for which the eventual direction of development is not yet clear. The purpose of the panel discussions will be to present different points of view and then to explore these views so as to define or clarify principal problem areas and benefits.

Nearly 250 computer experts from 20 states and five foreign countries, including representatives from the Soviet Union, Japan, Canada, France and England, will speak or participate in the discussions and demonstrations.

A highlight of the three-day conference will be a special panel discussion on "Management Information Systems." Session Chairman James P. Anderson said "the panelists, all recognized experts in the field, will discuss the requirements and objectives of top management for computer information systems."

The panel will review computer techniques and systems being developed for industrial/commercial users, and study management's view of them. Discussion will center on the various and frequently controversial activities that go into Management Information Systems.

Another session, expected to attract wide interest outside the EDP community, is one entitled "Aspects of Computer-Assisted Instruction." Following presentation of technical papers on Wednesday morning, April 19, Dr. Duncan Hansen of Florida State University, Dr. Sylvia Charp of the Philadelphia Department of Education, and Mr. Donald Frush of IBM Corp., will join the authors in a panel discussion of the subject.

The Program in Brief

After the Keynote Session, the schedule for the first day of the conference includes the following:

1. Dynamic Allocation of Computing Resources
2. Managing the Development of Computer Programs — a User's Viewpoint.
3. Computer logic and Organization.
4. Visual Output Recording
5. Applications of Analog and Hybrid Computers
6. Data Management
7. Handling the Growth by Definition of Mechanical Languages
8. Illiac IV — An orientation session
9. I/O Devices
10. Biomedical Computer Applications

The second day of the conference will be taken with the following papers:

1. Security and Privacy in Computer Systems
2. Computing Algorithms
3. Macromodular Computer Systems
4. Some Aspects of Computer Assisted Instruction
5. Analog/Hybrid Techniques for Solving Partial Differential Equations
6. Information Processing in the Business Environment
7. Techniques in Programming Languages — Part I
8. The Best Approach to Large Computing Capability — A Debate
9. The Expanding Roles of Analog/Hybrid Computers in Education
10. Logic-in-Memory
11. Scientific Programming Applications
12. Techniques in Programming Languages — Part II
13. Will Integrated Circuits Remove the Military/Commercial Split?
14. Papers of Special Interest

The final day will be devoted to the following:

1. Advances in Software Development
2. Techniques in Programming Languages
3. Some Ideas from Switching Theory
4. Non-Rotating Mass Memory
5. Failure Finding in Logical Systems
6. Special Session — Panel Discussion on Management Conditions for Management Information Systems
7. Legal Protection of Computer Software
8. What's New in Programming?
9. Should There Be Standardization of Machine Instructions?
10. Computers for Industrial Process Analysis and Control.
11. Simulation Languages — A Tutorial Session

AWARDS

John W. Backus, an IBM scientist specializing in computer languages, has been selected as the recipient of the 1967 W. Wallace McDowell Award. The award will be presented to Backus by the Computer Group of the Institute of Electrical and Electronic Engineers.

Backus was selected for the award for his contributions to the field of higher level computer languages, in particular for the conception and leadership in the first FORTRAN projects and for his work in syntactical forms incorporated in ALGOL.

His concern with higher level languages dates back to the IBM SSES Computer in 1948. He was Project Leader of a team which prepared the interpretive systems for the IBM 701. After these early endeavors, Backus prepared specifications of the FORTRAN language and led a group which prepared the version that became available for the IBM 704 in 1954. He also contributed to the development of the International Algorithmic language, called ALGOL.

The so-called Backus, or Backus-Naur, form of a language has been a formalizing tool greatly aiding the development of ALGOL. Backus is currently on a five-year appointment as an IBM Fellow and is a visiting lecturer at the Electro-Engineering Department of the University of California at Berkeley. He is also engaged in research at the University.

FILM SERIES

The unique partnership of man and machine will be dramatically portrayed in a film series to be shown at the Computer Science Theatre.

More than 30 outstanding motion pictures depicting the computer as an extension of man's intellect have been selected for continuous showing during the three-day Conference.

The films, obtained from dozens of industrial, educational and governmental organizations, cover subjects ranging from use of computers in the space program to social implications of electronic data processing.

One entitled "Child of The Future" examines the use of computer technology in the classroom. It shows how schools and colleges are shedding their traditional apathy toward machines and exploiting mechanical and electrical teaching aids.

Another entitled "Rush Hour — Space Age" illustrates how major world communities, including London, Chicago and San Francisco, are using computers to restore balance to their overworked transit systems.

"Living Machine," a film previously shown at the 1966 Fall Joint Computer Conference in San Francisco, where theater attendance reached more than 2,000, will be shown again this year. It explores the progress made in electronic technology and the new frontiers of knowledge machines are opening to man.

Two theaters will operate simultaneously in Convention Hall during exhibit hours.

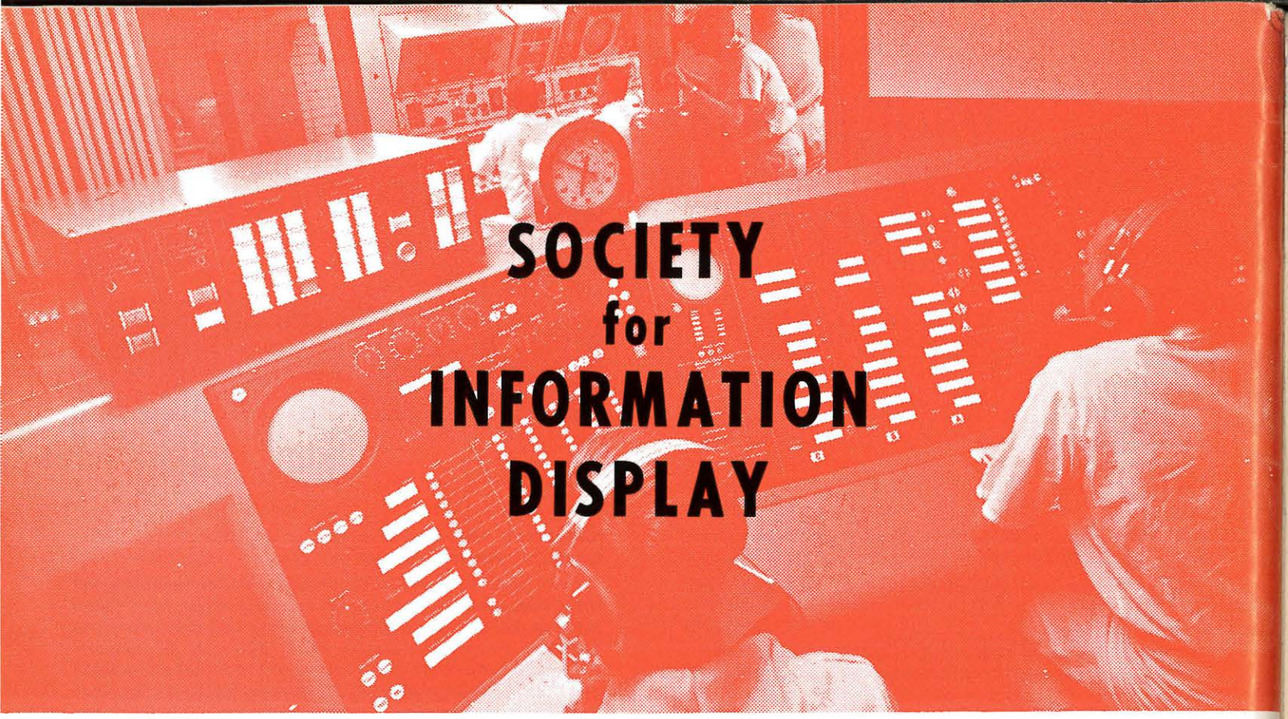
LADIES ACTIVITIES

A three-day program blending educational and entertaining activities has been arranged for ladies attending the 1967 conference.

Highlight of the activities will be a presentation on "Computers and Children" by Professor Duncan N. Hansen of Florida State University. Also included will be a demonstration of a video data display terminal similar to the TV-type-devices being used in schools with pilot programs in computerized instruction.

A hospitality room will be maintained in The Solarium throughout the conference, from 9:30 A.M. to 4 P.M. each day and hostesses will be available to answer questions, aid registration and offer assistance as needed.

Ladies activities have been planned by a committee headed by Miss Mary Nagle, RCA Electronic Data Processing, Cherry Hill, N.J. Other committee members include Miss Barbara Boyle and Miss Elizabeth Gunson, International Business Machine Corp., Philadelphia, and Miss Ann Gingrich, RCA. Other events, luncheons, and demonstrations are scheduled.



SOCIETY for INFORMATION DISPLAY

Aims & Purposes

- Encourage and contribute to the scientific advancement of Information Display
- Promote the use of Information Display
- Maintain a central file of display information for use by members
- Provide forums for the exchange and dissemination of ideas and knowledge relating to Information Display
- Promulgate definitions and standards pertaining to the field of Information Display
- Stimulate new ideas in Information Display and foster their development

Information Display encompasses all methods and media used to present specific information to people

MEN IN THE FIELD OF INFORMATION DISPLAY are concerned with virtually the entire spectrum of scientific and engineering problems. Their interests range from the profound psychological problems raised by the man-machine interface through information theory, operations research analysis, systems design, the physics of display components, optics, electro-optics, storage media, electronic circuit design, and information processing.

IN ITS MOST SOPHISTICATED FORM, Information Display is a highly interdisciplinary field intimately concerned with the processing, dissemination, and presentation of intelligence to man through the application of scientific and engineering principles, inventions, machines, and systems.

THE SCIENTIST, THE ENGINEER, AND A SCORE OF OTHERS have found themselves in need of a forum devoted to the advancement of Information Display.

To provide such a meeting place, yet allow the pursuit of specialities represented by existing associations, is the reason why SID was formed

SID

Use These Cards

SID MEMBERSHIP

Membership is open to all who can benefit from the Society and wish to further its goals. Both individuals and companies are welcome to apply.

Members receive free the bi-monthly Society journal, Information Display, the published proceedings of symposia, and news of National and Local Chapter activities. They may attend, at member rates, the symposia and other technical meetings. Participation in the local chapter's regular meetings and other activities, is encouraged.

To apply, complete this application, enclose membership fee and mail to the Society.

REMITTANCE

Present through January 31, 1968

Member and Associate Member	$ 15.00
Student Member* (full-time)	3.00
Sustaining Member	150.00

*Symposia proceedings not included with Student Memberships

SUSTAINING MEMBERSHIP

The Society for Information Display is pleased to invite a limited number of sustaining memberships from corporations or other business organizations interested in contributing to the advancement of display technology.

Sustaining members need not complete the education or experience sections of this form. Merely supply:

1) The listing desired. This will be printed in each issue of the journal, Information Display, Symposia Proceedings and other Society publications.

2) The billing address. Sustaining members may either remit payment with application or request billing. An address is needed for later use.

3) Five mailing addresses. These five locations or individuals will receive the journal, Information Display, Symposia Proceedings and other Society publications.

See reverse for Membership Section of the Society by-laws.

Society for Information Display
MEMBERSHIP APPLICATION FORM

NAME_____ DATE_____

MAILING ADDRESS_____ ☐ HOME? ☐ BUSINESS?

COMPANY_____ DEPARTMENT_____

POSITION OR TITLE_____

YEARS IN PROFESSION_____

OTHER PROFESSIONAL SOCIETIES_____

DEGREES OR CERTIFICATES_____

FIELDS OF SPECIAL INTEREST _____

Send with fee of $15.00 payable to the Society for Information Display, 654 N. Sepulveda Blvd., Bel Air, Los Angeles, California 90049.

$_____ Membership dues enclosed. ☐ Bill me. ☐

(Additional postage necessary if this card is mailed outside the U.S.A.)

FIRST CLASS
Permit No. 48334
Los Angeles, Calif.

BUSINESS REPLY MAIL
No postage stamp necessary if mailedin United States

POSTAGE WILL BE PAID BY:

Society for Information Display
654 No. Sepulveda Blvd.,
Bel Air, Los Angeles,
California 90049

Society for Information Display
MEMBERSHIP APPLICATION FORM

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MAILING ADDRESS_____ ☐ HOME? ☐ BUSINESS?

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POSITION OR TITLE_____

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Bel Air, Los Angeles,
California 90049

SID

Use These Cards

SID MEMBERSHIP BY-LAWS

(ARTICLE 3)

Section 1: Grades and Qualifications — The membership of the SID shall be composed of five grades with the qualifications listed below for each:

a) Student Member — An individual interested in furthering the purposes of the SID who is in essentially full-time pursuit of an undergraduate or graduate degree. The student member must transfer to a higher classification within one year after termination of such student status.

b) Associate Member — An individual interested in furthering the purposes of the SID.

c) Member — An individual active in a profession related to the field of information display who has at least a bachelor's degree or its equivalent in such field.

d) Fellow — A member elected by the Honors and Awards Committee from nominations at large made annually of outstanding engineers and scientists in the information display field who have made widely recognized and significant contributions to the advancement of that field.

e) Sustaining Member — A corporate or other business organization interested in furthering the purposes of the SID by means of a financially supporting role.

If membership blanks have been removed, write to the Society for Information Display, 654 N. Sepulveda Blvd., Los Angeles, California 90049 for additional copies by return mail.