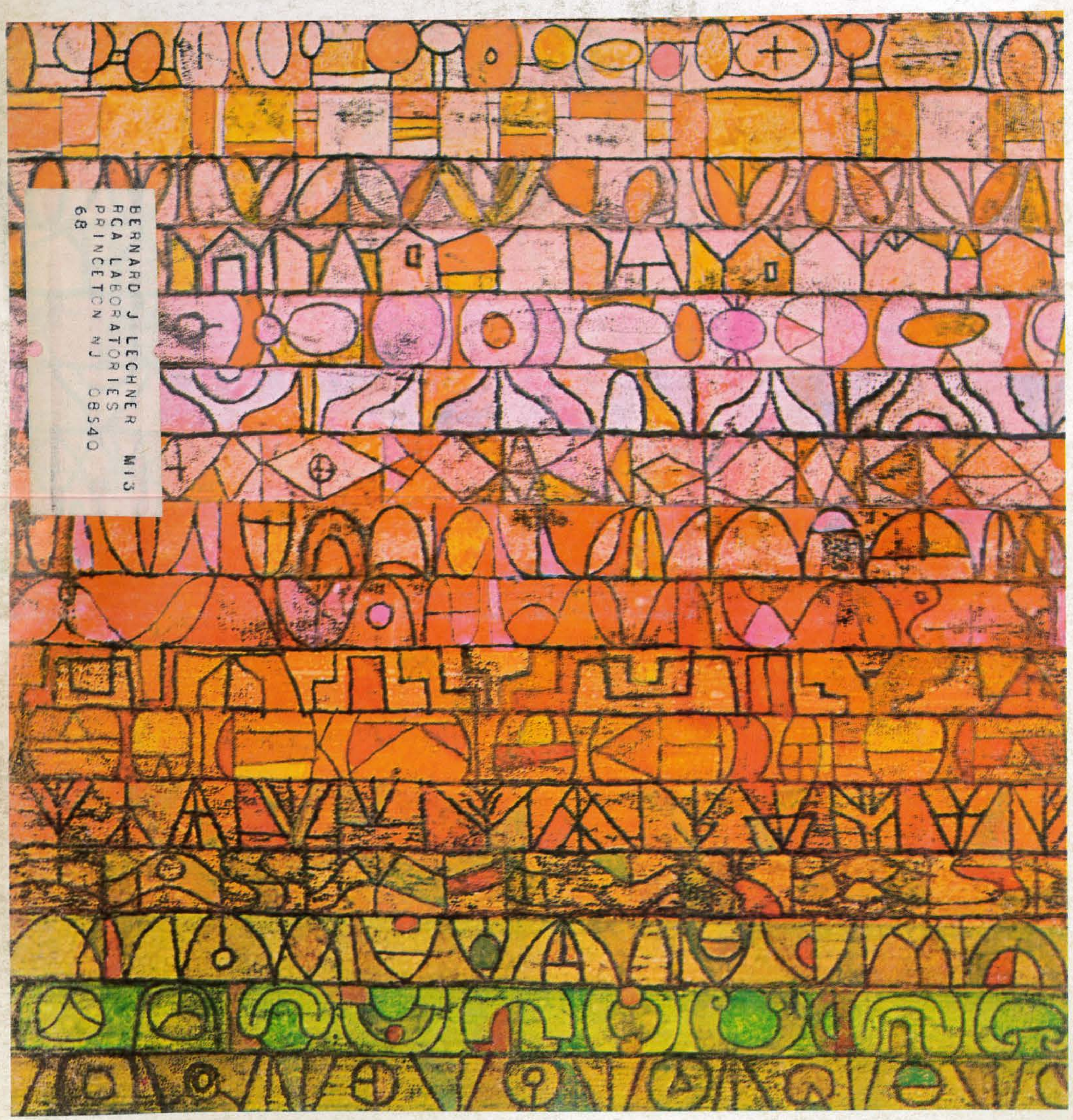
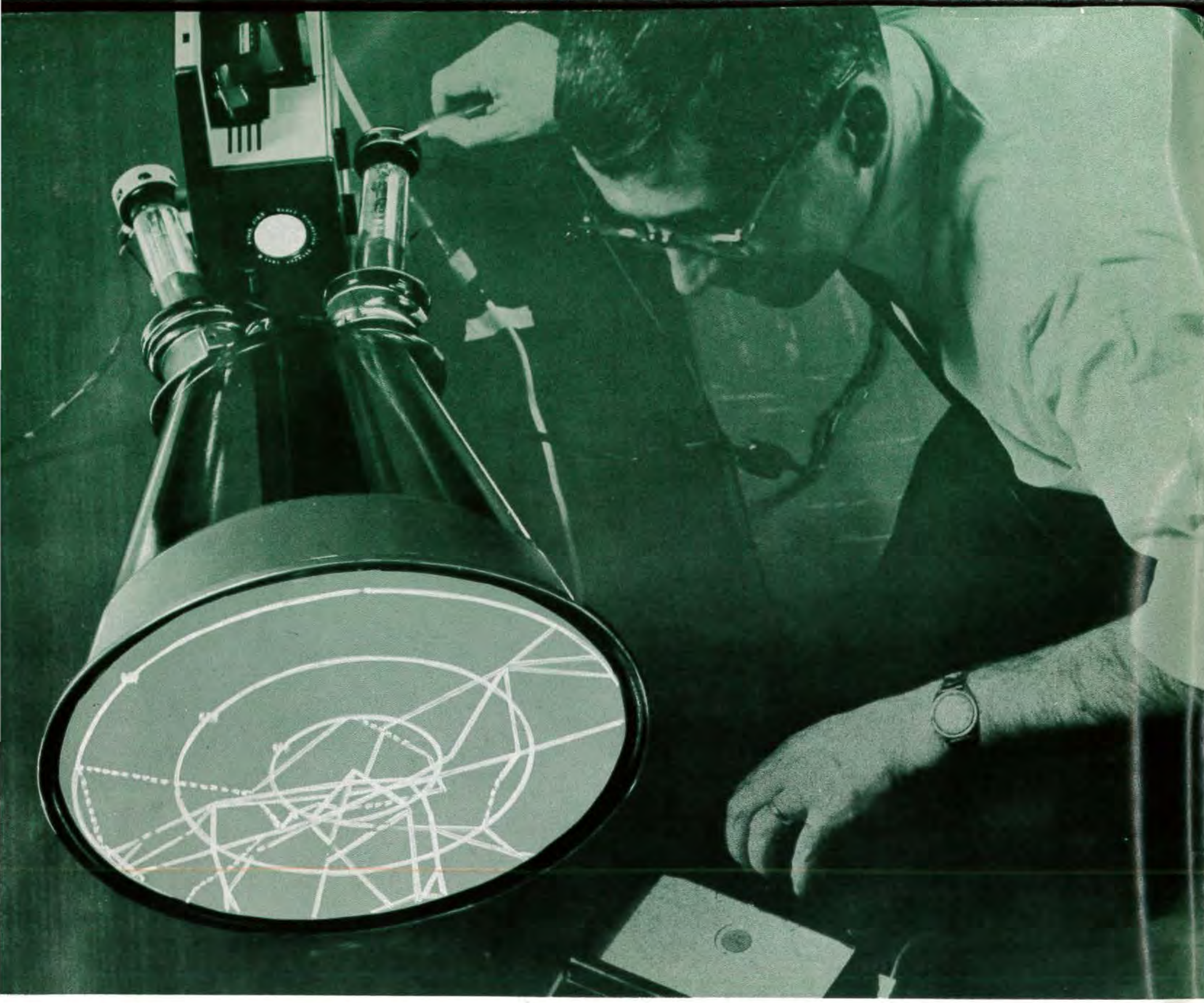
Volume 5 Number 2 March/April 1968

Information Display

Journal of the Society for Information Display





Now Rauland offers you a flat face CRT for data display with dual neck and rear port

DUAL NECK permits two independent scans with negligible keystone effect.

REAR PORT permits both optical overlay projection and photo recording.

HYBRID PHOSPHOR for bright, flicker-free display.

HIGH RESOLUTION with up to 2,000 lines.

CHARACTER GENERATION for computer readout. Choose either magnetic or electrostatic.

LIGHT WEIGHT AND MAXIMUM SAFETY assured by metal cone and laminated implosion shield.

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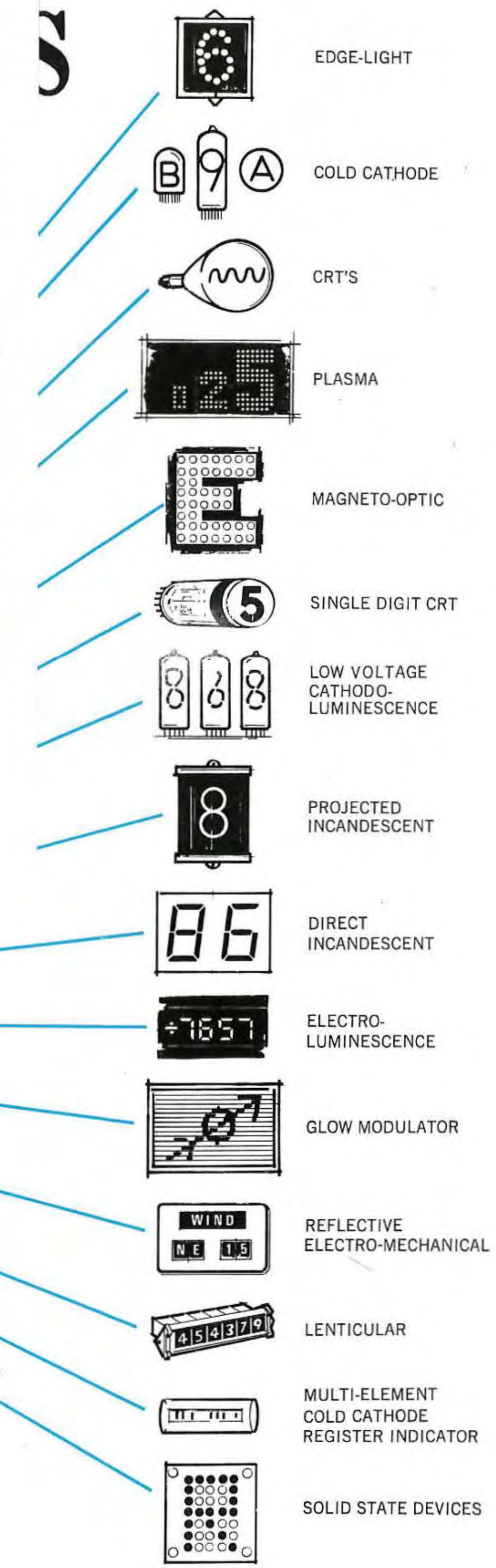

Burroughs

*Illustrated, for your information, are some present and future display devices. Some are of Burroughs manufacture while the rest are manufactured by other companies.

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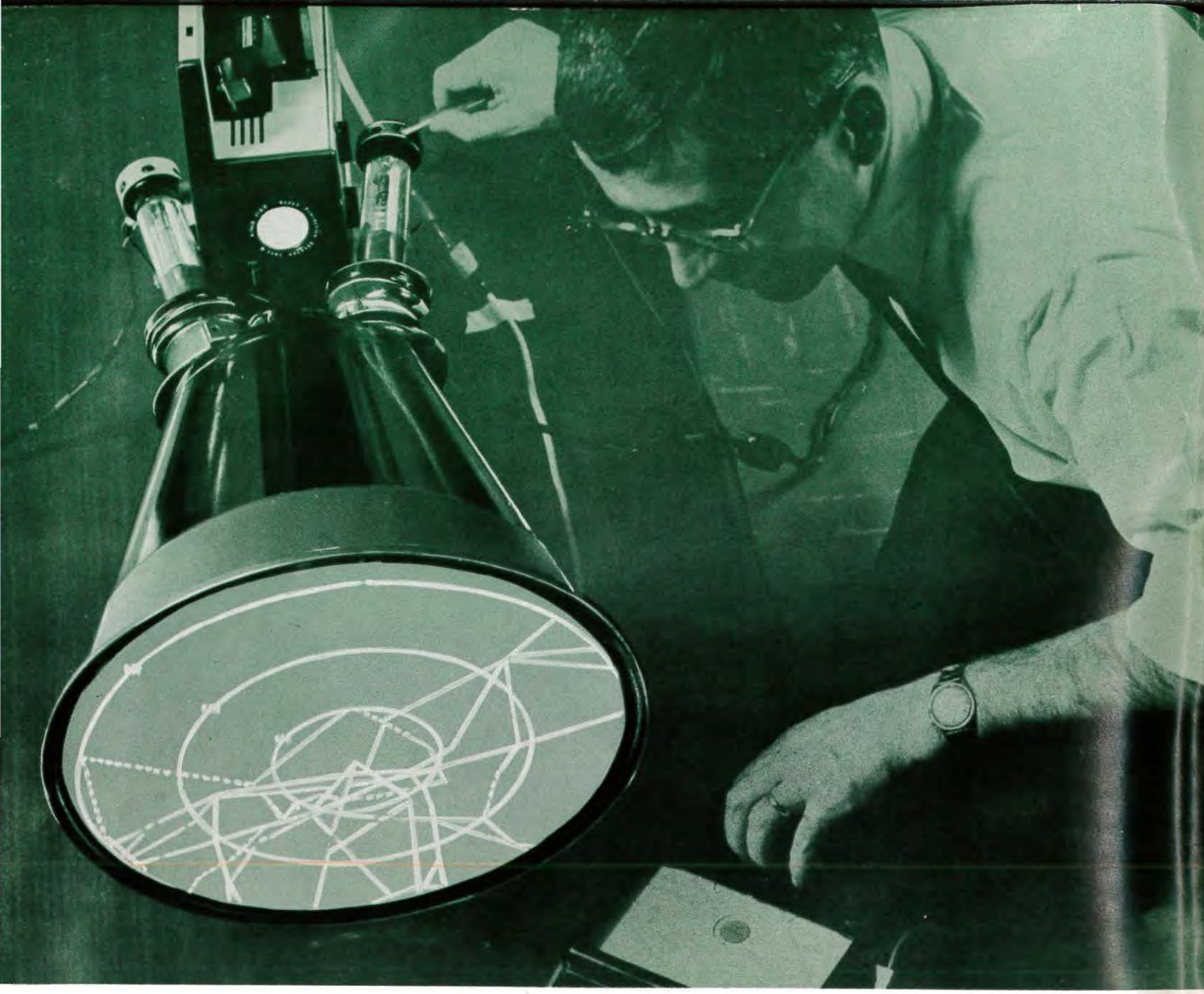

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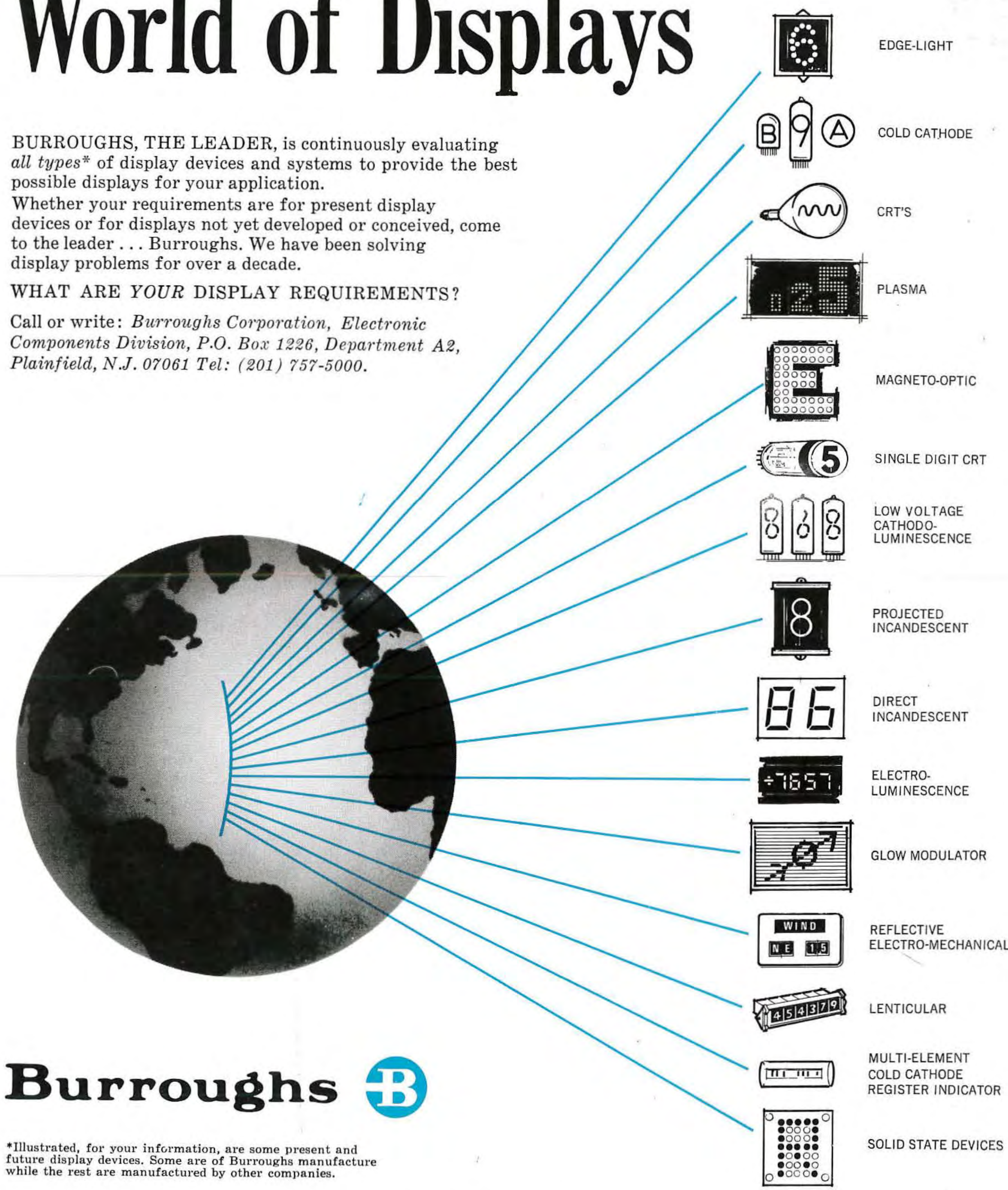

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Volume 5 Number 2 March/April 1968

Information Display

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the cover

Cover art depicts a symbolic numerical system with digital uniformity: a spectrum of color for a spectrum of research. Detail from a painting by Harry Bliss, from the collection of Cornell Aeronautical Laboratory Inc., Cornell University.

SWITCH CRAFT FORUM

on the new DW "Multi-Switch"®*

A secret weapon, eh? I can tell you right now, if the new DW "Multi-Switch" doesn't save on space and cost, it's going to be a dud!

That's the point. Switchcraft designed this compact pushbutton switch to do both. It's not just a scaled down version of an existing "Multi-Switch".

I'll buy your design philosophy so long as you haven't sacrificed the versatility and quality we've been accustomed to on your larger switches. And, don't forget economy.

Let's tackle your points one by one, and see how the new Series 65000 DW "Multi-Switch" shapes up!

We've guaranteed versatility by using simplified modular construction. Essentially, the switch consists of a frame up to 18 stations long, latch bar for function control and switching modules that provide up to 2C (DPDT) circuitry.

Fig. 1

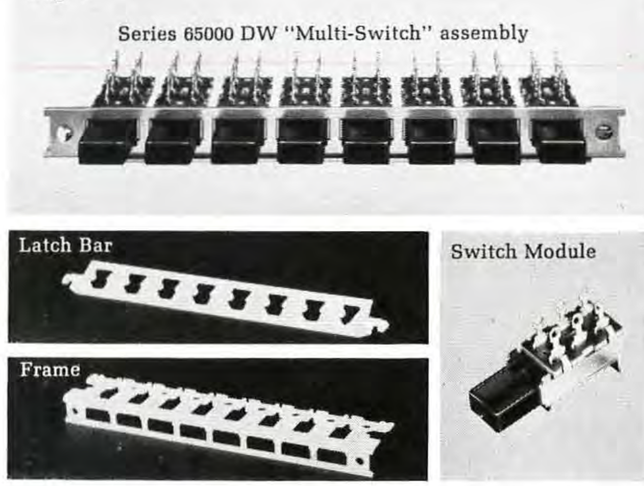
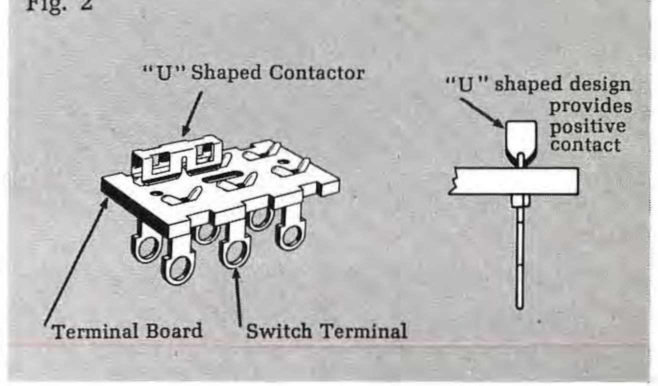


Fig. 1 shows how these elements are combined to complete the switch. The latch bar and mating actuator configuration determine the functional operation, such as: Interlock, All-lock, Non-lock and even special functions.

We don't have space to cover all the versatility details, such as, printed circuit terminals, pushbutton engraving, accommodation for mounting with Tinnerman nuts, etc. JUST CIRCLE THE READER SERVICE NUMBER FOR NEW PRODUCT BULLETIN #174.

An example of quality construction is the rigid frame, and double-wipe contactors used for extreme reliability. Fig. 2 shows how the 'U' shaped contactor provides positive contact and minimizes "bounce". Also, the molded nylon pushbutton actuators are an integral part of the module. They can't be lost or pilfered. Our quality story ties right into economy. You can't buy a better made, compact multiple-station pushbutton switch for the money.

Fig. 2



We'll accept the commercial, only because you have the reputation to back it up. The design looks great, but what about ratings and special circuit applications?

Typical ratings for silver-plated contactors would be 3 amps. A.C., 0.5 amps. D.C. 125v. non-inductive. For dry circuit applications, gold flashed contactors and terminals could be furnished. As usual, we're glad to engineer specials to accommodate your volume requirements.

I'll probably have more questions after we get a few samples on test. In the meantime, I'd like certain members of my staff to get complete engineering details on the DW "Multi-Switch" switch.

Just have them drop us a request on your company letterhead for complete technical scoop. Also, we'll add their name to our TECH-TOPICS mailing list to receive this engineering-application magazine every-other month. Over 10,000 engineers find the application stories very interesting and useful in their work.

*Patent applied for

SWITCHCRAFT INC.
5531 N. Elston Ave.
Chicago, Ill. 60630

Photo: Courtesy NASA

A significant part of the "crew" aboard NASA's Lunar Orbiters, which sent back pictures from the moon, was the CBS Laboratories Line Scan Tube. We developed this special form of flying spot scanner for high resolution photo transmission applications like these. Our products have now scanned more than 95% of the moon's surface, areas where our astronauts may land in a few short years.

Sophisticated programs like this one demand high level technical performance. Demand for our services is constantly increasing from government and industrial customers. To meet the demand, we require mechanical engineers, electronic engineers and physicists at all levels. We have immediate opportunities for:

ELECTRICAL PROJECT ENGINEERS
...to assume responsibility for the electro-optical design and test of ■ advanced camera tubes ■ image sensor systems and/or ■ high resolution TV systems.

ENGINEERS / PHYSICISTS
...challenging assignments at all levels of experience in ■ materials investigations ■ ion implantation techniques ■ vacuum lubrication ■ film transports ■ pulse circuit design ■ CRT design ■ mechanical design ■ wide band width—low noise TV system design ■ optical processing ■ holography ■ systems analysis and development ■ servo mechanisms.

ELECTRON BEAM DEVICE ENGINEERS / SCIENTISTS
...to design and test electron optics, electromagnetic structures, non-conventional focus/deflection systems and high-emission, long-life thermionic cathodes.

MECHANICAL PROJECT ENGINEERS
...to assume responsibilty for design, development, test and delivery of ■ precision mechanisms; precision motions and film or tape transports and drives ■ mechanical packaging; electro-optical; mechanical and high vacuum systems.

And we have other positions. Our R&D projects often demand interdisciplinary versatility; this encourages our professionals to widen their technical backgrounds. Lunar Orbiter just scratches the surface of our technical capability.

Our outstanding compensation program is supplemented by benefits that include a stock purchase plan and tuition refund program for advanced study. Broaden your professional horizon. Send your resume in confidence to Mr. William Soter, Personnel Manager, 227 High Ridge Road, Stamford, Connecticut.

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IBM introduces the new System/360 Model 85.

It's big. Big enough to take on scientific or commercial jobs for companies that need more powerful computing. It has an expanded main storage capacity four times greater than the next largest model of System/360. And it's fast.

This combination of size and speed means that in scientific areas you can solve more complex problems faster... problems like differential equations, linear programs, matrix inversions or simulations.

In commercial areas you can use Model 85 for the complete range of business applications, from determining optimum use of resources to general accounting. But now you can do them faster than before. Probably the most important feature is compatibility—the ability to grow into this model from a smaller model, without reprogramming.

Model 85 is backed with tested programming support including FORTRAN, COBOL and PL/I. It's backed with a library of application programs for both science and industry. And it's backed with the IBM Operating System/360, a comprehensive set of language translators and service programs.

In 1964, IBM announced System/360 as an open-ended system capable of satisfying a wide range of computing needs. Model 85 is part of this concept.

Model 85 is not for everyone. But if you have large-scale and expanding computing needs, think Model 85.

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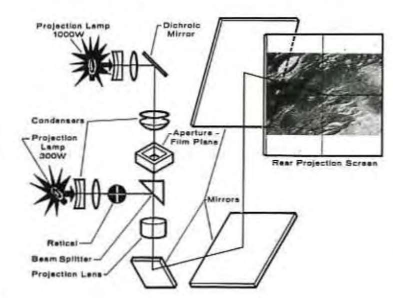
We have a right to be proud of our original designs of precision film transport mechanisms which have been chosen as STANDARDS in the instrumentation industry for over two decades.

Listed here are just a few of our many major products. Send for free descriptive brochures — or submit specification data for special projects.

R-660 Optical Schematic



MODEL R-660
PRECISION FILM READER SYSTEM
16MM, 35MM and 70MM

MODEL R-660 Film Reading System provides X-Y and θ measurements taken at the film plane for optimum accuracy rather than measuring the projected image at the screen. The entire film stage moves in the X and Y directions by joystick control. Repeatability is less than 10 microns. Electronic readout system provides output to punched cards, tape or typewriter.

MODEL R-660 Film Reader is especially designed for those laboratories that cannot tolerate the inaccuracies of film reading equipment which measures a magnified image at a viewing screen. The θ measurement is made by means of a precision reticle projected through the same objective lens as the film image.

Precision Film Transports

Most units are interchangeable on Richardson equipment as well as systems produced for other manufacturers.

16mm – 12 MODELS

35mm – 30 MODELS

70mm – 42 MODELS

5″ – 2 MODELS

140mm – 3 MODELS

9½ – 2 MODELS

14″ – 2 MODELS

Send for brochures on our complete line of film transport mechanisms, film readers, and viewers.

Richardson Camera Company 2201 West Desert Cove Road ■ Phoenix, Arizona 85020 ■ P.O. Box 1897

Introducing the CØMPLØT™ remote time sharing digital plotting system

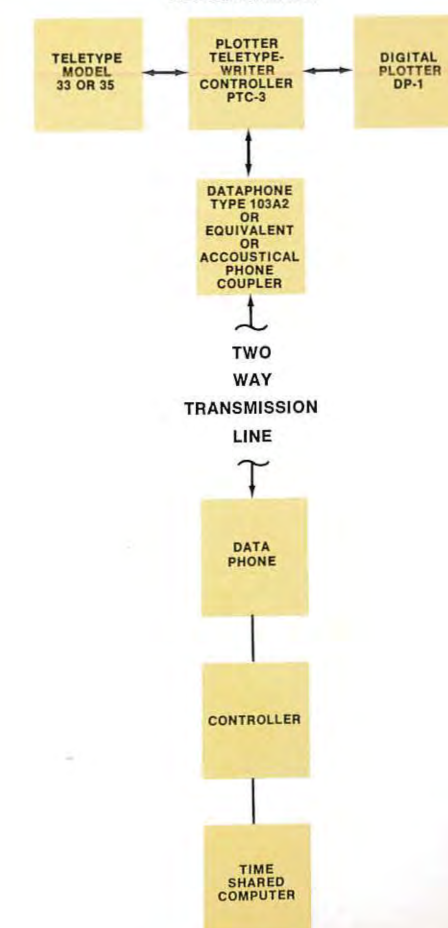
PTC-3 Plotter/Teletypewriter Controller $5250.
DP-1 Digital Plotter $3550.

When graphic presentation means more than numbers, the CØMPLØT™ system saves time and money

Used at the remote terminal of a time-sharing computer, this CØMPLØT™ time sharing digital plotting system provides fast, accurate plots of scientific, business, engineering and financial data. Tedious columns of tabular matter come alive in graphic form—in minutes.

The Plotter/Teletypewriter Controller PTC-3, located in the desk drawer, connects to a Model 103A2 Dataphone, or equivalent, or to an appropriate acoustical phone coupler. The PTC-3 monitors incoming data and directs it to the Teletypewriter (TTY) or to the Digital Plotter DP-1. The information for the TTY is handled exactly as if the TTY was directly connected to the Dataphone. If the information is intended for the Digital Plotter, the PTC-3 decodes it and drives the DP-1 Digital Plotter.

BLOCK DIAGRAM



Competitively priced . . . feature by feature

Speed:	260 increments/sec. limited only by transmission line speed
Chart Size:	11″ x 144′ Z-fold
Paper movement:	Bi-directional
Price:	PTC-3 Plotter/Teletypewriter Controller — $5,250 DP-1 Digital Plotter — $3,550
Software:	No additional charge with purchase of system.

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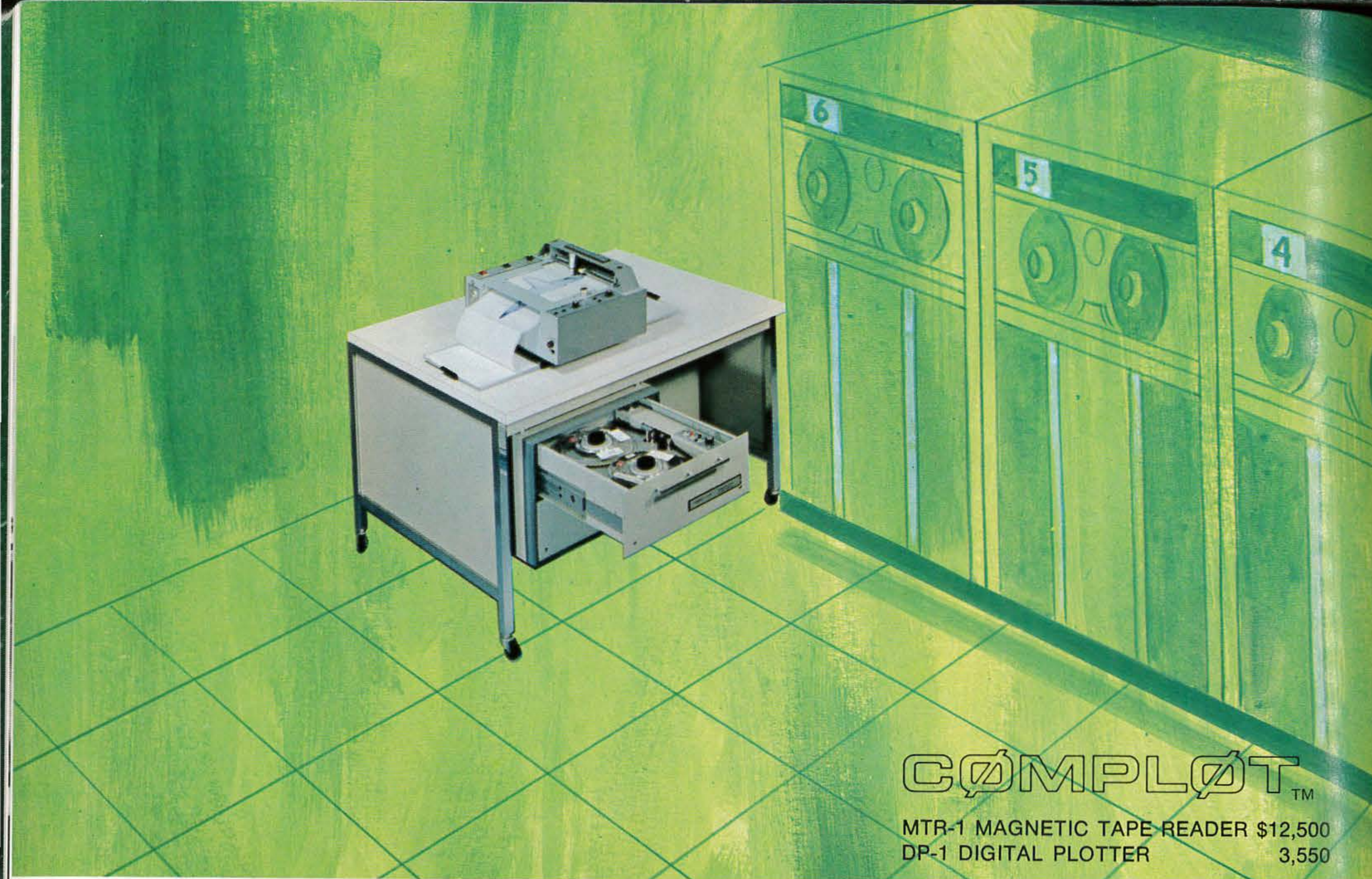


New off-line plotting system offers convenience, speed, low cost

This new CØMPLØT™ off-line system features an incremental magnetic tape reader coupled to a digital graphic plotter to produce fast, highly accurate plots of numeric data. Designed to accept 8½" tape reels directly from the computer, the unit is virtually a "load and go" operation that writes at 300 increments/second. Housekeeping software is provided at no additional cost.

CØMPLØT™ ON-LINE DIGITAL PLOTTER

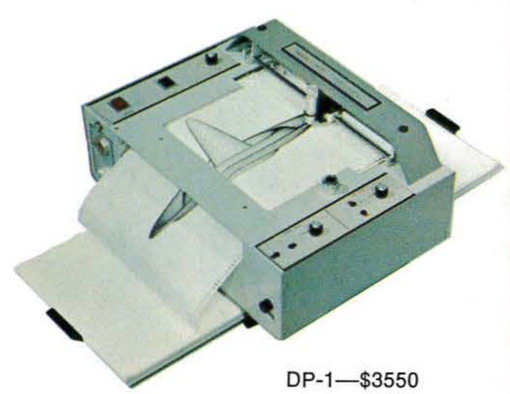
The DP-1 will plug into existing computer interface couplers with no change required.

The all-new CØMPLØT™ DP-1 plots up to 300 increments per second on 11" x 144' Z-fold chart paper. Most economical plotter on the market today. Housekeeping software available at no additional cost!

SPECIFICATIONS

	DP-1
Maximum incremental speed in steps per second	300
Incremental step size	.010" .005" .1mm
Maximum plot size: Y Axis (pen) X Axis (paper)	 11" 144'

Booth #1102 Spring Joint Computer Conference



DP-1—$3550

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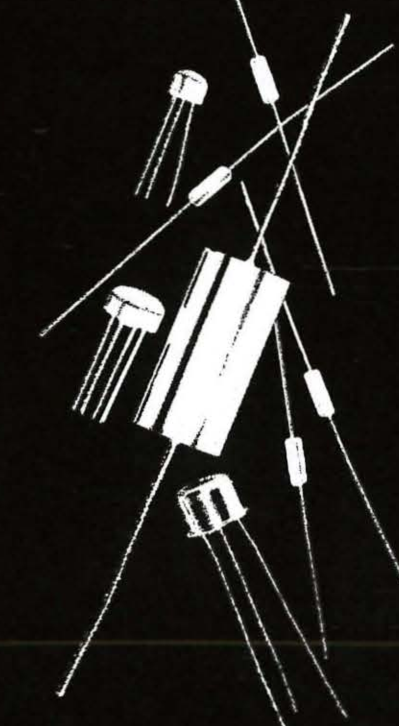
BALL BROTHERS RESEARCH GREW UP ON SOLID STATE



Ball Brothers Research Corporation's video technology is almost tubeless. Our Miratel Division has more solid-state picture monitor experience than any other monitor maker. Miratel has developed, manufactured and sold more solid-state monitors than anyone. BBRC's other video products are solid-state, too. Next time you're in the market for any of the products we make, consider buying some solid-state experience. Ours.

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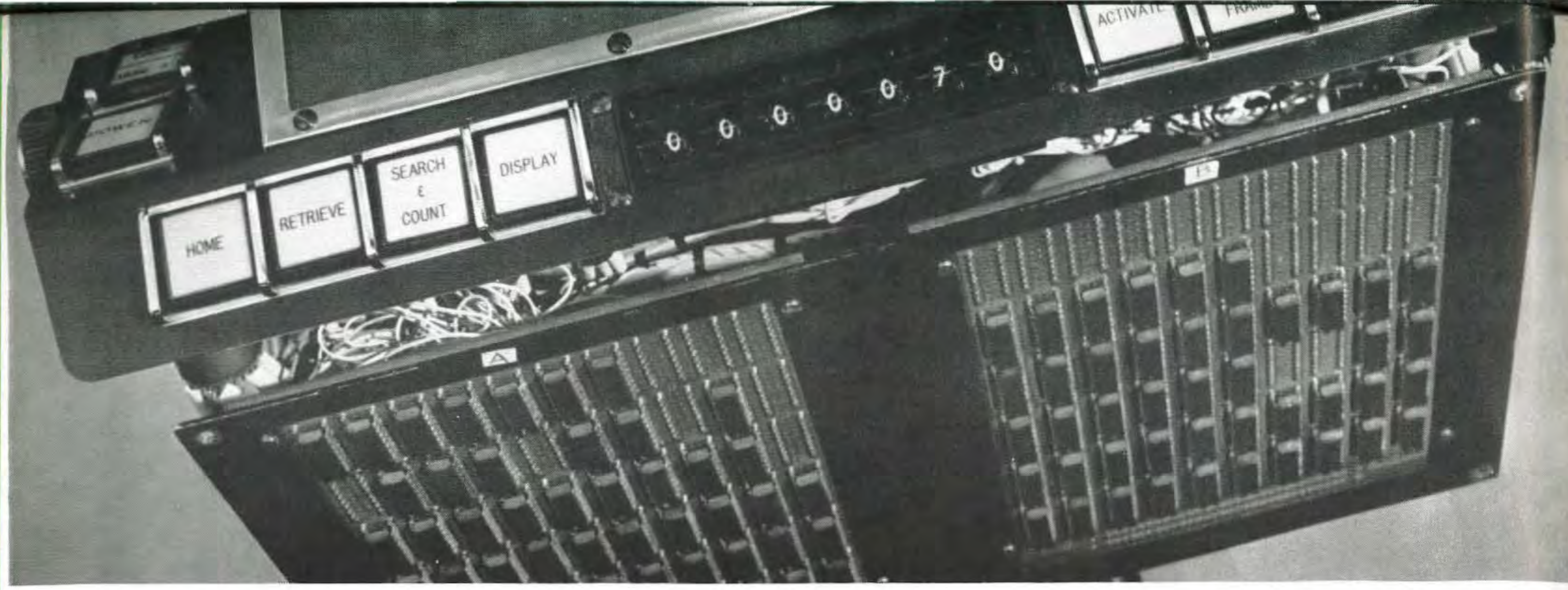


What Kollsman knows about digital electronics

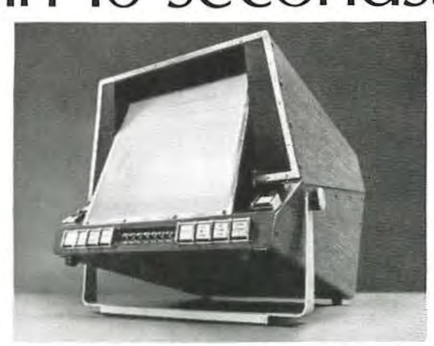
finds 1 out of 2100 pages in 10 seconds.

Kollsman calls it DataSKan.™

In 10 busy seconds, it counts, scans, selects and displays information from among 2100 pages spread out on a 100-ft film roll.

Kollsman designed the entire mechanism, including logic system and the optics. The all-silicon digital electronics includes 15 photo sensors. And the film drive is a powerful new stepping motor that eliminates expensive Geneva drives and pull-down claws.

Kollsman is developing DataSKan™ for the Naval Applied Sciences Laboratory. But total recall



of active records is important for any industry. And with DataSKan™ portability, it can produce 10-second records almost anywhere.

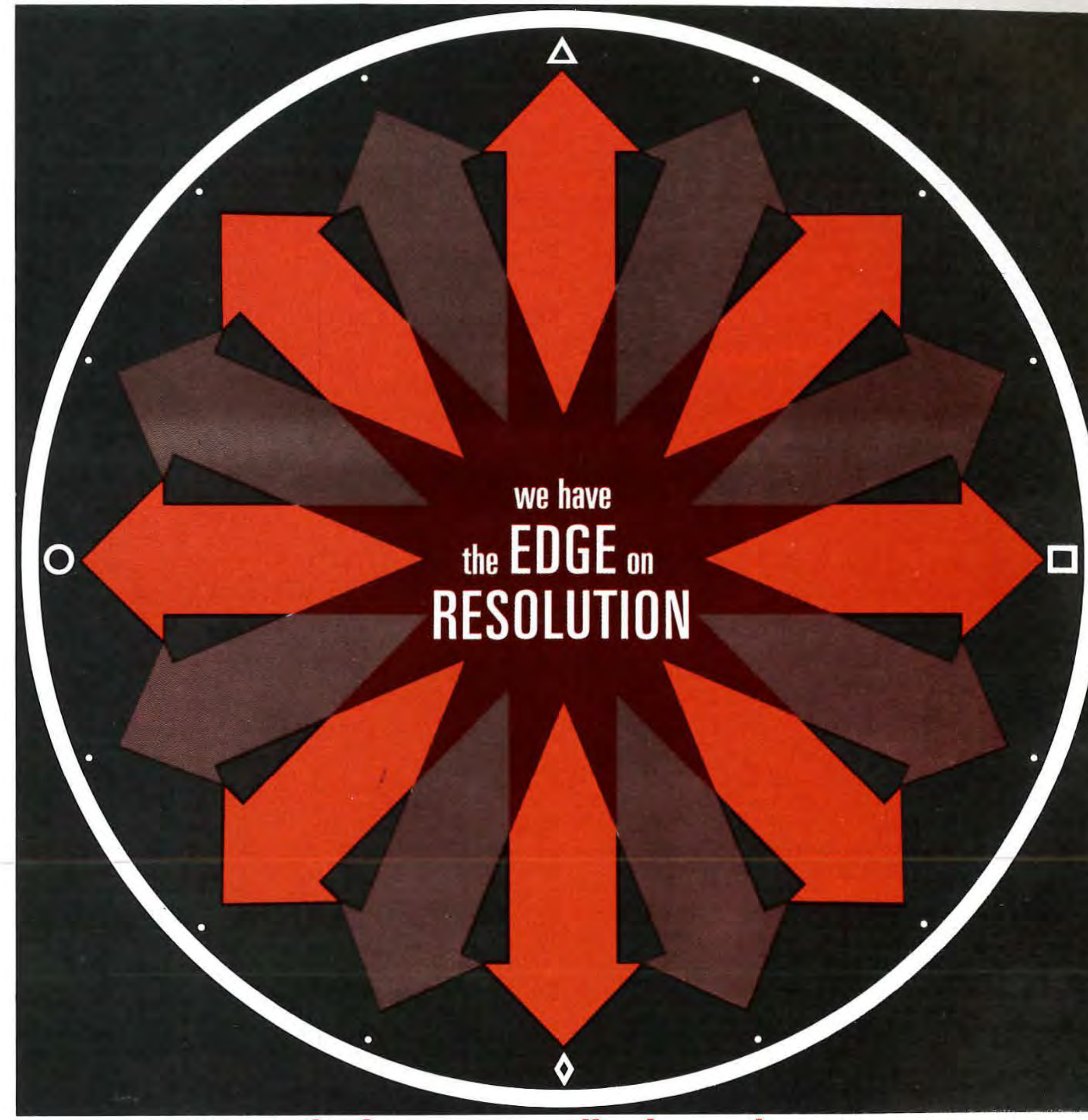
Now Kollsman is thinking of more applications for DataSKan. Like automatic print-out of copies, or a computer-linked system of one or more units.

DataSKan™ information retrieval is another example of Kollsman ingenuity in action, from flight data instrumentation to systems management to electro-optics.

Kollsman plants at Syosset and Elmhurst, N.Y. Subsidiaries: Kollsman Motor Corp., Dublin, Pa.; Kollsman Instrument Ltd., Southampton Airport, England; and Kollsman System-Technik GmbH, Munich, West Germany.

Kollsman Instrument Corporation Syosset, New York. Subsidiary of Standard Kollsman Industries, Inc.

Circle Reader Service Card No. 10



in large area display tubes

Fairchild-Dumont has advanced the state of the art to offer uniform edge to edge resolution without image degradation. Our large area displays assure consistent spot brightness, superior definition and unsurpassed clarity.

Our proven technology and design give you a **definite edge** with these advantages:

- **ELECTROSTATIC DEFLECTION** and focusing of high writing speed
- **ADVANCED GUN DESIGN** and assembly which minimize defocus and astigmatism at the edges
- **CORRECTION VOLTAGES** within transistor ratings when required
- **UNIFORM SPOT SIZE** within close tolerances without costly external circuitry
- **FLAT SURFACE GEOMETRY** minimizing pattern distortion, facilitating readability.

Typical examples of Fairchild-Dumont advanced design in Large Area Displays . . . 12 inch KC 2598A, 16 inch KC 2764 and 19 inch KC 2690. For complete data on all Fairchild-Dumont display tubes consult your local representative or call us directly. No matter what your C.R.T. needs are in Large Area Displays you can look to Dumont—the world's leader.

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Data Display Devices from Raytheon

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.

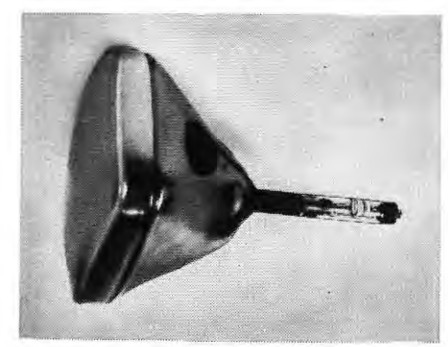
Raytheon's wide range of Dataray* CRTs cover the screen sizes from 7 to 24". Electrostatic, magnetic and combination deflection types are available for writing alphanumeric characters while raster scanning. Raytheon also offers combination deflection or "diddle plate" types and all standard phosphors.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

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

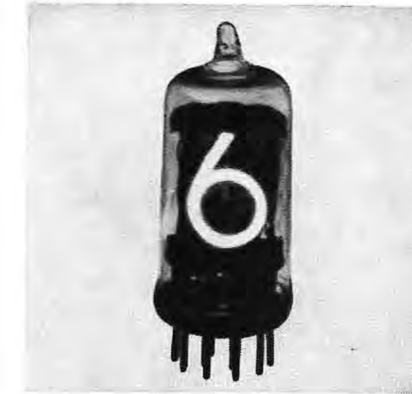
Cathode-Ray Projection Tube. A new family of Projectoray* CRTs provide high quality projection of television or other displays. As compared with more conventional projection tubes, the Projectoray provides substantial improvement in life and brightness without sacrifice in picture quality.

These devices are available in designs which utilize refractive optics or Schmidt optics, with one special design using a Schmidt spherically-curved mirror built within the cathode-ray tube.

The high light output and long life—more than 500 operation hours—are due to novel design. The phosphor screens are deposited on thermally conductive materials capable of being cooled readily by air flow or liquid cooling techniques to inhibit screen burning. The final display will provide 15 foot-lamberts on a 3-foot by 4-foot lenticular screen, permitting operation of the projection system in a lighted room.

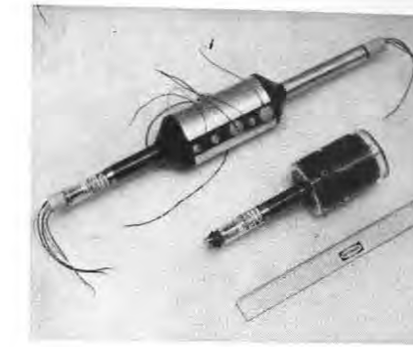


Dataray* Cathode Ray Tubes. Raytheon makes a wide range of industrial CRTs—including special types—in screen sizes from 7" to 24". Electrostatic, magnetic, and combination deflection types are available for writing alphanumeric characters while raster scanning. All standard phosphors are available and 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* Side-view Tubes. Type 8754 with numerals close to the front, permits wide-angle viewing. These side-view, in-line visual readout tubes display single numerals 0 through 9, preselected symbols, + and − signs, and decimal points. Their 5/8" high characters are easily read from a distance of 30 feet. Less than $5 each in 500 lots, they can be supplied with lacquer coating to eliminate the need for expensive filters. Datavue types are interchangeable with NL840, 841, 842, 843, and 848 tubes.

Datavue* End-View Tubes. Raytheon makes round (CK8421) and rectangular (CK8422) Datavue indicator tubes on automated equipment capable of high production rates and top quality. The CK8422 rectangular tube is also available with decimal point, ± symbols, and in other special versions. Both round and rectangular types fit existing sockets and conform to EIA ratings. These ultra-long-life tubes are designed for 200,000 hours or more of dynamic operation.



Recording Storage Tubes. The two new designs shown utilize miniaturized guns and necks to provide high deflection and focus sensitivity, resulting in savings in coil and power supply weight and size. They provide Kiloline resolution, long storage and fast erase capability. The single-gun version is Type CK1537 and the dual-gun version is Type CK1535.

Raytheon's complete line of electrical-output storage tubes feature high resolution and non-destructive reading. 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.

Send Reader Service Card for literature on the:

Symbolray CRT	No. 12
Projectoray CRTs	No. 13
Datavue Indicator Tubes	No. 14
Recording Storage Tubes	No. 15
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V91R2	125	91±2	1.0	0.1 — 2.0	3.0	0.1	0.3
V103R2	135	103±2	0.8	0.2 — 2.0	3.0	0.2	0.25
V110R4	170	110±2	1.5	0.5 — 4.0	6.0	0.5	0.95
V115R4	155	115±2	0.8	0.15 — 4.0	6.0	0.15	0.3
V116R2	150	116±2	0.6	0.12 — 2.0	3.0	0.15	0.3
V139R1.9	190	139±4	0.5	0.3 — 1.9	3.0	0.3	0.6
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PHILLIP P. DAMON
Membership Chairman
and
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Applications of holograms as displays

by B. P. HILDEBRAND

Battelle Northwest Laboratories
Richland, Washington
Applied Physics and Electronics Department

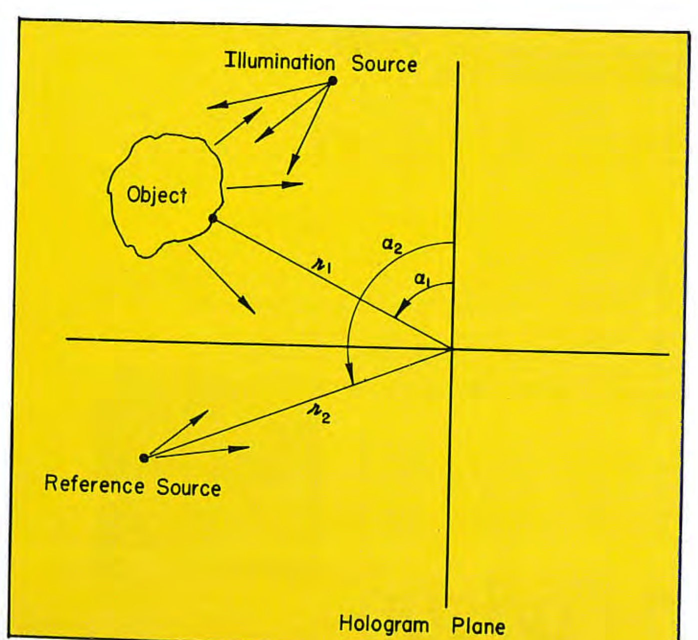

FIGURE 1: Hologram making and reconstruction procedures; symbols defined

INTRODUCTION

It is well known that a hologram possesses the remarkable ability to reconstruct in complete detail a three-dimensional scene. The immediate reaction of most engineering oriented people who see such a reconstruction for the first time is that here we finally have a means for true three-dimensional motion pictures and television. This may well be the case, but many significant component improvements will be required (1). In this paper we attempt to define possible applications of holograms as they exist now, to displays.

A good general discussion of holography appeared in INFORMATION DISPLAY by J. V. Parker about a year ago (2). Therefore, we will not repeat the development here, but will merely write down the necessary equations.

Figures 1 and 2 represent the hologram making and reconstruction procedures and define the various symbols used in the equations. The image position equations are

$$\frac{1}{r_b} = \pm\frac{\omega_1}{\omega_2}\left(\frac{1}{r_1} - \frac{1}{r_2}\right) - \frac{1}{r_a}$$

$$\cos\alpha_b = \pm\frac{\omega_1}{\omega_2}(\cos\alpha_1 - \cos\alpha_2) - \cos\alpha_a$$

where ω_1 = recording frequency
ω_2 = reconstruction frequency

The upper sign refers to the conjugate image which is generally real and the lower sign refers to the true image which is generally virtual. The magnification of the image is expressed by the set of equations:

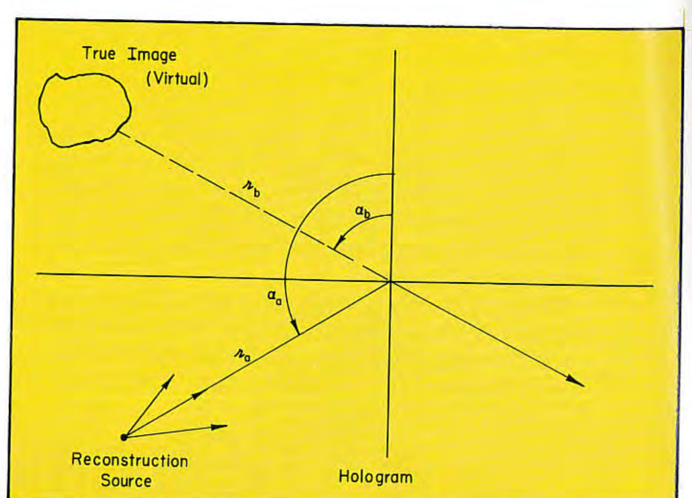

FIGURE 2: Hologram making and reconstruction procedures; symbols defined

$$M_L = \pm\frac{\omega_1}{\omega_2}\frac{r_b}{r_1}$$

$$M_R = \pm\frac{\omega_1}{\omega_2}\left(\frac{r_b}{r_1}\right) = \frac{\omega_2}{\omega_1} M_L^2$$

$$M\alpha = \frac{\omega_1}{\omega_2}\frac{\sin\alpha_1}{\sin\alpha_b}$$

These magnifications are related to the origin of the coordinate system. That is, these equations are correct only for the observer at the origin or center of the hologram. More general expressions may be derived by referring to Figure 3. The actual image magnification at an arbitrary observer position may be expressed as

$$M_L' = M_L$$

$$M_R' = M_R \cos\psi$$

$$M_\alpha' = -M_\alpha\left(\frac{r_b}{r_v'\cos\beta}\right)\left[\cos(\alpha_b + \alpha_v) - \frac{r_b}{r_v'}\sin(\alpha_b + \alpha_v)\sin\psi\right]$$

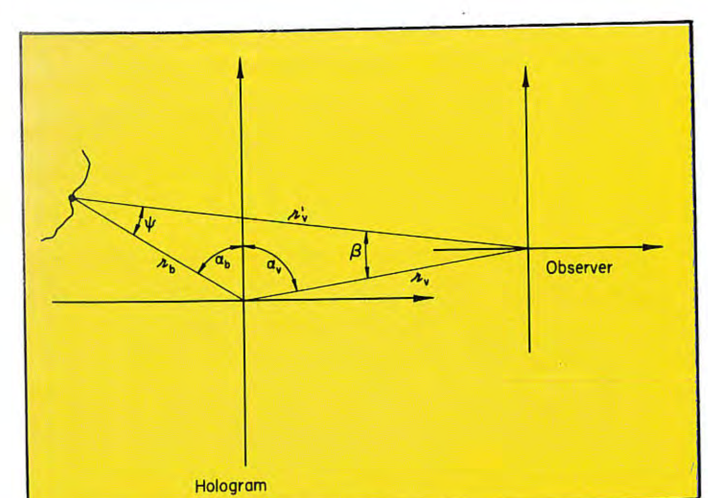

FIGURE 3: General expressions derived

where $\psi = \cos^{-1}\left[\frac{r_b - r_v\cos(\alpha_b + \alpha_v)}{r_v'}\right]$

$$\beta = \sin^{-1}\left[\frac{r_b\sin(\alpha_b + \alpha_v)}{r_v'}\right]$$

$$r_v' = \left[r_v^2 + r_b^2 - 2r_vr_b\cos(\alpha_b + \alpha_v)\right]^{1/2}$$

In general the observer will position himself so that his line of sight passes through the center of the hologram. In that case $(\alpha_b + \alpha_v) \cong \pi$, $r_v' \cong r_b + r_v$, $\psi \cong 0$ *and* $\beta \cong 0$. Equations 4 then become

Lateral $\quad M_L' = M_L$

Radial $\quad M_R' \cong M_R$

Angular $\quad M_\alpha' \cong M_\alpha \frac{r_b}{r_b + r_v}$

We see from Figure 2 that for a virtual image $|r_b + r_v| > |r_b|$, whereas for a real image $|r_b + r_v| < |r_b|$. Hence for the virtual image $M_\alpha' \leqslant M_\alpha'$and for the real image $M_\alpha' \geqslant M\alpha$. Due to the finite thickness of the photographic emulsion [3] we must reconstruct the hologram with the reconstruction source angular position $\alpha_a \cong \alpha_2$ for the true image or $\alpha_2 \cong \pi - \alpha_2$ for the conjugate image. In this case the angular magnification $M\alpha = \pm 1$. Hence

$|M_\alpha'| \leqslant 1$ for the virtual image

and

$|M_\alpha'| \geqslant 1$ for the real image

Holograms in Training Devices

With the preceding analysis we may now consider the problems involved in using holograms in training devices. We will restrict ourselves to the use of a single hologram designed to perform a single training mission. Suppose we wish to train an astronaut for rendezvous maneuvers. The real-life situation is represented schematically in Figure 4. The astronaut sits at a fixed distance from the window and looks at the target vehicle, represented by the arrow, as he approaches it. The distance from the lens to the retina is also fixed but the focal length of the lens is not. By the simple lens formula we have

$$\frac{1}{D+s} + \frac{1}{d} = \frac{1}{f}$$

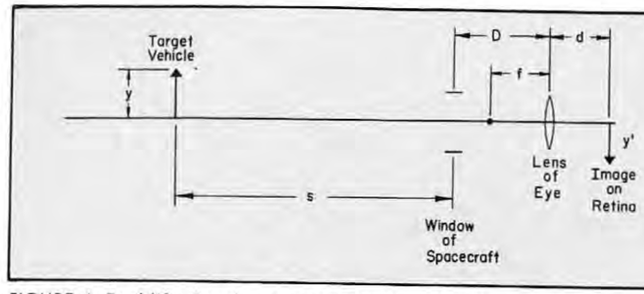

FIGURE 4: Real-life situation represented schematically

and hence

$$f = \frac{d\,(D+s)}{D+d+s}$$

by the lens magnification formula we have

$$M = \frac{-f}{D+s-f} = -\frac{d}{D+s}$$

Therefore, the size of the image on the retina is

$$y' = My = -\frac{d}{D+s}\,y$$

As the capsule approaches the target vehicle the rate of change of image size is

$$\frac{dy'}{dt} = \frac{\partial y'}{\partial s}\frac{ds}{dt}$$

$$= \frac{yd}{(D+s)^2}\,v_s$$

$$\text{where } v_s = \frac{ds}{dt} = \text{speed of approach}$$

This behavior is what we wish to simulate with a single hologram and a moving reconstruction source. First of all, we assume that the hologram is made with the object angular position $\alpha_1 = \pi/2$ and with the reconstruction source frequency, ω_2, equal to the recording source frequency, ω_1. Figure 5 is a schematic representation of such a simulator with the hologram acting as the cockpit window. In this case we use the virtual true image. By repeating the previous analysis we obtain the image size

$$x' = \frac{d}{d+r_b}\,x$$

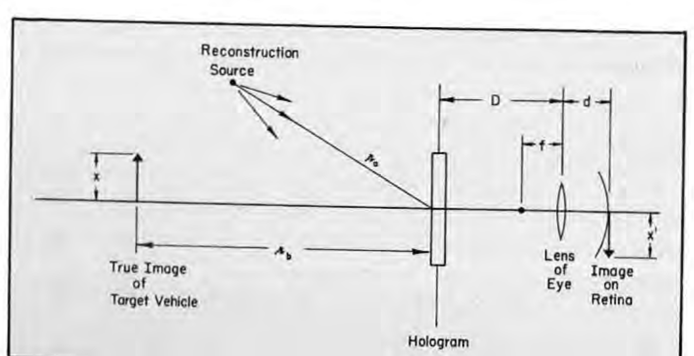

FIGURE 5: Schematic representation of simulator with hologram acting as cockpit window

In this case, however, x is not fixed since the size of the hologram image changes as the reconstruction source distance, r_a, varies. According to equation 3 the lateral magnification of the hologram image and hence x changes as

$$x = M_L x_1 = \frac{r_b x_1}{r_1}$$

where x_1 is the size of the object of which the hologram was made and r_1 is its distance from the hologram. Hence, the retina image size becomes

$$x' = \frac{r_b d}{D+r_b}\frac{x_1}{r_1}$$

The rate of change of x' is

$$\frac{dx'}{dt} = \frac{\partial x'}{\partial r_b}\frac{dr_b}{dt} = \frac{\partial x'}{\partial r_b}\frac{\partial r_b}{\partial r_a}v_a$$

where $v_a = \frac{dr_a}{dt}$

Thus

$$\frac{dx'}{dt} = -\frac{x_1 D}{r_1}\frac{d}{(D+r_b)^2}\left(\frac{r_b}{r_a}\right)^2 v_a$$

For $r_b >> D$ we have

$$x' \cong \frac{x_1 d}{r_1}$$

$$\frac{dx'}{dt} \cong -\frac{x_1 D d}{r_1 r_a^2}\,v_a$$

From equation 15 we see that the image size x' is essentially a constant. This, of course could be inferred from the discussion of the angular magnification achievable with the virtual image of a hologram. It was shown that for this case $|M'_\alpha| \leq 1$. For the real image, however, $|M'_\alpha| \geq 1$. We thus conclude that a hologram display utilizing a virtual image cannot be used for simulation purposes. We then consider the real image as shown in Figure 6.

Using the same kind of analysis as in the preceding paragraphs we get

$$x' = \frac{d}{D+h}\cdot\frac{H-h}{r_1}\cdot x_1$$

and

$$\frac{dx'}{dt} = -\frac{d}{(D+h)^2}\frac{D+H}{r_1}x_1\,(H-h)^2$$

$$v_a\left[\frac{1}{H-h}-\left(\frac{1}{r_1}-\frac{1}{r_2}\right)\right]^2$$

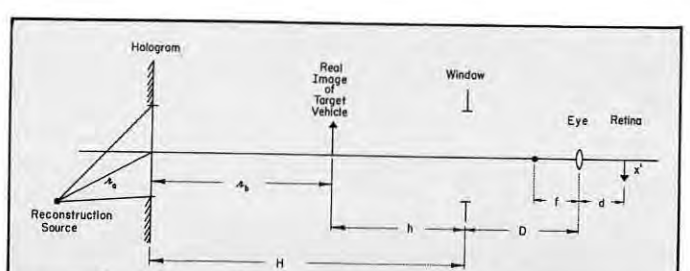

FIGURE 6: Real image

In order to compare the simulation to the actual case we will graph equation 8, 9, 15 and 16.

In order for the simulation to be the same size as the real object when it reaches the window we must have

$$\frac{x_1}{r_1} = \frac{y}{H}$$

This allows us to compare the two curves of Figure 7 directly. We see that if H is made large enough, then the simulator will duplicate the behavior of the object reasonably well. If we now wish to make the rate of change appear the same when the image reaches the window we have the additional requirement,

$$v_a = \left(\frac{H}{H+D}\right)\left[\frac{r_1 r_2}{(r_2-r_1)\,H - r_1 r_2}\right]^2 v_s$$

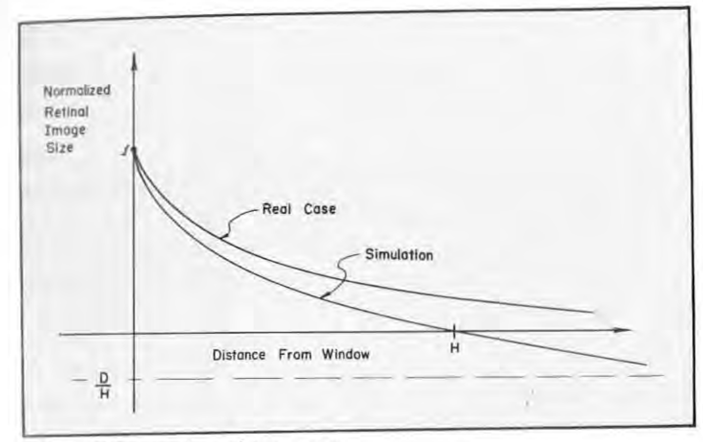

FIGURE 7: Comparison of two curves

We see that if we make the reference distance, r_2, equal to the object distance, r_1, when making the hologram, equation 18 simplifies to

$$v_a = \frac{H}{H+D}\,v_s$$

From Figure 8 we see that this condition results in a rate of change curve which approaches zero as the distance, H, approaches infinity. In other words, the simulation behaves more like the real situation for large H. As a matter of fact, the equations show that they are exactly alike if we make $H \to \infty$.

We have shown that a simple simulator, using a single

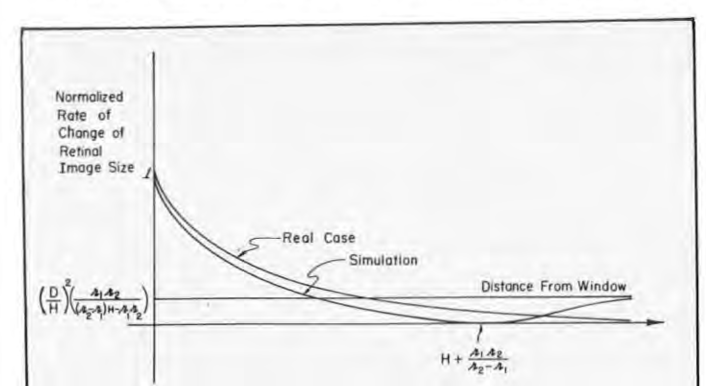

FIGURE 8: Condition results in rate of change curve approaching zero as distance approaches infinity

hologram and a moving reconstruction source can accurately simulate an approach maneuver. Up to now we have assumed a straight line motion of the reconstruction source. Within limits, we can also move the source through a small angle to obtain angular motion of the image. The limitation on the angle arises due to the effect of the finite thickness of the photographic emulsion on the photographic plate. If the angular position of the reconstruction source relative to the hologram changes from that of the reference source when making the hologram, the image dims and ultimately extinguishes [3]. For holograms made on 649F glass plates, the maximum deviation before image extinction is on the order of ±4° up to ±15° depending on the relative size of the object in relation to its distance from the hologram. The angular change in image position is directly related to the change in reconstruction source position. Thus a reasonable image angular shift can be obtained.

There are a number of practical problems to consider. Probably, the most important is image intensity. The hologram is really a complicated diffraction grating and the image is its first order diffraction pattern. For an ordinary hologram, the maximum energy one can diffract into the image is 6% of the reconstruction source energy. If the hologram is bleached so that we now have a phase grating the image can be brightened at some cost of signal-to-noise ratio. In this case the diffracted energy may be increased to 25% of the reconstruction source energy.

A second important consideration is that of image aberration and distortion. It has been shown that for any magnification other than unity, the image will have all the aberrations present in lenses [4]. In addition from equations 3 and 5 we see that the radial magnification M'_R is equal to the square of the lateral magnification M'_L. For a virtual image this is not apparent to the eye because the angular magnification remains essentially constant. However, for a real image the angular magnification becomes large, which has the effect of emphasizing the distortion. For this reason we must be very careful in designing the scene to minimize this effect. One of the things one might do is to use a model that is foreshortened so that at a particular magnification the image has the correct proportions.

The correct proportions are perhaps most important when the image nears the window of the trainer. This is where the astronaut's eyes will provide the greatest depth cues, both binocular and monocular. As the image recedes from the window the monocular cues diminish until at 12 feet the focus cue of the eye no longer provides information. Although the stereopsis cue exists up to about 2,000 ft. it is not particularly good [5]. Hence, if the simulator provides no anti-cues, such as fixed surfaces, or lights, it may be practicable to build a hologram simulator with surprisingly good results. The hologram itself should be placed as far as possible from the observer (at least 30 ft.) and should be designed to give a correctly proportioned image when it is nearest to the observer. Then, although as the image recedes it will become foreshortened, the eye becomes less able to detect the distortion and it may become tolerable. Only a series of experiments utilizing human observers will determine this.

Holograms in Cockpit Displays

There are in development certain cockpit displays as navigation aids. These displays typically are of the CRT type and portray a set of straight lines which converge near the top of the display to simulate the appearance of perspective [6]. The display is changed to simulate required banks and turns so that the pilot merely has to reorient the aircraft to return the display to a straight course. A hologram of a particular type can perform this function much more simply and convincingly without any electronic circuitry.

The manner in which this may be done is to make a hologram of a point source. This hologram, is however, deliberately made non-linear, so that the reconstruction consists of a row of points [7]. A sequential exposure hologram can be made with the point object in another position. The hologram then reconstructs two rows of points. If the experiment is designed properly one can obtain two lines of points receding behind the hologram with a true 3-dimensional perspective.

The hologram parameters can be adjusted so that the real image points extend lines out in front of the hologram. If the reconstruction source is moved in angular position, the rows of points rotate and bank in an extremely realistic manner. Since a laser is not needed for reconstruction we can use ordinary white light sources of small size. The effect of the white light is to smear the points out in a multicolored line which provides an arresting effect.

The theory involved is relatively simple. Consider the system shown in Figure 9. We can describe the field at a point x in the hologram plane as

$$ae^{jk(u_1x + \beta_1x^2)} + be^{jk(u_2x + \beta_2x^2)}$$

$$\text{where } U \cong \frac{2\pi}{\lambda} \cos\alpha$$

$$\beta = \frac{2\pi}{\lambda}\left(\frac{1}{2r}\right)$$

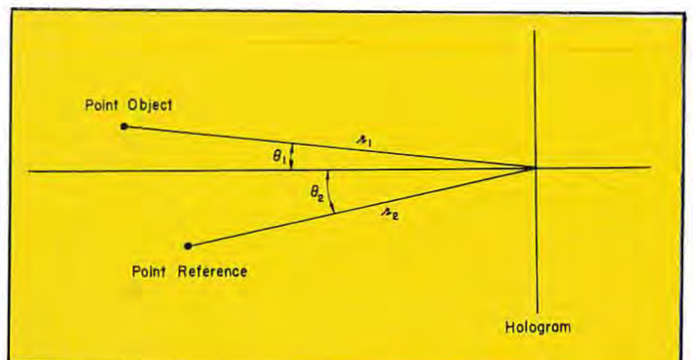

FIGURE 9: System

Here we have made the approximation that the true distance to the point x may be expanded about the distance to the origin in a binomial series and terms of higher order than the square in x can be neglected.

If we were to make a "good" hologram we would record the field in a linear manner. That is, we would set the bias level and the ratio of the intensities of the two sources so that the film records at a $\gamma = 2$. For our purpose, however, we want a non-linear recording which we obtain by making the two beams equal in intensity so that we achieve 100% modulation. Thus, the threshold level and saturation level of the film causes the film to act like a slipping device. The quantity recorded on the film is

$$I(x) = \left| e^{jk(\alpha_1 x + \beta_1 x^2)} + e^{jk(\alpha_2 x + \beta_2 x^2)} \right|^{\gamma}$$

When this expression is expanded we obtain

$$I(x) = 1 + \frac{\gamma}{2}\cos k\,[(u_1 - u_2)x + (\beta_1 - \beta_2)x^2]$$

$$+ \frac{1}{2!}\,\frac{\gamma}{2}\left(\frac{\gamma}{2} - 1\right)\cos^2 k\,[(u_1 - u_2)x + (\beta_1 - \beta_2)x^2]$$

$$+ \frac{1}{3!}\,\frac{\gamma}{2}\left(\frac{\gamma}{2} - 1\right)\left(\frac{\gamma}{2} - 2\right)\cos^3 k\,[(u_1 - u_2)x + (\beta_1 - \beta_2)x^2]$$

$$+ \cdots$$

When the higher order terms in cos are expanded we eventually obtain terms of the type

$$\cos k\,[(u_1 - u_2)x + (\beta_1 - \beta_2)x^2]$$
$$\cos 2k\,[(u_1 - u_2)x + (\beta_1 - \beta_2)x^2]$$
$$\cos 3k\,[(u_1 - u_2)x + (\beta_1 - \beta_2)x^2]$$
$$\vdots$$
$$\cos nk\,[(u_1 - u_2)x + (\beta_1 - \beta_2)x^2]$$
$$\vdots$$

Upon illumination of such a hologram with another point source expressed at the hologram plane as

$$e^{jk(u_a x + \beta_a x^2)},$$

We obtain terms of the form

$$\exp\{\pm k[(u_1 - u_2 \pm u_a)x + (\beta_1 - \beta_2 \pm \beta_a)x^2]\}$$
$$\exp\{\pm k[(2u_1 - 2u_2 \pm u_a)x + (2\beta_1 - 2\beta_2 \pm \beta_a)x^2]\}$$
$$\exp\{\pm k[(3u_1 - 3u_2 \pm u_a)x + (3\beta_1 - 3\beta_2 \pm \beta_a)x^2]\}$$
$$\vdots$$
$$\exp\{\pm k[(nu_1 - nu_2 \pm u_a)x + (n\beta_1 - n\beta_2 \pm \beta_a)x^2]\}$$
$$\vdots$$

These terms represent a series of spherical waves centered at the distance r_{bn} where

$$\frac{1}{r_{bn}} = \pm n\left(\frac{1}{r_1} - \frac{1}{r_2}\right) - \frac{1}{r_a}$$

and on a radius at an angle calculated from

$$\cos\alpha_{bn} = \pm n(\cos\alpha_1 - \cos\alpha_2) - \cos\alpha_a$$

As an example, suppose that

$$r_2 = \infty,\ r_a = \frac{r_1}{2} \text{ and } \alpha_2 = \alpha_a = \frac{\pi}{2}.$$

Then we have

$$r_{bn} = \pm\left(\frac{r_1}{n \mp 2}\right)$$

$$\text{and } \cos\alpha_{bn} = \pm n\,\cos\alpha_1.$$

The point reconstructions from the hologram look like the sketch in Figure 10 where $\alpha_1 = 85^{\circ}$. We see that for all practical purposes all the points lie on a straight line, although there is a slight discontinuity across the hologram plane. The points designated by "crosses" represent images due to the term normally called the "true image" and the

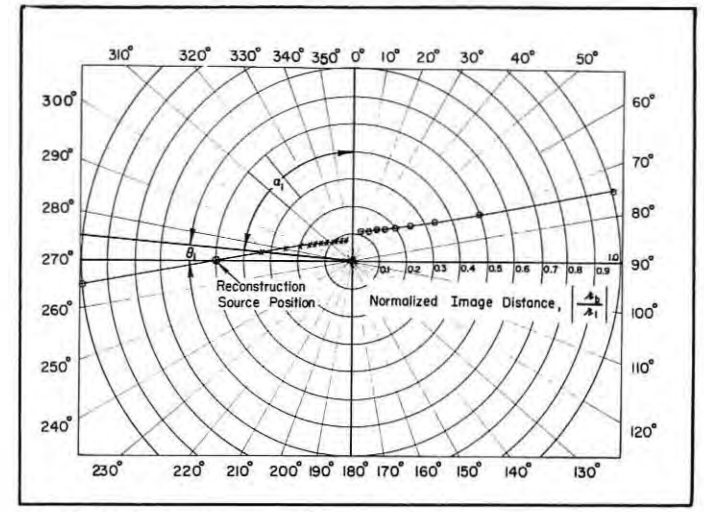

FIGURE 10: Sketch where $\alpha_1 = 85°$

points designated by "circles" represent images due to the "conjugate image" term. We see here that some of the "conjugate image" points are virtual and some are real.

The intercept angle of the line of points with the *Z-axis* can be shown to be approximately $2\theta_1$ for small θ_1. Hence, we can design the system for any desired convergence angle and distance. To get a second line of points we merely make another exposure with the object point moved to another angular position, preferably $(-\theta_1)$.

Again we must consider the fact that the emulsion is not infinitely thin. If it were, then theory and practice would concur and a hologram such as was described would be easy to make. In practice, however, the thickness of the emulsion generally prevents the simultaneous imaging of more than the 3rd order. In other words, due to Bragg angle effects, we cannot see the images very far off the axis of the first order image. The smaller θ_1, the more images can be reconstructed.

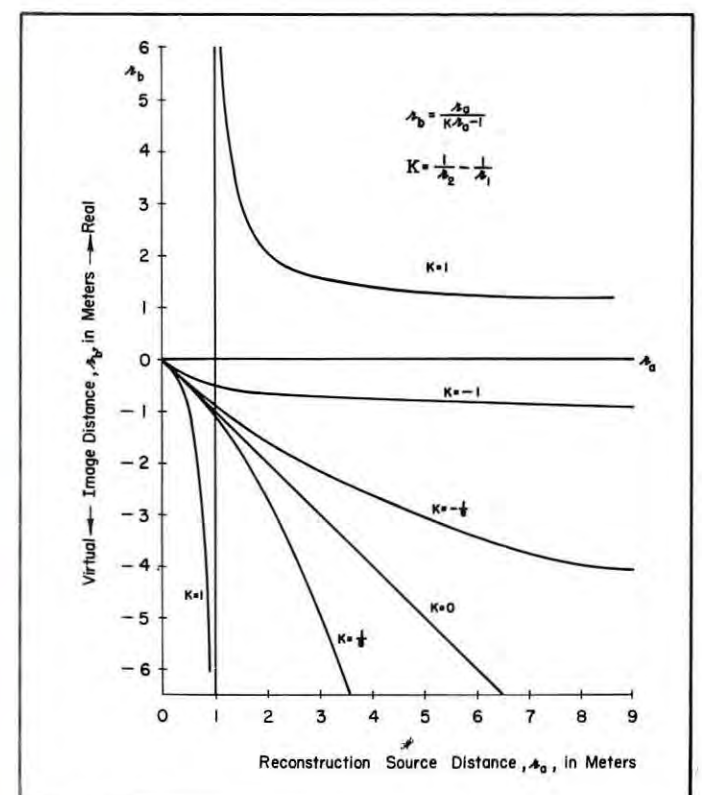

FIGURE 11: Experiment designed correctly for true image

In fact, if $\theta_1 = 0$ we have reconstructed as many as 7 or 8 orders. For the purpose at hand, however, we need off-axis points in order to obtain the correct perspective. Consequently we need films with very thin emulsions.

If we bleach the hologram we obtain brighter images as well as bringing out a few more orders. Since $|\cos\alpha_{bn}| \leq 1$ we see from equation 25 that the number of images, n, must be finite. For the example used in figure 10, we have a maximum number of 12 true and 12 conjugate images, one of which is at infinity and one a virtual image.

Static Displays

Photography is used extensively in public relations work by government agencies and private corporations and for advertising. It seems likely that holography will find its uses here also. The following paragraphs will discuss techniques for making holograms with special effects.

In a display of a space capsule, for instance, we would like to have a star field background appear at infinity to be realistic. This can be done by studying the image position equations and designing the experiment correctly. Let us rewrite equation 1 as

$$r_b = \pm\frac{\omega_2}{\omega_1}\left(\frac{r_1}{1 - Cr_1}\right)$$

$$\text{where } C = \left(\frac{1}{r_2} \pm \frac{\omega_2}{\omega_1}\frac{1}{r_a}\right)$$

and plot r_b as a function of r_1 with C as a parameter. This is done in Figure 11 for $\omega_1 = \omega_2$ and for the true image The corresponding plot for the magnification is shown in Figure 12.

An inspection of Figure 12 reveals that if we choose $C = 1/8$, then for an object at a mean distance $r_1 = 0.5\ m$ the im-

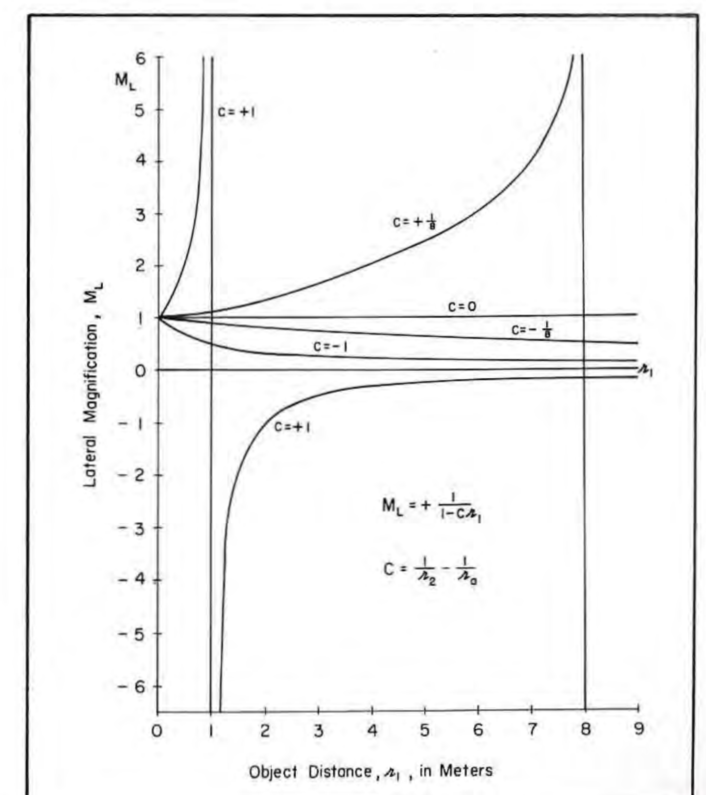

FIGURE 12: Corresponding plot for magnification

age will have a nearly constant magnification whereas an object at $R_1 = 8\ m$ will have an image of infinite magnification. From Figure 11 we see that it will also occur at an infinite distance. We have shown previously that the angular magnification for the virtual image is on the order of unity. Thus the star field will appear at infinity on the correct scale.

The example cited above results in a rather awkward set-up for making the hologram, since the two parts of the object are so far apart. For more compact set-ups we would have to use a larger parameter, C. For instance, if we used $C = 1$ we could place the model star-field at a distance of 1 meter. In this case, however, the variation in magnification for the spacecraft model at the distance of 0.5 meters is rathere severe. This may or may not be objectionable, depending on the extent in depth of the object.

From the plot of r_b as a function of r_a with

$$K = \frac{1}{r_2} - \frac{1}{r_1}$$

as a parameter we see how the image can be varied by changing the reconstruction source position. As shown in Figure 13 we see that we can actually make the image real or virtual. Thus, a variety of special effect holograms are possible by using the correct layout for both the construction and reconstruction processes.

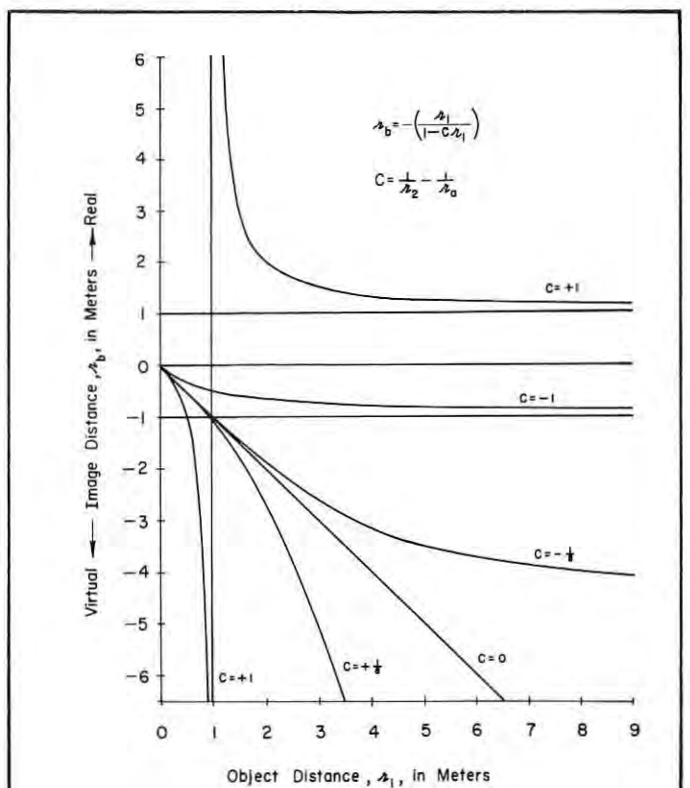

FIGURE 13: Image real or virtual

Conclusion

We have attempted to illustrate the usefulness of holography for certain specific types of display. We have purposely concentrated on those uses which can be achieved with holography as it exists today. It is obvious that future developments will bring many new and exciting applications such as three-dimensional motion picture and television.

In this report, however, we examine the possibility of using a single hologram for various purposes. These are (1) Training Devices (2) Cockpit Displays, (3) Static Displays. It appears that even for these restricted purposes, holograms can be useful. Preliminary experiments appear to bear this out.

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A flexible computer graphic system for architectural design

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ABSTRACT

This paper describes a man-machine communications system for the computer production of graphic displays for use in design. Recognizing that any design method which forces an unnatural pattern of behavior on the designer is bound to fail, the system couples the data input system to man's natural and highly developed skill in positioning a pencil upon a writing surface. The input media is a "Grafacon" tablet used to enter sketches on-line into the computer and to selectively command specific operations to be performed on the sketches. The system operates on an IBM 1800 computer with a 16K memory, digital register input/output capability, and a Calcomp Plotter (series 500). The computer transforms the data and produces, on the plotter, various perspective views based on the sketches and keyboard command information. The program design and data organization are such that complex objects can be input and plotted in a few minutes. This work is specifically oriented toward applications in architectural design but the system as developed is general enough to find application in any problem requiring a three-dimensional visual analysis based on a two-dimensional graphic input. This paper illustrates a typical application of the system to visually pretest a building form as it would appear on its selected site. The generation of multiple views from different positions and viewing distances can simulate the visual experience of moving through an environment. It can also facilitate a thorough visual analysis as the design is progressively modified.

INTRODUCTION

One of the major difficulties incurred in applying the traditional process to designing an environment is that there is no thoroughly developed way of pre-testing a proposed project against the requirements of the problem. This paper seeks a systematic procedure for the careful examination of physical three-dimensional situations so as to form a basis for the kind of decision-making faced by the architectural designer.

Design problems are often divided into stages which typically include such things as "programming and problem definition", "general research and study", "development and evaluation", and "refinement". The procedure described relates to those stages of the design process which require understanding the visual relationship between physical elements as a basis for a decision making process. This study is committed to the idea that "seeing", in the literal sense, is fundamental to understanding, and that it is valid to develop various "lenses" to help the creative mind focus conceptual images and help test them against the physical constraints of reality. The inward-looking device may be thought of as an objective mirror which reflects ideas from new perspective, thereby displaying an additional dimension for use in an evaluative process.

In order to do this we have devised a system allowing one to sketch planar views of physical objects and then, by keyboard controls, to examine three-dimensional representations of the objects in any specified position in space. This method is closely akin to the designer's traditional graphic studies of ideas which often use plans, sections, elevations and perspective sketches. Because of this kinship there is no revolutionary change in process involved and no need to fear a characteristic change in applying the cheapest and most common tool available to the designer — the human brain. The principal objective of this work is to develop an efficient procedure for using the computer and the brain as a team — each doing the things it can do well.

Description of the User Program

The Hardware. The system uses a "Grafacon" [1,2] tablet as the input medium, connected to an IBM 1800 computer with a 16K memory, digital register input/output capability, and with a Calcomp Plotter for the final output medium. A CRT monitor is used to display a record of the input data, allowing careful position checking and error determination. The hardware components of the system are illustrated in Figs. 1, 3, and 4. Figure 2 shows the template used, on the Grafacon

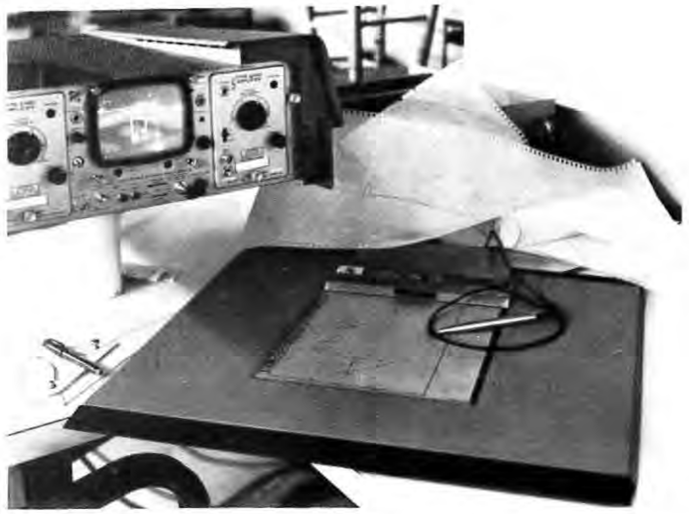


FIGURE 1: User sketches with pen-like stylus on "Grafacon" tablet. The CRT monitor displays a record of the input data allowing careful position checking and error determination.

tablet surface, to enable the inputting of control and command information. These control options are summarized in Table I, and discussed later in the text.

The Software. The program package has three distinct parts:

GRAF — An assembly language interrupt subroutine, which processes the pen contact on the tablet surface, keeping track of whether the pen point is depressed or not. GRAF also controls the display on the storage scope, generating a stored point for every pen down contract, and providing a non-storing monitor of pen position when the pen is up.

PRSPT — The output program, written as a FORTRAN subroutine, generates and draws a perspective view of the line segment figure defined by the input data.

GRIN — The master program, also written in FORTRAN, performs the logical analysis of the input data, builds the data arrays, and provides executive control of the program system.

All three programs are resident in core at the time of operation and under the current program configuration require in

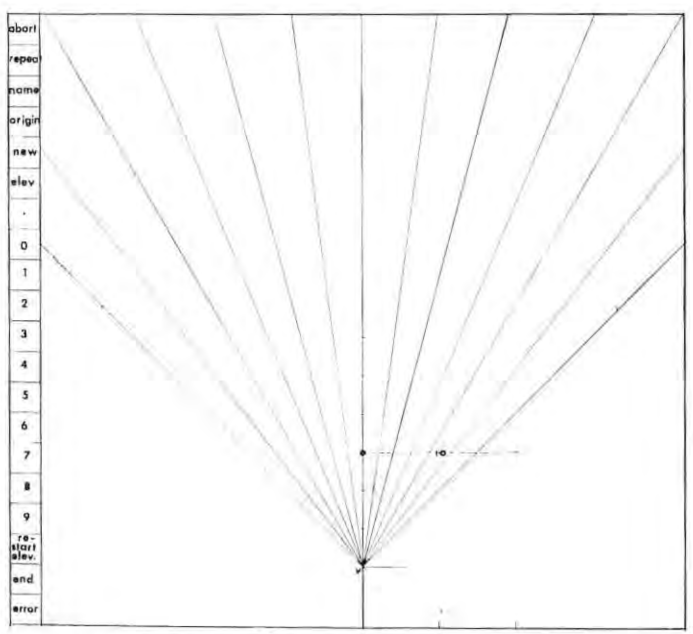


FIGURE 2: The keyboard template controls computer operations and is used to supply information and commands relating to the sketch.

excess of 10,000 16-bit words. Of this figure, roughly 5,000 words are used by the data arrays. The program is operated under version 2 of IBM's time-sharing executive program with a skeleton in excess of 5,000 words. Hence the program, as currently configured and operated, almost completely fills 16K of memory.

Data Organization and Program Structure

When viewed as a computer task there are two primary aspects to the problem: the specification of the data structure and the choice of an input medium. In both cases it is necessary to provide for convenience and flexibility, while still providing for significant data compression. We have chosen, in this study, to limit ourselves to those graphs which can be constructed from straight line segments. The problem, therefore, is reduced to choosing a method for inputting and storing an array of points and their respective connectivity. Prior papers [3, 4] have considered a data structure that consists of a simple ordered list of points to be consecutively connected, which were input via cards. The on-line system described in this paper makes use of a "Grafacon" tablet (Fig. 1). System control is accomplished by inputting to the digital input channels of the IBM 1800 computer, and operating under external synchronization provided from the "Grafacon".

TABLE I

Abort	Commands the computer to eliminate all the previous data and restart from the beginning.
Repeat	Directly follows the input of an elevation (height of horizontal plane) change and instructs the computer to re-issue all the information from the previous elevation to a new elevation. If the same floor plan is repeated on many successive elevations for example, it only needs to be sketched once and then repeated as many times as is necessary.
Name	Allows special designation to be placed on individual sketches in order that each may be specifically called and either re-drawn, re-scaled, or drawn in a new position. If a permanent record is desired of the digital information used in a particular drawing, the "name" will code the set of data for that drawing. It may then be re-called at any date and re-drawn on command from typewriter instructions.
New	Indicates that the section of data relating to a particular elevation is complete and the user wishes to begin a new sketch.
Elevation	Instructs the computer to anticipate floating numbers which represent the location of the plane containing suceeding information. All data is assumed to lie in this plane until the system is instructed otherwise. The decimal point and nine digits are used to input floating point numbers which describe the third coordinates of each set of data.
Restart Elevation	Allows the user to eliminate all the data relating to a current elevation without disturbing data relating to previous elevations.
End	Instructs the computer that a block of data is complete.
Error	Allows the user to strike out and change a preceding data point.

TABLE 1: Summary of Grafacon keyboard control inputs.

Since this choice of input medium gives a convenient two-dimensional input, but only two dimensions, a nontrivial problem is deciding how to organize the data so as to structure a three-dimensional array of points and the information describing their connectivity. The technique developed is particularly simple and provides a surprising amount of flexibility for the sort of elements of concern in the context of architectural design. Two dimensions are input by means

FIGURE 3: Sense switches on the console of the IBM 1800 are used to control the various options of the program. Console typewriter may be used to type in data variables such as scale and position of the object with respect to the viewer.

of positioning the stylus on the tablet surface. A ½" strip on the left margin of the "Grafacon" tablet is converted to a "keyboard" consisting of 20 squares, as illustrated in Fig. 2. Of these twenty squares, or keys, eleven are used to provide numerical information. The other nine, whose functions are described in Table I, are used to provide control information both for data definition and for error correction. This keyboard provides both a means of controlling the program from the tablet, and a medium for inputting the third dimension. Clearly, the choice of which two coordinates to input conventionally is arbitrary. The most convenient pair usually is a function of the geometric characteristics of the objects to be described. Because it is convenient for many types of objects, we shall consider in the following discussion that the x and y coordinates are input directly via tablet coordinates and that the z (height of a horizontal plane) information is input via the logical keyboard at the left of the tablet.

The x and y coordinates are structured as a two-dimensional array, x_{ij}, y_{ij}, where the first subscript refers to a point number, and the second to an elevation number. The first step in inputting an object description is the specification of an origin and a scale factor for the x and y information. This is done by contacting, with "grafacon" stylus, the square marked "origin." The next two points must be on the main body of the tablet and specify the origin and a 10 unit benchmark from the origin, respectively. The next step is the specification of an elevation, which is assumed constant until changed. All points on that elevation plane are numbered consecutively in the order in which they are input, and the point numbers so derived provide the index for the first subscript of the x, y array. The assumption is that consecutive points input on the same elevation are connected and that, unless otherwise specified, each point is connected to the same numbered point of the following elevation. Thus x_{ij} is connected to x_i plus $_{1,j}$ and x_i minus $_{1,j}$, if they exist, and also, unless the contrary is specified, to $x_{i,j}$ minus $_1$ and $x_{i,j}$ plus $_1$ if they exist.

The elevation is specified by making contact with the square marked ELEV followed by a keyboard number of not more than six characters including the decimal point. The x and y coordinates of the first point are input by making pen contact in the appropriate spot on the main body of the

tablet. The coordinates are determined from the position of the pen with respect to the origin and scale factor as previously input. If additional points are specified on the table, all of these successive x,y coordinates will be assigned the same z value until a new elevation is specified via the logical keyboard. If is often desirable to generate a set of points which is not connected to the set of corresponding points of the previous elevation. This is done by specifying that the elevation is "new" by contacting the square so marked on the logical keyboard before inputting the elevation information. The successive points on such an elevation will, themselves, be sequentially connected. Although it appears that this might place restrictions on the connectivity or lack of it for coplanar points, any number of planes may exist at one elevation so the only restriction is the data storage capability of the computer. The present system restrictions are 30 points per elevation and 25 elevations, and arise solely from the limitations on core storage in the 1800 computer. These restrictions could be removed by either storing data or portions of the program on disc.

FIGURE 4: Computer driver plotter displays perspective views ranging from a few seconds to three or four minutes.

In addition to the above capabilities, a square marked "repeat" is provided to enable the user to conveniently define a new elevation for a set of x,y points with exactly the same coordinates as those of the previous elevation. This feature is not only convenient for defining many conventional structures, but also provides for a much higher quality drawing. This is because all connecting verticals are vertical and parallel, since no error is introduced in specifying the points from one elevation to the next. Because even slight errors in vertical lines are conspicuous to the naked eye, this is an important feature of the program.

Three error correction options are provided. First, by contacting the "error" square, it is possible to eliminate the last input to the "Grafacon". Second, by contacting the "restart elevation" square, it is possible to eliminate from the data list all points on the elevation currently being processed.

Finally, by contacting the abort square, it is possible to completely restart the program, forgetting all previous input information. The input process is concluded by contacting the "end" square, at which time control is transferred to the output program.

The output program takes the x,y,z coordinate information, provided from the input program, and computes a two-dimensional array of points for output to the plotter. This is done by assuming a view point in the y-z plane, using the x-z plane for the picture plane. The equations are:

$$X_{ij} = \frac{(x_{ij} + XM)D}{D \div y_{ij} + YM}$$

$$Y_{ij} = z_j + ZM + (y_{ij} + YM)\,\frac{(H - z - ZM)}{(D + y_{ij} \div YM)}$$

where X_{ij}, Y_{ij} are the output coordinates
x_{ij}, y_{ij} are the "Grafacon" input coordinates
XM, YM, ZM are optional displacements of the origin,
and
D, H are distance and height of the viewing point with respect to the origin.*

Since the program makes use of the standard plotter subroutine available on the IBM 1800 system, the information must be provided to the plotter as a set of points to be sequentially connected. The data organization is arranged so that this can be done in a particularly simple and convenient fashion. The points representing the first elevation are drawn and the plotter is moved with the pen up to the first point of the new elevation. At this point, the indicator which specifies whether or not this is a new elevation is checked. If it is set, the points of the new elevation are drawn with lines connecting each point. If the indicator is not set, a line is drawn from the first point, to the first point on the preceding elevation and back. This is done before the line is drawn connecting the first point to the second point on the same elevation. The pattern is then represented for all succeeding points on the elevation. Although this system of drawing involves some re-tracing, it should be recognized that, except for very special figures, some re-tracing is inevitable and the simplicity of the basic system more than compensates for the slight redundancy in re-tracing.

A number of options are provided in the output program to enhance the flexibility and usefulness of the program. These options are implemented by means of five of the sense switches on the face of the 1800 computer and can be summarized as follows:

Sense Switch No. 2 — This switch allows the user to reposition the perspective drawing in space by adding a constant to all of the x coordinates, all of the y coordinates and/or all of the z coordinates. Thus, since the viewing point and picture plane stay the same, the effect is that of translating the object in space. With sense switch 2 in the ON position, the operator must input, via the console typewriter keyboard, the three values XM, YM, ZM, representing the x,y and z translations

*These equations are derived in Reference 3.

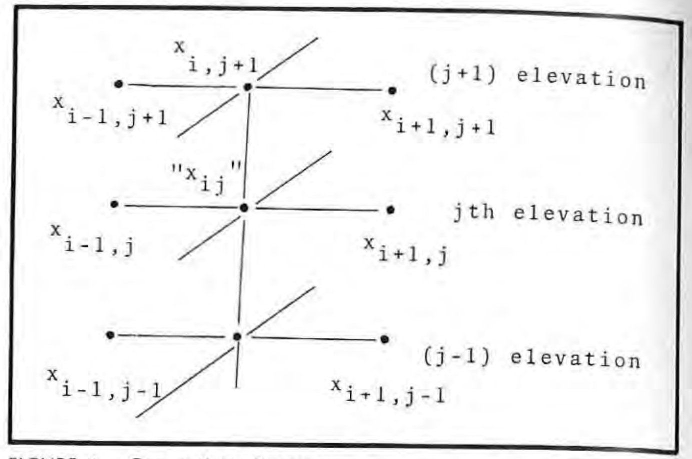


FIGURE 5: Connectivity System.

respectively. If the switch is in the OFF position, these translations are automatically set to zero.

Sense Switch No. 3 — This switch is called to change the scale and/or the perspective of the drawing by re-setting the three variables which control the form of the plotter picture. These are D — the distance from the viewpoint to the picture plane, H — the height of the viewpoint above the ground or reference plane, and SCL — the number of inches per user's unit to be used along the x-y axis of the plotter. If sense switch 3 is OFF, the variables are set initially to 15, 5, and .4 units respectively. To re-set the variables the sense switch is turned ON and D, H, and SCL are input from the console typewriter. (NOTE: If sense switch 2 is also ON, six values must be typed, representing XM, YM, ZM, D, H and SCL.) If sense switch 3 is OFF, the program uses the D, H and SCL values which were last defined.

Sense Switch No. 4 — This switch allows the option of inputting data taken from successive vertical planes, rather than successive horizontal planes. If sense switch 4 is ON, the program understands the y and z coordinates to be interchanged, i.e., the x-y axis on the "Grafacon" represents a vertical plane. In inputting data in this mode, it is necessary to remember that with switch 4 ON, the viewer will see the underside of an object unless it is placed a distance less than H from the x axis.

Sense Switch No. 5 — Sense switch 5 allows the previous output to be re-drawn. If the switch is ON, the paper moves 20 user units in the x direction. After accepting any control inputs called for by sense switches 2 and 3, the figure is re-drawn. If the switch is OFF, the paper does not move; the pen returns to the origin; and control is returned to the "Grafacon" input program. Since the origin remains the same, this feature can be used to add data to an existing drawing.

Sense Switch No. 6 — This switch provides for a permanent output of the data point array. If the switch is ON, the x,y, and z coordinates are punched on cards, along with an identifying number. Thus, a particular set of input points can be saved and stored away for later viewing. Moreover, this provides for the capability of combining drawings to represent, for example, a campus master plan.

APPLYING THE SYSTEM

If the viewpoint for the perspective is preset and indicated either on the drawing to be input (or upon the template as shown in Fig. 2), a great many, if not all, of the "hidden lines" can be removed from the perspective drawing. This is done simply by noting at the time of input which points of the data array are visible from the preset viewpoint. As an aid in performing this task at the time of input, a template may have a family of rays emanating from the viewing point. Inputting is, of course, somewhat more laborious if one is trying to eliminate the hidden lines. Many "new" elevations are required as some of the lines of the figure are masked by portions which are in the foreground.

The time required to input the data for a drawing depends on its complexity. Input times range from as little as a few seconds to as much as perhaps 10 minutes for a very complex view with most hidden lines removed. Many interior details such as beams, couches, fireplace, people, etc., obviously require considerable input time. Figures 6 through 12 show examples of these extremes, along with drawings intermediary in difficulty. For the IBM 1800 computer the computational time for this program is negligible. The plotting time depends principally on the scale to which the figure is drawn. For very large complex figures, a drawing can take up to 5 minutes, whereas small drawings can often be made in a matter of seconds.

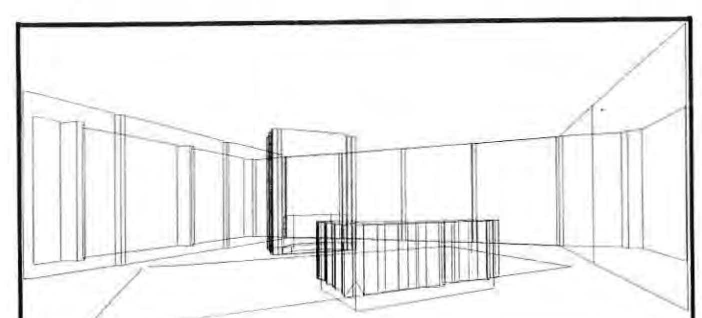
CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK

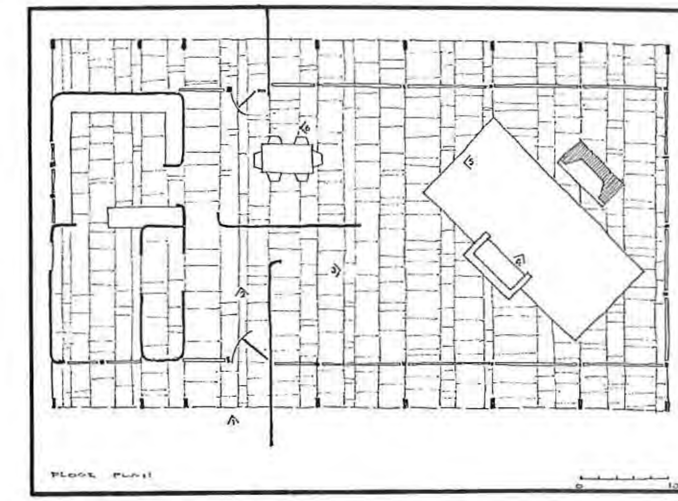
The specific objectives of this work have been successfully realized by the development of a flexible graphical input system which is convenient to use during a design process. The concept of pretesting with simulation is feasible with these tools and the system allows convenient access of a powerful objective consultant. The operational procedure may be used for personal considerations of solutions as well as for communications which pass beyond our personal sphere. Experiments have shown that the system may be used in a rapid-time analysis of a proposal-state design.

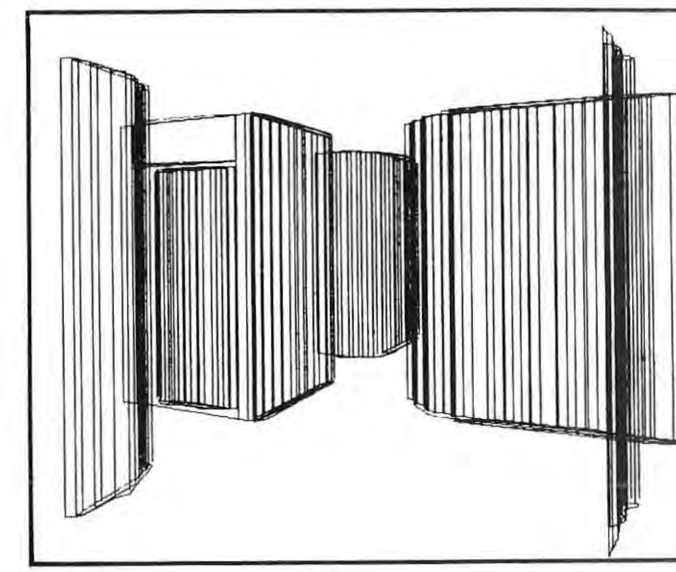
Future work may include the development of an apparatus similar (not necessarily in principle) to the Grafacon but considerably larger in format and less expensive. Such a device might resemble a conventional drafting machine and utilize a sensitized marking pen which directly records the input data thus eliminating the expensive CRT monitor. An output format should be developed which utilizes overlays and various photographic techniques. Various three-dimensional display techniques are now under development and some of these may prove effective for the display of ideas.

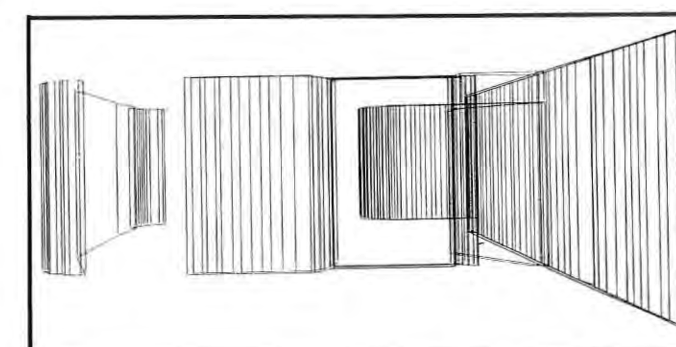
It is often convenient to operate on vertical-plane sections (elevations) as well as horizontal-plane "floor plans". One of the systems options allows the user to imagine the Grafacon tablet represents a vertical plane in space. The following sketches illustrate this capability.

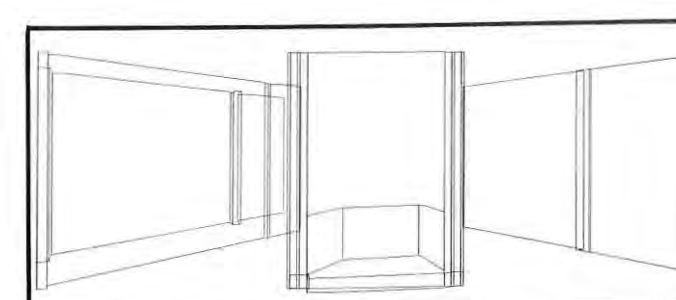
Illustrations one through six correspond to the six viewing points on the preceeding floor plan. It is emphasized that these are *working sketches* for use during the process of progressive modification of a design.

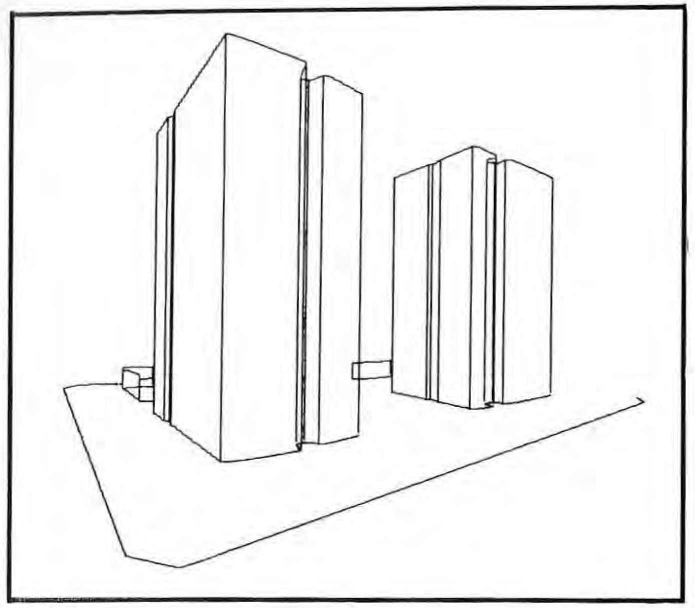


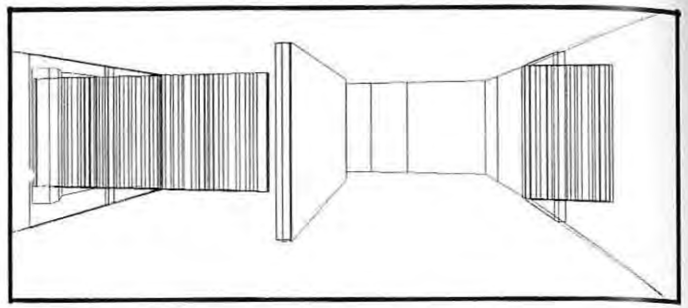


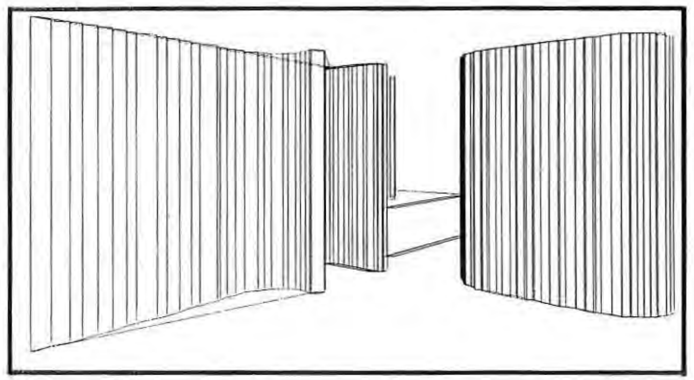


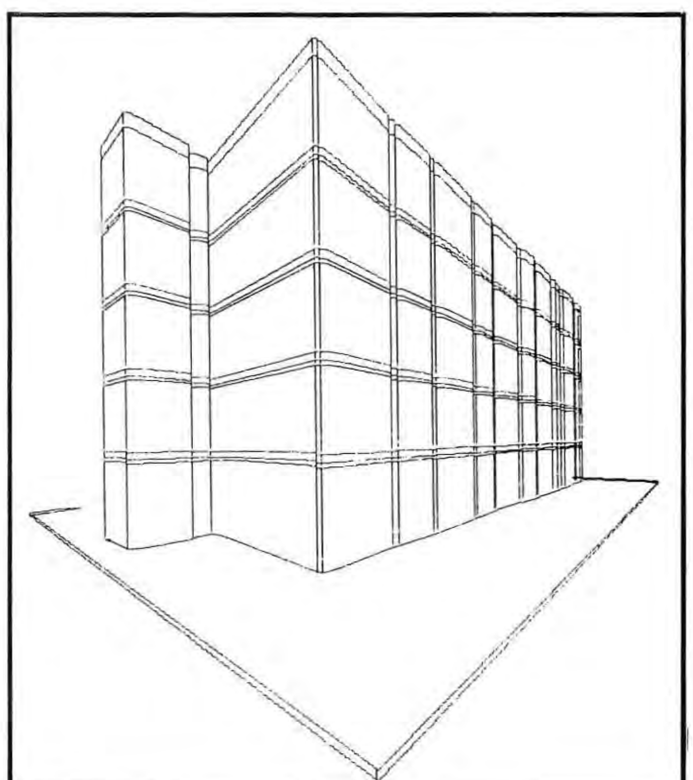












ACKNOWLEDGEMENT

The authors wish to acknowledge the assistance of Mr. Gordon Buck of the University of California Santa Barbara, who modified his Grafacon input program to produce GRAF. The authors are also indebted to Mr. Lloyd Dennis Grubbs who provided valuable assistance in solving perplexing hardware problems.

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BIOGRAPHY

ROGER C. WOOD received his BS (1954) and MS (1956) from the University of Minnesota and his Ph.D. (1966) from UCLA. He was with Ryan Aeronautical Company for five years and with System Development Corporation for six years before joining the faculty of the Electrical Engineering Department at UCSB in 1965. He is coauthor of a textbook and of a number of technical papers in the areas of computer applications, communications theory, and operations research.

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The distribution of illumination

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ABSTRACT

This paper deals with the distribution of illumination between working (reading) surfaces and display surfaces where excess illumination reduces contrast. It is based on equations given in the Illuminating Engineering Society Handbook. It shows how the data may be organized to permit easy estimates of the effects of painting surfaces, interposing shades, etc.

In data centers it is frequently necessary to provide sufficient illumination at the operating desk to permit the comfortable reading of hard copy, while restricting illumination on a critical area, as on a projection screen, to permit achieving good contrast. To provide this distribution the designer has as tools the selection of the size, type, and placing of the luminaire, the use of shades, and the painting of nearby surfaces. It is the purpose of this paper to show how the design computation may be made to a reasonable accuracy without complete specification on the luminaire and without excessive labor.

Illumination may fall on the desk or the critical area by either of two routes — directly from the luminaire, and indirectly via intervening surfaces. The equations for the direct illumination of the point "P" on any surface are given in Fig 1, where E_d is the direct illumination in foot-candles, B_1 is the brightness of the source in foot-lamberts, the dimensions are in feet, the angles are in radians, and the line M is at one end of the source and perpendicular to its axis. (These and the equations in Fig. 2 are from Appendix A of the Handbook of the Illuminating Engineering Society, with their permission) For these equations the notation "spherical" means that the source has a light distribution pattern shaped like a tangent sphere (a distribution following Lambert's law). This includes all luminaires whose light flux issues through a diffusing plate. The notation "toroidal" means the light distribution approximated by a bare fluorescent lamp.

Assuming the surface at the point P to be a diffuse reflector, a condition most surfaces approximate fairly well, the brightness of the surface in foot-Lamberts is $B_n = E_d\ Q_n$ where E_d is the incident illumination and Q_n is the reflectivity of the surface. This brightness will also exist over the surrounding area so long as the distance from the source and the angle to the source are not greatly changed. The selection of the dimensions of the "surrounding area" is a matter of personal judgement, the wish for precision leading to a small area and the wish for a reasonably short computation

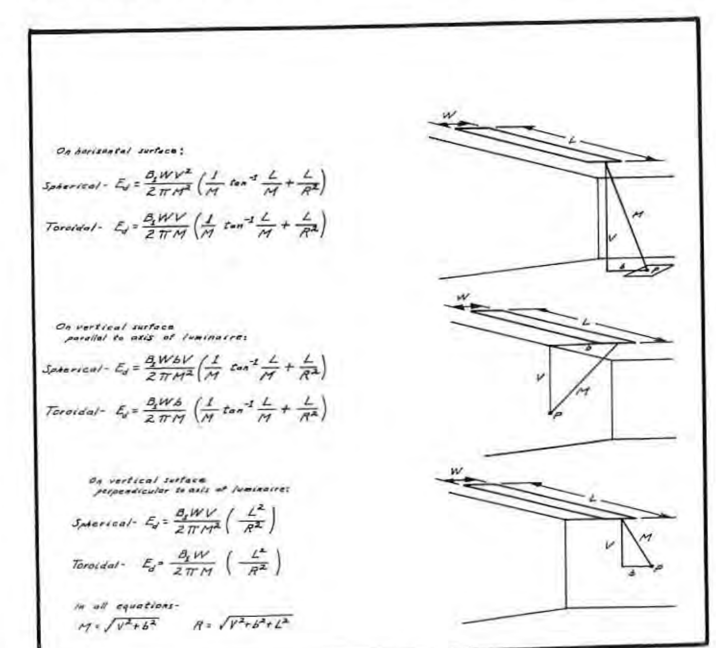

FIG. 1: Equations for direct illumination.

leading to a large area. In making this choice one must consider the accuracy of the input data and the precision with which the design decisions will be carried out, and a highly precise calculation is rarely warranted.

The equations for the indirect illumination of the point P by any interviewing surface are given in Fig. 2, where E_n is the illumination in foot-candles from the nth surface falling on the point P, B_n is the brightness of that surface in foot-Lamberts, the dimensions are in feet, the angles are in radians, and the line D is perpendicular to the intervening surface. (Remember that the ceiling is an intervening surface when an indirect luminaire is used.)

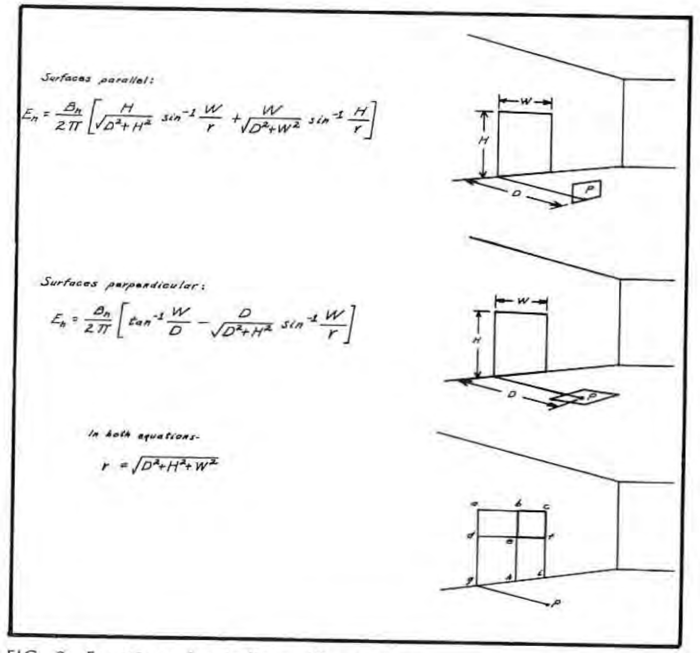

FIG. 2: Equations for indirect illumination.

Of course each intervening surface illuminates each other intervening surface, the light reverberating in the closed chamber, and this additional illumination must be considered in any precise calculation. But each reflection is accomplished by a loss, so the illumination contributed by successive reflections becomes smaller and smaller. Again considering the precision with which one can get the data and carry out the decisions, there is doubt that the inclusion of more than one reflection is warranted. (The ratio of direct to once-reflected illumination in the example below lends strength to this opinion.)

The effect of sources or intervening surfaces with more complex shapes may be found by summing the effects of the component sub-areas, with proper attention to sign. Thus if the surface extends on both sides of the normal from the point P, its effect may be computed as the sum of the effects of two surfaces, one on each side of that line. If it falls short of the normal from the point P, its effect may be computed as the sum of the effects of two surfaces, one (the missing part) contributing a negative illumination. And the effect of an isolated area such as b, c, f, e in Fig. 2 may be found by adding the effects of areas a,c,i,g, and d,e,h,g, then subtracting the sum of the effects of areas a,b,h,g and d,f,i,g,.

The total illumination is

$$E = E_d + \Sigma E_n$$

Both E_d and E_n are of the form $E = CB_1$, where C is a constant for each area. For direct illumination the value of C is defined completely by the geometric relations indicated in Fig. 1 For indirect illumination C takes the form $C_1Q_nC_n$, where C_1 is established by the geometric relation of the luminaire to the intervening surface (Fig. 1), Q_n is the reflectivity of the intervening surface, and C_n is established by the geometric relation between the intervening surface and the point P (Fig. 2).

Once the values of the individual C's have been established for a given set of conditions, the computation may be made in the following steps:

a) Sum the C's for the illumination of the desk.
b) Using this value and the value of illumination required on the surface of the desk, compute the brightness required of the luminaire.
c) Sum the C's for the illumination of the critical area.
d) Using this value and the brightness of the luminaire, compute the illustration falling on the critical area.

If the illumination on the critical area is too high, it may be lowered by interposing a shade so as to block one path of illumination, or by darkening one or more surfaces so as to reduce their reflectivity, hence their contribution to the illumination. In the computation these steps require merely eliminating the value of C corresponding to the blocked path or changing the value of Q for the repainted surface

To illustrate the process, consider the arrangement shown in Fig. 3, wherein it is planned that the luminaire will extend almost from wall to wall, covering three operator's desks side by side. It is assumed for the example that an illumination of 15 foot-candle is required on the desk top, that the luminaire includes a diffusing screen set flush with the ceiling, and that the illumination falling on the projection screen must be limited. With the assumed dimensions the values of C are as indicated in Table 1.

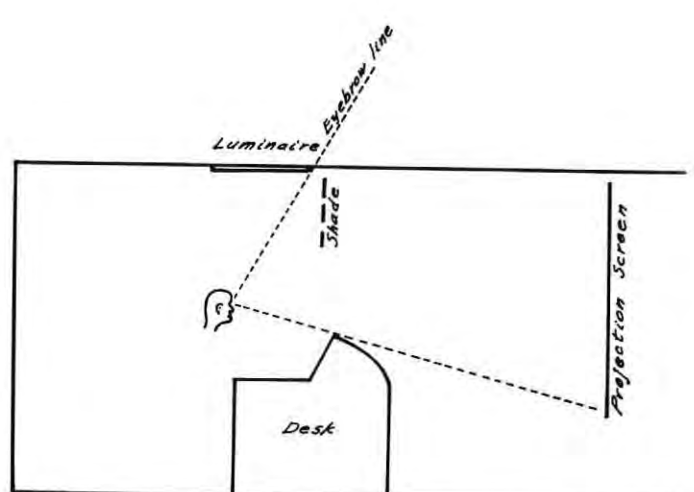

FIG. 3: Arangement used for an example.

With no shade and with pearl gray paint throughout, the computation is as indicated in Table 2, where it is shown that the brightness of the diffusing screen in the luminaire must be 70 foot-Lambert and that this brightness causes an illumination of 3¼ foot-candle on the projection screen.

Assuming for the illustration that this is intolerably high, let us consider the effect of painting the back wall black and adding a shade between the luminaire and the projection screen. The computation, shown in Table 3, indicates that the illumination falling on the projection screen is now 0.57 foot-candle. ■

TABLE 1:

Values of C for Assumed Dimensions

Arrangement of Fig. 3

Illumination Path		Value of C
From	To	
Luminaire	Desk	.213
Luminaire	Projection Screen	.036
Luminaire	Rear Wall	.057
Luminaire	Side Wall (either)	.13
Luminaire	Shade	.293
Rear Wall	Desk	.045
Rear Wall	Projection Screen	.118
Side Walls (both)	Desk	.028
Side Walls (both)	Projection Screen	.120
Shade	Desk	.062

TABLE 2:

Distribution of Illumination
Original Conditions

Illumination on Desk

Via	C_1	Q_n	C_n	C
Direct				.213
Rear Wall	.057	.5	.045	.0013
Side Walls	.13	.5	.028	.0018
			Total	.216

15 ft-c / .216 = 69.5 ft-L required of luminaire

Illumination on Projection Screen

Via	C_1	Q_n	C_n	C
Direct				.036
Rear Wall	.057	.5	.118	.0033
Side Walls	.13	.5	.120	.0078
			Total	.0471

69.5 ft-L x .047 = 3.26 ft-c on projection screen

TABLE 3:

Distribution of Illumination
Rear Wall Painted Black and Shade Added

Illumination on Desk

Via	C_1	Q_n	C_n	C
Direct				.213
Rear Wall	.057	.1	.045	.0003
Side Walls	.13	.5	.028	.0018
Shade	.293	.5	.062	.0091
			Total	.224

15 ft-c / .224 = 67 ft-L required of luminaire

Illumination on Projection Screen

Via	C_1	Q_n	C_n	C
Direct				0
Side Walls	.13	.5	.120	.0078
Rear Wall	.057	.1	.118	.0007
			Total	.0085

67 ft-L x .0085 = .57 ft-C on projection screen

A. C. STOCKER graduated from Ohio State University in 1928, and had his first contact with displays in 1930 when he joined a television development group. He has had wide experience in system synthesis and equipment design; he holds thirty-nine patents, fifteen related to displays.

He served in the Navy during World War II, learning about installation at a navy yard, about operations with an amphibious force, and about maintenance with a service squadron. His interest in the problems of command centers stems from service on the staff of a Commander, Amphibious Force, where he designed the display facilities on the first Command/Communications ship and took part in the invasion of Sicily. He holds the rank of Commander, USNR, Retired.

Since the war he has contributed to a number of studies of data handling for command, including the Naval Tactical Data System and the NORAD and other command centers. For seven years he was the display specialist in an RCA systems engineering group. These works led him to believe that the greatest opportunity for improvement in displays is in the details of their application.

Mr. Stocker is presently a Senior Engineer with the RCA Service Company Cherry Hill, New Jersey.

JTM-CRT means of setting printers' type electronically

by JOSEPH T. McNANEY

A novel cathode ray tube*, called the JTM display tube, is designed to store a wide variety of printers' type font, select any desired series of type, control type size and display, as lines of type, for printing at speeds of many thousands of characters per second.

With this new concept each character is stored, in a matrix of the tube, as an array of small apertures which convert a primary electron beam into a character shaped arrangement of minor electron streams. A matrix containing 100 different letters, numerals, etc., will contain a total of 100 corresponding arrays of apertures, each array overlapping one another in the same general area of the matrix.

Each of the 100 arrays may be comprised of several hundred, or several thousand, apertures for providing the character shaped arrangement of electron streams. Each stream, therefore, will be a type font resolving bit, and each arrangement will be capable of presenting characters of high quality. Since the formation of all of the characters takes place on a common axis of the optical system in the tube, the line-of type registration of characters on the viewing screen will be readily accomplished.

In a description of the JTM display tube which follows reference will be made to the use of 30 x 30 arrays of beams from which characters will be formed; however, arrays up to 60 x 60 may also be utilized. This would depend on application requirements in regard to print quality.

A simplified diagram of this tube is shown in Fig. 1, and supplementary diagrams of Figures 2 and 3 will be referred to in describing the character storing and forming matrix assembly. This assembly includes a matrix of overlapping characters and a character selection mask supported in the path of an electron beam between the gun and the screen. The primary and secondary coils will be used to make the required selections of characters to be displayed on the screen and the final deflection unit will effect the line of type positioning of the characters on the display screen. The mask focusing lens will control the size and imaging of the characters at the screen.

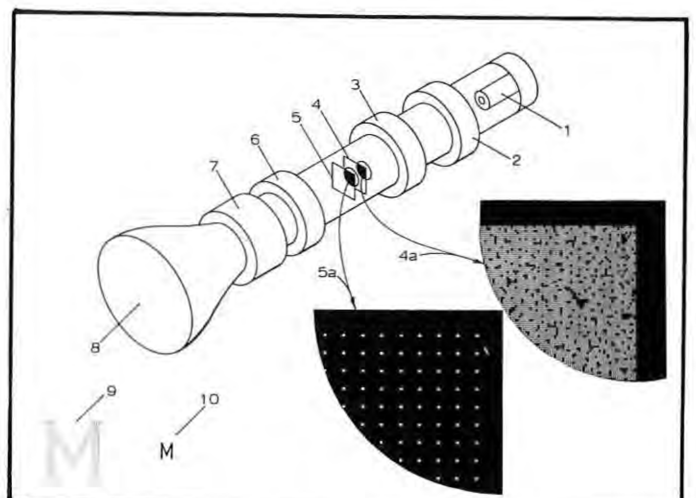

FIGURE 1: Display Tube Components: Simplified diagram.

The enlarged portion of the matrix in Fig. 1 shows a definite lack of intelligible information by reason of the fact that all of the character information it may contain is overlapping and thereby somewhat ambiguous until it has been reciphered. The selection mask and control of the angular approach of electrons toward the matrix will be used for this purpose.

The function and make-up of the mask and matrix assembly can be explained in connection with Fig. 2 and Fig 3. In Fig. 2 an enlarged, but limited portion, of the matrix and mask combination is illustrated. Instead of showing apertures through which electrons may pass, however, a portion of the matrix has been drawn to show an orderly arrangement of horizontal and vertical lines presenting cross over points at which apertures may be engraved for the passage of electron beams. As indicated, these cross over points fall within subareas A-1, A-2, A-3, etc., B-1, B-2, etc. and each sub-area contains a 10 x 10 array of the crossover points.

Since each sub-area contains a 10 x 10 array of cross over points at which an aperture, or type font resolving bit, may be inserted, such a matrix will store up to 100 different characters. And the number of sub-areas in the matrix is related to the type font resolving capabilities of the JTM display tube. A 30 x 30 array has 900 sub-areas.

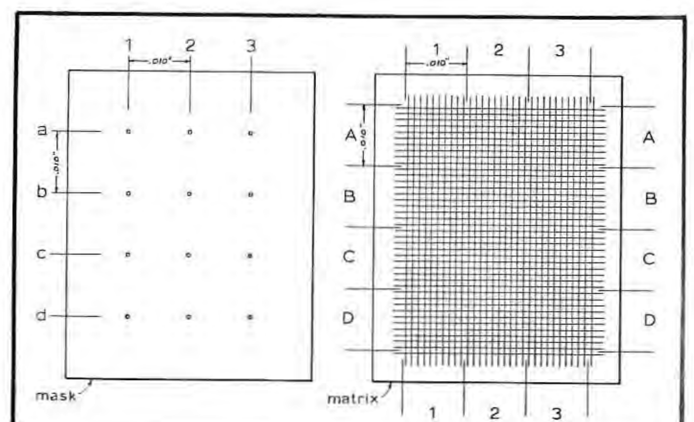

FIGURE 2: Enlarged, limited portion of matrix and mask combination.

The diagram of the mask shows a 4 x 3 array of openings and this array corresponds to the 4 x 3 array of sub-areas in the matrix. Each sub-area is thereby provided with a mask opening to which it may be optically related. It may be noted that the dimensions, .01" x .01", of each sub-area are equal to the center-to-center spacings of the openings in the mask. A 30 x 30 array of these sub-areas will measure .3" x .3".

If, by way of example, the matrix were to be placed directly on the mask, and properly oriented therewith, each of the openings in the mask could be brought, successively, in optical alignment with corresponding cross over points of the sub-areas. Then by moving the matrix in horizontal and/or vertical directions, in relation to the mask, each of the 100 different cross over points of each sub-area could be selectively aligned with a corresponding opening in the mask.

From the description thus far, it is probably apparent that at each of the 100 different cross over point positions of a sub-area apertures may, or may not, be inserted. This, of course, will be determined by the number and type of characters to be stored in the matrix. Having engraved the apertures accordingly, there might be a total of 100 different characters, all overlapping one another, in the same general area of the matrix. By then directing a beam of light at the matrix, while changing the X-Y position of the matrix with respect to the mask, each of the characters could be viewed singly at their correspondingly arranged openings in the mask.

It should be clearly noted, however, that in the JTM display tube the matrix is exposed to a source of electrons, and not light radiation. By controlling the angular approach of the electrons in the direction of the matrix the openings in the mask will be illuminated with character shaped arrangements of electron beams, from the matrix, as a function of the approach angle of the electrons.

To illustrate further the character generation aspects of this tube, a single sub-area of 100 cross over points of the matrix is shown in Fig. 3, in combination with a single beam selection opening of the mask. In this particular sub-area there are openings at cross over points identified as 1 - j, 6 - g and 8 - b. In the envelope of the JTM display tube the mask will be forward of the matrix a few tenths of an inch, or more, and when electrons from the gun follow a direct path to the matrix those electrons reaching the mask through the three openings shown in the matrix will be absorbed by the solid portion of the mask. In fact, while on a direct path the electrons will be blocked passage through the mask even though there happens to be an aperture at each of the 100 cross over points in the sub-area.

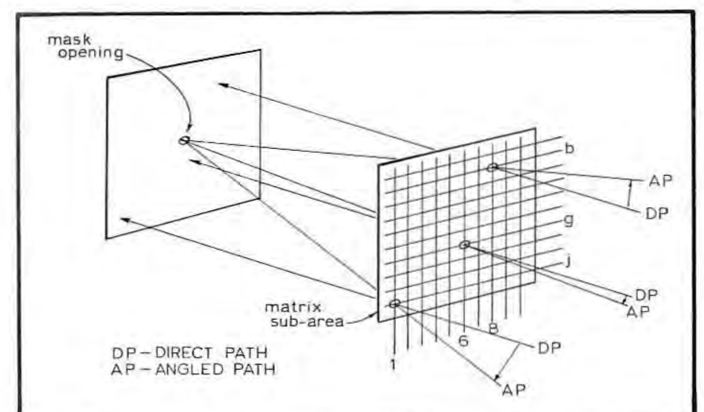

FIGURE 3: A single sub-area of 100 cross over points of matrix in combination with single beam selection opening of mask.

Only while following a particular angled path will electrons be able to reach the opening in the mask after having passed through an aperture in the matrix. The angled paths of electrons that reach the opening in the mask through the apertures 1-j, 6-g and 8-b correspond with the respective positions of these apertures in the sub-area illustrated.

An examination of each of the 900 sub-areas appearing in a complete matrix will show that they all function in a like manner. They differ from one another only in that they contribute to the formation of but one particular element of the character being selected for display.

The selection of a character from the matrix for display begins with the coupling of a set of control currents to the primary and secondary selection coils. Electric fields resulting therefrom establishes the path to be followed by the electron beam from the gun to the matrix and mask assembly. Upon such selection a character shaped arrangement of openings in the mask will have been illuminated with electrons. These illuminated openings are then imaged on the display screen by the mask focusing lens of the tube.

In Fig. 1, an example of a letter M is shown as it will appear, electronically, at the plane of the mask openings, and then as it will appear at the display screen as a light image. In view of the dimensions set forth, the letter M at the mask will be composed of a corresponding arrangement of electron beam cross sections; each cross section being .001" in diameter, or less, on .010" center-to-center spacings.

Subsequent influence on this letter M arrangement of electron beams will cause it to be reduced in overall dimensions, if necessary, imaged on the display screen, and converted to a solid tone appearance. The size of the letter M will be controlled by the lens action of the focusing coil, but the individual electron streams from the openings in the mask will be controlled independent of the focusing coil, so as to provide a solid tone character. This will be accompanied by a relatively small spiralling of the character being displayed and thereby illuminate areas of the screen which are larger than those of the spot size beams from each of the openings in the mask.

The final deflection unit, in addition to receiving the necessary deflection currents for positioning lines of type on the screen, will receive small, but high speed, deflection currents to effect the necessary movement of the type for changing the fractional tone of each type face to the solid tone.

It is believed that the storage capacity of 100 characters in a single JTM display tube, in addition to readily changing their size to cover an almost infinite range of sizes, should satisfy a very large number of graphic arts printer applications. The latter is true especially in light of the print resolving capabilities of this electron device. The ability to generate all characters on a common optical axis of the tube lends itself to straight line of type displays. This is not so easily accomplished in many other cathode ray tube printing approachs. The character selection mask and matrix principle of this new tube, therefore, actually forms each and every one of its characters at a common plane, and on a common axis, independent of any external circuitry functions, or character malformations resulting therefrom.

JOSEPH T. McNANEY is a registered professional engineer in electrical engineering and a senior member of the IEEE. He was with General Dynamics Corporation as technical director of the Stromberg-Carlson Division, San Diego, until 1960. Mr. McNaney has since been engaged in independent research and development in connection with high-speed data processing, printers and displays. The JTM-Display tube patent is the 105th patent granted Mr. McNaney since his original Charactron tube patent issued in 1942.

*U.S. Patent No. 3,329,858

Character font design on a graphic display

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The traditional method of designing a character font is by using a drafting technique. Characters are laid out on a piece of grid paper several times the size desired, and then photographically reduced to the proper size. The obvious problem in constructing character fonts manually is the inability to quickly change the shape and size of the characters being designed. In addition, the appearance of the character on paper is different from its appearance on the CRT.

An experimental program has been written for the IBM 2250 display unit to assist in the designing and evaluating of character fonts for use on CRT displays. The program can generate the CRT characters in two ways: by a series of short vectors or by plotting points.

The font design program allows a designer to sit at the display console and generate, evaluate, and modify character designs iteratively, in real time. The program can handle up to 256 character fonts at one time. The actual design is performed with a light pen. By using only the pen, the program can guide the designer, reducing both errors and the error checking required.

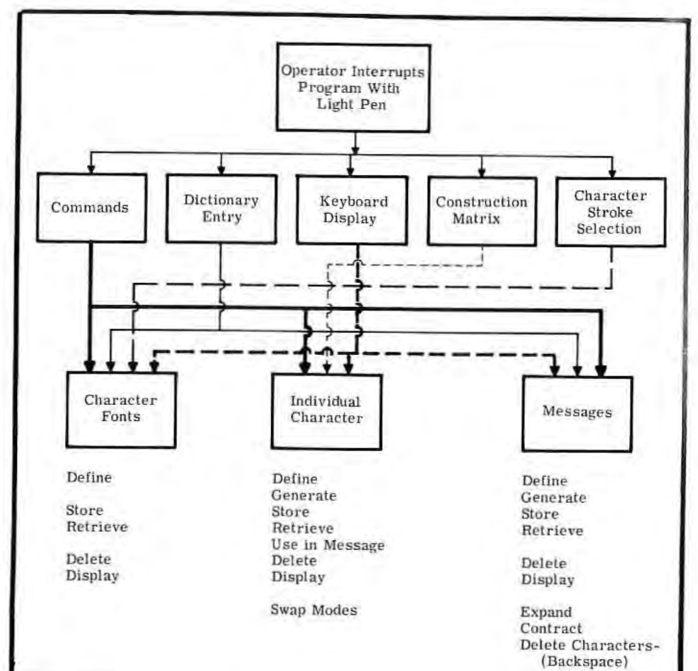
After a font has been designed or its size, shape, or spacing altered, it can be displayed in test messages for checking its appearance and legibility under actual operating conditions. When a design has been completed, it can be stored on a disk.

PROGRAM STRUCTURE

The program operates in a "conversational mode" — reciprocal exchange of messages between designer and computer — with the font designer seated at the display unit. The designer requests the computer to perform all functions by selecting, with a light pen, control words or phrases displayed on the CRT screen. The resulting interruption of the computer is analyzed by the program, and control is transferred to a light-pen-interrupt-service subroutine.

The light-pen interrupt routine sorts the light pen interrupts into one of five general classifications of action which can be taken:

- *Commands.* Nine primary commands are displayed together on the screen selecting the various options required in font design. Two of these have secondary commands which are displayed when the primary commands are selected with a light pen. The commands are:
  - Define font
  - Get font
  - File font
  - Delete font
  - Select character
    - Define character unit
    - Define character position
    - Define new vector
    - Delete old vector
    - Store character
  - Swap mode (go from vector point plot mode or vice versa)
  - Define message
  - Delete message
  - Display message
    - Expand message
    - Contract message
    - Backspace (delete characters from message going right to left



Character generation program functions. Five classes of action are performed on three communication components, resulting in functions listed at bottom of diagram.

- *Character Stroke Selection.* The operator identifies the character strokes to be detected by the program.
- *Construction Matrix.* A square, dot pattern that indicates assignable points of a character — which is used as end points — is displayed on the screen. Any number of points within the 32-by-32 matrix selected by the font designer can be used to define character spacing, size, and position, and vector locations.
- *Dictionary entry.* Two types of dictionaries are stored and maintained by the program: one for storing fonts which have been defined, the other for storing test messages which have been entered. From these dictionaries the designer selects the font or message to be used in subsequent operations.
- *Keyboard Display.* A 248-keyboard is displayed at the bottom of the screen. The keyboard consists of four identical 62-character sets of letters (upper and lower cases), numbers, and special characters. A key is "depressed" by pointing at it with the light pen. The keyboard display is used to assign names to font and message definitions, and to select characters for design and modification.

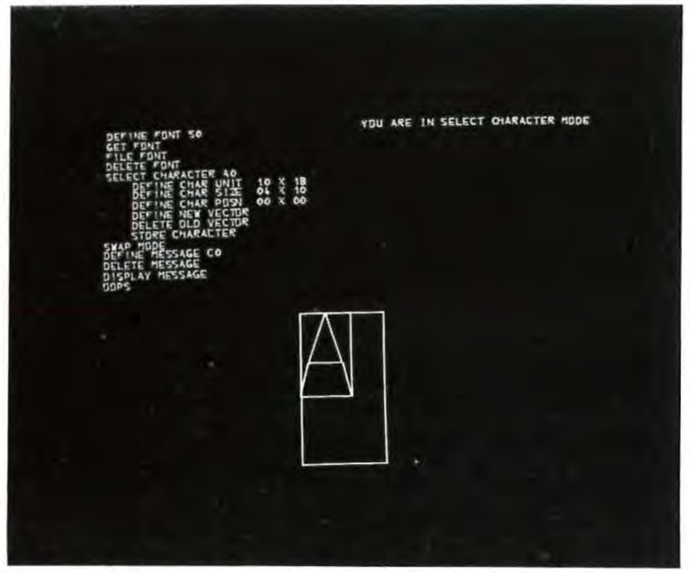
The interrupt codes are further subdivided for routing to separate routines. Each subroutine performs the functions which are unique to the particular operator action, and then sets a code for the display routine. When these two functions have been completed, control is transferred to the display routine. The display routine turns certain control phrases on or off, and generates the proper character or message display. The display buffer is then updated and the display regeneration is restarted. At this point, an exit is made to the operating system to restore the program that was in progress before the interrupt occurred.

The most complex part of the program is concerned with the storage and retrieval of the generated data. Storage allocation must be flexible, and there must be a capability to relate information fragments. For example, the program must be able to handle several fonts as a group, or a single font, or a single character within a font. Also, since character designs constantly change, an easy method of storing and changing the data is required. To solve these problems, a list-type structure is used to contain the data. A basic set of list-handling subroutines is used to generate, connect, disconnect, and delete the list blocks. In addition, there is a selective search routine which follows a list and interprets two control codes contained in storage blocks. The list approach appears to work quite well, and tends to utilize storage effectively.

Operator has just defined a character on an IBM 2250 Display Unit, using a font-design program. The nine primary commands and one set of secondary commands used to direct program are displayed in upper left-hand corner of screen.

The basic storage block for character design is 36 words. The first two are used by the list-processing routines for the control codes and address linkages. The next two words contain the character code, spacing, size, and offset parameters. These parameters control the character-to-character spacing, the space available to the character within the spacing matrix, and the position of the character in the spacing matrix, respectively. The balance of the block (32 words) is used to store the stroke information needed to generate the character. Each word consists of four one-byte entries specifying the beginning and ending points for the strokes.

A message is stored in a 66-word block. Again, the first two words are used by the list-handling routines, and the next word is used to indicate the number of characters which are contained in the present message. The balance of the block is used to store character codes, one per byte.



A character has been selected from the font dictionary prior to redesign. Outer box defines total space available for character, including spacing to next character. This feature permits generation of proportional spacing if desired.

PROGRAM OPERATIONS

The characters that can be used are those contained in the displayed keyboard. When a font is defined, the program generates, in computer memory, a list of "null characters" — areas reserved for characters. If the operator chooses to use a previously defined font, he selects an option which causes a font dictionary to be displayed — a list of font names which already have been defined to the system. The program will determine if the font is in core storage. If it is not, it will be loaded from disk, and core storage space will be allocated.

One of several test messages stored by the program has been displayed, using a newly-defined font. This facility permits designer to evaluate spacing, balance, etc., of characters in continuous text. Light pen keyboard is displayed at bottom of screen.

CHARACTER OPERATIONS

A number of character parameters can be established or modified. First, the character spacing, size, and local positioning are variable. The character-to-character spacing specifies the total area used by this character on the display. A "character size" parameter specifies what subarea of the character unit is actually to be used for the character display. A third parameter called "character position" defines the character's position within the character unit.

Secondly, the character-stroke data can be defined or deleted. To add a stroke, the operator selects the "Define New Vector" option. This action causes a point matrix to be superimposed on the present character description. The designer selects two points, corresponding to the two end points of the stroke. When the first point is selected, it will be intensified on the screen to indicate the selection. When the second point is selected, the stroke is displayed.

The character modifications are performed by the program in a "scratch area" — a separate block of core memory. When the designer is satisfied with the character design, he transfers the contents of the scratch area to a storage block which then becomes part of the font description. If a previous definition is present at the time that the store option is selected, the new definition replaces it.

MESSAGE OPERATIONS

Messages can be defined, displayed, or deleted. To define a message, the operator is asked to supply a name for the message, as in the "Define Font" operation. A message block is generated and the block is cleared. The operator then keys in the message.

To display a message, he selects the "Display Message" option and a message dictionary list is presented. Selection of a dictionary entry causes the corresponding message to be displayed using the currently selected font. He can add to the message at this time by selecting characters from the keyboard. As each character is selected, it is entered into the message block, after which the displayed image is updated to reflect the new message text. Message characters can also be deleted.

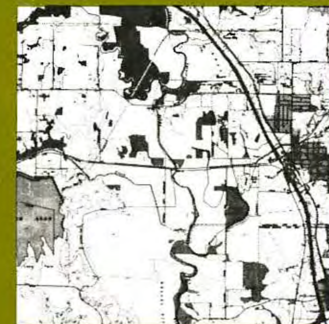
The size of the characters within the message can be scaled up or down. The scale factor is an integer value which determines the ratio of display raster units to character units. This ratio, in the 2250 display, has a minimum value of one; i.e., each unit-length stroke becomes one raster unit long on the screen. The scale factor can be increased or decreased by selecting options. Each selection causes the scale factor to be changed by a value of one.

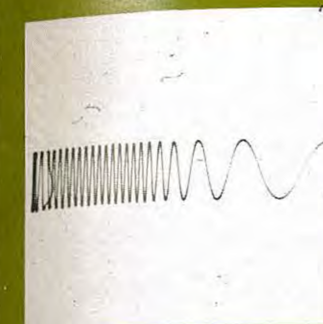
The program also has a capability to generate characters, using a series of individual points to approximate a stroke.

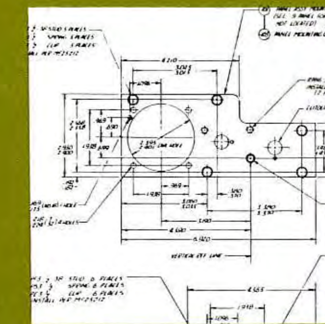
CONCLUSIONS

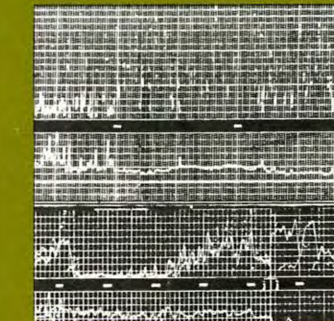
The program was written at the request of a display engineering group which has used it for font definition and evaluation. The font designers are convinced that it has saved them a large amount of design-cycle time. They also believe that it has saved money, since they no longer consider it necessary to make hardware mock-ups to verify the designs. ■

J. BRUCE DAMERELL is a system analyst in graphic development for IBM Corporation, Kingston, N.Y. He has worked with displays, both as an analyst and programmer, since 1962. He has a degree in electronics from Valparaiso Technical Institute.









Human Sophistication — machine precision

Information International is a pioneer in automatic image analysis — the computer-directed interpretation of graphic information. This new technology is a fundamental step upward from simple storage, retrieval, and conversion of information on film. It introduces pattern recognition and decision making into the transfer process, thus combining human sophistication and machine precision.

Equipment to perform these complex functions has been under development at Information International for several years, and numerous systems have been installed for a variety of applications. Common to all is a computer controlled electronic light source of extremely high speed and resolution. Under program control this electronic/optical system can read or record images selectively, that is, transferring only information of interest to or from digital storage. The system can be programmed to process a large quantity of images automatically, or it can interact with an operator via CRT display and light pen in a "creative" mode. All systems designed by Information International are general purpose in nature. They can be programmed for virtually any image analysis problem.

The most recent system to emerge from our development program is Programmable Film Reader-3 described in detail below. To get an idea of PFR-3's capability, we can summarize just one of the tasks it is now performing, the reading of theodolite film (cover photo). Here the objective is to extract azimuth and elevation readings from dials whose images appear in each of thousands of frames on 35 MM film.

To do this, the system must first locate the image of the dials (which vary somewhat from frame to frame), recognize two sets of arabic numerals, locate markers on the dial faces, and convert the marker positions into numerical form accurate to 1/1000 of a degree (.01 mm on the film). All the information thus derived is digitized in real time for output to magnetic tape.

The PFR-3 records on film too, with equivalent sophistication and precision. Recording programs expose selected points with variable intensity and resolution, converting computer-generated data into text or graphics on microfilm.

It is important to realize that the Programmable Film Reader finds and extracts data selectively from the film at a speed fast enough for bulk processing. This scanning technique is a significant improvement over conventional "flying spot" techniques, in that the latter are forced to gather and store all data points on the raster. To hold that much data requires a very large memory, and extensive processing is subsequently required to extract the information of interest.

Programmable Film Reader-3

Programmable Film Reader-3 automatically reads or writes visual data at high speed and resolution. A built-in general purpose digital computer contains decision-making logic and provides control of a high resolution electronic/optical scanning system. Film (16, 35, or 70 mm) is read at a rate of up to 200,000 data points per second and advanced automatically. A display scope allows the operator to monitor the film reading process. Output is in digital form on magnetic tape compatible with IBM format.

System Components

Optical-Mechanical Unit

Contains film handling equipment and primary, reference, and projection optical systems together with photomultipliers and associated control and monitoring devices. Image focus, image size, and orientation angle of the film being viewed can be adjusted.

Signal Processing and Logic Unit

Electronic circuitry to process the photo-multiplier output and perform density comparisons. Processed output is relayed to the Scan Control and Monitor Unit to govern further film scanning actions.

Programmable Light Source

A point-plotting cathode ray tube with various degrees of resolution. x and y coordinates are displayed as a spot of light on the tube face. Light points may be plotted at rates as high as 1 point every 5 microseconds. Magnetic deflection and focusing techniques result in a uniform resolution over the entire usable area of the face. Eight levels of intensity are available.

Scan Control and Monitor Unit

A high speed digital computer to operate the film reading system under the guidance of an appropriate program. Program features include: single address instructions, multiple step indirect addressing and logical arithmetic commands. The word length is 18 binary digits. Special film reading instructions control input of status information to the Scan Control and Monitoring Unit, positioning of the light spot, density decision requests, and forward and reverse film motion.

The magnetic core memory of the Scan Control and Monitoring Unit holds 8192 words of 18 bits each. Cycle time is 1.0 microseconds. It may be expanded, in increments of 4096 words, to a maximum of 32,768 words.

Display Equipment

A 21-inch CRT with light pen and many controls allowing operator monitoring and control of the entire film reading process. Analog sweep and character and vector generator can be included.

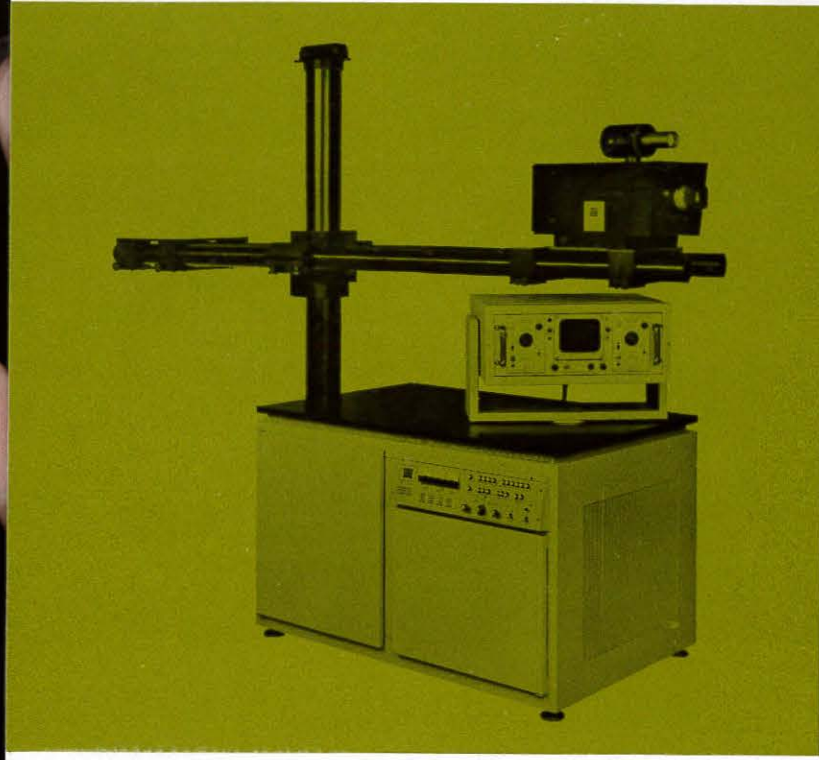
Options

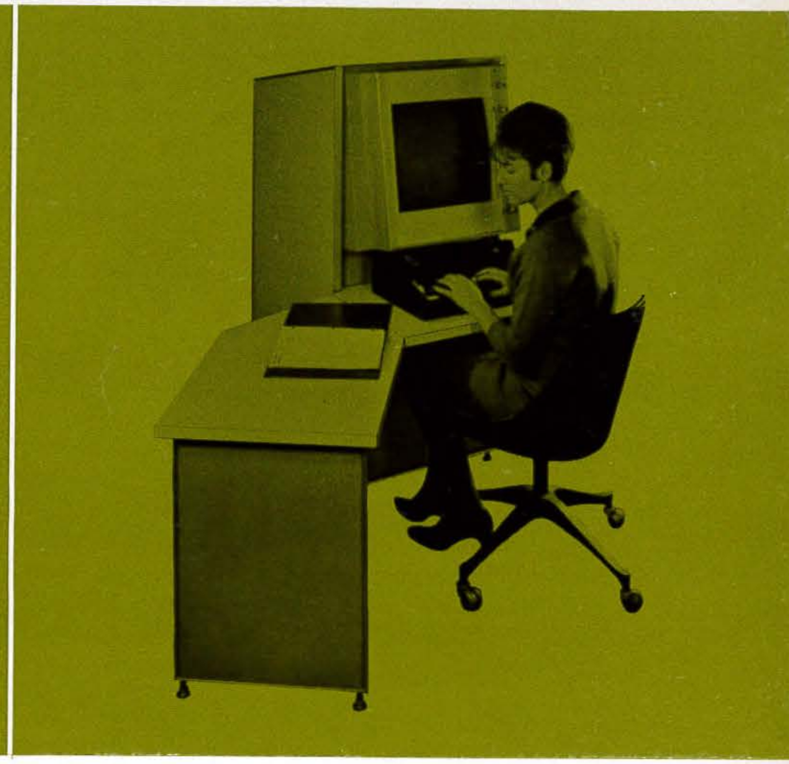
Magnetic Tape Equipment

Character- and word-transfer systems of low and medium densities. Compatible with IBM format.

Density Detection Equipment

Includes 2-level or 64-level density detection and a program-controlled density threshold detector. Density range 0.0 to 3.0.





The Computer Eye

Our Computer Eye is an optical input system combined with a general purpose computer which can measure and interpret real world scenes. The sensor of the eye differs from a TV camera in that it selectively examines points of interest under program control. In many respects the Computer Eye is equivalent in sophistication to the PFR-3, but the Eye responds in real time to external events.

An industrial application, for example, would be automatic quality control of manufactured parts, where the Eye commanded production line equipment. In bio-medical research, the Eye can examine and classify blood cells and chromosomes seen in a sample under a microscope. Applications now being developed on delivered systems point to virtually unlimited industrial and scientific uses.

Time Shared Display System

Our Model 1060 Graphical Display System provides a common display processor interfacing to the computer and controlling up to 12 remote keyboard display consoles.

This equipment is designed for simultaneous operation by several users of graphic display programs, while putting a minimum load on the computer. Character and vector generation, program interrupt, and memory refresher functions are contained in the Display Processor. The 1060 is also very effective for general program debugging and editing, since whole pages of instructions can be called up and modified far faster and with less demand on the computer than is the case with hard copy output devices.

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The image dissector camera, a new approach to spacecraft sensors

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ABSTRACT

The Image Dissector Camera, using a newly adapted sensing technique, provides capabilities heretofore unattainable in spacecraft television systems. Based on the Image Dissector Tube, a non-storing scanned detector, these cameras can add the versatility to meet the challenge of new and unusual requirements. Two cameras have now been developed for spacecraft use, one for the Nimbus B Satellite utilizing the slow scan capability of the tube and one for the ATS-C spacecraft, using the versatile scan format capabilities of the tube. A general discussion of the tube itself and its application to these two cameras will be given with emphasis on the variety of applications where such a system may have distinct advantages.

INTRODUCTION

The experimental efforts of the NASA and ESSA programs in the 1960's are providing the basis for the operational hardware of the 1970's. From these programs come the experience and growth that will continue to challenge the designers of the next decade. This is particularly significant in the spececraft television field where the potential and variety of electronic cameras is just being realized. The use of the Image Dissector Tube as a camera sensor is one of the new techniques being used in meteorological applications.

The National Aeronautics and Space Administration has supported a wide variety of television cameras for use in meteorological satellites. These include several types of vidicons, the dielectric tape camera, and the image orthicon. We are quite familiar now with the vidicon camera systems that have operated on the Nimbus I and Nimbus II satellites and the ESSA and TIROS satellites. In the Automatic Picture Transmission cameras for Nimbus I and Nimbus II a special long storage vidicon was used. This tube had a dielectric surface capable of holding the image for the required 200 seconds readout period. When Nimbus B is launched (designated Nimbus III after launch) it will have a completely different camera, utilizing a non-storage camera tube, the image dissector, from ITT Industrial Laboratories. The Image Dissector Camera will replace the Nimbus APT and Advanced Vidicon Camera Subsystems. The progression of camera tube types is an attempt to achieve a combination of high resolving power, photometric fidelity, and long life that meets the operational concepts of meteorological satellites. It is felt that the Image Dissector Camera Subsystems will show the capacity to achieve these goals for the polar orbiting earth oriented Nimbus and for the synchronous orbit, spin stabilized, ATS-C satellite. The Applications Technology Satellite application is quite different from that of Nimbus, requiring a scan format adapted to the variable spin rate of the satellite and designed to reduce any effects of nutation. These two development programs utilize different characteristics of this new sensor tube, and are an indication of the potential of the Image Dissector.

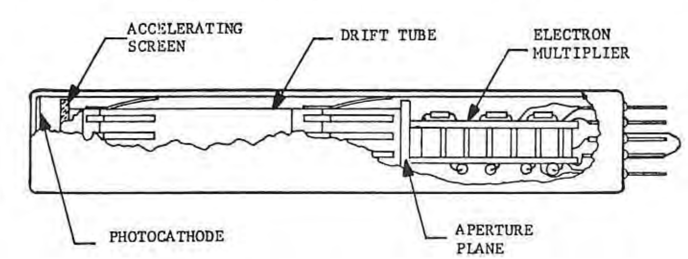

FIGURE 1: Image Dissector Tube Parts

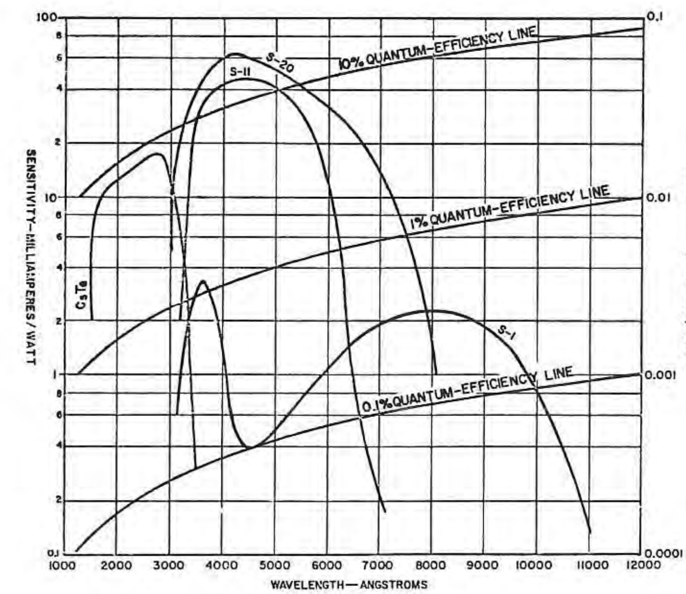

FIGURE 2: Spectral Response Characteristics

The Image Dissector Tube

The Image Dissector Tube is a type of photomultiplier tube in which the sensitive area of the tube may be sampled in an elemental fashion using electronic scanning means. Figure 1 shows the tube and its basic components, which are a photocathode, an accelerating screen, a drift tube, an aperture, and an electron multiplier. Excitation of the photocathode by light causes electrons to be emitted in direct proportion to the light level applied. These electrons are accelerated from the photocathode and pass through a fine mesh screen into a unipotential drift space. A magnetic focus field is applied such that the electrons make one complete spiral arriving at the aperture plane with the same spatial relationship as the optical image on the photocathode. The optical image has thereby been translated into an electron image and transferred to a single plane within the tube.

At the center of the aperture plane is a hole chosen to admit electrons from a selected area of the photocathode. The size and shape of this aperture may be chosen for the sampling technique and resolution required (within the general range of 0.0005 to 0.150 inches). For the case of

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image generating scans this aperture size is the resolution determining factor. An aperture of 0.001 inches theoretically provides an image resolution of 1,000 line pairs or 2,000 television lines per inch. In actual practice the limit from a 0.001 inch diameter aperture has approached 1800 television lines per inch.

In order to generate the proper scan sequence for a normal raster it is then necessary to apply a transverse magnetic field in the drift space. This field causes the complete electronic image to shift orthogonal to the direction of the magnetic field in direct proportion to the intensity of the field. The focus coil is a long solenoid enclosing both the photocathode and aperture plane in a uniform field of approximately 30 gauss. The deflection coils which are similar to vidicon or image orthicon deflection coils develop a transverse field of about 5 gauss to move a selected area from the edge of the photocathode to the centered aperture.

Since the photo-electric effect can occur for any photoemissive surface it is possible to select the photocathode type to suit the application. Surfaces available range from a solar blind ultraviolet sensitive photocathode using Cesium Telluride or Cesium Iodide to the extended infrared response of the special S 1 photocathodes. A graph of some of the more popular photocathodes is given in Figure 2.

One of the principal features of the image dissector tube is the direct relationship of electron current output to light flux input. This relationship, expressed as quantum efficiency, is shown on the graph. The more useful term for design purposes is the photocathode output in amperes per watt of power input. To determine the total current from a given portion of the surface it is necessary to calculate the power distribution on the surface as a function of wavelength and integrate the total output current from the product of the input power and the photocathode response. It can be seen that the use of lumens and luminous efficiency is very misleading, since few real applications attempt to match responses to luminous equivalents. Table 1 gives a tabulation of matching factors for several combinations of light sources and photocathode responses. A quoted response of (I/L) microamperes per lumen may be multiplied by this factor for the sources given.

	S1	S4	S11	S17	S20
P1 phosphor	0.0497	0.9965	1.0625	1.141	0.5758
P4 phosphor	0.10616	2.100	1.955	1.793	1.1378
P11 phosphor	0.1481	6.235	5.397	4.654	2.753
P20 phosphor	0.07668	0.6163	0.7161	0.7815	0.5199
Cool white fluorescent	0.1083	1.195	1.173	1.126	0.7995
CIE-"A"	—	0.9763	0.986	0.987	0.9903
Sun in space	0.4101	2.638	2.169	2.078	1.428
Sun + 2 air masses	0.3744	1.840	1.669	1.571	1.154
Day sky	0.378	3.665	2.763	3.403	1.681
6000°K black body	0.4377	2.835	2.272	2.203	1.499
3000°K black body	0.9445	1.084	1.062	1.057	1.013
2870°K black body	1.0373	1.022	1.013	1.014	1.0056
2854°K black body	1.0618	1.0079	1.0021	—	1.0089
2042°K black body	3.011	0.6303	0.6944	0.7404	1.145

TABLE 1 Change in Luminous Sensitivity with Flux Source, $(I/L) / (I/L)_{2854}$

From the calculation of emitted current it is possible to determine the current through the sampling aperture and its final value after multiplication in the electron multiplier assembly. Most of the present tubes have a 1:1 magnification of the image from the optical to the aperture plane, and approximately 50% loss of electrons at the accelerating mesh of the drift tube. The output (anode) current may therefore be calculated by

$$I_a = SEa\,\tau\,G \qquad (1)$$

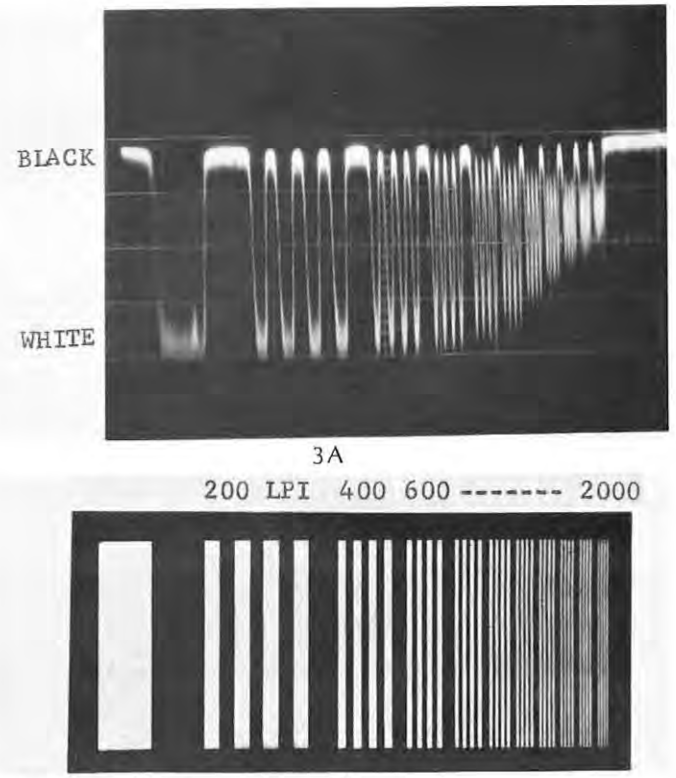


FIGURE 3: Video Response 3B

where Ia = anode current in amperes

SE = integral product of input power and photocathode sensitivity.

In luminous units one can use S in microamperes/lumen and E in lumens/ft²

a = aperture area (in square feet)

τ = accelerating screen efficiency, typically .5

G = multiplier gain, typically 10^6

Note that the output current does not have a time factor, and is not dependent upon scan conditions or tube variables (requiring only that electronic focus be maintained). Maintaining focus requires regulation of both the focus current and accelerating voltage. The gain of the multipliers is dependent upon the voltage applied between stages and requires some care in design of the voltage sources. The limiting factors on anode current are determined by the current handling capacity of the dynodes at the high limits, and generally by noise conditions at the lower light levels.

NOISE IN SIGNAL

For a typical Image Dissector application the noise in the camera output is related directly to the instantaneous value of the output current. While thermal noise is important in most multiplier phototubes, it is not important in the image dissector. Because of the very small portion of the photocathode being sampled at any one time, only the thermal electron noise from that area is detected by the sampling aperture. In typical cases this is equivalent to an input light level below 10^{-8} ft. candles.

The contributing noise is due to the quantum flucuations of the generated current, and follows the well known shot law:

$$i_{nk}^2 = 2e\,I_k a f \qquad (2)$$

where

I_k = current entering the defining aperture

$= S\,E\,a\,\tau \qquad (3)$

e = Charge on the electron = 1.6×10^{-19} coulomb

$<f$ = noise bandwidth of the output amplifier

i_{nk} = rms noise component of I_k

An additional factor is added by the electron multipliers

The dependence of noise on signal and the action of a 0.001 inch sampling aperture are shown in Figure 3. Note the absence of noise in the dark regions of the signal and increasing noise in brighter areas. It should be noted that as the signal increases, the noise does also, but at a slower rate. It is therefore desirable to use the tube in such a way as to maximize the light input, consistent with photocathode current loading limitations. Figure 3 relates the signal output to a resolution bar chart. The group of four bars represents 200 TV lines per inch, and the highest resolution group represents 2000 TV lines per inch. The .001 inch aperture shows 25% modulation at 2000 TV lines per inch. For the Nimbus B Image Dissector Camera the relationship of signal to noise ratio, tube output current and scene brightness are given in Figure 4 indicating very useful characteristics for meteorological work.

The Nimbus B Image Dissector Camera Subsystem

The application of the Image Dissector tube in this camera capitalizes on its ability to operate at relatively slow scan

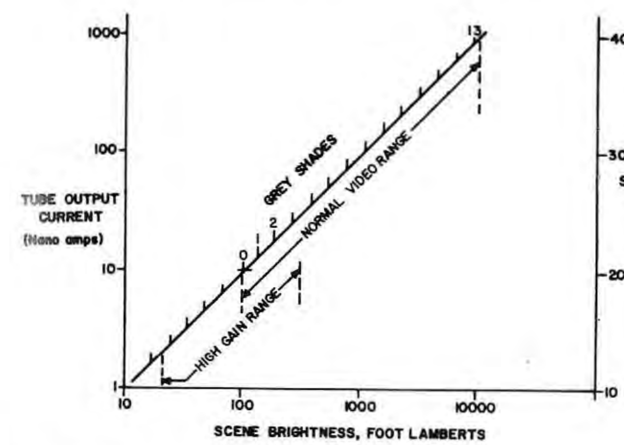


FIGURE 4: Nimbus B Camera Sensitivity

which have a random fluctuation of secondary emission ratio. The total noise out of the tube may then be expressed as:

$$i_{na}^2 = 2SEa\,\tau \left(\frac{\sigma}{\sigma - 1}\right) G^2 \qquad (4)$$

$\left(\frac{\sigma}{\sigma - 1}\right) = 1.5$ for typical multiplier structures

These two equations may then be combined to present a peak signal to rms noise ratio for the tube.

$$\frac{I_s}{I_n} = \frac{S}{N} = \frac{1}{1.23} \left(\frac{SEa\,\tau}{2_e <f}\right)^{1/2} \qquad (5)$$

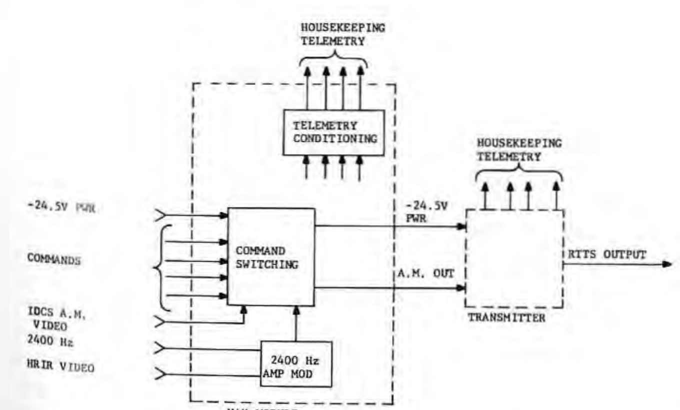


FIGURE 5: Nimbus B Real Time Transmission System

rates with increasing efficiency compared to storage type camera tubes. At a frame rate of 200 seconds per frame the vidicon is nearing its charge storing limit while the additional sampling time allows a higher signal to noise ratio in the IDC output signal.

Added features of the image dissector sensor are its simplicity of construction, absence of thermionic cathode, linear light transfer characteristic, and no requirement for a mechanical shutter. The Image Dissector Camera is a completely electronic unit which contains no moving parts. It was designed to provide outputs at APT rates. One of these outputs is transmitted directly to earth through the Real Time Transmisison System (RTTS) while two other outputs at the same line rate but with a slightly modified format are stored on redundant spacecraft magnetic tape recorders for later transmission to the Nimbus receiving stations at AVCS rates.

In order to provide the desired wide angle coverage (1600 n mi. by 1600 n mi.) at a line rate of four hertz from a satellite orbiting at a 600 n mi. altitude it is necessary to use a combination of satellite motion (like airborne line scan cameras) and electronic scan. This combination allows the 1600 n mi. coverage per picture in the orbital direction while the satellite advances only 680 n mi. This supplementary electronic scan is an example of the capability of this type of sensor to adapt to a specific mission requirement by adding to or compensating for satellite motion.

A block diagram of the RTTS is shown as Figure 5. This subsystem will provide the transmission to earth on a real time basis of either High Resolution Infrared Radiometer (HRIR) or IDCS video information. The normal operating mode will be to transmit HRIR pictures at night and IDCS pictures during the day. With its Automatic Picture Taking format of timing and scanning functions, the Image Dissector Camera Subsystem includes the most basic elements for this type camera. The Nimbus B IDCS is shown in Figure 6. Figure 7 shows the block diagram of the camera. The camera is adapted for enhancement of cloud images through the use of a minus blue filter in front of the 108° Tegea lens. Wide variations of light level from ground and cloud return are accommodated in the video amplifier. The preamp and video chain are designed for a 100 to 1 dynamic range within any one image, and an additional 20 to 1 video gain control to compensate for variations in illumination as the satellite moves from the equator to the polar region. With this additional control, the video output will remain nearly constant over the complete sun lit portion of the satellite orbit.

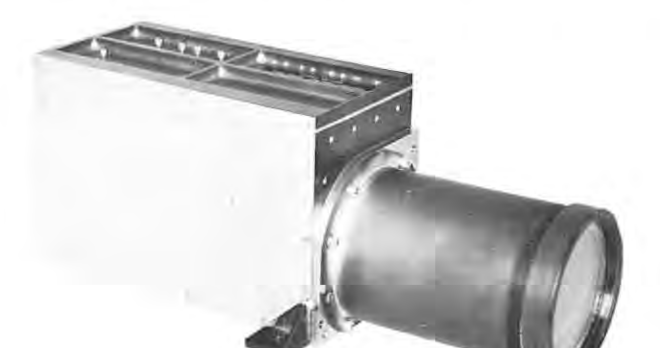


FIGURE 6: Image Dissector Camera for Nimbus B

Camera design and development were guided by a six month operating life requirement. The combination of efficient packaging techniques and high reliability components provides a camera unit with an MTBF of over 16,000 hours, giving a 90% probabiilty of operation for the 6

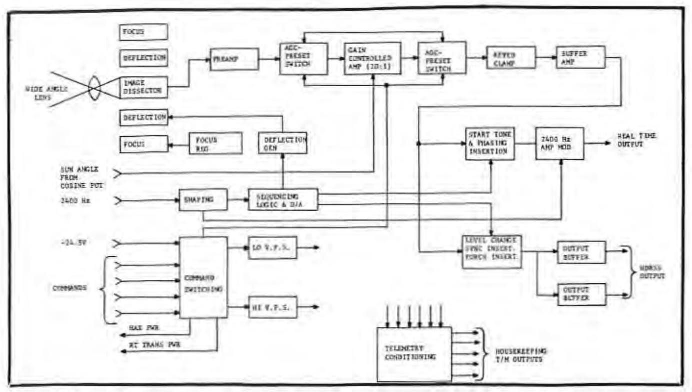


FIGURE 7: Nimbus B Camera Block Diagram

month orbital lifetime. The complete camera weighs 12.5 pounds, of which nearly 3 pounds is the lens and lens assembly. The camera power consumption is a constant 12.25 watts. Construction of the Nimbus IDC is shown in Figure 6. The basic camera housing is 5 by 6 by 9.5 inches, the lens is 6 inches long and 4.0 inches in diameter. The camera tube for this unit is an ITT F4012A, a 1 inch diameter tube having an S11 photocathode of 0.7 inches diameter. The circular sampling aperture is 0.001 inches diameter. The camera system provides 25% response at 800 TV lines per picture width.

The development and test of the Nimbus B Image Dissector Camera Subsystem has provided the means for testing the new tube approach in a situation where its sensitivity and reliability are well suited. The Nimbus B Satellite is expected to be launched in late 1967 and, like its predecessors, is expected to serve a useful experimental and operational function at the same time.

The ATS-C Image Dissector Camera

Utilization of the Image Dissector tube in the camera system that is to fly aboard the Applications Technology Satellite-C (ATS-C) is based upon capabilities of this tube not available in other electronically scanned camera tubes.

ATS-C is one of a group of five experimental satellites and is the second spin stabilized synchronous satellite in the series. From its stationary position 19,400 nautical miles above the equator at 50° west longitude the ATS-C will afford full time exposure to the same portion of the earth. A continuous series of images of the earth's cloud cover sufficient for tracking cloud formation changes can therefore be obtained from an imaging device placed aboard the satellite. The spacecraft is a cylindrical structure which will rotate with its spin axis parallel to the rotational axis of the earth. The satellite's spin rate of approximately 100 rpm (60 rpm to 140 rpm limits) is sufficiently fast to require an exposure time for photographic or shuttered cameras of less than ten microseconds to prevent image blurring. This fact severely limits the use of vidicon or image orthicon tubes. Since the image dissector is a non-storage device, the dwell time of a single element determines the blurring effect, and may be selected by the choice of scanning parameters.

The wide satellite spin speed range of 60 rpm to 140 rpm requires the camera system scan rates to vary as a function of satellite spin. This additional requirement is no problem for an image dissector camera.

An additional characteristic of spin stabilized satellites that hinders the use of on board imaging devices is nutation or wobble of the satellite spin axis. The effect of satellite nutation is a displacement in the track of a radial element such that adjacent lines of information from a scanning sensor might diverge or overlap significantly. To compensate for nutational errors the IDC generates the camera line scan along the satellite spin axis while at the same time generating a derotational scan in the opposite direction from satellite spin. This combination results in a line scan across the earth parallel to the satellite spin axis once for each satellite rotation. Adjacent scan lines are displaced one resolution element by initiating successive scans at a rate that is slightly slower than the satelite spin speed. In this manner the lines progress across the earth until the global image is obtained. The nutational errors for this scanning mode are primarily the displacement of scan lines in the direction of scan. Through the use of nutation information from an on board nutation sensor, the IDC ground station equipment can then correct these placement errors and the displayed video will not be significantly degraded.

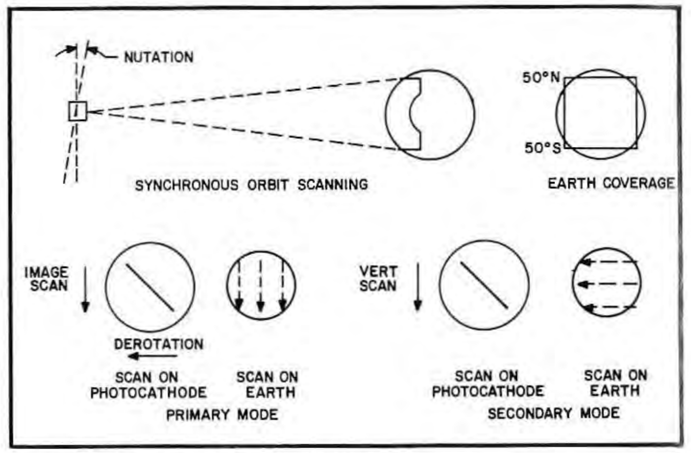


Figure 8A: Scan Format for ATS-C Camera.

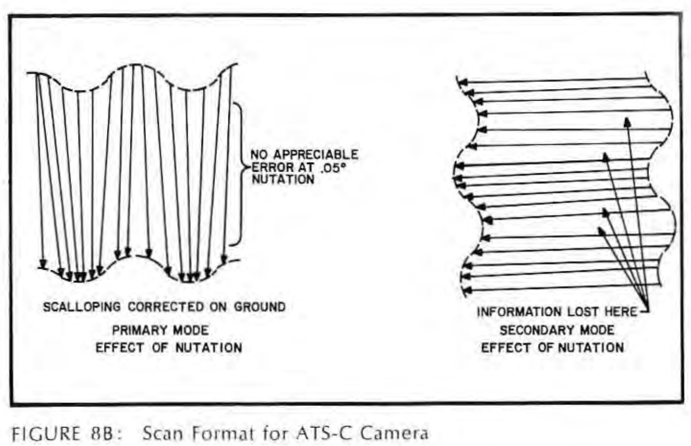


FIGURE 8B: Scan Format for ATS-C Camera

If the satellite displays negligible nutation (below .001°) the IDC can be operated in its secondary scanning mode. In this mode satellite spin motion is used to achieve line scan while the camera tube is deflected one resolution element parallel to the spin axis once each satellite rotation until a complete raster is obtained. The two scanning modes are shown in Figure 8. This figure also shows the first order effects of nutation on the information obtained from both scanning modes. When ground correction is achieved the picture obtained in the primary scanning mode will contain no appreciable errors in the central ¾ of the display for a satellite nutation half cone angle of .05 degrees. For the same amount of nutation the secondary scanning mode would produce pictures exhibiting loss of information

through the display that would drop the resolution in those areas to less than one-half of that which the optical aperture defines.

Development of the ATS camera required a full understanding of the satellite motions and consideration of the effects noted above. Certain other problems became apparent during the design study phase, the largest of which was the need for an accurate timing source that recognized the changes in satellite rotation rate accurately enough to control the timing of the sweeps and the initiation of video sequences. The details of this time network are interesting and will be reported in other articles. The general block diagram of the ATS camera unit is shown in Fig. 9. It can be seen that the basic modules of the IDC are common to the use of the tube, but that the timing and logic blocks are unique to this satellite application. The timing system is automatic, sensing sun pulses and continually correcting a crystal controlled oscillator when the output frequency deviates from an established error margin. This basic frequency, which provides 32,768 pulses per satellite spin, functions as the master clock. It increments the camera logic which sequences the camera operation and synchronizes camera scan initiation with proper positioning of the satellite so that the camera is viewing the desired portion of the earth when the tube is scanned. Since the sun-satellite-earth angle does not remain constant during the day, it is necessary to continually add a "Time-of-day" correction

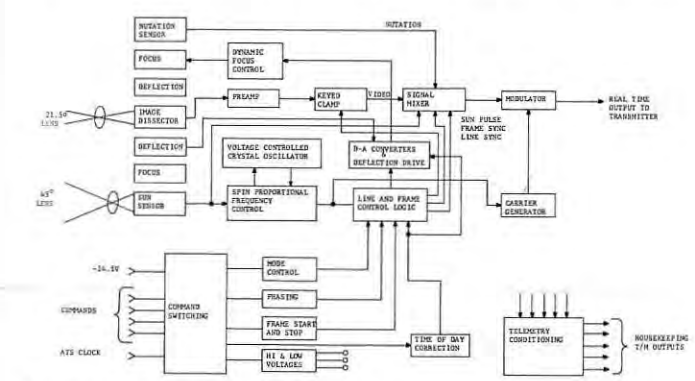


FIGURE 9: ATS-C Camera Block Diagram

once every 2.64 seconds to move the apparent look angle such that the center of each picture is at the center of the earth image. The apparent look angle may be controlled by ground command in the event that the starting position of a picture is not correct. Once corrected, the following pictures will keep the same direction with respect to the earth. In the automatic mode of operation, the camera will generate a complete picture every 15 minutes. The period will consist of 13 minutes of active video transmission and a 2

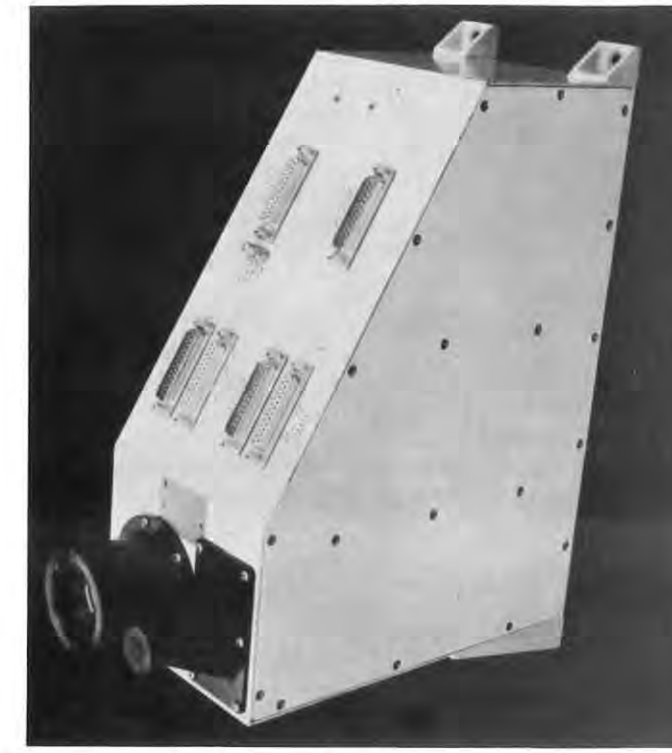


FIGURE 10: Image Dissector Camera for ATS-C

minute interval between frames.

Ground commands will be used to switch from the primary mode to secondary mode for experimental purposes. The effect of nutation, if any is present, will then be apparent in the resulting image, by distortion of the earth contours if the nutation is great enough, or by a reduction in resolving power at low nutation levels. At the present time the ground station is capable of correcting nutation errors in the primary mode and may be able to partly correct for it in the secondary mode. An interesting aspect of such an electronic scanning system is its potential for correction of nutation in the sensor, but, because of the increased logic required, the ATS-C Camera does not have this feature at this time.

The ATS Camera has physical features adapted to the cylindrical satellite configuration and is shown in Figure 10. Construction features include the use of a modified ITTIL F4012 Image Dissector Tube, a 1 inch diameter tube with an S11 slit photocathode and a round aperture of .0007 inches (.017 mm) diameter. The system incorporates over 300 integrated circuit flat packs to generate the timing and scan functions. A sun sensor was specially designed for high resolution detection of the sun edge for spin detection,

Lens	Photocathode	Tube Size	Aperture	Multiplier	Deflection	Focus	Video Processing
Any	CsTe (UV)	1 in. dia.	Round	Box	Magnetic	Mag.	Analog
	CsI (UV)	1.5 in.	Square	Channel	Electrostatic	E.S.	Digital
	S11	2.25 in.	Slit		Raster		Pulse Counting
	S20	4.5 in	Shaped		Spiral		Phase Sensing
	S1		.0005 in. diameter to 0.150 in.		Digital		Photometric
					Random		
					Star		
					Circular		

TABLE 2 Image Dissector Tube Variations

while the nutation sensor is of the same type as used on ATS I for measurement of nutation amplitudes. The output video is an amplitude modulated sub carirer, whose frequency is proportional to the satellite spin rate. In the composite video output signal are details of the image from the 36 KHz video amp, a nutation level signal, the line and frame sync pulses, and a sun pulse signal. Commands and telemetry are typical of satellite subsystems. The 48 mm lens and camera unit occupy approximately 280 cu. in. and weigh 19.6 pounds. The power input is approximately 20 watts including the nutation sensor.

The ground station for this unit receives the signal from the NASA receiving station and records it on magnetic tape and film. The output image is expected to reproduce the 13 gray shades and 1300 line resolution of the camera signal. The data from the system will be used to evaluate the camera performance from the standpoint of tube, synchronizer, and logic operation, and video fidelity. Detailed results of the experiment are expected to influence the direction of future satellite instrumentation.

THE CHALLENGE

While the two present Image Dissector Camera systems represent new applications of the image dissector, they are not the only ways that this sensing device may be used. The ability to interchange elements of the tube to fit new applications provides an almost endless variety of sensing and image processing techniques. It is only necessary to use a sound engineering approach in the determination of signal levels, noise characteristics and video processing. To illustrate the variety, Table 2 shows some of the elements of the tube with listings of some of the variables. Figure 11 shows three sizes of image dissector tubes, 4½, 1½, and 1 inch diameters. So far the two space cameras use S11 photocathodes, 1 inch diameter envelopes, round apertures of 0.0007 and 0.001 inches, box multipliers and ten stage multiplier structures. In both cases the video is analog and used for picture generation.

FIGURE 11: Typical Image Dissector Camera Tubes

As we expand our vision into the next decade we can see the need for higher tube sensitivities coupled with high resolution and higer photocathode loading capabilities. Add these to a tube having computer controlled scan and on-board data processing to separate the mapping function from the photometric process and you have a sensor that meets most of the needs of the Earth Resources Satellite.

Interchanged in another way, using several shaped apertures, each with its own electrical output, you have an automatic correlation device that detects selected shapes out of a mixed background.

Using the pulse counting technique to detect the presence of each photon arriving at the cathode provides the very highest theoretical sensitivity for particle counting, background light detection, and astronomical information.

Another configuration using a digital scan and a tracking mode provides a star tracker with electronic gimbaling.

Add a raster or spiral scan mode and you have a seeker as well as a tracker.

As with any new device, acceptance is determined by operation in a rigorous application. With the use of the CBS Reconotron in the Mariner as a star tracker, the ITT FW145 series as star trackers in the OAO and Lunar Orbiter and the ITT F4012 in two meteorological camera applications, it appears that this tube technique is being proven and generally accepted by the industry.

The Image Dissector tube has demonstrated its ability to act as a versatile photodetector. Based on the principle of photoemission and field scanning, the sampling of an optical image is set by chosen parameters of sampling aperture size, photosensitive surface and deflection pattern. Within the limits of noise-in-signal and cathode loading these characteristics may be selected at will to meet the application. Two examples of Image Dissector Cameras demonstrate the application to meteorological cameras that will be launched in 1968. Extension of these concepts are shown capable of providing the versatility to adapt to the expanding needs of the next decade. ■

THE AUTHORS

G. A. BRANCHFLOWER received his BSEE in 1960 from Texas Technological College and an MSEE in 1965 from the University of Pennsylvania. He was with RCA Astro Electronics Div. from 1960-1964 as a systems engineer on Satellite Meteorological Camera Systems. From 1964 to the present he has been with NASA Goddard Space Flight Center as primary investigator and technical officer for the Nimbus Image Dissector Camera System and Applications Technology Satellite Image Dissector Camera System. He is responsible for an advanced image dissector sensor development.

EDWARD W. KOENIG received his BSEE, Purdue University, 1952, and an MSEE, Purdue University, 1953. He has been employed in the ITT Industrial Laboratories, Fort Wayne, Indiana, for fifteen years as a designer, project engineer, and department head in the general field of advanced television sensors and displays. Typical programs have included the AN/AAG-5 airborne storage tube radar display, stroboscopic television system, and low light level satellite tracking television systems. As manager of the Applied Electronics Department the activities have expanded into specialized camera systems for the Nimbus, ATS, and other satellites, and application of the many new tube developments of ITT Industrial Laboratories. He is a member of IEEE, Tau Beta Pi, and Sigma Xi.

New security alarm telephone system provides total prison communications

by VERNON L. PEPERSACK
Former Commissioner of Correction
Maryland Department of Correction

[Because accompanying illustrations were inadvertently omitted from this article in the July/August 1967 issue of Information Display, the complete paper is offered here for Journal readers. Our apologies to the author for the original omission. — Ed.]

Although this article does deal with display devices, it is a departure from our usual editorial policy in that it does not exclusively feature display technology. It was felt, however, that it represented an area of application of which our Society should be aware. Your comments on the appropriateness of this kind of story are invited — L. M. Seeberger, Publ. Chm.

INTRODUCTION

Fast, reliable communications in correctional institutions have always been a priority requirement, since the efficient flow of information contributes to better prison security and daily administration.

The Maryland Department of Correction and the Chesapeake and Potomac Telephone Company of Maryland have combined efforts to establish what might be considered a new standard in prison communications. Called the Security Alarm System, it meets all institutional requirements for emergency and normal communications in a single communications network.

Two Maryland penal facilities have installed the Security Alarm System: Baltimore City Jail and the Maryland Correctional Institution at Hagerstown. In addition, similar systems are being installed at the Maryland Penitentiary in Baltimore, and the Maryland House of Correction — Institution for Women at Jessup. Systems also are planned for Baltimore's new Female Detention Home, to be built soon, and the new addition to the Hagerstown Institution. Because the Security Alarm System links all security phones to a central console, the arrangement provides a number of communications features that are vital to penal administrators in the operation of their facilities.

Installation Operation

Let's examine the installation at the Maryland Correctional Institution, a modern maximum security prison which houses a daily average of 1,353 male inmates between 16-

*This article was on the press when the Editors learned that Joe Cannon had been appointed to succeed Commissioner Pepersack.

25 years of age. The institution's Security Alarm System is designed to provide special communications for routine operation of the prison, as well as for coping with possible emergency situations, such as fire or inmate disturbances.

Security officer at the Baltimore City Jail's communications center confers with a guard via the prison's new Security Alarm System. All phones within the facility are linked to the communications network. Lights on the console indicate reports incoming from various stations, as well as telephones in use. The guard at left is handling controls for electrically operated doors. The closed circuit TV screen above the console provides a constant view of the entrance to the prison's maximum security section.

Heart of the institution's communications system is a security console. Although no larger than a conventional switchboard, it provides an array of information to the staff member on duty there. The console contains a series of miniature status displays, each numbered for an extension phone in the system. Each display indicator is divided into quarters, with each section designating a different condition, depending on what information the security guard wishes to relay.

For instance, the system offers a guard reporting feature. Guards make periodic reports from throughout the institution simply by dialing one digit from a security phone. This signals the attendant at the console by illuminating an amber lamp behind one section of the indicator reserved for that phone station. In addition, the report is registered on a print-out device which shows the time, date and station reporting.

To report a fire, a staff member would simply dial another predetermined digit to trigger an audio signal at the console and illuminate a red lamp behind another section of the indicator reserved for that phone location. This report also is recorded on the print-out device. The console, in addition, "locks-in" the call so that it can be released only at the console — even if the phone receiver is replaced.

In either fire or guard reporting, the visual display supplies immediate station identification and location. However, the attendant can pick up the call and get additional details by phone from the person making the report. To anticipate multiple emergency conditions that could conceivably exist, the equipment is designed to receive a numbers of calls simultaneously.

The console also has an audio signal and visual indicator to relay a no-dial-alarm condition or "guard in distress." This alarm sounds at the control center if dialing doesn't start within a few seconds after a phone is lifted from the switch hook. In this situation, a green lamp is illuminated behind the section of the indicator corresponding to the phone. This enables the attendant to quickly identify the location and inform near-by authorities to check the difficulty.

Safeguard Systems

The Security Alarm System is under a continuous line test. Each station is continuously tested and any abnormal condition gives a visual and audio alarm at the console. For example, if a telephone is torn loose or a component removed, the trouble station is immediately identified by the appearance of red and amber behind the corresponding status segment. Although these visual indicators remain lighted until the trouble is corrected, the audio alarm can be turned off until repairs are completed. This built-in safeguard makes the system virtually tamper-proof.

Another feature of the system is line load control. This prevents "jamming" of the phone network by coordinated efforts of unauthorized groups, since designated extensions can be excluded from service to enable key locations to continue normal operations.

A guard at the Maryland Correctional Institution at Hagerstown uses a Security Alarm System telephone to report in. The "guard reporting" feature of the Institution's new communications system enables security officers throughout the facility to make periodic reports by dialing a single digit on the telephone.

The system also includes an executive over-ride feature which enables key administrators such as the warden and security officer to reach other telephones within the communications network even though they are busy on another call, simply by dialing a special digit. This assures key staff people that calls can be connected to other stations even though the phones may be busy, ensuring administrative control at all times.

In addition, a command conference arrangement enables key administrators to call a group of pre-determined stations simultaneously. If a station is in use at the time a

Hiram L. Schoonfield, warden of the Baltimore City Jail, explains that the new Security Alarm System makes communications within his facilities "more exacting." According to the warden, "Our communications system takes the guesswork out of reports, provides the certainty and speed so essential in penal operations. In addition to being able to link all present phones into a single system, Security Alarm offers the flexibility for future expansion such as inclusion of the Female Detention Home when it is built."

conference call is established, a distinctive ringing notifies the prison official that a command conference call is waiting. By hanging up and picking up the phone again, he is automatically connected to the conference call.

Since the lamp indicators provide vital information to the attendant at the console, it is important that these lamps be in constant working order. Therefore, the console is equipped with a lamp testing button which can illuminate every indicator on the console to immediately identify any that have burned out.

CONCLUSION

Now that operation of the Security Alarm System has been outlined, there are several other important aspects of a communications network such as this which should be explored.

Captain Kirkwood S. Wyatt, correctional officer at Baltamore City Jail, makes administrative call while scanning Security Alarm System console for reporting calls. Signal lights at bottom of consoles indicate purposes of calls made from security phones. Miniature displays represent phones throughout the facility.

We have spent a tremendous amount of time studying communications, knowing that a better system can save money in personnel and enable officers to perform their duties more efficiently. Before the Security Alarm System was installed, there was some discussion that we might be better off with two separate systems — the reasoning being that one might break down and the other still be in operation. But with the communications arrangement supplied by the telephone company, we actually have a number of different systems in one, so that continuous operation is assured. For instance, one inoperative phone or system does not jeopardize the institution. We have fire and guard reporting, signals that indicate when the telephone is knocked off the hook, communications procedures which assure reaching the various staff members, a command conference as well as conventional telephone communications. To-

This is the communications center of the Maryland Correctional Institution. The guard at the Security Alarm System console talks with a reporting security guard at one of the phone locations. The console, heart of the Institution's new communications system, has visual and audio indicators to signal alarm conditions. Lights in the console's minature displays indicate phone stations reporting as well as phones in use. At left (resembling an adding machine) is the print-out device which automatically records date, time and station number reporting in via Security Alarm System. In the foreground, an attendant handles the regular phone traffic using a modern desk-top console and direct station selection equipment.

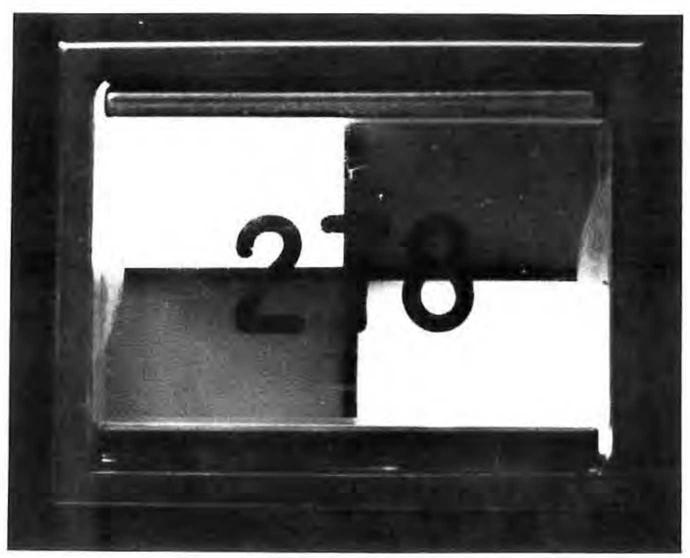
gether they provide a number of ways to keep information flowing. We also found that two different types of installations can create confusion among employees at certain times. In other words, we would have to train everyone in the uses and procedures of two communications systems.

Another aspect is maintenance. When an institution is built, the cost of providing the facilities is just the start. Other problems that must be visualized are maintenance and operating costs. With this system, all equipment and maintenance are provided by the telephone company. Consequently, there is no need for capital expenditure to purchase equipment, no need to employ communications specialists to install the system or train men to keep it operating. Another vital factor is that purchase of a system, this year for example, would mean that it always would be a 1967 model. Eventually, it would be obsolete. However,

(Left to right) Preston L. Fitzburger, superintendent of the Maryland Correctional Institution at Hagerstown, General Richard G. Prather, USA retired, Chairman of the Advisory Board of the Maryland Department of Correction, and Edwin C. Sokel Jr., C&P Telephone Company's Sales Accounts Manager, discuss features of the Security Alarm System. The new communications system was placed in operation in the Fall of 1966.

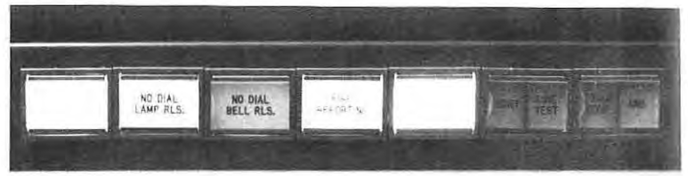
the Security Alarm System will be continuously up-dated as new communications equipment is developed by Bell System.

The Security Alarm System also provides flexibility for long term planning by penal administrators. For example, eventually we hope to link several adjoining penal institutions with one communications network that would channel information to a central console. With this system, facilities can be added to the network as required so that all communications would come into a central communications center. This would enable information to be pieced together to provide a picture of total prison activity.



This close-up shows a display on the Security Alarm System console and the four sections that provide the attendant with visual status indicators for station number 278. As the security guard makes a report by dialing a single digit from this phone location lamps with appropriate colors are illuminated in the various display sections. For example, the phone in use is shown by a white light in the upper left section. When the guard makes a normal security report, the display shows this white light as well as an amber lamp in the lower left section. The upper right section contains a green lamp to signal a no-dial alarm. The lower right section provides a red light for fire reporting, theoretically the condition reported here.

For example, let's say a call comes in reporting a fire in a particular section of No. 4 yard in one of the institutions. Meanwhile, another security guard reports a fight, followed by a report of an attempted escape at the vehicle entrance. With two or three pieces of information coming into a central communications center, the complete picture can be assembled. It becomes apparent that the fire and fight are probably decoys, intended to shift our attention from the real situation. If the fire report was registered in a location other than the communications center, the true picture would not be apparent and forces could easily be deployed incorrectly. Having the three institutions linked by a single network also provides a ready access of available manpower for a real crisis.



These indicators at the base of the Security Alarm System console pinpoint the particular report for the attendant on duty, while the display shows the location reporting. The indicators also serve as release keys, since the console automatically locks-in the station signaling an alarm.

We also expect the Security Alarm System to be invaluable in a situation like the riot we experienced recently at the State Penitentiary. It was impossible to get a call through during this crisis since every phone was off the hook. This was not deliberate jamming by inmates, but simply an overburdened switchboard and everyone trying to get a connection. The non-jamming feature of the Security Alarm System and the command conference arrangement, coupled with executive over-ride, would have alleviated this problem.

Because the Security Alarm System consists of telephones spaced regularly around the institution, it is of double value to us. It not only fulfills emergency reporting needs, but also provides for internal and external communications which are as important in the operation of an institution as security and safety. It's used to get information to different divisions in the movement of prisoners, alert groups of employees to attend meetings, arrange sick call procedures in the cell house and a variety of other administrative functions. Good communications to an institution is like gasoline to a car — it can't run without it. ■

THE AUTHOR

VERNON L. PEPERSACK was born in Baltimore and educated in parochial schools and the Evening School of Johns Hopkins University. He was appointed Commissioner of Correction in 1964 by Governor J. Millard Tawes. Before his appointment he was warden of the Maryland Penitentiary for eleven years. He is Secretary-Treasurer of the Correctional Administrators Association and is active in many other committees dealing with community problems.

Ninth annual symposium planning report

HIGHLIGHTS OF PAPERS SELECTED

A challenging group of papers has been assembled by Erv Ulbrich, Papers Chairman. Five basic sessions have been outlined. They include:

1) Civil Applications
2) Business Applications
3) Military Applications
4) Educational Techniques and Applications
5) Advanced Techniques

A sampling of papers from this group includes a paper from Japan on the advantages of the field sequential techniques over dot techniques for color oscilloscopes. Another paper from abroad deals with an experimental 4000 picture element gas discharge TV display panel. Other papers include a color film on computer animation as a tool for education, helicopter station-keeping displays, and air pollution command and control displays.

EXHIBITORS LIST GROWS

The Society has had an excellent response from exhibitors thus far. At present the following companies will exhibit at the Symposium:

1) Transistor Electronics Corp.
2) CELCO—Constantine Engineering Laboratories Co.
3) General Atronics Corp.
4) Magnetic Shield Division
5) Perfection Mica Co.
6) Polaroid Corp.
7) Beta Instrument Corp.
8) Thomas Electronics
9) Electronic Tube Division of Litton Industries
10) Raytheon Co.
11) Video Color Corp.
12) Kaiser Aerospace & Electronics
13) USECO Division of Litton Industries
14) Ferranti Electronics, Inc.
15) Radio Corporation of America
16) Digital Equipment Corp.
17) Gamma Scientific Inc.
18) Isomet Corp.
19) Tung-Sol Division of Wagner Electric Corp.
20) Ball Brothers Research Corp.
21) Datanetics Corp.
22) Houston-Fearless Image Systems
23) Sylvania Electronic Products
24) Hughes Aircraft

Exhibit Management Chief Byron Perkins is still actively soliciting more potential exhibitors. Firms desiring to exhibit should contact Mr. Perkins at 395 Huntington Drive, Pasadena, California 91107. Telephone number is (213) 795-9561.

UNUSUAL PROGRAM FEATURES

Bob Woltz, Program Chairman, promises an exciting schedule of luncheon speakers. Emphasis will be placed on the creative and humorous aspects of information display.

JIM BELCHER
Publicity Chairman INFO '68

SJCC convenes in Atlantic City April 30 through May 2

According to Chairman *Albert S. Hoagland*, IBM Corporation, this year's SJCC will have the largest exhibit of computer-related hardware and data processing systems to be found, coupled with a broad ranging technical program of excellence for computer professionals. Attention will be focused on the growing interrelation of computers and communications, the objective being to promote a constructive dialogue on the issues involved in the emerging interdependence of these fields in terms of their long range evolutionary perspective.

Convention Hall has been designated as Conference Headquarters, with member society affairs and conference social functions located in hotel facilities closeby. Opening and closing sessions are being held in Usher Hall, a 19th century hall offering classic contrast to discussions of the 20th century computing art. All other sessions of the Scientific Program are being held at McEwen Hall and at the halls of Appleton and David Hume Towers of Heriot-Watt University.

Conference Exhibits will feature more than 135 exhibitors in Convention Hall. The Exhibition area will be open according to the following schedule:

Tuesday	April 30	11:00 A.M.—6:00 P.M.
Wednesday	May 1	10:00 A.M.—8:00 P.M.
Thursday	May 2	10:00 A.M.—5:00 P.M.

All paid Conference registrants will have access to the exhibit area at any time during the hours listed above. Non-conference registrants will be admitted to the exhibit area upon payment of a $1.00 registration fee.

TECHNICAL PROGRAM

Technical Program Committee Chairman *T. R. Bashkow* reports the program consists of 21 sessions, a third of which are panel sessions at which no formal papers will be presented. In view of the deepening penetration by computers into seemingly every business and technological area, an attempt has been made to include as many examples of such use as possible, making program emphasis to some extent on the computer as part of a broader system. There are, of course, many sessions concerned with topics of particular interest to computer and computing specialists. Only three parallel sessions at any given time are planned so as to offer as few conflicts of interest between sessions as possible.

SPECIAL PROGRAM

The best of currently available films about the information sciences will be included in a special daily program of motion pictures to be shown in an auditorium among the meeting halls of the scientific program. In addition, a competition will be held for a piece of music composed by a computer which forms an artistic whole, with the prize-winning entries being played at the Congress.

From the 200 people who attended the first Computer Conference in 1951, attendance has grown to an international audience of more than 5000 registrants and 10,000 visitors, reflecting the growth of the information processing industry and the far-reaching effects of computers on almost every aspect of national life.

SID Activities

SOUTHWEST CHAPTER

The new *Southwest Chapter* recently held its first general meeting in Dallas. The 53 attendees, who represented diverse interests from CRT and large screen military type display systems, to commercial and educational TV, were guests of the National Society for cocktails and dinner. Featured speaker for the evening was Mr. Carl Machover, Secretary of *SID*, who explained the history, purpose, goals, and activities of *SID*. For the technical program, Larry L. Pipken of Texas Instruments presented a movie and discussion of TI's large screen laser display system.

The Southwest Chapter has the following officers: Chairman—Chuck R. Stobart of LTV Electrosystems; Vice-Chairman/Programs—Larry L. Pipken of Texas Instruments; Secretary/Treasurer—Ted W. Falconer of Texas Instruments and Membership—Tom Calvert of LTV Electosystems. Interested persons within the areas of Texas, Oklahoma, Arkansas, and Louisiana are invited to join this local chapter and may obtain further information on activities and future programs by writing any of the officers at P.O. Box 34581, Dallas, Texas 75234.

BAY AREA CHAPTER

Members of the *Bay Area Chapter* recently toured the production facilities of the *Wall Street Journal*, whose facilities include type linecasting machines operating from punched tape punched from wire links, and facsimile transmission of the locally made-up pages to other printing plants by microwave. Walter Phillips, production Manager, Dow Jones & Co., Inc., explained how the newsgathering and editorial facilities of Dow Jones & Co. operate and how the results are converted into a national newspaper. A no-host dinner preceded the meeting.

ARTWORK HONORED

Bruce Borley, of Philco-Ford, has received first prize for promotional pieces in the Third Annual Bay Area Exhibition of the Technical Illustrators Management Association. The prize was for design of mailers, envelopes, programs, etc., for the SID Eighth National Symposium held in San Francisco last Spring. The work was built about Mr. Borley's logo, showing blocks with various symbols of *SID*, San Francisco, and information hardware photographed against a background on a man's head. The Bay Area Chapter of *SID* offers its congratulations to Mr. Boley and thanks to him and Philco-Ford for their assistance.

LOS ANGELES CHAPTER

The *Los Angeles Chapter* recently toured the Bunker-Ramo facility, where the firm's personnel demonstrated advanced on-line software techniques utilizing the BR85 and 90 consoles. No-host cocktails and dinner preceded the meeting.

NEW *SID* MEMBERS

ANDREWS, FLOYD A., *Honeywell, Inc.;* BASS, J. E., *Recognition Equipment, Inc.;* BATES, CHARLES T., *Elliott Automation Ltd. (England);* BAUER, JAMES E., *S & S Associates Inc.;* BAWOROUSKI, JOHN, JR., *Litton Industries;* BRADY, JAMES *Hughes Aircraft Company;* BUTLER, DAN, *Kemco Inc.;* BUTTERFIELD, JAMES F., *Color-Tel Corporation;* CADORETTE, NESTOR C., *Grumman Aircraft;* CANFIELD, FRANK B., *UNIVAC—Federal Systems;* CARSON, ROBERT E., *Remington Rand Office Systems;* CEDARSTROM, ROY A., *Hughes Aircraft Company;* CHADHA, K. C., *DRL Laboratory (India);* CHANEY, LARRY L., *Hughes Aircraft Company;* CHRISMAN, JAMES J., *Corning Glass Works;* CLEVELAND, JAMES L., *IBM Corporation;* CLIFTON, JOE ANN, *Litton Industries;* COLEMAN, CURTIS W., *CalComp;* COLLENDER, ROBERT B., *Lockheed Aircraft;* CULP, ROLLAND D., *EMR Computer Division;* CUNNINGHAM, JAY L., *University of California at Berkeley.*

DANIEL, WILTON J., JR., *Texas Instruments;* DIETZ, CHARLES H., *Stromberg-Carlson;* ESHLEMAN, DEAN B., *Control Data Corporation;* FIFIELD, ROBERT K., *Aerospace Corporation;* FLOREY, BERNARD I., *General Electric;* FOLEY, ROBERT T., *National Research Corporation;* GOLDSMITH, C. THOMAS, *Fairchild Camera & Instrument Corporation;* GUEDJ, RICHARD A., *C.I.I. (France);* HARBERTS, HAROLD H., *H. H. Harberts Associates;* HATVANY, Jozsef, *Hungarian Academy of Science (Hungary);* HENNING, Ormond F., *Texas Instruments;* HIX, RICHARD C., *Mardix Inc.;* HOLDEN, ALISTAIR, *University of Washingtin;* HOROWITZ, JOSEPH, *Grumman Aircraft;* HOWARD, RICHARD A., *Adage Incorporated;* KAYE, MORTON, *Kaye Scientific Corporation;* KIOSTERUD, VIGGO H., *Pacific Technical Analysts, Inc. (Hawaii);* KOELSCH, ALBERT C., JR., *IBM Corporation;* KORELITZ, T. H., *The Badger Company Inc.;* MANN, HAROLD J., *General Electric;* MENDENHALL, C. E., *Amplex Corporation.*

MILLER, WILLIAM E., *NASA Manned Spacecraft Center;* MOL, HANS, *The Digitran Company;* McANDREW, THOMAS V., *USN Underwater Sound Laboratory;* McCOLLOUGH, DARRELL G., *CalComp;* McINTYRE, DONALD C., *Honeywell Inc.;* NAMORDI, MOOSHI R., *General Electric;* NASH, WILLIAM E., *Sanders Associates;* NIXON, RICHARD J., *Adage Inc.;* OSNESS, ROBERT H., *The Boeing Company;* RAGLE, HERBERT U., *R.T.I., Inc.;* ROGERS, BENJAMIN C., JR., *Airtronics, Inc.;* ROSEN, S. R., *First National City Bank;* ROSTOCKI, STANLEY J., *Air Force Avionics Laboratory;* RUDER, DONALD J., *Data Disk Inc.;* RUDISILL, JOHN C., JR., *Corning Glass Works;* SAAD, JOHN R., *U.S. Navy Undersea Warfare Center;* SCHAEFER, L. J., *Adage Inc.;* SCHAUWECKER, ERWIN H., *Hughes Aircraft Company;* SCHMIDT, ERNEST J., *Philco Ford Corporation;* SCHUPHORST, RICHARD A., *Philco Ford Corporation;* SHEPHERD, LLOYD T., *Honeywell Inc.;* SMITH, THEODORE, J., *Independent Consultant;* STERRITT, Lanny W., *Data Disk Inc.;* TRESSEL, WILLARD J., *Friden, Inc.;* WACHTEL, ALAN, *Sanders Associates Inc.;* WILLIAMS, PETER R., *United Aircraft Corp.;* WIRTH, MARTIN T., *Honeywell Inc.;* WOLTER, HEINZ, *Trans World Airlines Inc.*

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RHODES, CONSTATINE, *Sylvania Electric;* SCHAEFER, L. J., *Adage Inc.;* RUDER, DONALD J., *Data Disc Inc.;* SCHOLZ, MAX. *ExCello Corporation;* SCOPACK, VINCENT, *USECO, Division of Litton Industries;* STERRITT, LANNY W., *ITT/Aerospace;* STEVENS, WILLIAM W., *Data Disc Inc.;* STRICKHOLM, HARRY, *LITCOM;* SUMMERS, LUIS H., *Yale University;* TOOPS, LARRY C., *Nortronics;* WILBORNE, PETER, *Cossor Electronics;* WILLIAMS, KENNETH J., *Sperry Gyroscope Company;* WILLIAMS, PETER R., *United Aircraft Corporation;* WOLTER, HEINZ, *Trans World Airlines Inc.;* YAMADA, TATSUY, *Tokyo Shibaura Research Laboratory.*

New Student Members

BRIDGES, KENT W, *University of California - Irvine.*

ANDERSON, RALPH J., *University of Minnesota;* BRIDGES, KENT W., *University of California;* STRZELECKI, Gene J., University of California

New Sustaining Members

The Society welcomes TRANSISTOR ELECTRONICS CORP., Minneapolis, Minn., and HUGHES AIRCRAFT COMPANY, Culver City, Calif., as new Sustaining Members. (Nominees for Hughes: L. W. Beck, C. T. Carroll, S. N. Roscoe, M. Weihrauch, and Technical Library). ■

SEMINAR SCHEDULED ON LASER DISPLAYS—

Dr. Dennis Gabor, Professor Emeritus of the Imperial College of Science and Technology in London, and Staff Scientist at CBS Laboratories, will join with a distinguished team of experts from industrial research in a panel meeting on the advances of laser technology to the field of information display.

Scheduled for April 10, the meeting will be held in New York, and is chaired by Leo Beiser, chairman of the Mid-Atlantic Chapter of *SID*. It is planned in cooperation with the Greater New York Section of the Optical Society of America. General subjects include human factors and needs for laser display; technological limitations; recent advances, and future potentials.

Among the distinguished representatives participating in the panel are Prof. W. R. Bennett, Jr., Director of Laser Research, Department of Physics and Applied Science, Yale University, and Dr. Robert Adler, Vice President and Director of Research, Zenith Radio Corp. Included as subject matter is discussion of laser sources; laser power requirements; systematic power losses, and laser deflection techniques. For further information, contact Tom Maloney, (212) 732-3960, Ext. 388.

GAMES COMPUTERS PLAY

A Westinghouse Prodac 50 computer has been playing a game in Pittsburgh, controlling an outdoor electric sign which departs radically from the simple on-off sequence of most flashing signs. According to Westinghouse, it is programmed to be "sophisticated, humorous, and challenging to the imagination—crediting the viewer's intelligence." The sign consists of a row of nine trademarks, each measuring 17.5 ft. in diameter, and composed of nine geometric elements—the circle, three dots, four lines in the W, and the letter's underscore—for a total of 81 light circuits. The combination makes possible 81 factorial ways in which the light can come on, each completing the assembly of the nine trademarks. Each sequence of patterns is first programmed on sets of drawings. From these, coding is generated on punch cards; the card data is in turn coded on magnetic tape and loaded into the computer. The computer transforms the data, which includes bit patterns and timing information, into its own language and stores the information in its 4000-word memory core.

Illustrating sequence where all but one of the emblems come on as faces that glare drolly at their nonconforming associate.

NAME CHANGE

The American Documentation Institute (ADI) recently became the American Society for Information Science (ASIS). ADI's new name reflects the emergence of information science as an identifiable configuration of disciplines, and emphasizes the fact that the membership is specifically concerned with all aspects of the information transfer process. *American Documentation*, the Institute's scientific quarterly, continues to appear under the same title, with the added subtitle, "official publication of the American Society for Information Science."

STAR GAZING — IN SEGMENTS

Under a NASA contract, engineers and scientists of the Perkin-Elmer Corp. developed a method and equipment used successfully to precisely align three segments of a 20-in-dia. mirror in a space chamber. Known as "active optics", the technique is held technically feasible by the firm for use in remotely positioning a score or more segments of a composite telescope mirror 10 ft. or more in dia. in space. Alignment of the mirror segments to a tolerance of less than 1/1,000,000 in. was accomplished in the experiments with sensing devices, electronic controls, and actuators applied to each mirror segment. Because of the stresses of the non-gravity environment of space, use of a composite mirror whose segments can be aligned in space, and then kept in alignment, is said to provide a more suitable alternative than creating the mirror with supports in a gravity environment. A significant consideration is the weight advantage possible with an active optics system: in a 400 in. aperture telescope, a single mirror of similar design and construction would weigh about 185,000 lb; an active optics mirror of the same dia. made up of 40 in. dia. sections, would weigh less than 20,000 lb.

Perkin-Elmer scientist Hugh J. Robertson makes final adjustments on segmented mirror for Active Optics program.

IRS TURNS TO FILM

Detailed records of millions of taxpayers, previously carried in 3 lb. ledgers, are now turned into microfilm by use of the Stromberg-Carlson 4400, which automatically translates computer data directly to readable alphanumeric data in page format, and then microfilms the data at rates of 15,000 lines a minute. Data was previously printed by mechanical line printers, working about 600-lines per minute, which compiled data on paper which was bound in ledgers measuring 11 x 14", were 4" thick and weighed 3 lb. According to the firm, the SC 4400 can produce up to 70,000 pages of data in 8 hours, superimposed with IRS forms, and encoded for fast retrieval of information. It monitors itself for errors and stops to signal an operator if it cannot correct the error. In the 1600 hours once consumed in printing annual listings for a single region, the SC 4400 can produce microfilm records for the entire nation.

IMAGE PROCESSING

A two-week course on Image Processing will be offered August 5-16, 1968 at M.I.T. The course will cover the theory and techniques of optical and computer image processing. Topics from image enhancement and biomedical image analysis will be discussed. Further information is available from the Director of the Summer Session, Room E19-356, M.I.T., Cambridge, Mass. 02139.

NEW BOOK ON DISPLAY PIONEERS

Display Systems Engineering, termed the "first book on the subject of displays and display systems to approach the subject from a fundamental and tutorial viewpoint," is now available from McGraw-Hill Inter-University Electronics Series. Edited by H. R. Luxenberg, Consultant in Information Systems, Lux Associates, and Rudolph L. Kuehn, Douglas Aircraft Co., and prepared by a staff of specialists, the book runs 444 pages plus index, and contains 304 illustrations. The book brings together under one cover the important contributions of the underlying classical disciplines encountered in display systems engineering as well as providing the overall conceptual and philosophical basis of such systems. Subject matter is explained by the use of a large number of basic illustrations and diagrams, a mathematical level suitable for the generalist without serious loss of precision, and certain special presentations in the areas of photometry, colorimetry, and optics. Dr. Luxemberg has been active in the information display field since 1958; he is a Fellow and Charter Member of *SID*; Mr. Kuehn was co-founder of the Society and inaugurated *Information Display*.

INFORMATION FLOWS FASTER

The AVCO Missiles, Space, and Electronics Group has introduced Mail-By-Telephone to its five geographically separated engineering and manufacturing plants. With the incorporation of the Alden 18 AlpurFAX (all purpose Facsimile), the group can exchange among plants any documents, regardless of size, without altering the original. Systems are Alden 18 AlpurFAX with one scanner and one recorder at each location. The network operates over ordinary voice grade telephone lines using 602C Dataphone subsets, and provides unattended transmission and reception day or night. To transmit, the sender puts the message into the transmitter. An 8½ x 11" piece of graphic material is transmitted in about four and ½ minutes. Companion equipment for microfilm users are the microfilm scanners which operate with the same recorders.

COMPUTER GROUP

The Second annual IEEE Computer Group Conference, "The Impact of LSI on the Information Processing Profession," will be held at the International Hotel, Los Angeles June 25-27.

NEW ENGLAND SYSTEMS SEMINAR

The eighth annual New England Systems Seminar is scheduled for Friday, May 24, 1968. The all-day symposium, sponsored by the New England chapters of the Systems and Procedures Association, will be held at the New Ocean House, Swampscott, Mass. David T. Kearns, Vice-President and Manager, Eastern Region Data Processing Div., IBM, keynotes the meeting with a talk on "Data Processing In the 70's." Additional information is available from Samuel Ryder, 275 Wyman St., Waltham, Mass. 02154.

SPACE TRACKS

A pair of satellites coursing space paths leave their traces on the display board in the North American Air Defense Command's Combat Operations Center. Sitting in the underground command post and watching the tracks of the objects as they pass by in space is Maj. Gen. J. N. Ewbank, Jr., director of the

center. Position information on space objects is gathered by a global network of satellite detection and tracking sensors and is assembled in the NORAD Space Defense Center. Both centers are housed inside a mountain near Colorado Springs, Colo. Paths of satellites, aircraft and missiles can all be displayed on the screen by an electronic computer for use by the NORAD commander in chief and his battle staff in directing a defensive air battle over the U.S. and Canada.

SHORT COURSE — SUMMER SESSION

New York University will sponsor a short course on the theme, "Built-In Test Equipment for the Maintenance of Complex Electronic Systems," to be conducted in conjunction with the operation of Project SETE, (Secretariat to the Electronic Test Equipment Coordination Group). Scheduled for July 22-26, 1968, the course will be held at the United Engineering Center, 345 East 47 St., N.Y. Further information may be obtained from Mari Fields, (212) LU 4-0700, Ext. 776.

LASER APPLICATIONS

The Society of Photographic Scientists and Engineers will hold a tutorial seminar April 25-26, 1968 at the Travelers Hotel, N.Y. Seminar is entitled "Applications of Lasers to Photography and Information Handling. The luncheon address will be presented by Professor Emmett N. Leith of the University of Michigan, who will speak on the future of holography. Professor Leith was recently chosen as the 1966 Man of the Year by the thirty-man Editorial Advisory Board of "Industrial Research" for his contributions to the development of laser holographic, lensless, three-dimensional photography. Further information may be obtained from the Society office, 1330 Massachusetts Ave., N.W., Washington, D.C. 20005.

DATA MANAGEMENT

The Tenth Annual Meeting of the Engineering Data Management Section (formerly the Engineering Documentation Section) of the AOA, will be held at the Shoreham Hotel, Washington, May 7, 8 and 9. Central theme is "Data Management at the Crossroads". Sessions are planned on the following: effect of automated drafting profession; effect of new data media on government management practices; relationships between engineering data management and resource management information systems in government and industry; and government/industry management response to congressional criticism. Further information is available from J. Mazia, program chairman, 1625 Eye St., N.W., Washington, D.C. 20015.

SEEING IN THE DARK

A foot-square screen that mounts behind aircraft windshields, the "Night Window", has been developed by Kollsman Instrument Corp. Using advanced optics to display an enhanced image of the real world with the same depth, size and realism a pilot would see if looking at the scene during daylight, the device will give pilots their "first clear, realistic view of night-darkened terrain," according to company spokesmen. Unlike systems which display the viewed scene as an image on a small picture tube below eye level, "Night Window" projects its images so that they appear to the eye like real objects in their true position. A laboratory model has undergone helicopter field trials at the Army's Night Vision Laboratory, Ft. Belvoir, Va., while the Air Force and Navy are also evaluating the system. Using radar and infrared equipment, the device is completely passive and emits no visible or invisible waves an enemy could detect or jam. It can see in darkness as dim as an indoor sports areana lit only with a pocket flashlight, or a landscape lit only by overcast starlight.

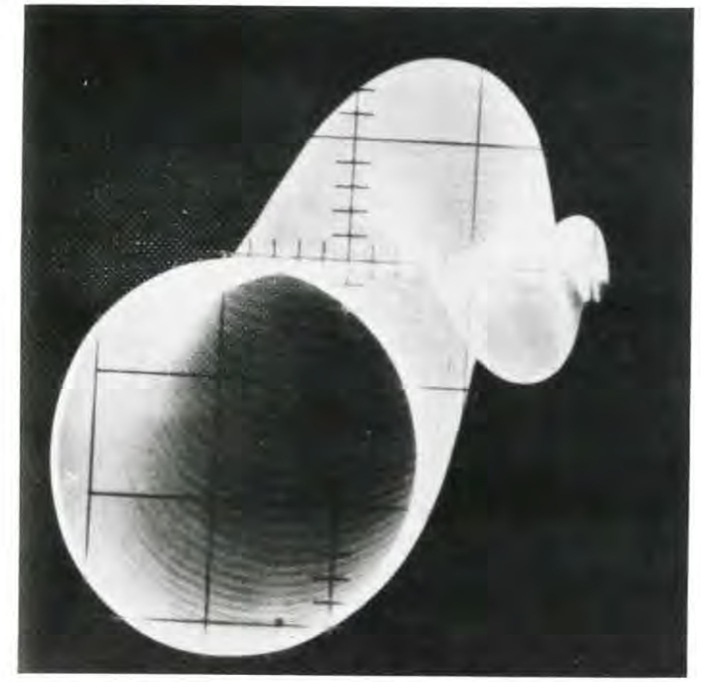
Simulated installation of "Night Window" showing pilot getting clear view of helicopter landing on twilight-shrouded field.

INSTITUTE OF NAVIGATION

The 24th Annual Meeting of the Institute of Navigation is scheduled to be held at the U.S. Naval Postgraduate School, Monterey, June 19-21.

THE SHELL GAME

Prof. David M. Raup of the University of Rochester's Dept. of Geological Studies has used digital and analog simulation methods to study shell geometries. According to Dr. Raup, the digital method has the disadvantage of being relatively costly in terms of computer time, while a cheaper and nearly as rigorous method has been developed using a standard Electronic Associates Inc. TR-20 Analog Computer and oscilloscope. The study was designed to analyze the func-



tional significance of the coiled shell; it has been found that the geometry of a shell form is directly related to biological phenomena. In geometric terms, the coiled shell is a tapered, hollow tube, which is open at its larger end and is coiled on a fixed axis. Growth takes place principally at the open end. To develop the analog computer program, a mathematical model representing the geometry of the shell was developed. The model has four principal parameters which can be adjusted, resulting in different geometric forms. The first parameter is the shape of the generating curve; the second the whorl expansion rate; the third the position of the generating curve in relation to the coiling axis, and the fourth the rate of whorl translation.

TELETYPE CONSOLES

The SDS 940 computer at Computer Sharing Inc., has been designed to serve multiple users through the time-sharing plan. This is made possible through a software package designed for this use. As stated by the company, the 940 enables up to 32 persons to sit at teletype consoles in their own offices, laboratories or classrooms and use the same computer at the CSI office simultaneously.

The software on the 940 includes a Monitor and Executive, a job scheduler, accounting routines, sophisticated facilities for debugging and editing user programs, compilers and assemblers and a growing library of applications-oriented programs. Because the system software is mostly re-entrant, it need not be swapped out of memory to permit the compilers and other service subsystems to accommodate successive users.

AMACUS

The Advanced Products Division of Link Group, General Precision Systems Inc., has delivered the first Automated Microfilm Aperture Card Updating System (AMACUS) to the U. S. Army Weapons Command at Rock Island, Illinois. This complex system is said to have capability of electronically revising microfilmed documents quickly and economically. With AMACUS, the usual procedures involved in updating microfilmed material, such as making the revisions on paper and refilming the paper, are eliminated.

The system incorporates a number of electronic devices parcelled in four basic units: Operator's Display Console, Memory System Console, Scanner/Processor Console and Computer. ■

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, a Directory, and news of National and Local Chapter activities. They may attend, at member rates, the symposia and other technical meetings. Participation in the local chapters, regular meetings and other activities is encouraged. To apply, complete this application, enclose membership fee and mail to the Society.

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 locations or individuals will receive the journal, **Information Display,** Symposia Proceedings and other Society publications.

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REMITTANCE
Dues through January 31, 1969

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

*Symposia proceedings not included with Student Memberships.

Business News

Mosiac Fabrications Div. of BENDIX CORP. has initiated full production in a new, separate plant equipped with high-speed automated processes to produce continuous, flexible fiber optic bundles over 50,000' in length. Also announced was a price cut to 9 cents per foot for quantity orders. The previous price was as much as $1.50 per foot . . . Houston INSTRUMENT DIV. of BAUSCH & LOMB has announced the introduction of the COMPLOT graphic plotter line and the formation of the COMPUTER GRAPHICS GROUP headed by L. C. Bower, general sales manager. Bower's responsibility will include new products and the formation of a specialized service team.

A contract in excess of $400,000 for six computer information display consoles has been awarded to TASKER INDUSTRIES of Van Nuys, Calif. by the MCDONNELL DOUGLAS MISSILE AND SPACE SYSTEMS DIV. in Long Beach. Tasker Industries president, W. E. Trantham Jr., said the consoles will effectively increase the utilization of computers on various aerospace contracts of MSSD . . . COMPUTER COMMUNICATIONS INC., Inglewood, Calif., has delivered two Fortran systems to INTERSTATE ELECTRONICS CORP. of Anaheim, Calif. The system, for use on Interstate's IEC-1010 computer, include a real time Fortran IV and the USASI Standard Fortran IV. Each of the systems also includes the compiler executive, the run-time package, the library of functions, the loader, and the run-time monitor.

DIGITEK CORP. (OTC), Los Angeles, has reached an agreement in principle to acquire MEASUREMENT ANALYSIS CORP., Los Angeles computer software company, for 196,000 shares of Digitek stock, according to James R. Dunlap, president. Under the terms of the proposal, Measurement Analysis Corp. would be acquired on a pooling interest basis and operate as a wholly owned subsidiary under the direction of its president, Dr. Julius S. Bendat . . . Dr. Robert T. Watson, president of ITT INDUSTRIAL LABORATORIES DIV., has announced that a camera development contract amounting to nearly $750,000 has been signed with the Goddard Space Flight Center of NASA. The camera will be used aboard a future *TIROS M* weather satellite. It will later be flown on the second-generation *ESSA* series of operational weather satellites.

CONCORD CONTROL INC., Boston, has delivered the $600,000 E-103 Automatic Cartographic System to the Naval Oceanographic Office in Washington. The system provides ability to produce and update charts and maps more easily, accurately and with greater speed than possible previously . . . G. J. Long, a Houston based geophysicist, has formed PARAGON SYSTEMS INC., entering the field of independent digital peripheral equipment mfgs. William W. Witt, previously vp/general manager of Geo Space Computer Div.'s Computer products dept., is president of the new company . . . SPERRY RAND has formed the FDS Systems Engineering and Applications Programming Group in Washington, D.C., to "reflect the company's recognition of the increasing importance of adequate software programs in support of computing systems." Richard S. Frary directs . . . ALDEN ELECTRONICS, Westboro, Mass., and its subsidiary, OCEAN SONICS INC., recently delivered the first altitude/depth sonar display system for the Navy's Deep Submersible Rescue Vehicle program. Alden is under contract to supply six systems . . . A $2,981,999 contract has been awarded RADIATION INC., for an advanced data collection system that will use the Nimbus-D research satellite. (Continued on page 79)

ID Correspondence

Sir:

The Bunker-Ramo Corporation is developing for the Office of Naval Research a human engineering guide for engineers designing visual displays, particularly those used in command/control systems. The intent is to provide a handbook describing the behavioral parameters (e.g., resolution, contrast, brightness, etc.) which influence the operator's perception of these displays and particularly how these parameters are applied in equipment design. We hope to provide a handbook which is much more design-relevant than ones previously developed for engineers by human factor practitioners.

We would greatly appreciate your bringing to the attention of your readers our interest in securing information on, copies of, or references to, standards of good engineering practice which we wish to cite in relevant sections of the guide. For example, we should like to know what design engineers who develop visual displays consider to be minimally acceptable and most desirable levels of resolution, contrast, brightness, distortion, or ambient lighting; how they take into account such factors as display presentation rate, color, number of display elements; how they determine optimal display size, etc.

We would be interested in corresponding with any of your readers who would be willing to inform us of the standards they employ, the conditions under which they employ them, the procedures they have used to develop these standards (if they have developed their own), the problems they have encountered in dealing with the parameters mentioned above and the factors they consider in dealing with these parameters. It should be noted that we are not interested in any proprietary information.

Their assistance (and yours) in providing the desired information will be of significant help to us in developing what we hope will be an important aid to the engineering profession.

DAVID MEISTER
Technical Director
Human Factors Programs
8433 Fallbrook Ave.
Canoga Park, Calif. 91304

Sir:

In reference to a new product release which appeared in the September/October issue of *Information Display*, I would like to make the following comment: the Master Specialties plug-in switch modules are not the first lighted pushbutton switches to use the crimp type wiring concept.

The Litton "ORCON" switch introduced the crimp type wiring connector approximately one year ago. The "ORCON" connector is wired in while the switch production order is in process. Switches and Indicator lights utilizing pin bases are plugged in upon delivery.

Director of Engineering
VIC SCOPACK
USECO Div.
Litton Industries

Sir:

The following corrections apply to the article appearing in Vol. 4, No. 6 Nov./Dec. 1967 *Information Display* entitled "The Stereoptiplexer—Competition for the Hologram". On page 28, last paragraph—4th line from the end "lines C and D" should read "lines D and E". Also in Figure 9 caption—second line—"33m camera" should read "35mm camera". Otherwise the article reads very well and I am grateful for your cooperation. Thank you.

ROBERT B. COLLENDER
North Hollywood, Calif. ■

(Continued from page 77)

RCA will provide data display units for the TIPI system being developed for the military services. Displays will be built at the west coast Div., Van Nuys, Calif., under contract to TEXAS INSTRUMENTS . . . The army has awarded a $200,000 contract to COMPUTER SCIENCES on behalf of the Military Traffic Management and Terminal Service to develop a computer-oriented information and control system which will provide up-to-the-moment information for controlling overseas shipments of vital military air cargo . . . MARSHALL INDUSTRIES has entered the computer software field with formation of MARSHALL INFORMATION SCIENCES. President is Wesley E. Niemond, formerly director of Southwest operations of COMPUTER SCIENCES CORP.

NASA has awarded contract for an "information retrieval and modification subsystem" to INFORMATION DISPLAYS INC., Mt. Kisco, N.Y. Subsystem will consist of three IDIIOM computer controlled graphic CRT displays, a hard copy recorder and printer, and an interface to a Univac 1108 computer . . . GF INDUSTRIES INC., Phoenix, has acquired DYNAMIC SYSTEM ELECTRONICS, Tempe, manufacturer of systems and components for data acquisition and conversion. Dynamic continues under its present management as a subsidiary of GFI . . . Warren Polk will direct work on programming support of the Exercise Production System from INFORMATICS' Bethesda, Md. office, under a contract from NMCS. As part of the project, Informatics will design and develop an Exercise Designers Handbook which standardizes exercise preparation procedures and records experience of training officers so that facilities of EPS are made more widely available. ■

SID Sustaining Members

ADAMS ASSOCIATES
Bedford, Massachusetts

AEROSPACE CORPORATION
San Bernardino, California

GRAPHIC SYSTEMS DIVISION
Computer Industries Inc.
14761 Califa Street
Van Nuys, California 91401

BUNKER-RAMO CORPORATION
Canoga Park, California

BURROUGHS CORPORATION
Defense, Space & Special Systems Group,
Paoli, Pennsylvania

CELCO
(Constantine Engineering Labs. Co.)
Mahwah, New Jersey

COMMUNICATIONS & ELECTRONICS DIV.
Philco-Ford Corporation
A Subsidiary of Ford Motor Co
Willow Grove, Pennsylvania

CONRAC DIVISION
Conrac Corporation
600 North Rimsdale Ave.
Covina, California 91722

ELECTRONIC COMPONENTS GROUP
Div., Sylvania Electronic Products Inc.
Seneca Falls, New York 13080

GENERAL ATRONICS CORPORATION
Electronic Tube Division
1200 East Mermaid Lane
Philadelphia, Pennsylvania 19118

HUGHES AIRCRAFT COMPANY
Culver City, California 90230

HUGHES AIRCRAFT COMPANY
Vacuum Tube Products Div.
Oceanside, California

IBM CORPORATION
Armonk, N.Y.

NAC INCORPORATED
7 - 1 Ginzanishi
Chuo-Ku, Tokyo, Japan

RADIATION INC.
Melbourne, Florida

STROMBERG CARLSON CORP.
Data Products, San Diego, California

SYNTRONIC INSTRUMENTS INC.
100 Industrial Road, Addison, Illinois

TRANSISTOR ELECTRONICS CORP
Minneapolis, Minnesota

ID Products

Sealed Capacitors

An hermetically sealed tubular design has been added to the family of metallized polycarbonate capacitors by SEI Manufacturing, Northridge, Calif. Completely moisture proof, the new capacitors are suited for circuits that require flat temperature coefficient, low losses, and small size over wide temperature and frequency ranges. Typical applications are wave filters, discriminators, and critical timing circuits. Designated SEI Series 22E, the line is available from stock in 200, 400, and 600 volt ratings in sizes from 0.174 Dia. x 0.500 L to 0.750 Dia. to 1.875 L. Capacitance values range from 0.001 to 5.0 mfd with tolerance from 20% to 1%. Other voltages, capacitances, and tolerances are available within three weeks of order. Characteristics include: operating temperature, —55° C to 105° C; insulation resistance, 100K meg x mfd min. at 25° C; dissipation factor, less than 0.3% at 1000 Hz and 25° C; TC, 1.5% max change from —55° C to 25° C, —0.7% max change from 25° C to 105° C. All units will meet or exceed the specifications of MIL-C-18312 and are tested 100% to Group A requirements as standard production quality control procedures.

Circle Reader Service Card No. 34

Remote Terminal Devices

Infotec Inc., Westbury, New York, has introduced the series 10 data collection recorder. According to the company, the source data is transcribed onto magnetic tape via a standard typewriter keyboard, producing at the same time hard copy listings for verification. Transmission of collected data to the central computing center can be made at speeds compatible to various modem rates.

Circle Reader Service Card No. 35

Digital Incremental Plotter

From Houston Instrument, Bellaire, Tex., the Omnigraphic 6650 Digital Incremental Plotter for use in on-line or off-line operation with digital computers is now available with both ball point and fiber tip pens. The pens will draw a continuous trace or plot points utilizing the programming inputs to the pen lift

circuitry. Elements are both replaceable and pen pressure is adjustable. The ball point pen has a fine trace of 0.002 in. and is suited for graphs or charts that must be read with maximum accuracy. The fiber pen with its trace of 0.02 in. excells where graphics or dimensional drawings are created and is easier to reproduce. Bi-directional stepping motors on both axes of the plotter produce incremental steps to move the paper or pen .01 in. (0.005 in. optional) in either direction. Plot produced can be immediately read and retained on the fan-fold paper, eliminating the old problems of storing rolls of paper and losing the graph into a roll of paper. Paper is perforated so that it can be torn out to fit flat into a notebook. The plotter may also be powered from either AC or DC sources.

Circle Reader Service Card No. 36

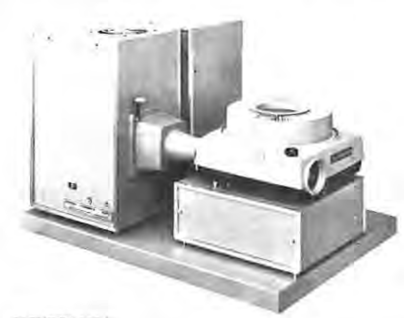
Two-Color, One-Gun CRT

Sylvania Electronic Components, Seneca Falls, N.Y., has introduced a two-color crt which uses only one gun. The 5 in. (SC-4689) and 10 in. (SC-4827) models use green and red phosphors; the red is Sylvania's rare earth europium red. Other tube sizes using the design can be custom manufactured to meet specific requirements.

Circle Reader Service Card No. 37

Xenon Lamp Slide Projector

Christie Electric Co., Los Angeles, has introduced a xenolite slide projector. The model BFL450-46 has been added to their line of



Xenon and Mercury Arc Lamp Illuminator Systems. According to the company, the 450 watt Xenolite projector is suitable for large auditoriums, outdoor amphitheater, display systems, trainers and other applications. Designed for use with standard cardboard mounted 35mm or super slides, it is also available with random access and remote controls.

Circle Reader Service Card No. 38

1000 Watt Universal Arc Lamp Source

From Oriel Optics Corp., Stamford, Conn., a new flexible source operates 450 to 1000 watt Xenon, Mercury, or Xenon-Mercury point source lamps interchangeably. The unit consists of a Universal D.C. Arc Lamp Power Supply with 1% Regulation and Ripple and a Universal Lamp Housing complete with blower mirror and U.V. grade quartz condensing optics. User can choose between lamps with the continuous spectrum of Xenon, the intense mercury lines, or a mixture of both. Research applications include spectroscopy solar simulation and U.V. irradiation studies.

Circle Reader Service Card No. 39

High Precision System

Systems Engineering Laboratories, Inc., Ft. Lauderdale, Fla., has announced the SEL 816A Computer Graphics System. SEL 816A is a high precision CRT display system designed for real-time and analytical off-line applications and is fully compatible with SEL 810A, SEL 840A, SEL 840MP, and SEL 810B Computer systems. In its basic configuration, the SEL 816A Computer Graphics System includes a 16-in. masked to a 10.24 by 10.24 in. image area, vector generator, intensity compensation logic, electromagnetic deflection network, maintenance controls and a digital control unit.

Standard system options include a high-speed character generator, line texture control unit, light pen, function switches and a computer graphics processor.

Circle Reader Service Card No. 40

Subminiature Nanosecond Delay Lines

ESC, Palisades Park, N. J., has designed a series of subminiature nanosecond delay lines with an unusually high packaging density, which are said to provide a high figure of merit in a small volume without compromising reliability. The SM Series conforms to applicable portions of MIL-D-23859A. Standard items range from 10 to 1200 nanoseconds at impedance levels of 100, 200 and 500 ohms; special variations with or without taps are available upon request. Originally designed for computer applications, the small size and lead configuration of the SM Series makes them well suited for mounting on printed circuit boards. Units are available in two standard sizes: 1 in. x .32 in. x .32 in. and 2 in. x .32 in. x .32 in.; both with ½ in. leads.

Circle Reader Service Card No. 41

Computer Graphics Terminals

Adage Inc., Boston, Mass., has introduced the Adage Graphics Terminal, a computer-generated CRT display. As stated by the company, the terminal is a fully-integrated general-purpose system. Model 10 graphics terminal includes 4K of 30-bit words core memory, CRT console, and Data-Phone interface to the central computer. Options include a hard copy display recorder and an analog input tablet.

Circle Reader Service Card No. 42

Automated Layout System

Ex-Cell-O Corp., Detroit, has announced availability of Optimat, a computerized layout system for production of integrated and printed circuit artwork. Two Arito Coordinatographs, one for readout and one for layout, are the basic elements in the system. A small computer, custom electronic interface, teleprinter/tape punch, and teleprinter/tape reader round out the system.

Circle Reader Service Card No. 43

Computer Transmission Control Unit

From Western Telematic Inc., Arcadia, Calif., the TM113 Transmission Control Unit (TCU) multiplexes remote teletype or IBM2741/1050 terminals in any combination of models or speeds to the IBM 1130 computing system. Up to 15 start-stop, half-duplex communications lines operate simultaneously. All data transmission is fully overlapped with 1130 1/0 and program execution. A keying option eliminates datasets for operation up to one mile. For greater distances or operation over common carrier, interface is with any serial by bit RS232B dataset. Supporting programs provide for interrupt servicing of terminal I/0 by direct program control subroutines which do error checking, code translation, character recognition (e.g. BSP & EOM), idle control, and character-to-message assembly/disassembly. These routines are invoked by Fortran Read/Write statements or by calling sequences embedded in assembly language programs. Because the terminal I/O routines utilize programming standards compatible with those used to support other 1130 I/O equipment (e.g. card reader/punch or printer), the applications programmer is insulated from the intricacy of the telecommunications environment. The software causes less than 10% throughout degradation and, depending on the number of terminal types and buffer sizes, occupies between 1,500 and 2,000 words of core storage.

Circle Reader Service Card No. 44

High-Speed Graphic Display

A high-speed graphic display system designed for real time applications in computer aided design, systems management, command and control systems, air traffic control and related areas is available from Sanders Associates, Inc., Nashua, N. H. Designated the Sanders Model 960/10 Display System, it features a 22-stroke cursive character generator, constant velocity vector generator, high-speed write-through-yoke techniques and advanced display timing circuitry. The system provides up to 128 different characters, including the standard ASCUII 96 character set, to be displayed at any of 1024 by 1024 addressable locations on a 14 x 14-inch display area.

Circle Reader Service Card No. 45

High-Speed Retrieval

Model 101, a high-speed information retrieval software system, has been introduced by Computer Corp. of America, Cambridge, Mass. The system is designed for use with IBM System/360 hardware using disc packs as the data storage medium. The new software technology is employed to achieve retrieval speeds orders of magnitude faster than obtainable by conventional techniques. Model 101 is specifically designed for purchase as a "packaged" software system for use requiring maintenance of large data files and rapiid retrieval of filed information.

Circle Reader Service Card No. 46

Pulsed Laser System

A pulsed laser system for industrial drilling and welding applications has been introduced by Raytheon Co.'s Laser Advanced Development Center, Waltham, Mass. Model LES-136 includes a laser head complete with protective covers and safety enclosures, a power supply, an optical system with closed circlit television for monitoring the operation, and a closed cycle cooling system. Output from the laser is variable to 20 joules to cover a wide range of work materials. Pulse width is variable, and three repetition rates—automatic operation at one pulse per second, one pulse per five seconds, and one pulse per ten seconds—are possible. Manual single shot operation is also possible. In use, a work piece is placed in the base of the enclosure beneath the upright laser head and is positioned by means of a three-plane XYZ positioner. Work piece position is shown on the television screen. After lining up the material within the graded cross hairs on the screen, the operator presses the firing button and the effects of the laser energy are shown on the screen.

Circle Reader Service Card No. 47

Digital/Video Disc Recorder

Raster-type TV monitors can be used for alphanumeric, graphic and digital-television-display systems when used in combination with Data Disc, Palo Alto, digital/video disc memory. Up to 100,000 bits on each track can be accessed at a 3-megabit rate, or up to 7.2 megabit capacity is available at bit rates up to 216 megabits/second with track-combining techniques. Up to 72 completely independent tracks can be provided on a single disc memory

Circle Reader Service Card No. 48

Videoprinter

Computer Communications Inc., Inglewood, Calif., has introduced the CC-310 Videoprinter as an optional hard copy output device on the CC-30 Communications Station. The unit can be used as a desk-top device and will provide either single or multiple hard copy output. Both alphanumeric and graphic images can be accommodated. Multiple exposure can be computer-directed to provide super-imposed alphanumeric and graphic information on a single hard copy. According to the firm, the printer process is completely dry; no solutions or developing agents are used.

Circle Reader Service Card No. 49

Binary To BCD Converter

AIC Instruments, Houston, Model 3000 Binary to BCD Converter translates binary inputs into a 1-2-4-8 BCD output at a rate of one microsecond per decimal digit. Model 3000 accepts unipolar binary inputs, or bipolar inputs in one's complement or two's complement code. Binary inputs of up to 20 bits with corresponding BCD outputs of up to 6 decades are available. Conversion capacity of units with less than 20 bits input can be expanded at any time by addition of plug-in cards. The all solid-state Model 3000 uses silicon transistors throughout and integrated circuits in the logic circuitry. It is packaged in a 5¼" high, 8½" wide, 12" deep box.

Circle Reader Service Card No. 50

Space-Saving Display

An instrument designed to display a maximum of information in a minimum of panel space is manufactured and marketed by Metra Instruments, Inc., Mountain View, Calif. Metrascope 12 occupies only 10½ in. of panel height in a standard relay rack. Up to 25 or more inputs—from thermocouples, strain gages, or other transducers — are sampled a minimum of 50 times per second and displayed on a CRT with electronically generated calibration. Inputs may be as low as 10 mv or as high as 10 volts DC for a full scale signal. Vertical height of each readout trace is directly pro-

portional to signal amplitude. The instrument incorporates a high-low alarm capability, causing the signal trace to brighten and a relay to close whenever any input signal exceeds its pre-set limit. Additional features include means for digital readout of signal levels; brightening of every fifth channel for quick channel identification; thermocouple cold junction reference when required; front access to all components; and quick-disconnect chassis and plug-in components to enable easy maintenance.

Circle Reader Service Card No. 52

Transistor Heat Dissipators

Waterbury Pressed Metal Company, Waterbuty, Conn., offers their series ST, HT, and RT transistor heat dissipators. As stated by the company, the ST series consists of six cooling fins, and may be used in either printed circuit board chassis mounting. Available in either aluminum or beryllium copper with a choice of finishes, and weighs .0014 lbs.

Circle Reader Service Card No. 53

Ceramic Material For Electronic Use

A ceramic material, useful as a component in advanced computer memory circuits, color television circuitry and in various space and undersea applications, has been announced by Bausch & Lomb, Rochester. The polycrystalline ceramic, known as SPN (Sodium Potassium Niobate) converts electrical energy into mechanical energy or mechanical energy into electrical energy in advanced electronic circuits. A hot pressing process produces a dense, uniform ceramic body which can be cut into thin sections to produce high-frequency extensional or shear mode transducers. These transducers have highly desirable characteristics for solid ultrasonic delay line applications. SPN exhibits relatively low dialectric constants and high radial coupling coefficients and operates over a wider range of temperatures than other piezo-electric materials in current use.

Circle Reader Service Card No. 54

Circle Reader Service Card No. 55

INFORMATION DISPLAY, March/April 1968

Magnetic Tape Digitizing System

The Grafacon 205-1 Magnetic Tape Digitizing System, a graphical input system for off-line digitizing of graphic data from hard copy such as drawings, strip charts, maps, etc., has been introduced by Bolt Beranek and Newman's Data Equipment Div., Santa Ana. The system is claimed to be several times faster to use than other graphic digitizing systems currently available. The system consists of the Grafacon 1010A digital tablet—a 10¼ in sq. production version of the RAND Tablet Graphic Input Device—with a pen-like stylus, alphanumeric keyboard, incremental magnetic tape recorder, and associated electronics assembled in a 30 in. H x 8½ ft. L. x 20 in. D cabinet.

Circle Reader Service Card No. 58

Digicator

Discon Corp., Fort Lauderdale, Fla., has recently released a catalog for the complete DiGiCATOR line. The catalog describes and

defines the specifications for the complete line of 7 incandescent lamp type numeric readouts and Universal Decoder/Drivers of both plug-in and chassis mounted configuration.

Circle Reader Service Card No. 59

Warning-Flashing Indicator Light

A sub-miniature indicator light mounts in ½ in. clearance hole and provides choice of red or amber lens caps with refractive inner surfaces for warning/caution signal indications. Available from Dialight Corp., Brooklyn, N.Y., intermittent lighting-flashing operation is obtained without use of thermal elements or any moving contacts. Flashing action is made possible by a high brightness neon lamp and solid state circuitry. Operation is obtained on ordinary 110-125V AC cirucits.

Circle Reader Service Card No. 60

Portable Lab Recorder

A portable strip chart recorder designed for a wide variety of laboratory applications has been introduced by the Van Waters & Rogers Div. of VWR United Corp., San Francisco. Available in two models, the Van-lab Portable Recorder is compact and lightweight (13 lbs.), yet ruggedly built of cast aluminum and stainless steel for maximum durability. The multi-speed recorder features advanced mosfet chopper and solid state circuitry with Zener controlled reference. Simplicity of operation is assured by quick-and-easy flip top loading of the large 8½ in. chart paper, and conveniently located controls. The Van-lab Recorder provides full-scale operation at 1, 5, 10, 50, 100 and 500 mv with chart speeds of ½, 1, 2½, 5 and 10 in. per minute.

Circle Reader Service Card No. 61

Portable Film Processor

Houston Fearless Corp. has announced the development of a new portable processor, Model 79PP. Compact and portable; the overall weight of the unit, with case, is approximately 110 lb. The case, which contains all the necessary elements, measures 24" (L), 14" (W), and 24½" (H). The processor will accommodate roll film in widths of 70mm, 5, 7, and 9½ in., and lengths from 5 to 500 ft. There is virtually no maintenance, according to the manufacturer.

Circle Reader Service Card No. 62

Sub-Subminiature Indicator Light

Vermaline Products Co., Franklin Lakes, N.J., offers B-7019 sub-subminiature indicator light with 1 in. leads, for computer and digital devices. It is manufactured of stainless steel and accomodates a T1 Bulb epoxied in place, 6V, 12V, 30,000. Lens size is 3/16 in. diameter x ¼ in from panel; unit mounts in 3/16 in. hole. The unit is available in many lens colors and various variations.

Circle Reader Service Card No. 63

New Indicators

The Eldema, Compton, line of indicator lights, C-Lite cartridge lamps and mating D-holders has been expanded to include several new styles of indicators. Used for both incandescent and neon type lighting, the new D-Holders are constructed to mount from the front and are available with RFI/EMI shielding. Mating cartridges and holders suit a variety of applications meeting MIL-L-3661. D-holders have anodized housings and nickel plated hardware.

Circle Reader Service Card No. 64

Microfilm Cartridge Carrousel

A microfilm cartridge carrousel with a capacity of up to 360 cartridges has been introduced by Information Design, Inc., Palo Alto. The rotary model, "360 Cartridge Carrousel," is

a modification of the carrousel produced earlier this year for use with the IRI Vendor Catalog File on Microfilm. Measuring 18 in. square by 36 in. high, the carrousel has a capacity of more than one million documents on microfilm. High impact polystyrene has replaced the wood and chrome of the earlier model and results in lighter weight and easier handling. New modular construction provides greater flexibility and versatility.

Circle Reader Service Card No. 65

Unidirectional High Speed Counter

A unidirectional, high-speed (15 MC) counter featuring cold-cathode neon type display and 4-line 8421 BCD coded output is available from Integrated Circuit Electronics, Inc., Waltham, Mass The unit provides reset and carry functions. Additional features include a high output drive that sinks a full 16 milliamps; sources up to 400 micro. The module is best suited for event counting and totalizing systems. Where a sample and hold feature is needed (as in frequency or interval counting), its sister module, the CS-100 count/display unit is recommended. The counter is readily adaptable as a building block for computer input/output, numerical control displays, and a wide range of digital instrumentation requirements.

Circle Reader Service Card No. 66

Encapsulated Shielded Static Focus Coil

Offered by Syntronic Instruments Inc., Addison, Illinois, the Type C5122 shielded static focus coil is designed for high temp. and/or high potential small precision displays, and for the new 1 in. neck dia. scan converter tubes. Heavy encapsulation construction to help dissipate heat is used; for optimum focusing accuracy, a precision soft magnetic iron case is used. Magnetic coupling between yoke and focus coil is prevented by a mu-metal shield.

Circle Reader Service Card No. 67

Capacitance Test System

A precision capacitance test system for sorting or grading semiconductors, voltage-variable capacitance diodes, packaged circuits, and all thin film capacitors, at up to 1200 measurements per hours, with 0.1% absolute accuracy, is now available from Micro Instruments Co., Hawthorne, Calif. Exceptional stability and accuracy are said to permit production sorting to tighter tolerances, thus reducing the "guard band" and resulting in a higher yield of tight specification devices than offered by other test equipment. Designated Model 1201-DS-2, the system includes a 1 MHz direct reading, four digit, solid state capacitance tester and two 4-digit comparators that allow sorting of components into several categories (e.g., 5%, 10%, 20%, or 5 - 10pF, 10 - 14pF, etc.) The system measures two and three terminal capacitance values, to MIL specs, up to 1,000pF in two ranges; 0-99.99pF and 0-999.9pF.

Circle Reader Service Card No. 68

Logicator Display

Bowmar Instrument Corp., Ft. Wayne, Indiana, has introduced a Logicator digital display designed for operation from digital computer signals, with both 5-wire and BCD logic units available. The DA-3303 has no mechanical parts other than the rotating display drum (with optional backlighting) which provides ¼" white-on-black numeral readout. A permanent magnet rotating armature is an integral part of the readout drum, and re-positioning is achieved by energizing combinations of windings on a stationary stator. Maximum time required for 180° reading change is 1 second, according to the firm.

Circle Reader Service Card No. 71

Rear-Project Readout

A 12-position, rear-projection readout, Series 160H, has been introduced by Industrial Electronics Engineers Inc., Van Nuys, Calif. Message area is 1.562" H x 1.125" W, over-all case size is 2.69" H x 1.56 W. Character brightness has been increased 150% over previous designs, according to the co. A lens system uses an improved condensing lens and a light gathering lens to increase average character brightness to 45 ft.-lamberts.

Circle Reader Service Card No. 72

Data Digitizer

Calma Co., Santa Clara, has introduced the Model 303P Digitizer, a device for reducing analog graphical data from strip charts, oil well logs and oscillograms to punched paper tape for computer processing and analysis. This Model features computer-compatible punched paper tape output and the variable interval programmed digitizing, according to the firm. Movements of the operator's manual tracing stylus are stored digitally and outputted as often as the paper tape punch is free to accept them. An accessory film projection system is available to allow direct reduction of data from projected film images. Model M Film Projection Accessory handles 16mm, 35mm and 70mm film.

Circle Reader Service Card No. 73

Voice/Data Accessory

Milgo Electronics Corp., Miami, has introduced the Model 10 Voice adapter, which allows users of the firm's Model 4400/24PB data sets to transmit voice or Teletype simultaneously with 2400 bps data over a single unconditioned telephone line. According to the co., their data sets, based on a narrow-band concept, are the only transmission units which permit this "piggy-back" use of unconditioned phone lines. The telephone-size unit plugs directly into a Model 4400/24PB data set and requires no outside power. It allows selection of: Voice/Data; Teletype/Data; and Full Voice. In addition to audible ringing, a lamp indicates when ringing is in progress.

Circle Reader Service Card No. 74

Hybrid Computer

Adage Inc., Boston, offers the Ambilog 200, a general-purpose hybrid computer, which features parallel arithmetic arrays integrated with a sequential digital processor, combined analog-digital array elements, simultaneous processing of analog and digital variables in a single program step, and system interfaces that may be analog, digital, or both. According to the co., the 200 has greater computing power per unit cost due to a new sequential-parallel organization, and faster solutions of processing problems involving both analog and digital data. The software package includes a resident Monitor for controlling the loading, linking, and execution of relocatable and linkable object programs, and a FORTRAN compiler.

Circle Reader Service Card No. 75

CRT's

The Du Mont Electron Tube Div., Fairchild Camera and Instrument Corp., has developed a line of "space saver" cathode ray tubes for airborne electronic counter measures equipment. The tubes are designed for performance in a small overall size with a variety of screen sizes and shapes. Said to be capable of providing small spot sizes and well defined high light output traces under severe airborne shock and vibration environments covered by Mil Std. 810, the CRT is said to be well suited for aircraft installation where size, cockpit brightness and environment are important.

Circle Reader Service Card No. 76

Digicator

Discon Corp., Ft. Lauderdale, has placed on the market a 7 segment, incandescent, lighted numeric readout. The multiple character display is contained in a single integral package ¼ of an inch thick. No additional bezels, polarized screens, mounting brackets, or rectangular panel cutouts are required, according to the firm. It mounts directly to the front panel while occupying relatively no space behind the panel. Each character measures 1 in. high by 9/16 in. wide and is readable at distances up to 50 ft. in bright daylight ambients.

Circle Reader Service Card No. 77 ■

HERBERT E. HEATH has been promoted to manager of engineering in the Microelectronics Laboratory of Bunker-Ramo's Defense Systems Div., according to JACK W. IRELAND, laboratory director. Heath's new assignment includes responsibility for improving in-house technology in the areas of thin-film resistor and capacitor adjustment. Heath joined Bunker-Ramo in 1964 and the prior two years was employed by Martin-Marietta Corporation as a research engineer.

DR. WALTER F. BAUER, president of Informatics Inc., has announced the appointment of GRAHAM E. SMITH as director/southeast operations. In this capacity Smith will manage Informatics business developments in the southeast U.S., working out of Melbourne Beach, Fla. Before joining Informatics, Smith served as consultant to Pan American Airways, Guided Missile Range Div. He has been active in the field since 1948 when he joined Engineering Research Associates, St. Paul.

WALTER P. SOBOLESKI, executive vice president of Gap Instrument Corp., has been elected a director of the company, according to an announcement by ALAN G. BINNIE, president. Soboleski joined GAP in 1962 as director of engineering. He was named a corporate vice president two years later, and in December of 1967 was promoted to his present position.

CLIFFORD H. LANE has been named as division vice president and general manager, RCA industrial Tube Division. JOHN B. FARESE, executive vice president RCA Electronic Components, made the announcement. Lane became associated with RCA in 1941 as a production engineer. In 1957 he was named manager, market planning, Industrial Tube Products Department. Since January, 1968 he has been general manager, RCA Industrial Tube Division.

KENNETH M. MILLER, SR., has been named vice president of Computer Industries Inc., and general manager of its Graphic Systems Div. ROBERT G. DEE, company president, made the announcement. Miller, formerly a vice president of Motorola Electronics, Daystrom Inc., and Lear Jet Industries, will be responsible for expansion of Graphic Systems' computer visual readout systems and graphic products.


KENNETH MILLER, SR.


TED BALZER

TED BALZER has been promoted to Western region director of sales for the Advanced Circuitry, USECO and Winchester Electronics divisions of Litton Industries. The appointment was announced by JOHN A. LOVETT, vice president of the national sales organization for the three divisions. Balzer will direct sales and engineering services throughout the Western U.S. for users connectors, printed and multilayer circuitry, fasteners, electronic hardware and pushbutton switches. He joined Litton in 1959.

ROBBINS G. HICKSON, former director of tactical systems for the army Engineers' mapping agency, has accepted the post of manager of mapping and geodesy for the Systems Management Division of Kollsman Instrument Corp., Syosset, N.Y. Prior to joining the corps in 1941 Hickson served with the U.S. Coast & Geodetic Survey agency and the U.S. Department of Agriculture, Soil Conservation Service.

KENNETH G. HARPLE has been named director of development engineering at Systems Engineering Labs, according to president A. G. RANDOLPH. Prior to accepting the post, Harple was general manager of Digital Products Div. of Canoga Electronics.

HAROLD E. CAMP has joined Chicago Aerial Industries Inc., Barrington, Ill., as group manager in charge of fiber optics, it was announced by ERNEST H. PALLME, vice president of engineering. He succeeds ANDREW A. MUELLER, who recently resigned. In his new position, Camp will be responsible for the development and manufacture of fiber optic components for the aerospace firm. Camp was formerly a senior physicist for Corning Glass Works Process Research Center.


HAROLD E. CAMP


FRANCES McKENDRY

The appointment of FRANCES J. McKENDRY to the position of manager, applications Engineering and product development for Signalite Inc., Neptune, N. J., has been announced by A. W. GERSHON, president of the company. McKendry will be responsible for assisting Signalite's customers in the integration of neon glow lamps in electronic circuitry, and for the design and development of new glow lamps.

FREDERICK B. GILLER has been elected vp/technical director and a member of the Board of Directors of International Information Inc. Formerly assistant prof. of Pharmacology at the Philadelphia College of Pharmacy and Science, Dr. Giller also holds the rank of Assoc. Professor at the Pennsylvania College of Podiatric Medicine.

Appointment of JIM WRIGHT to manager of new product development was announced by A. R. MASTERS, executive vice president of Transistor Electronics Corporation of Minneapolis. Wright has been active in the computer field since 1952 when he joined Electronic Research Associates, which later became Univac. Moving to Control Data in 1961, Wright managed a design group which investigated the effects of redundancy technique on computer reliability and, more recently, a group which designed and developed automated test equipment for checkout of the Apollo space capsule.

RODNEY B. MURRAY has been named national sales manager of California Computer Products Inc., Anaheim, Calif., replacing RON HENDERSON, who has assumed the newly created post of assistant to RICHARD L. MARK, vice president, marketing. He previously served as director of programming for Computer Laboratories, district sales manager of Control Data Corp., and manager, seismic marketing, at Scientific Data Systems.

WILLIAM E. WARE has been appointed director of marketing for Systems Engineering Laboratories Inc. Announcement was made by A. G. RANDOLPH, president of the company. Prior to his present position Ware was industrial Control sales manager for Honeywell's Computer Control Div. He is the author of numerous technical papers and publications and is a member of the IEEE, and a senior member of the Instrument Society of America.

General Electric has announced the structure of its new information systems business organization and its key managerial assignments. The Company's information systems operations become the Information Systems Group. Vice president J. STANFORD SMITH is group executive of the new group which will be made up of four new divisions. The Information Systems Equipment Div. is headed by general manager LOUIS E. WENGERT, with headquarters in Phoenix, Arix. Reporting to Wengert is the newly formed Information Systems sales and service organization, headed by deputy div. general manager VERNER S. COOPER. The Information Services Div. is headed by general manager JEROME T. COE with headquarters in New York; The International Information Systems Div. by general manager ARTHUR E. PELTOSALO; and the Advanced Development and Resources Planning Div. by JOHN W. HAANSTRA, also headquartered in New York.


VERNER S. COOPER


PETER S. PHILIPI

DONALD A. POTTER, vice president of Stewart-Warner and general manager of its electronics division, has announced appointment of PETER S. PHILIPI as manager of facsimile products, responsible for marketing, product engineering and service activities, including direction of Datafax Corp. Philippi comes to Stewart-Warner from the position of sales manager of Midwestern Instruments Co., Tulsa, Okla.

Elected vp in charge of R&D for Trans-Lux Corp. is CHARLES J. HOLLOMAN, formerly chief engineer. He joined the firm in 1965 to head development of electronic communications systems. The firm has been involved in extensive research in the use of microcircuitry for such displays in all industries.

The appointment of CURTIS D. OAKES as Washington district sales manager for the Photolamp Div. of Sylvania Electric Products Inc., has been announced by DOUGLAS J. MAGEE, Eastern regional sales manager. Oakes is responsible for the Washington, D.C. area sales office. He succeeds G. BROWN ROBERTS, who has been assigned to the company's Philadelphia office. ■

ystems Catalog

lamaroneck, N.Y., offers a cribing the theory, operany of Sealectroboard cordnd switching systems. The formation on the utilizafor computer programing e tool control, telemetry lators, audio signal distrighting systems, mfg. test systems, instrumentation digital coding and decodas well as numerous other n reports.

Service Card No. 80

eprinter Defined

ulletin, covering the basic of several types of mobile eria for selecting a proper lable from Codamite Div., Electronics Co., Anaheim. e Teleprinter" briefly exbetween electronic and rinters, dividing the latter assifications and defining the bulletin provides a stion and answer section ria to be considered when printing unit. The final etin relates existing policy nmunications Commission nobile teleprinting devices circuits.

Service Card No. 81

Indicator Lights

The entire Eldema, Compton, line of indicator lights for military, industrial and commercial applications is described in an eight-page condensed catalog. Highlighted in the catalog are Eldema's Logic-Lites, indicators with built-in transistorized lamp driver networks, and the RFI/EMI shielded versions of lampholders which provide effective attenuation for interference shielding. Specifications called out for the many varieties of Eldema holders for the use with the midget flange-based T-1¾ incandescent and T-2 neon lamps, D-holders designed to mate with corresponding plug-in C-Lite cartridges, and the T-Series family of relampable holders and lens caps for use with the T-3¼ bayonet-based incandescent and neon bulbs. Also detailed are the permanent mounted type E-Lites, relampable H-Lties for military applications, and the permanently mounting subminiature J-Lites.

Circle Reader Service Card No. 82

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Circle Reader Service Card No. 84

Illuminated Push Buttons and Indicating Lights

GEA-7390B—an eight-page illustrated publication describes General Electric's line of CR103 Type D push buttons and indicating lights for application on control and instrument panels, office machines, laboratory instruments and other data processing equipment. These rectangular push buttons and indicating lights are available in two- or four-lamp forms. Five lens colors and four housing colors are shown, as well as solid and split color fields. Photographs and diagrams show ease of installation and lamp replacement, contact arrangements and color combinations. Panel mounting dimensions are given for both push buttons and indicating lights. Tables list complete ordering information.

Circle Reader Service Card No. 85

on the move

HERBERT E. HEATH has been promoted to manager of engineering in the Microelectronics Laboratory of Bunker-Ramo's Defense Systems Div., according to JACK W. IRELAND, laboratory director. Heath's new assignment includes responsibility for improving in-house technology in the areas of thin-film resistor and capacitor adjustment. Heath joined Bunker-Ramo in 1964 and the prior two years was employed by Martin-Marietta Corporation as a research engineer.

DR. WALTER F. BAUER, president of Informatics Inc., has announced the appointment of GRAHAM E. SMITH as director/southeast operations. In this capacity Smith will manage Informatics business developments in the southeast U.S., working out of Melbourne Beach, Fla. Before joining Informatics, Smith served as consultant to Pan American Airways, Guided Missile Range Div. He has been active in the field since 1948 when he joined Engineering Research Associates, St. Paul.

WALTER P. SOBOLESKI, executive vice president of Gap Instrument Corp., has been elected a director of the company, according to an announcement by ALAN G. BINNIE, president. Soboleski joined GAP in 1962 as director of engineering. He was named a corporate vice president two years later, and in December of 1967 was promoted to his present position.

CLIFFORD H. LANE has been named as division vice president and general manager, RCA industrial Tube Division. JOHN B. FARESE, executive vice president RCA Electronic Components, made the announcement. Lane became associated with RCA in 1941 as a production engineer. In 1957 he was named manager, market planning, Industrial Tube Products Department. Since January, 1968 he has been general manager, RCA Industrial Tube Division.

KENNETH M. MILLER, SR., has been named vice president of Computer Industries Inc., and general manager of its Graphic Systems Div. ROBERT G. DEE, company president, made the announcement. Miller, formerly a vice president of Motorola Electronics, Daystrom Inc., and Lear Jet Industries, will be responsible for expansion of Graphic Systems' computer visual readout systems and graphic products.

KENNETH MILLER, SR.

TED BALZER

TED BALZER has been promoted to Western region director of sales for the Advanced Circuitry, USECO and Winchester Electronics divisions of Litton Industries. The appointment was announced by JOHN A. LOVETT, vice president of the national sales organization for the three divisions. Balzer will direct sales and engineering services throughout the Western U.S. for users connectors, printed and multilayer circuitry, fasteners, electronic hardware and pushbutton switches. He joined Litton in 1959.

ROBBINS G. HICKSON, former director of tactical systems for the army Engineers' mapping agency, has accepted the post of manager of mapping and geodesy for the Systems Management Division of Kollsman Instrument Corp., Syosset, N.Y. Prior to joining the corps in 1941 Hickson served with the U.S. Coast & Geodetic Survey agency and the U.S. Department of Agriculture, Soil Conservation Service.

KENNETH G. HARPLE has been named director of development engineering at Systems Engineering Labs, according to president A. G. RANDOLPH. Prior to accepting the post, Harple was general manager of Digital Products Div. of Canoga Electronics.

HAROLD E. CAMP has joined Chicago Aerial Industries Inc., Barrington, Ill., as group manager in charge of fiber optics, it was announced by ERNEST H. PALLME, vice president of engineering. He succeeds ANDREW A. MUELLER, who recently resigned. In his new position, Camp will be responsible for the development and manufacture of fiber optic components for the aerospace firm. Camp was formerly a senior physicist for Corning Glass Works Process Research Center.

HAROLD E. CAMP

FRANCES McKENDRY

The appointment of FRANCES J. McKENDRY to the position of manager, applications Engineering and product development for Signalite Inc., Neptune, N. J., has been announced by A. W. GERSHON, president of the company. McKendry will be responsible for assisting Signalite's customers in the integration of neon glow lamps in electronic circuitry, and for the design and development of new glow lamps.

FREDERICK B. GILLER has been elected vp/technical director and a member of the Board of Directors of International Information Inc. Formerly assistant prof. of Pharmacology at the Philadelphia College of Pharmacy and Science, Dr. Giller also holds the rank of Assoc. Professor at the Pennsylvania College of Podiatric Medicine.

Appointment of JIM WRIGHT to manager of new product development was announced by A. R. MASTERS, executive vice president of Transistor Electronics Corporation of Minneapolis. Wright has been active in the computer field since 1952 when he joined Electronic Research Associates, which later became Univac. Moving to Control Data in 1961, Wright managed a design group which investigated the effects of redundancy technique on computer reliability and, more recently, a group which designed and developed automated test equipment for checkout of the Apollo space capsule.

RODNEY B. MURRAY has been named national sales manager of California Computer Products Inc., Anaheim, Calif., replacing RON HENDERSON, who has assumed the newly created post of assistant to RICH vice president, marketing. He p as director of programming Laboratories, district sales m Data Corp., and manager, at Scientific Data Systems.

WILLIAM E. WARE has rector of marketing for S Laboratories Inc. Announce A. G. RANDOLPH, preside Prior to his present positic trial Control sales manag Computer Control Div. H numerous technical paper and is a member of the member of the Instrument

General Electric has ann ture of its new informatic organization and its key ments. The Company's i operations become the I Group. Vice president J. is group executive of the will be made up of four Information Systems Equipn by general manager LOUIS headquarters in Phoenix, Wengert is the newly f Systems sales and service o by deputy div. general m COOPER. The Informatior headed by general manage with headquarters in New national Information Syster manager ARTHUR E. PEL Advanced Development ar ning Div. by JOHN W. HA quartered in New York.

VERNER S. COOPER

DONALD A. POTTER, Stewart-Warner and gener electronics division, has a ment of PETER S. PHILIPI simile products, responsib product engineering and s cluding direction of Data comes to Stewart-Warner of sales manager of Midv Co., Tulsa, Okla.

Elected vp in charge of Corp. is CHARLES J. HO chief engineer. He joined head development of el cations systems. The firm in extensive research in circuitry for such displays

The appointment of CU Washington district sales Photolamp Div. of Sylvani Inc., has been announcec MAGEE, Eastern regional sa is responsible for the Wa sales office. He succeeds G. who has been assigned Philadelphia office.

New Literature

Cordless Systems Catalog

Sealectro Corp., Mamaroneck, N.Y., offers a 20-page catalog describing the theory, operation, use and economy of Sealectroboard cordless programming and switching systems. The booklet provides information on the utilization of the product for computer programing and testing, machine tool control, telemetry systems, flight simulators, audio signal distribution networks, lighting systems, mfg. test centers, telephone systems, instrumentation and test equipment, digital coding and decoding diode matrices as well as numerous other applications, the firm reports.

Circle Reader Service Card No. 80

Mobile Teleprinter Defined

An application bulletin, covering the basic operating principles of several types of mobile teleprinters and criteria for selecting a proper system, is now available from Codamite Div., Pacific Ordnance & Electronics Co., Anaheim. "Selecting a Mobile Teleprinter" briefly explains differences between electronic and electromechanical printers, dividing the latter into 6 different classifications and defining them. Additionally, the bulletin provides a comprehensive question and answer section relating to the criteria to be considered when selecting a specific printing unit. The final section of the bulletin relates existing policy of the Federal Communications Commission as concerned with mobile teleprinting devices operating over radio circuits.

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Circle Reader Service Card No. 85

Training Systems Bulletin

Litton Industries Inc., Washington, D.C., has announced a bulletin describing the co.'s Combat Information Center Tactics Trainer, Device 15F6, developed for the U.S. Naval Training Device Center. The 6-page fold-out bulletin contains equipment photos, block diagram and exposed view of typical installation. It also lists unusual engineering features of the equipment, as well as a description of a Radar Countermeasures Field Trainer.

Circle Reader Service Card No. 89

Wiring Systems

Bulletin E-7 describing and illustrating the versatility of aci Signaflo Wiring Systems is now available from the aci Div., Kent Corp., Princeton, N.J. The bulletin presents the basic elements and techniques of aci Signaflo wiring systems as well as applications for signal transmission, control wiring, flexing wires, and interconnection and structural systems for memory devices. Illustrated are aci Signaflo wiring systems designed for controlled impedance valves, propagation velocity, cross-talk, capacitance, and other physical and electrical parameters. Also shown are single and multilayered systems as well as systems shielded on one or two sides with various shielding materials such as metal foil, deposited metal, wire mesh, and special dielectrics.

Circle Reader Service Card No. 90

Uses Unlimited No. 28

The latest edition of "Uses Unlimited" is now available from Micro Switch, div. of Honeywell. The informative 8-page booklet describes more than a dozen switch applications that help solve industrial problems.

One of the features describes how mercury switches help increase food production. Another describes a method of speeding delivery of office mail. Still other features describe the use of various types of switching mechanisms used in model car racing, information handling, projector application, crane operation by remote control, Hi-Fi application, signal device on process cycling, fluid flow control, a timer application and weld control installation. An application is described whereby slides can be converted into "movies".

Circle Reader Service Card No. 91

Alco Catalog

A 12-page catalog featuring design ideas for engineers has just been published by Alco Electronic Products Inc., Lawrence, Mass. The catalog features an expanded section for miniature electronic swtiches, miniature remote control relays, miniature readout indicators and pilot lights, miniature ceramic terminal strips and machined aluminum knobs. Each product section has complete listings and prices dimensioned drawings and engineering specifications.

Circle Reader Service Card No. 92

Analog Computer Brochure

A 16-page brochure is available from GPS Instrument Co. Inc., Newton, Mass., on their 200T high speed computer. The computer features all solid state construction with unequalled bandwidth, according to the firm. The illustrated brochure includes general description of the entire system as well as the details on key components such as: Integrator Networks, Operational Amplifiers, Comparators, Function generators, controls, addressing systems, patch networks and the like.

Circle Reader Service Card No. 93

Product Reference Guide

An updated 6-page Product Reference Guide covering the company's line of high intensity light sources, electronic accessories and related products has been published by PEK, Inc., Sunnyvale, Calif.

The new two-color publication offers both general and technical information on the firm's mercury and xenon short arc and flash lamps, mercury capillary lamps, power supplies, pulse generators and lamp housings.

In addition to applications information on the complete line of products, a new section outlines PEK's capability in the design and production of complete electronics systems custom-engineered to lamp-oriented applications.

Circle Reader Service Card No. 94

Contours of Prism Deflecting Cam

Capabilities of electronic data processing and N/C in the generation of precise contours is illustrated by this prism deflecting cam for spectral analysis manufactured by Cam Technology Inc., Elmsford, N.Y. Comupter techniques were employed to accommodate an unusual type of follower linkage so that optical scanning would deflect a mirror or prism used as a mirror. Difficult if not impossible to make by conventional cam generating systems, the multiple revolution cam was a straightforward task for CamTech's N/C prototype facilities. Lead time was significantly reduced by the elimination of conventional manual procedures including the compilation of ordinate tables, hand machining and hand finishing. Computed design was put on tape to control the continuous path numerical facilities with appreciable savings in time and the elimination of special tooling costs.

Circle Reader Service Card No. 95

Disc Pack Brochure

Memorex, Santa Clara, Calif., offers a complete brochure on their new Mark I disc pack, basically an assembly of six discs providing 10 recording surfaces and enclosed in a heavy-duty dust proof container. It is mechanically and operationally compatible with most existing disc drives including the Memorex 630 Series. It can be used with drives that record on 100 tracks per recording surface, such as the IBM 1311, or with higher density drives such as the IBM 2311, which records on 200 tracks.

Circle Reader Service Card No. 96

Decade/Display Module

A data sheet describing Models D-100 and D-101 decoding display module is available from Integrated Circuit Electronics Inc., Waltham, Mass. The unit provides decimal readout on the familiar cold-cathode neon tube. It accepts 4-line 8421 BCD code at typical I.C. logic levels. Readout is clear and provides minimum center-to-center spacing in multidecade arrays. Model D-101 is identical to the D-100 except that it includes a decimal point. Advantages are said to include interchangeability with a wide variety of competitive models; plastic encapsulated case; no moving parts nor lamp filaments; requires no code converter—accepts both 4-line and 8-line BCD code.

Circle Reader Service Card No. 97

Magnetic Shielding Material

Technical data on new Shildmu 30 CU magnetic shielding material for full-spectrum shielding of sensitive electrical and electronic components from 1 Hertz to 10 Gigahertz is given in bulletin available from Magnetic Metals Co., Camden, N.J. Bulletin shows how the new foil shielding, available in either sheet or spool wound tape form, can be cut easily with ordinary scissors, and prices per linear foot are included.

Circle Reader Service Card No. 99

Mold Release Brochure

A 4-page, 2 color brochure introduces a new concept in the mold release field, called *FreKote-33 Releasing Interface*. Different from conventional release agents, it forms a releasing surface that remains on the mold to produce successive releases and to assure no contamination of parts. Thermally stable to 900°F., it is useful on a wide variety of materials and molding processes. Prices of aerosol and bulk are included, from FreKote, Inc., Boca Raton, Fla.

Circle Reader Service Card No. 100

Photometers Catalog

Pacific Photometric Instruments, Berkeley, Calif., announces a 4-page catalog which gives abbreviated specifications for the line of photometers and cross-references for photomultiplier tubes and various housings. Various filter-photomultiplier combinations are listed for measurements in the ultra-violet and daylight regions of the spectrum.

Circle Reader Service Card No. 101

Datatron Brochure

Capabilities for producing low cost, high performance digital data products, systems, timing instrumentation, and data transmission systems are described in a twelve page brochure from Datatron Inc., Santa Ana. Products descriptions include the firm's datacoupler, digital to analog converter, time code translator/generator, time code generators, time code translator, and tape search units. Also shown are photos of key members of the company with biographical sketches detailing previous accomplishments in developing some of the nation's largest and most sophisticated commercial and government instrumentation and control systems.

Circle Reader Service Card No. 102

Two Graph Plotters

Two graph plotters, designed to provide pictorial hard-copy output for SDS Sigma computers, are described in a new data sheet, 64-26-03A, from SDS, Santa Monica.

The graph plotters operate on the digital incremental principle and are drift-free. Two models offer a choice of drum widths: Model 7530 with 12-in.-wide drum, plot size of 11 in. by 120 ft., and incremental speed of 300 steps per second; and Model 7531 with 30-in.-wide drum, plot size of 29.5 in. by 120 ft., and incremental speed of 200 to 300 steps per second.

The data sheet covers physical characteristics, operator controls, operational features, and specifications for the two graph plotters.

Circle Reader Service Card No. 103

Automatic Speech Generation

A four-page brochure providing technical and application information for two models of automated speech generation equipment for use in data processing, communications and instrumentation systems is now available from Cognitronics Corp., Mt. Kisco, N.Y. The brochure describes Models 631 and 632 which are engineered to provide a direct and flexible means of machine-to-man audio communications. Vocabularies up to 31 words are stored in the Speechmaker and spoken back either singularly or in any group sequence on command. Model 631 vocabulary selection is by means of individual switch closures for each of the tracks. Model 632 contains a binary decoding matrix which enables it to perform vocabulary selection from a standard 5-bit binary code Both units contain a 3-in. photographic film audio memory drum with up to 32 tracks. The 632 has the capability of multiple, simulaneous variable output using standard Cognitronics multiplexing electronics.

Circle Reader Service Card No. 104

Executive Tape Preserver Data Sheet

A line of Executive tape preserver containers is illustrated and described in 2-color 2-page Data Sheet 190, published by Magnetic Shield div., Perfection Mica Co., Chicago. Included are dimentional drawings and a table listing technical details. The Executive line stores and protects from full or partial erasure, valuable personal and business data committed to magnetic tape.

Circle Reader Service Card No. 105

New Lighting Concept

Available from Western Indicator Co., Inc., So. El Monte, Calif., a catalog introduces a concept of indicator lights, edge-lighted panels and instrument lighting. The products featured in this catalog are designed for use with a "Pogo" lamp which contains a spring loaded center contact, eliminating the requirement for moving contacts in the permanently mounted light socket assemblies.

The product line is offered in a wide range of indicator light colors and lens cap styles. Lamps are available in both long-life and high brilliancy types, in rated voltages from 1.5 through 28 and neon.

Circle Reader Service Card No. 108

Captive Hardware

An illustrated 8-page catalog describing the company's complete line of "Presserts", stainless steel captive hardware for soft or thin metal panels, parts or chassis is now available from Precision Metal Products Co., Stoneham, Mass. The publication lists seven types of captive fasteners that won't pull, push or torque out after simple press fit installation. These include flush, extension, self-locking, and floating nuts to correct chassis hole misalignment. A wide range of stainless-steel studs is also shown. Full details on threads and sizes and other ordering information are also contained in this informative catalog.

Circle Reader Service Card No. 109

Bimat Film Processing Equipment Brochure

Mark Systems, Inc., Santa Clara, Calif. has published a brochure that describes their line of equipment for photo processing using Eastman-Kodak Bimat Diffusion Transfer Film as the processing medium. Bimat processing allows the production, in minutes, of a simultaneous positive and negative, either in the field or at fixed base installations.

While ready-to-use Bimat can be obtained from Eastman-Kodak, it is sometimes necessary to have an on-location ability to perform the chemical activation as needed. Equipment for such a requirement, called "presoaking" is included in the catalog, along with information about equipment for processing the film and for post-treatment washing, drying, and fixing when archival permanence is desired. Descriptive data and specifications are given for two different presoaker models, five different processor models, and one post-treatment machine.

Circle Reader Service Card No. 110

Illuminated Push Button Switches

From Dialight Corp., Brooklyn, N.Y., catalog L-208 provides complete data, drawings and ordering information for 513 Series Momentary Action Switches with printed circuit terminals. Described are S.P.S.T., N.O.; S.P.S.T. N.C.; and two circuit (one N.O.; one N.C.) switches. The break occurs before make. Switch ratings are: 3 amps, 125V AC; 3 amps, 30V DC (resistive load); operating force: N.O. - 20 ozs. approx.; N.C. - 10 ozs. approx. Button travel is 3/32". Designed for mounting from back of panel in ½" clearance hole—in panels up to 3/16" thick, these switches accommodate ½" or ¾" round or square push button caps —rotable or keyed Caps may be had with solid-colors, or with black, gray or white opaque sides with a colored face. Caps can also be furnished with underlying colored filter This would result in the complete lens cap or lens face being visible as white when not energized and in another color when the assembly is energized. Engraved and filled digits, symbols or letters can be provided on lens caps.

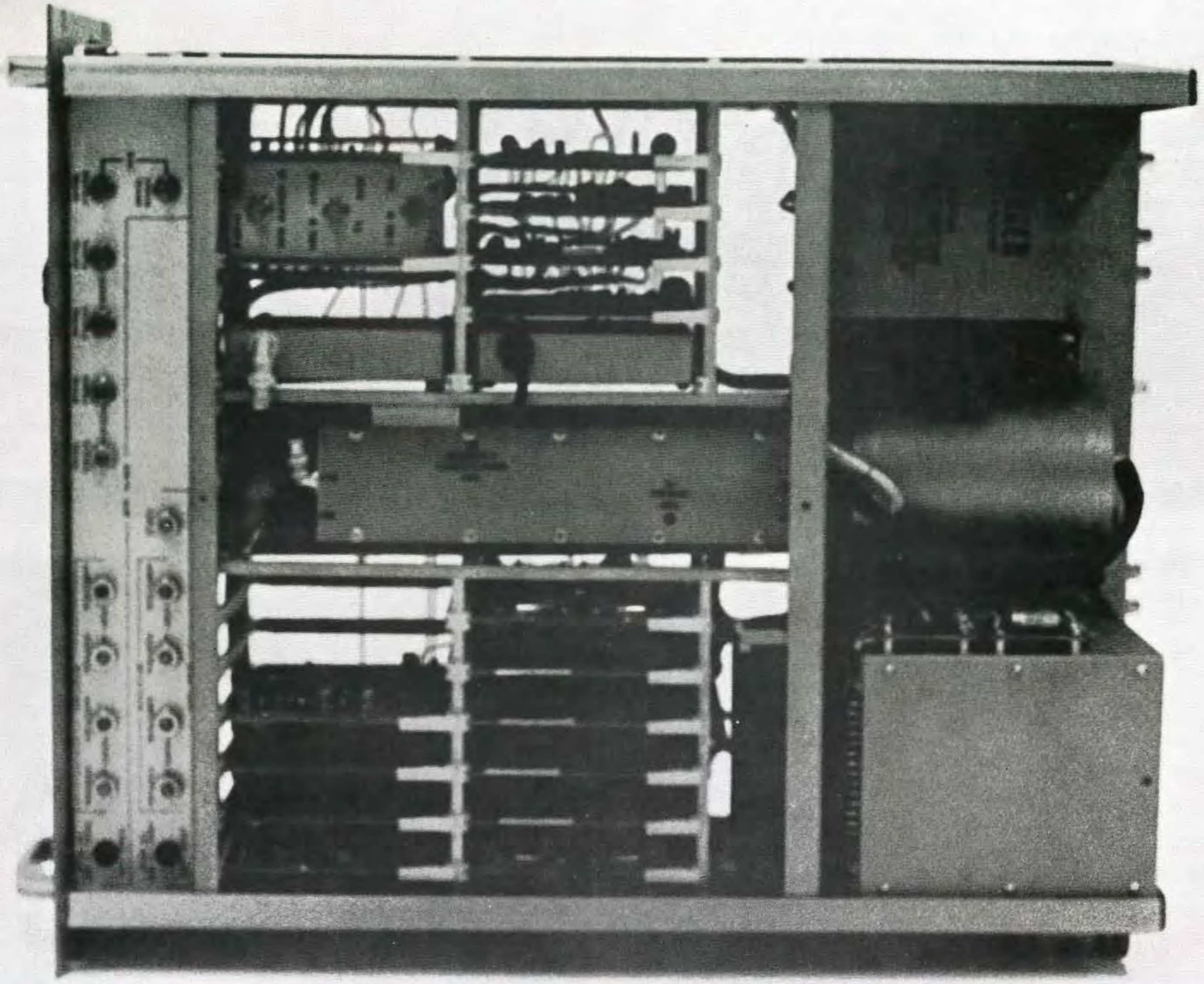
Circle Reader Service Card No. 111

Electro-Magnetic Numeric Readouts

Two-page, two-color catalog data featuring a new product line of "C-Rite" burnout-proof 1" and 1½", fully electro-magnetic, seven segment numeric readouts for control panels, instruments, indoor and outdoor commercial numeric displays and all industrial and military uses where maintenance-free display is required, is available from the Components Division, James Electronics Inc., Chicago. Illustrated with model specification tables, technical notes and dimensional drawings, the new literature explains in detail the C-Rite segment which is readable in all light conditions from bright sunlight to dimly lit control rooms. It cannot burn out or fail as do light actuated systems. The C-Rite system is available for both momentry and memory latching operations, 6 12 and 24/28 volt drive with up to five digit display assemblies made with associated symbols. ■

Circle Reader Service Card No. 112

ID Advertisers



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And its key.

Hughes commercial scan converter systems are built around the strongest tubes in the business. Ours.

There's a Hughes system for all phases of scan conversion. Slow scan to TV format. Raster scan to PPI. For use in infrared, laser scanning readout, and computer readout.

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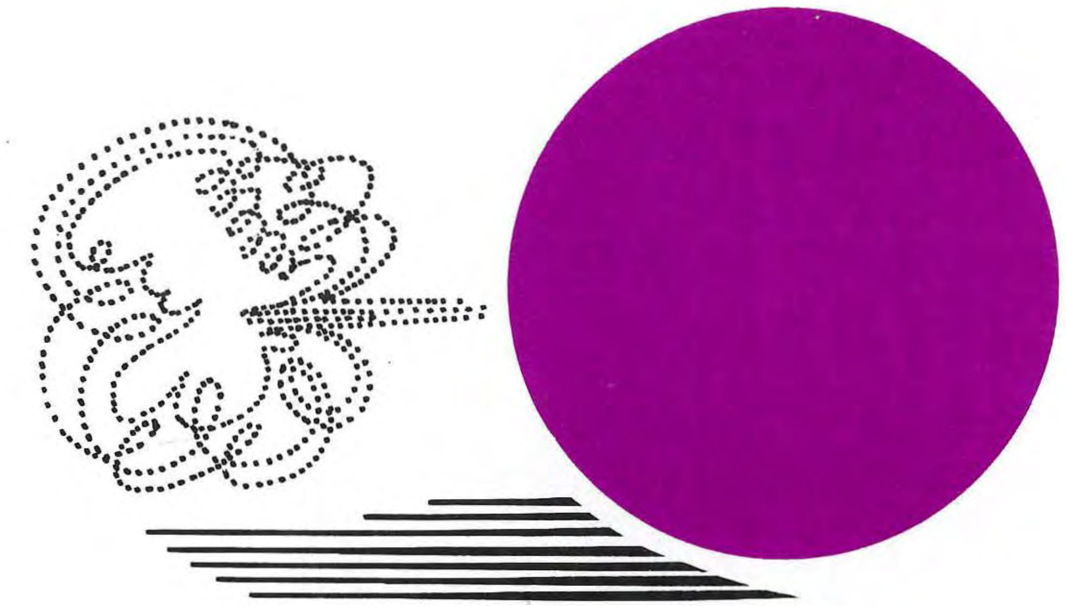
OCEANSIDE, CALIFORNIA

Circle Reader Service Card No. 115



For CRT SPOTS in a hurry...

...the fastest deflection amplifiers available in the world today.

New Beta ±35 volt Deflection Amplifiers, series DA223*, DA224*, and DA225* are the fastest now available. They are capable of supplying up to ±2.0, ±4.0, and ±6.0 amperes of deflection current respectively to each axis of a directly-coupled deflection yoke.

POWER SUPPLIES — The Amplifiers offer maximum performance in terms of bandwidth and settling time when operated from ±35 volt power supplies. They can, however, be operated from any power supply level from 15 to 35 volts. Further, for raster scanning applications where the flyback is always in the same direction, the amplifiers can be operated with any two unsymmetrical power supplies totaling up to 70 volts (i.e. +55 volts and −15 volts), thus offering a still greater flyback voltage capability.

DAMPING & BANDWIDTH — A unique method of damping is a feature of this family of Amplifiers. It is adjustable by means of a potentiometer, and optimizes the Amplifier for the particular yoke being used with respect to settling time and bandwidth. Another most significant feature is the Amplifier's property of exhibiting essentially constant small-signal bandwidth irrespective of load inductance.

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