Volume 4 Number 3 May/June 1967

Information Display

Journal of the Society for Information Display

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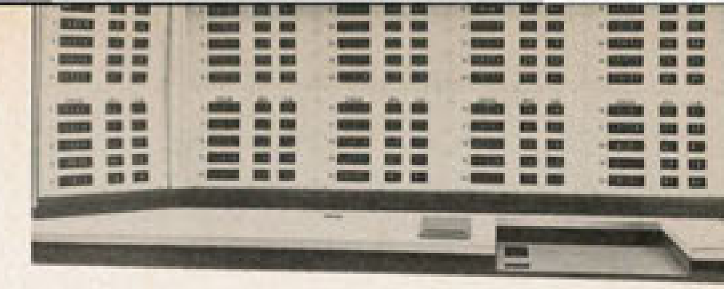

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Volume 4 Number 3 May/June, 1967

Information Display

Journal of the Society for Information Display

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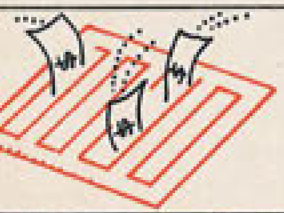
the cover

Symbols of display technique join with a representation of the San Francisco cable car in this distinctive 8th National Symposium design, conceived and executed by artist Bruce Borley. The photographer was Karl Moore; both are members of the Philco-Ford WDL Division Graphic Art Staff.

WHY PAY 50% MORE TO DRAW PICTURES FROM COMPUTERS?

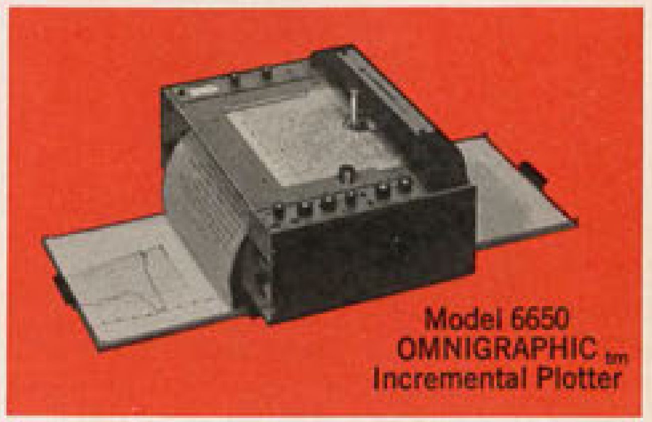


Why let money go down the drain . . . up to $1700 per unit

WHEN Model 6650 **OMNIGRAPHIC** Recorder T.M.

offers every spec. every feature of competition?

ONLY $2850.



Offering Z-fold chart paper with bidirectional movement . . . requires only 3 volt signal of any shape . . . and 18,000 increments/min. speed

PLUS OPTIONS

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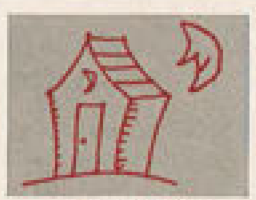
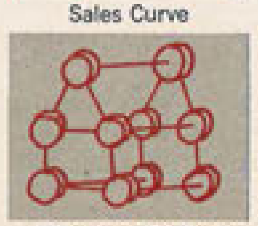
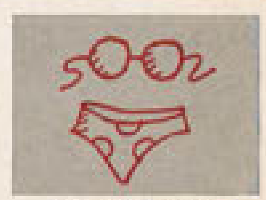


Perspectives

Sales Curve



Structure Designs



Apparel Designs

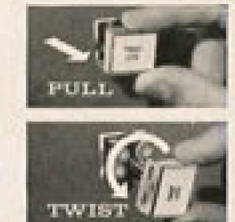
And Even . . .

OEM inquiries invited from:
IBM UNIVAC CONTROL DATA
BURROUGHS HONEYWELL
RCA NCR GE

If we missed you,
Sorry — Write anyway.

MSC Series 10E ...the lighted pushbutton switch for reliable answers to your toughest design problems!

The MSC Series 10E Twist-Lite® Switch can provide an answer to virtually every functional or environmental design requirement you might encounter. Standard and optional features range from a positive hardmount, achieved without special brackets or extraneous hardware, to the optional drip-proof seal for equipment destined for duty in severe environments. Four-lamp operation provides unlimited flexibility in color selection and control for performance under any ambient light condition. The front lens provides maximum legend area per panel space occupied, with optional configurations ranging from full to 4-way splits. Ease of maintenance is assured by the twist/lock principle for quick lamp, legend or color filter change from the panel front without tools of any kind. These are the features that have made the Series 10E the preferred illuminated switch for critical aerospace and industrial control systems. Investigate the advantages the Series 10E holds for you. Contact your nearest MSC regional office or write and ask for an operating demonstration. **SEND FOR CATALOG NUMBER 2000.**



EXCLUSIVE TWIST/LOCK RELAMPING WITHOUT TOOLS
Easily done without fear of accidental switch actuation. Lamp/Lens assembly remains connected to the housing during relamping to prevent transposing with adjacent units.

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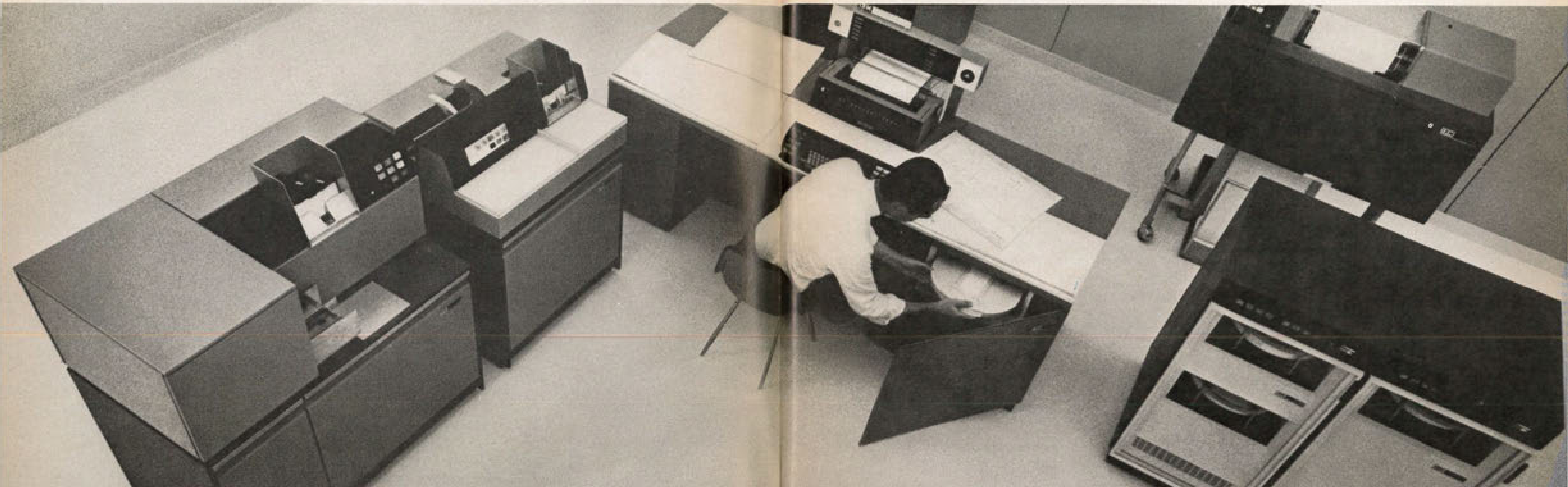
25 YEARS IN INFORMATION DISPLAY AND CONTROL DEVICES

IBM announces:

big computer features for the "little" 1130.



Now you can get a faster, more powerful, more responsive IBM 1130 Computing System. We've just introduced five new CPU models. We've extended the range of input/output speeds and on-line storage capacities. And we've improved data communications capabilities for the 1130.

In short, we've enhanced the present 1130 line so it can grow as your needs grow. Now you can get an 1130 that will tackle the big jobs—an 1130 with bigger capacities and faster throughput.

Five new CPU's. Now you have a wider choice of core sizes and speeds. We've added five new CPU's for a total of nine. You can get an 1130 with 4K, 8K, 16K or 32K words of core, depending on your requirements. And you have a choice of two memory speeds.

Up to five disk drives. Now you can hook on up to five disk drives for an on-line capacity of 2,560,000 words. All five disks can be operated simultaneously. Since the drives use interchangeable disk cartridges, you can amass unlimited off-line storage.

Faster printers and readers. Take your pick of three printers with speeds ranging up to 600 lines a minute. Choose one of four card readers with speeds ranging from 300 to 1000 cards a minute. You can even add an optical mark page reader. With an expanded line of I/O gear, you can put the 1130 to work on a wider range of applications.

Improved data communications. With the improved Synchronous Communications Adapter, the 1130 can become an economical terminal for your SYSTEM/360 while retaining its stand-alone computing power. The adapter can transmit at 2400 bits per second in either of two modes—Synchronous Transmit Receive (STR) or Binary Synchronous (BSC) depending on your interfaces and programs. With the addition of BSC, you get more efficient, more flexible data transmission because it is code-insensitive.

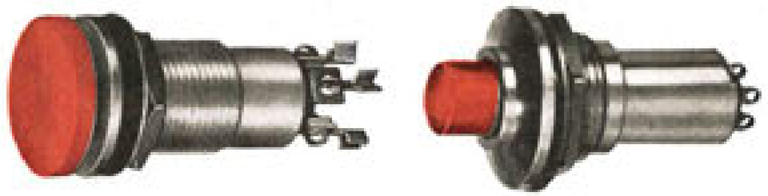
New Disk Monitor System. IBM supports the 1130 with a Disk Monitor System which includes a FORTRAN compiler, a Supervisor Program, a Disk Utility Program, an Assembly Program and a Subroutine Library.

Then, there's quite an array of application programs already available for the 1130. In the engineering fields, for example, there are programs for civil engineering, programs for petroleum engineering and exploration, programs for gear and spring design. There are scientific subroutines, linear programming and project control programs. There are commercial subroutines for applications like payroll and cost accounting.

Room for growth. With the expanded capabilities of the IBM 1130, you have a system that will grow with you. As your company or department grows, as your data processing applications become more numerous, your 1130 will keep right in step. Extended capabilities, powerful programming support, versatility, growth potential. These are the things you get, along with IBM service, from the 1130, our "little" computer.

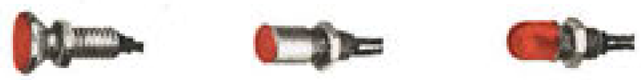
IBM®

EMI/RFI-SHIELDED PUSHBUTTTON SWITCHES



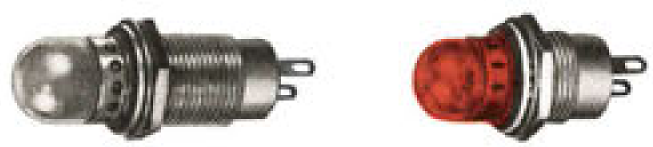
Four models, one with wide button. Choice of two and four circuit momentary, plus DPDT push-push. Ratings of 1 to 10 amps at 28 vdc; 1 amp at 120 vac.

SUBMINIATURE EMI/RFI-SHIELDED INDICATOR LIGHTS



Dome, flat and flush mounting. Lens diameter of 7/32", .22" and .383" respectively; 5v and 28v. Six lens colors, plus clear.

STANDARD EMI/RFI-SHIELDED INDICATOR LIGHTS



Translucent and transparent dome-type lenses. Incandescent, standard neon and high-intensity neon lamps in all popular voltages. Six lens colors, plus clear.

These EMI/RFI-shielded switches and indicator lights available at Control Switch distributors now!

Still more new EMI/RFI-shielded components on the way.

Need shielding from EMI/RFI leaks in panels and systems? Look to Control Switch . . . first to introduce the types of shielded switches and lights shown above. Now we are deep into the development of still other shielded components. Tell us your requirements. We may be working on the component you need and be able to help you fast. Order EMI/RFI-shielded switches and lights from your Control Switch distributor, or contact us direct.

FREE BULLETIN!

Check number on Reader Service Card corresponding to number at left below for our Bulletin on EMI/RFI-shielded components. While you're at it, get all the items listed below.

- #8 **EMI/RFI-shielded Component Bulletin 62A**
- #9 **Condensed Switch Catalog 100**
- #10 **Basic Snap-Action Switch Catalog 110**
- #11 **Toggle Catalog 180**
- #12 **Indicator Light Catalog 120**
- #13 **Hermetic Switch Catalog 130**
- #14 **Switchlite Catalog 220**
- #15 **Pushbutton Catalog 190**

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CONTROL SWITCH DIVISION
1420 Delmar Drive, Folcroft, Pennsylvania 19032
A Subsidiary of
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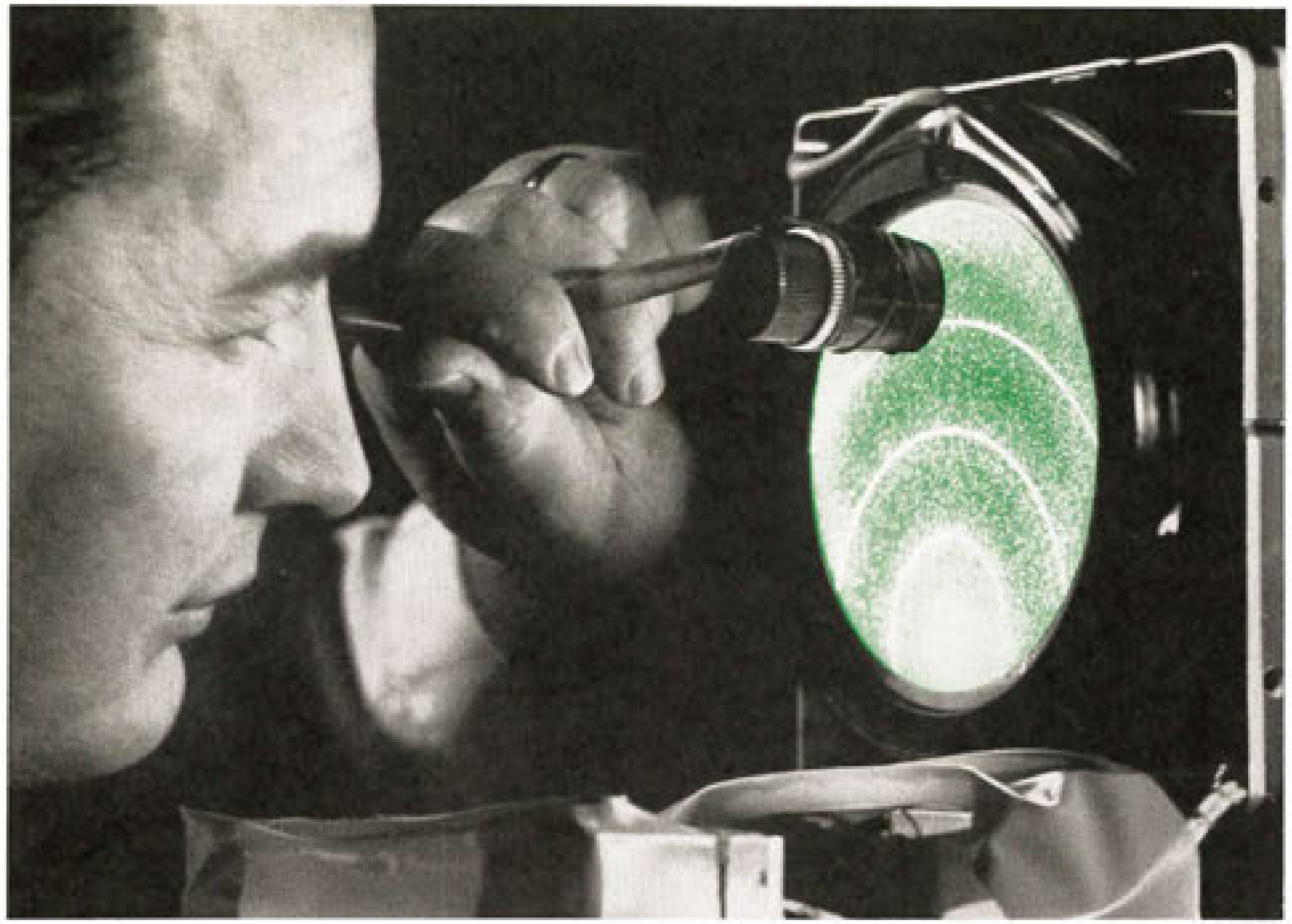


People who need uniformity, dual mode capability, and high resolution, focus on us.

That's why you'll find our direct view storage tubes in military avionics systems, terrain-following radar, in terminal guidance missile system display and commercial aircraft weather radar indicators.

We're specialists in meeting systems manufacturers' specs, which usually originate with MIL specs. All our tubes have a unique weld-ring construction that permits precise gun alignment not affected by sealing. This means you get unusual tube-to-tube uniformity.

Our capability shows up as soon as you flip the on switch. You get high resolution, up to 130 written lines per inch; writing speed up to one million ips. There are no halos to degrade the image. What's more, you have a tube with superior edge-to-edge lighting. Fast erase speeds—as fast as 0.5 milliseconds without dunking. This allows TV displays at standard frame rates without smearing.

We're also specialists in getting involved in our customer's problems. We stick with the design engineer until he has the tube that meets his requirements. Whether it comes off the shelf or is a custom design.

So if you can't tolerate flaws and want a working partner who can't either, focus on us. Write: Dept. ID, ITT Electron Tube Division, International Telephone and Telegraph Corporation, P.O. Box 100, Easton, Penn. 18043.

ELECTRON TUBE DIVISION ITT

BEING FIRST MEANS EXPERIENCE

RCA Victor Company, Ltd. was the first to develop digital-to-video conversion (DIVCON) apparatus. With this achievement, rests the responsibility of success.

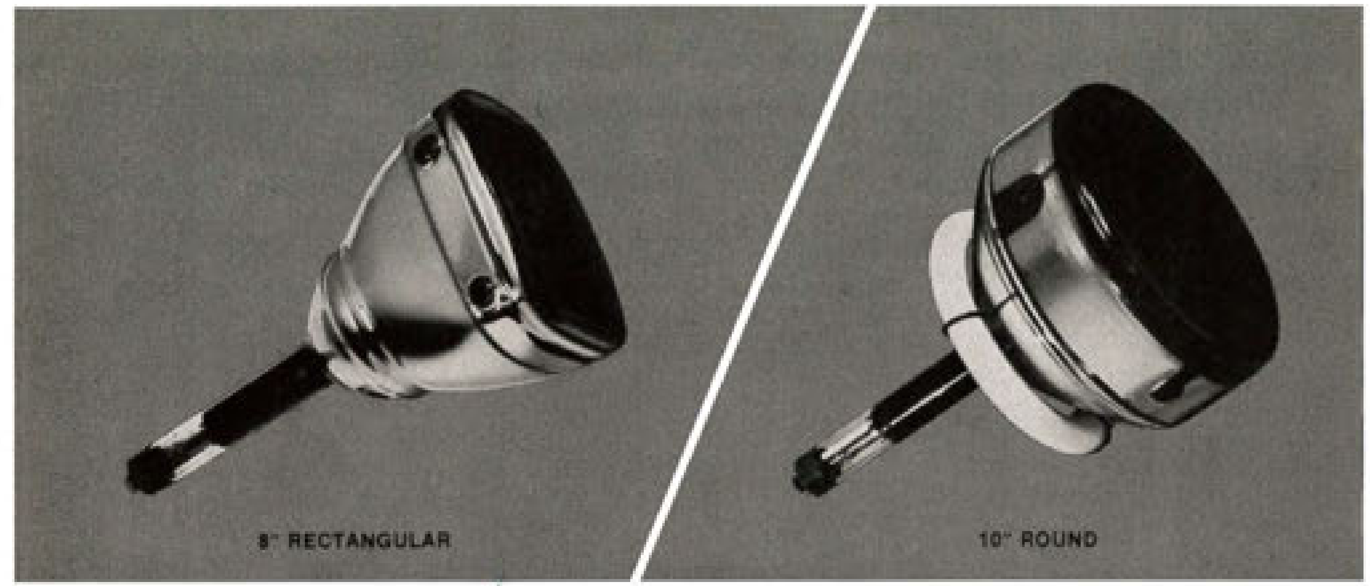
First used by:	The National Broadcasting Company, for US election coverage in November 1964.
Used by:	The Canadian Broadcasting Corporation, for both English and French election coverage in 1965.
Used by:	CBS, ABC, NBC, during the 1966 general elections.
Used by:	The British Broadcasting Corporation, during the 1966 British elections and budget programs; by Independent Television News in Great Britain for this year's budget speech.
Used by:	The Montreal and Canadian Stock Exchanges to provide 10 channels of up-to-the-second stock quote prices to over 200 brokers, all on a single cable.
Used by:	Air Canada for the world's first automatic flight information system announcing arrivals and departures, automatically up-dated from a computer.
To be used by:	The Chicago Board of Trade to provide instantaneous price information to members of the world's largest commodity exchange.
To be used by:	British European Airways at London's Heathrow Airport in the largest computer control flight information system yet purchased.

Growing out of this experience comes the RCA Victor Multiplex Display System for recall of hundreds of frames of information to an unlimited number of users on but a single cable distribution system.

RCA VICTOR COMPANY, LTD.
Technical Services Division
1001 Lenoir St., Montreal 30, Can.

another new development from Thomas Electronics

HIGH DEFINITION, LONG STORAGE WITH DARK TRACE STORAGE TUBES



HAVE YOU REEXAMINED DTST's LATELY?

High resolution information can be retained for hours, days . . . even weeks with the standard 7- and 10-inch diameter dark trace storage tubes from Thomas Electronics. Important characteristics of both the Model 7M28P10 and Model 10M55P10 tubes include:

- Resolution typically 6-mil line width; as low as 1-mil available
- Excellent contrast for alpha-numeric displays
- Dual mode operation for indefinite storage or continuous erasure
- Simple power supply requirements
- Ruggedized for military applications
- Lower cost
- Each tube supplied with fluorescent lamp.

These magnetic deflection and focus tubes have potassium chloride scotophor screens which develop a deep magenta when exposed to an electron beam. Dark trace storage tubes are excellent for applications in avionics systems, all-weather radars, anti-submarine warfare systems and data processing displays.

Thomas Electronics also can provide other dark trace storage tubes with round or rectangular face plates up to 10 inches in diameter. For more detailed information or quotations write or phone:

THOMAS ELECTRONICS, INC.

100 Riverview Drive, Wayne, New Jersey 07470 □ 201-696-5200

Data Display Devices from Raytheon

New Raytheon Recording Storage Tubes extend your system capabilities

Two new miniature types, new high resolution tube added to Raytheon's broad line.

Raytheon's wide range of Recording Storage Tubes enable you to design additional capability into any system which stores and transfers electronic information. Applications include: scan conversion, stop motion, integration for signal-to-noise improvement, time delay or phase shift, correlation and slow-down video.

The new miniature types—Raytheon's CK1516 and CK1518—are designed for compact packaging, such as in airborne and space satellite applications. Both tubes provide high resolution and erase capability in a fraction of a second. The CK1521 is a new standard type featuring ultra-high resolution of 2500 TV lines and fast erasure in milliseconds.

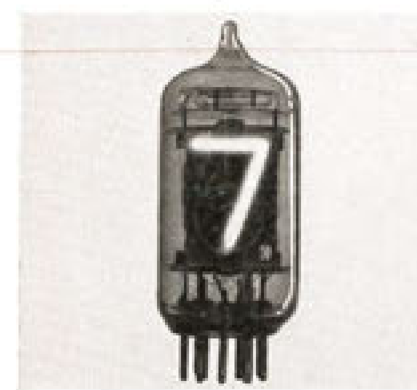
Raytheon Recording Storage Tubes are electronic input-output devices which feature: fast write, immediate and nondestructive read, long storage, high resolution, and fast erase. Information can be written and stored using sequential scan techniques or by random access writing. Erasure can be complete or selective. Dual and single gun types are available.

For more information or demonstrations, contact your Raytheon Regional Sales Office.

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

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

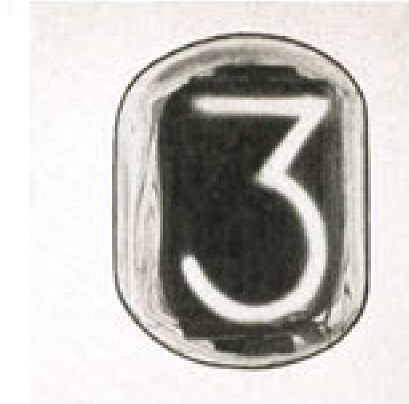
The Projectoray's high light output and long life are due to its novel design. The design incorporates liquid cooling of the phosphor backplate. This allows the phosphor to be energized with a very intense electron beam. At high beam levels, very high peak light output is obtained. The light image is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



Datavue* Side-View Tubes. New Type CK8650, with numerals close to the front, permits wide-angle viewing. These side-view, in-line visual readout tubes display single numerals 0 through 9 or preselected symbols such as + and – signs. Their ⅝"-high characters are easily read from a distance of 30 feet. Less than $5 each in 500 lots, they also cost less to use because the bezel and filter assembly can be eliminated and because their mating sockets are inexpensive.

Symbolray* CRT Tube. The new Raytheon CK1414 Symbolray tube provides alphanumeric inputs for computer readout devices. The tube's 2" target can be scanned electronically to select symbols, characters, and punctuation marks in sequence to form the readout on a display tube. This type has applications with data processing equipment as an economical method for generating characters for hard copy print-out or for cathode ray display. Design with 64 and 100 characters are available.

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



Datavue* End-View Tubes. 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.

Send Reader Service Card for literature on the:

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Symbolray CRT	20
Dataray CRTs	21

Or call your Raytheon regional sales office. Or write to *Raytheon Company, Components Division, Quincy, Mass. 02169.*

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No matter!
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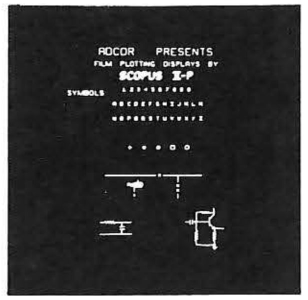
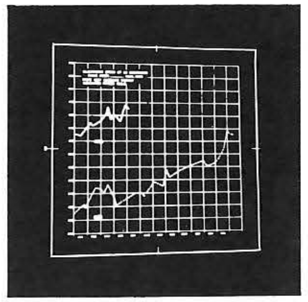
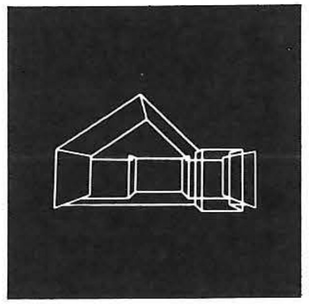
SCOPUS II

ANALOG?

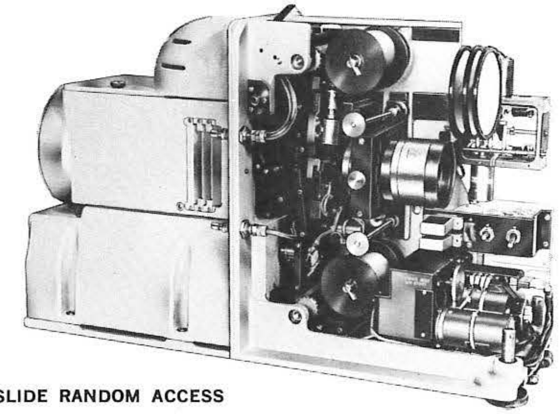
A unique concept in high speed film plotting for front or rear projection



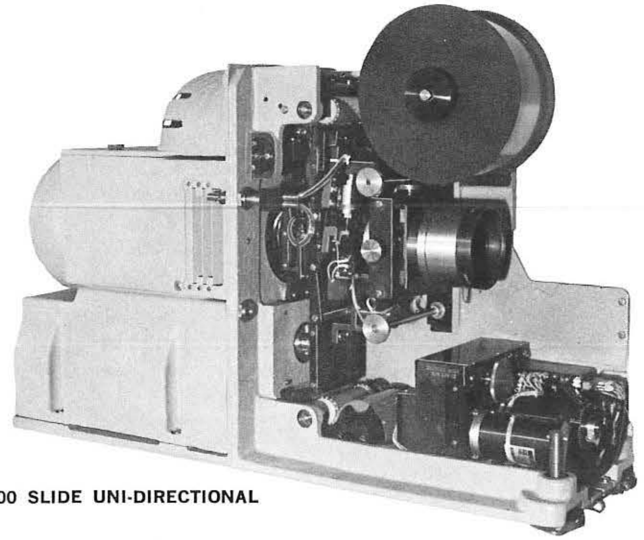




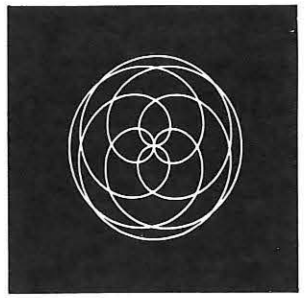
Actual photos taken of 7 foot by 7 foot display screen.

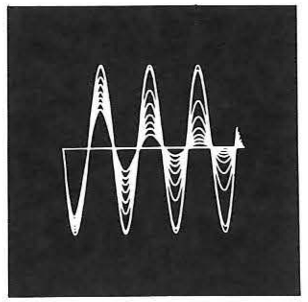


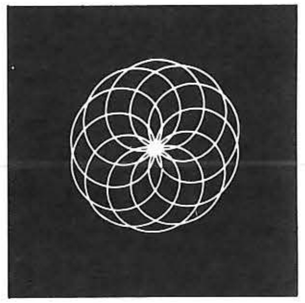
100 SLIDE RANDOM ACCESS



2000 SLIDE UNI-DIRECTIONAL







Actual photos taken of 7 foot by 7 foot display screen.

The new SCOPUS II offers:

. . . Plotting on 70 mm stabilized polyester film
. . . Low logistics cost
. . . Simplified storage and retrieval
. . . High speed accurate display of dynamic track data, alphanumerics and special symbols
. . . Time sharing
. . . Acceptance of digital, analog and manual inputs

Available as a —

Plotting projector
Spotting projector
Reference projector

in configuration as —

100 slide random access
2000 slide uni-directional

INFORMATION DISPLAY SYSTEMS
APPLIED DEVICES CORPORATION / (FORMERLY BELOCK INSTRUMENT CORPORATION)
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WANT A CHANCE TO DISPLAY YOUR TALENTS?

THE DATA SYSTEMS DIVISION OF LITTON INDUSTRIES
IS CURRENTLY OFFERING UNIQUE OPPORTUNITIES FOR
INFORMATION AND SYSTEMS DISPLAY ENGINEERS

WHAT YOU'LL BE DOING

You will be involved in the design and development of advanced microelectronic display systems utilizing multiple gun CRT techniques. Your assignments will include systems design, development of overall specifications, and advanced circuitry and electronics to meet the system requirements. For these projects we need graduate engineers with experience in high resolution cathode ray techniques, storage tube display equipment, scan convertor techniques and circuitry and application of microelectronic techniques to display equipment.

WHAT WE'VE DONE

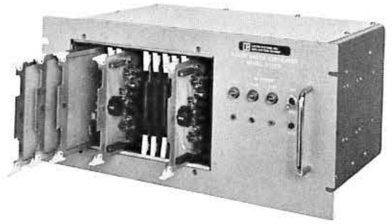
The Data Systems Division is notable for the design and development of the highly mobile MTDS (Marine Tactical Data System) and the ATDS (Navy Airborne Tactical Data System) for the E2A aircraft. We are engaged in the following systems work: air defense, air traffic control, command and control, data processing and display, reconnaissance, space information and surveillance.

WHAT WE'RE DOING NOW

Typical of current DSD projects are these advancements:

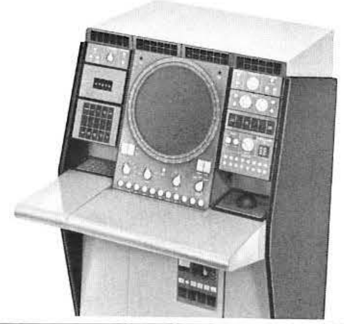
LC-25, 25 Megacycle Radar Sweep Convertor

This unit accepts radar sweep data from a Radar Azimuth Convertor, symbol position data from a computer, and converts these for application to a display console. The high speed capability of the unit, utilizing primarily integrated circuits, permits display of high resolution sweeps at lower ranges than previously possible, with no switching disturbances. Current mode integrated circuits and Digital-to-Analog convertors are used.



Advanced Display Console

The Advanced Display Console is a product of Litton's continuing program to develop a line of display modules, with which displays to suit the varied applications can be constructed. Emphasis has been placed on standardization of components, reduction in weight and power, and advanced display techniques. Modules designed and constructed include Radar Azimuth Convertor, Symbol Generators, Data Entry and Readout Units, and both electromagnetic and electrostatic CRT Display Units.



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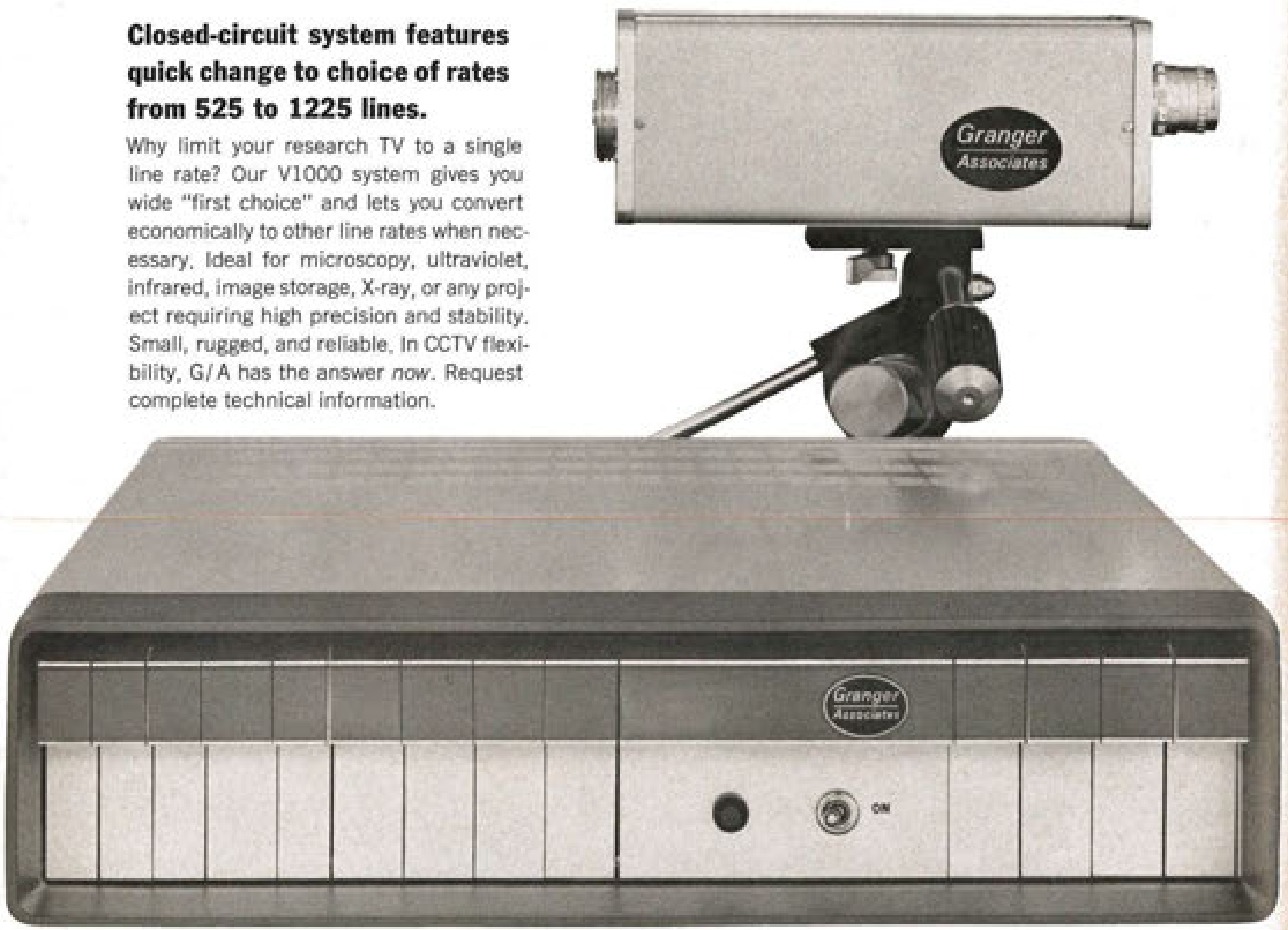

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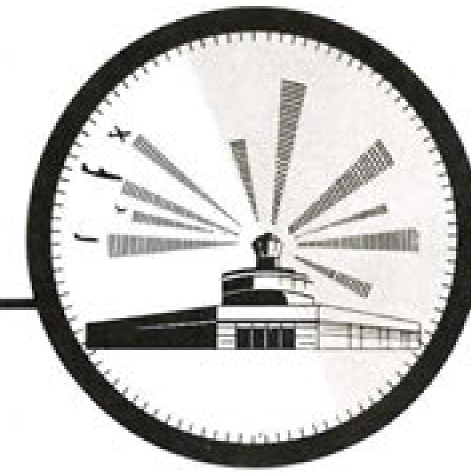

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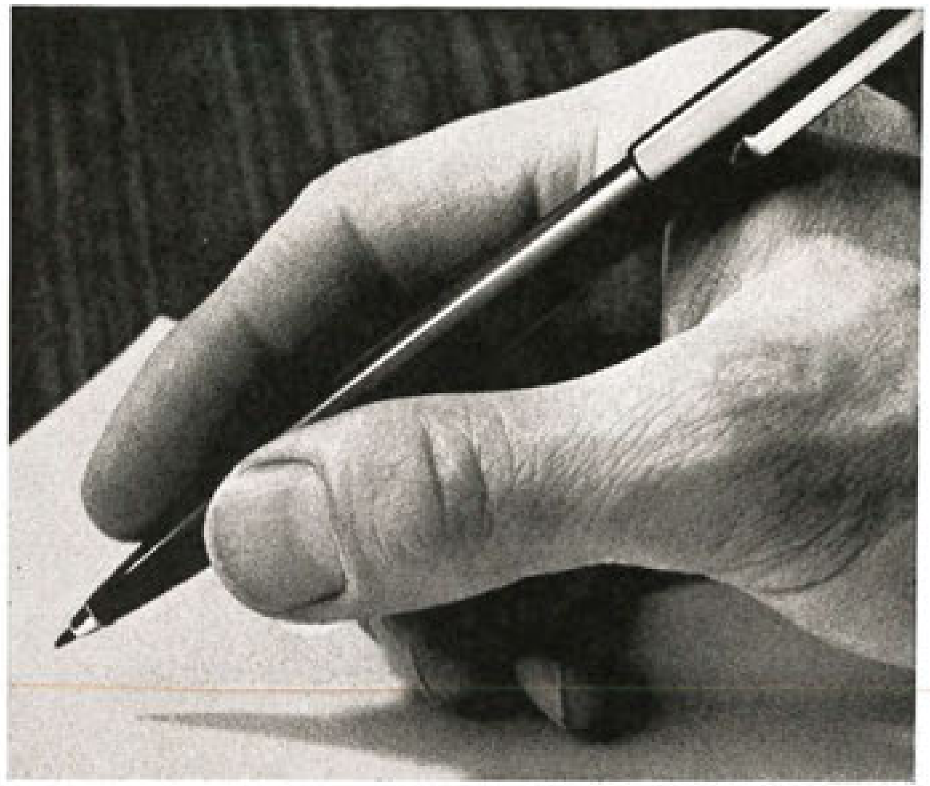

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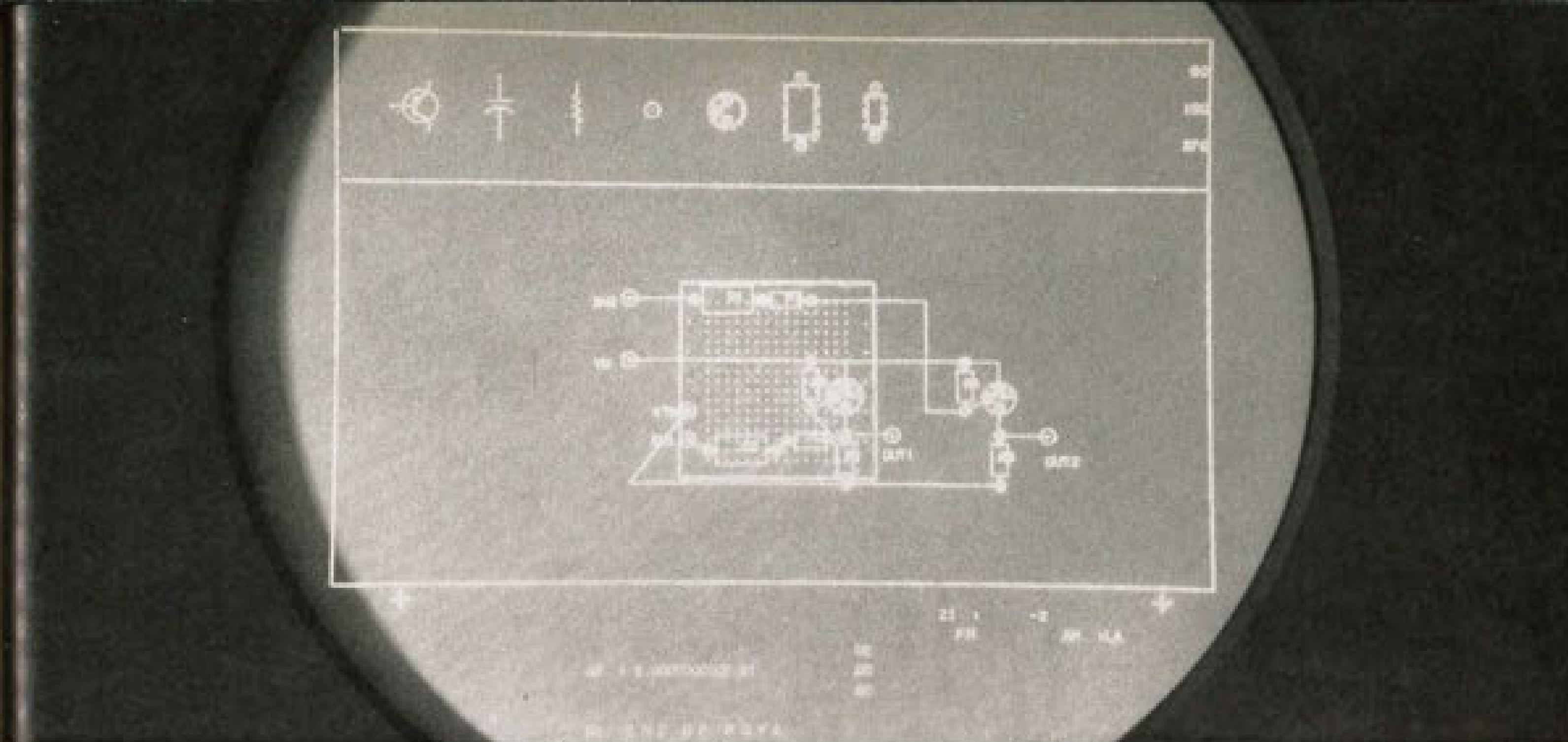

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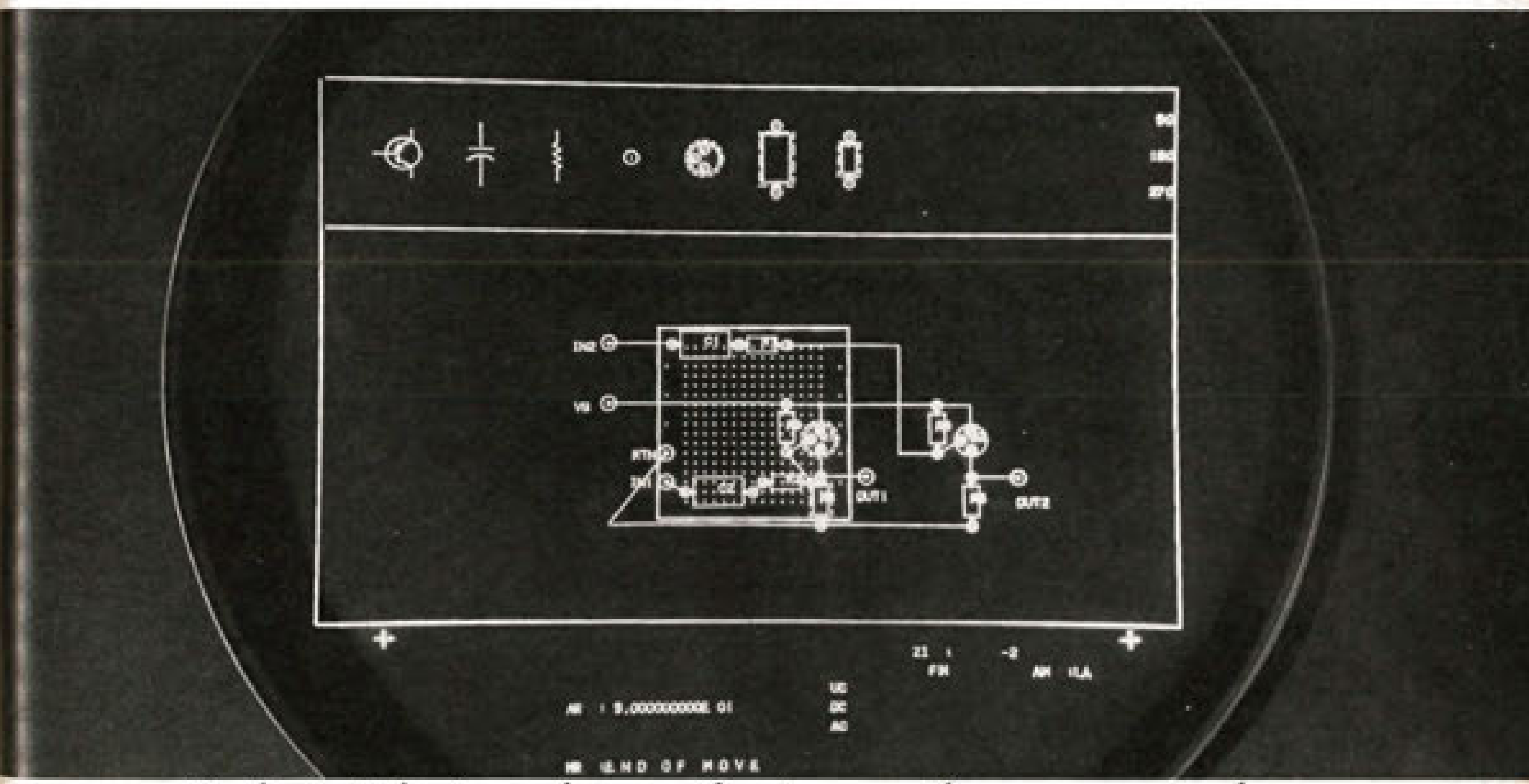

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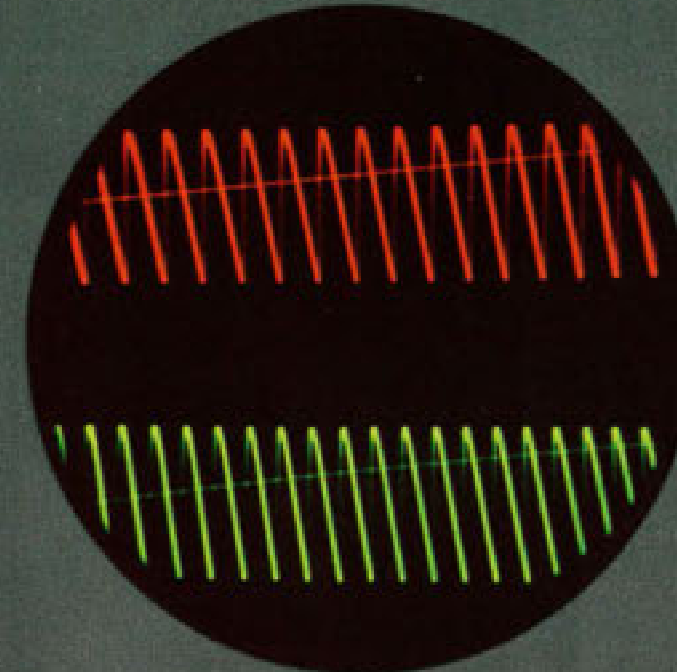

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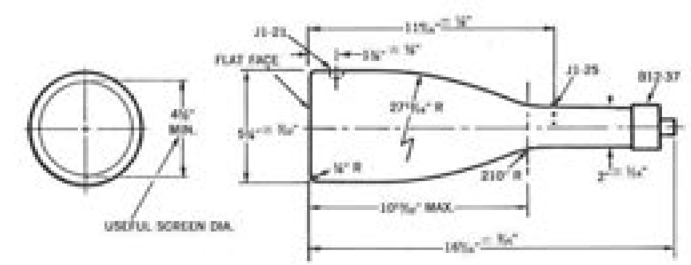

This is Sylvania's new type SC-4689. It features excellent color separation from red to green by switching the voltage on anode No. 3 from 6,000 to 12,000 V.

It's a one-gun tube. Multilayer phosphors of red and green produce the color outputs on the tube face. The new tube has very high resolution, because it eliminates the need for the shadow mask and the three dots of different phosphors required for each information point in conventional three-gun color tubes. Thus, more information can be displayed in a given area.

The SC-4689 uses a 5″ diameter screen and a high resolution gun—offering spiral post deflection acceleration. This minimizes the changes in deflection sensitivity and pattern linearity as anode No. 3 is switched.

Sylvania can apply the same principles used in the SC-4689 to other sizes and to other types, such as a 2-gun device, to meet users' specific needs. For example, a 2-gun device, when operated at the 2-voltage levels, gives independent color display.

Sylvania Electronic Components Group, Sylvania Electric Products Inc., Seneca Falls, New York 13148.

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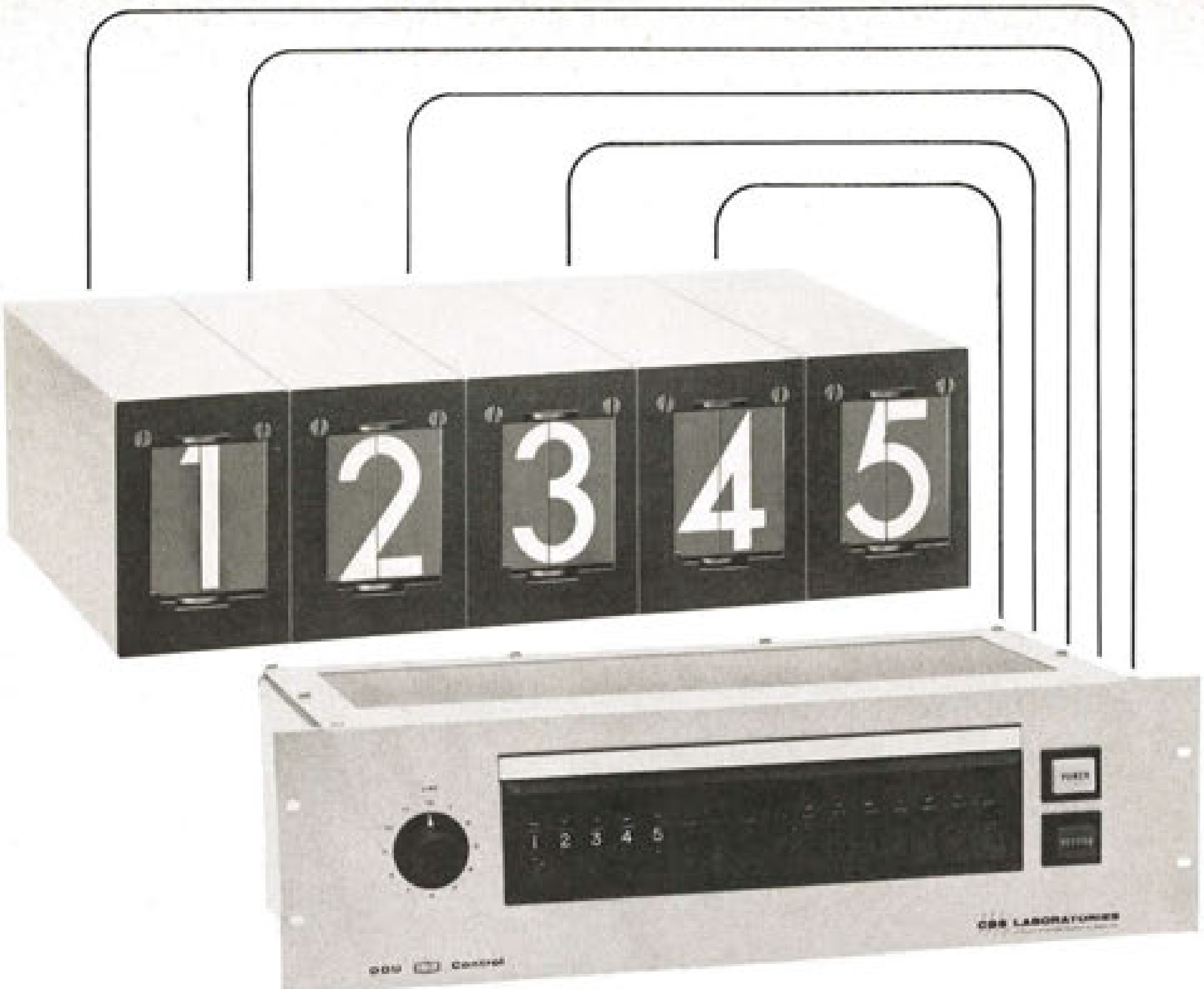

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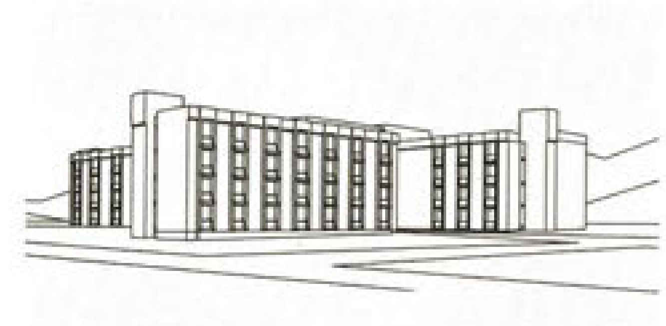

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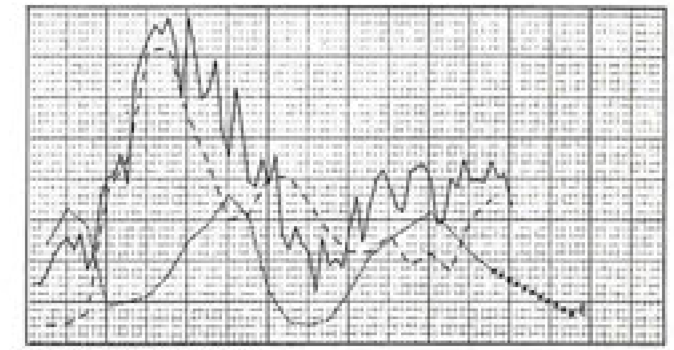
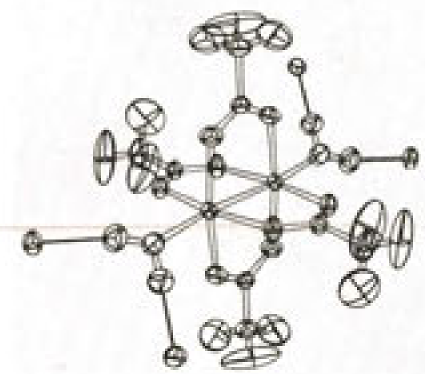


statistical trend charts



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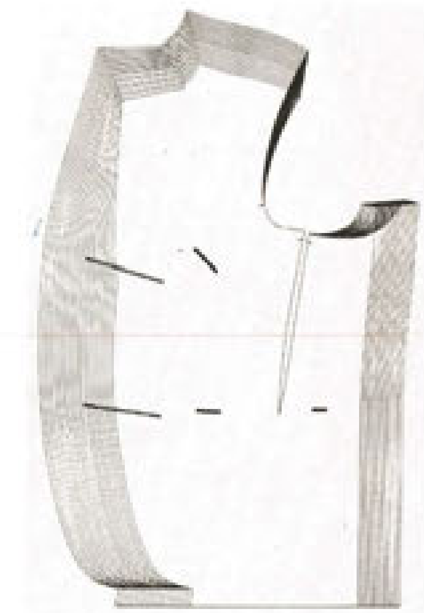

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GUEST EDITORIAL

Do you really know how to use displays?

ABSTRACT

A fundamental of display use is discussed which is often overlooked or thwarted by non-essentials. The prime function of display is to provide the means for fast, silent dialogue with a system which incorporates a computer. By means of the dialogue, the operator can then exercise an essential control function. The dialogue may either be simple repetition of closely similar sequences or it may be an iterative process with highly variable sequences.

Future applications of displays will be recognized with greater frequency and display systems will be designed for these applications with improved effectiveness if two basic capabilities of displays are kept firmly in mind: fast, silent presentation of information, supplemented usually by the light gun's capability to identify a portion of the presented data upon which some operation is to be performed. Both of these capabilities, for present purposes, may be subsumed by the capability of silent speed. Past failures can often be traced to the fact that this basic capability has not been central in the design. Either the application did not really demand silent speed, or else other capabilities of the display were inadvertently emphasized at significant cost to essential speed. The above ideas are certainly not new, yet I feel stirred by evangelistic zeal to call upon designers of display systems to repent and to return to the faith: when silent speed is required, design for it; when not required, admit it.

Just what, you may ask, is so complex and mysterious about this requirement of silent speed? True, it is not complicated and you have heard about it long, long ago.

Baldly stated, I am describing the requirement for an operator, as a mandatory element of a system, to provide numerous system inputs which often are affected by or dependent upon output data provided to him by the system, all within a period of time which must be minimized as a critical requirement of the system. Although this requirement description is certainly familiar, there is a problem in designing to meet it. As in the usual case, the problem is not one that is obvious. The problem is one of recognition. Perfunctory analysis of a system may not unearth the above classic requirement, while a more thorough and detailed analysis will make the requirement quite plain.

Operator functions which characteristically must be performed in a repetitive fashion on an obviously predictable basis are easy enough to identify as proper candidates for display use, assuming the time restriction exists and the economics are favorable. For example, in a system in which an operator is required to monitor and edit communications traffic for accuracy of address, precedence and the like, the same functions would be performed for each message in a highly repetitive and predictable manner.

A valid display requirement more easily missed than the above example is one involving a variable number of iterations in order to complete a given action. It is usually missed because a superficial analysis does not uncover the worst-case situations which may occur with a frequency which is not insignificant. Certainly, the analysis has been inadequate if maloperation and special cases have not come to light. There is no substitute for direct observation of the current system or for simulation of a radical departure from an existing system. Analytic error here is a human error in the same class with trying to beat the red traffic light when the traffic cop is not around. For this analysis, the "traffic cop" should be the realization that the iterative sequence to complete a given action has potential for being the most rewarding application of displays. It is the most rewarding because this classic situation has two significant elements: the exercise of operator judgement is best utilized in this fashion; and the speed inherent in displays may be the only capability permitting such exercise of judgement.

Several key characteristics often aid in identifying the variable-iteration situation: low probability of completing the action in the first iteration, e.g., exploration of alternatives; continued iterations dictated by high cost of failure until a solution is found; wide variation in the required number of iterations required, e.g., an acceptable solution found immediately; dependence of a given intermediate result upon preceding steps and its probable modification by subsequent steps; and finally, a time schedule which must be met.

Since all good sermons should conclude with a rousing admonition to be carried away by the congregation as they file out the door, I will add one last thought. Whereas display applications are properly justified on the basis of silent speed, their performance is also evaluated on the same grounds as their justification. Therefore, in the course of developing the system, resist the temptation to add a bit of sophistication here and a bit of elegance there. If you yield, these tempting luxuries are likely to eat up so much time that the speed finally achieved is not speedy at all.

BENJAMIN F. LOHR
National Science Foundation
Washington, D.C.

THE AUTHOR

BENJAMIN F. LOHR, *a National Director for the South East Region, is a charter member of the organization and has served as the first Mid-Atlantic Chapter Chairman. He has been active in display for ten years as a Project Officer for the Navy's first command and control display system on shore and subsequently with the Bunker-Ramo Corporation. He is now with the National Science Foundation as Associate Program Director of Information Systems.*

President's annual report

April 1967

by WILLIAM P. BETHKE

President, Society for Information Display
Chief, Engineering Division
Rome Air Development Center
Rome, New York

During the past year, *SID* engaged in a number of activities and projects. Each venture was interesting, challenging and different. All, we feel, were worthwhile and pertinent. We have progressed in two important aspects: (1) as a vehicle for the exchange of technical information and ideas; and (2) as a bonafide organization with workable structure and specific goals. We have realized a transition from the level of *ideals* and *philosophy* to the solid ground of *ideas* and *implementation*.

The symposium held in Boston in October was a major, tangible indication of progress on the technical side of our activities; it produced an encouraging number of interesting and topical technical papers. In addition, our Society journal continued to expand in calibre and content.

On the organizational side, *SID* realized a long sought-for position. A revision of the Articles of Incorporation established *SID* as a non-profit, scientific society, and not a business league. In addition to the professional image gained by this action, we accrued some practical benefits in the form of tax deductions and mailing privileges. Approval of the revision was given by members at the annual business meeting.

In February of this year we established a Central Office with a full-time manager. Located at 654 N. Sepulveda Blvd., in Los Angeles (see Fig. 1), it is comprised of three suites serving as *SID*'s main business offices. In the final planning stage is an answering and request service which will receive and record incoming calls 24 hours a day. The business manager will act on these calls during normal working hours. Installation is anticipated within the next few months. In addition, we are planning to establish a permuted index (author or key word in context) for use by *SID* members. Although in the planning stage, the index should be a realization sometime this year. When deemed necessary, other office equipment will be installed.

We have retained the firm of Seidman and Seidman, accountants and auditors. They have established recognized accounting procedures which meet the requirements of *SID*. We've prepared a new membership directory which was distributed to our members last summer. The first of its kind, the directory will be an annual project. The next edition will include expanded additional membership information and special formating for chapter, regional and state identification.

FIGURE 1: Exterior of SID National Offices in Los Angeles

FIGURE 1A: Mrs. Sharon Satterfield, Office Manager

The financial resources and expenditures are indicated in the accompanying chart (Fig. 2). Our increase in fund balance has continued to rise and it is expected that this will continue in spite of the increased operating costs of the new Central Office.

YEAR ENDED JANUARY 31		
Receipts:	1967	1966
Dues	$14,946	$12,941
Profit from sales of journal	5,974	3,889
Interest on savings account	702	427
Total receipts	21,622	17,257
Disbursements:		
Office management expenses	3,173	2,100
Net cost of symposiums	2,868	1,010
Chapter operations	1,973	1,516
Postage and mailing	1,489	1,171
Election expenses	762	—
Professional fees	750	152
Executive board and officers' expenses	619	683
Printing of directory	512	—
Lapel pins and tie tacks	467	—
Insurance	385	—
Stationery and office supplies	148	870
Total disbursements	13,146	7,502
Excess of receipts over disbursements	8,476	9,755
General fund balance at February 1, 1966	19,279	9,524
General fund balance at January 31, 1967	$27,755	$19,279

FIGURE 2: Statement of Receipts and Disbursements

The area of honors and awards has been given specific attention. A special Francis Darne Memorial Award was established to be awarded an *SID* member for outstanding technical achievement in the Display field. A suitable plaque was designed (see Fig. 3), and several models purchased for future awards. We have also designed and approved fabrication of a membership pin for distribution to *SID* members. A quantity of these pins, tie-tack and lapel versions, was purchased. They're available to the *SID* membership at $3.00 each.

Recognition was given to a number of our outstanding members in the following manner.

FIGURE 3: Francis Darne Memorial Award

ELEVATION TO FELLOW GRADE

Mr. William Ross Aiken — for his development of the flat cathode-ray tube and continued advancement of the display state-of-the-art.

Dr. George H. Dorion — for his work in applying photochromic techniques to display systems.

Mr. Solomon Sherr — for his contributions in the areas of display system analysis, generalized functional design, and display system transfer functions.

Dr. Sid Deutsch — for his extensive work in television systems, pattern recognition, and education.

SPECIAL CITATION

Mr. Phillip Damon — for his long and dedicated service to the *SID* in both National and Chapter activities.

Progress has been reported in the area of standards and definitions. The committee is comprised of a member from each Chapter, who in turn is a Chairman of a local Standards and Definitions Committee. Since standards and definitions promulgated by the Society must represent the consensus of the membership, work performed by the local Chapters and submitted to the National Committee should have received prior test of acceptance by the local Chapter membership. In this manner, a sample of the membership will at least have had an opportunity to interact with the proposed standard and/or definition. Initial activity has been to emphasize definitions. This was due primarily because the issuance of standards is a large, time consuming activity and requires extensive procedural apparati and coordination with other agencies. Such activity was not considered an effective initial activity of the Society. In the area of definitions, primary emphasis was placed upon those definitions which imply or define measurements of significant display parameters.

Assignments made to Chapters were:

Northeastern Chapter:	Resolution
Mid Atlantic Chapter:	Colorimetry
Washington Chapter:	Luminance & Luminance Discrimination
San Francisco Chapter:	Colorimetry
Los Angeles Chapter:	Resolution
San Diego Chapter:	Luminance & Luminance Discrimination

The emphasis and concentration on the areas mentioned restricted somewhat the attention to membership details by our officers. Activities concerning the increase of either chapter or total membership, though not specifically ascented, did not remain static. The Society *did* grow in total membership, and *did* increase the sustaining memberships. The present membership status is shown on the accompanying photo (Fig. 4). We might add that two organizational meetings were held — one in the Philadelphia-Delaware area, and the other in the Chicago area. Both areas seem to offer extremely promising prospects as new chapters.

The above terms (e.g., resolution, etc.) were meant to denote broad areas of measures and terms (e.g., acuity, grating bar, sine-wave, etc.) rather than a singular term to be defined. It is expected that the end product of this effort will be a comprehensive listing of the various definitions already in use by others in each of these areas. Of course, if editorial comment and/or proposed revisions are suggested by the Chapters, they will be considered.

It will be noted that the majority of our efforts were of the organizational type. This was essential because our Society has rapidly expanded. It was apparent that specific procedures were required for a number of organizational functions. In this aspect, we consider our efforts in the past year to have been extremely successful.

FIGURE 4: Membership Status of *SID*

The attendant duties and responsibilities of their respective offices are a source of major concern to all elected officials. In order to clarify the situation, a concerted effort by all officers was undertaken during the past year. The result was a specific "job description" of each officer, outlining the responsibilities entailed in his position. This effort is the first step toward the preparation of an operations and procedures manual for our Society. The development and realization of such a manual will be accomplished during the coming year.

The objective of the Society's officers is to concentrate on the areas of expansion and growth, from both a Chapter aspect and membership — total and sustaining. It is toward this end that our efforts will be directed during the coming year.

WILLIAM P. BETHKE is Chief of the Engineering Division, Rome Air Development Center. A native of Milwaukee, Wisconsin, he received his BEE from Marquette University College of Engineering and also studied radio and microwave theory at the Illinois Institute of Technology. He was directly responsible for the Airport Surface Detection Equipment (ASDE or Taxi Control Radar) which involved the use of K-band frequencies and extremely narrow pulses. (The equipment was subsequently installed at Idlewild Tower in New York City where it remained for operational evaluation for about a year). Since 1961, he has had complete responsibility for the over-all planning, direction, coordination and management of the Division program. He directs applied research and development in solid state devices, reliability and maintainability, mechanical engineering and displays. Mr. Bethke is President of the Society for Information Display (*SID*); a senior member and past Chairman, Mohawk Valley Section, IEEE; Chairman, Scholarship Committee, National Communications Symposium; a member of the Professional and Technical Group on Engineering Management, as well as the Professional and Technical Group on Military Electronics, IEEE; Chairman, Scientific and Professional Committee, RADC; Chairman, Vocational Advisory Committee, Board of Education, Rome, New York; past Northeast Regional Director, *SID*; past Chairman, Definitions and Standards Committee, *SID*; past member, National Editorial Advisory Board, *SID*; listed in Who's Who in the East, 1963. Mr. Bethke received the Decoration for Exceptional Civilian Service in 1964. This is the highest civilian award made by the Air Force. He was elevated to Fellow in *SID* in 1966. He has been nominated for Fellow in the IEEE in 1967.

High resolution cathode ray tubes for the system designer

by JIM E. WURTZ
Applications Engineer
Electron Tube Division
Litton Industries
San Carlos, California

ABSTRACT

In this day when everybody is talking about solid state devices, it appears that there is one vacuum tube component which is not likely to be replaced for some time. This is the cathode ray tube. It is the prime transducer of information from the intangible electrical medium to human beings and is also widely used for film scanning and recording. The cathode ray tube today is fast, versatile, accurate, and is capable of demonstrating a resolving ability which challenges optical lenses.

The purpose of this paper is to discuss the category of cathode ray tubes which are capable of resolving detail which is beyond that which the human eye can appreciate. This is the class of tubes used primarily for scanning of film or recording on photo sensitive materials.

High resolution gun designs will not be discussed. The major purpose here will be to give the designer who is interested in high-resolution cathode-ray tube systems a guide for use in intelligent selection and practical operation of these tubes.

Applications

Below are listed some of the applications to which high resolution tubes are being put today:

- Side looking radar processing and recording
- Atomic particle track scanning
- Document scanning
- Inspection of film recordings
- Picture recording, satellite
- Infra-red recording
- Cell counting
- Densitometry
- Film based large screen displays
- Scanning for simulators, radar land mass, etc.
- Scanning for photo-interpretation
- Character recognition
- TV scanning
- Video recording
- Computer controlled scanning and recording
- Document storage and retrieval.

Before selecting and applying high resolution cathode ray tubes to a particular system, careful attention should be given to the subject matter in various sections of the following article covering the tube's geometrical outline, the phosphor face, and the electronic driving equipment.

Resolution

The first question asked about high resolution tubes is: What is the spot size? The claims of manufacturers sound impressive in this respect. By reading the manufacturer's data sheet it would appear that there are several tubes on the market with rated spot sizes of under one one-thousandths of an inch (0.001 in.) or, as it is referred to in the industry, 1 mil.

The system designer then figures that he has 1000 elements to the inch, extended over 4 in. of screen area on a 5 in. tube, so he can realize over 4000 elements on a trace across the tube. Unfortunately, it is not as simple as that. There are several factors which will modify the ideal number to a more useful resolution figure. These are:

(1) The method by which the resolution is to be evaluated
(2) The degree of response or modulation depth required for a given resolution
(3) The spot size at the light output (hence, beam current) required for the application
(4) Deflection defocusing.

Measuring method and modulation depth are tied together. A number of methods are available for measuring resolution. The shrinking raster method is common, mostly because it is easy to do. A raster with a known number of lines is generated on the tube face and the vertical size is decreased until the lines disappear, or merge. The height of the raster is measured at this point and the measurement is divided by the number of lines. The method is valid as long as the beam is not distorted so that the spot is wide along the length of the raster lines and the evaluator is aware of what level on the spot light distribution curve he is measuring.

Generally, the spot profile will be a gaussian curve. If the measurement at a particular level is known, those adept at mathematics can calculate their system resolution.

One of the better methods of measuring resolution is to actually make a picture of the spot profile[1], as shown in Figure 1. This is done by moving the spot past one or two slits which are small compared to the spot. A phototube on the other side of the slit will display the spot profile on an oscilloscope. There is at least one slit analyzer now on the market for measuring cathode ray tube resolution.

Another method is to scan the spot while it is being modulated with superimposed sine waves in such a way that the output of a phototube looking at the spot modulation through a small slit will produce a measurement of spatial frequency response in cycles per unit length.

Several other variations of these methods are available and, of course, one can always measure the spot directly with a high power microscope. This latter method is probably the least recommended since it is difficult to determine where the spot edge is.

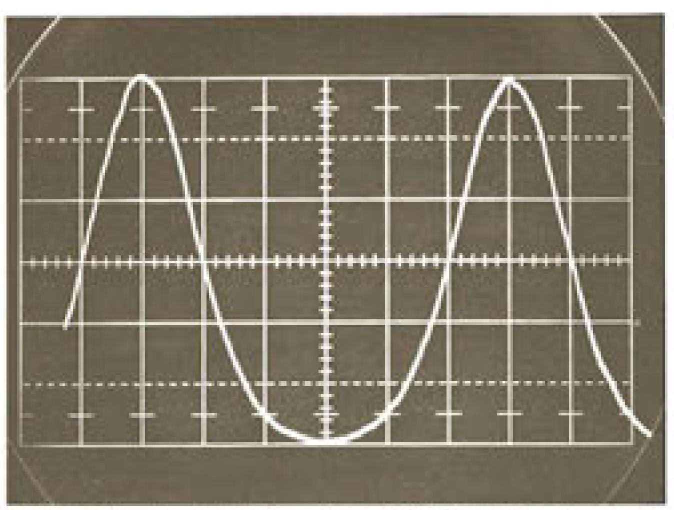

FIGURE 1: Spot profile taken with a CELCO two slit analyzer using slits to produce 0.0005" per centimeter.

Remember that in film recording systems, various film emulsions will "see" the spot profile at different levels.

In the final analysis, the tube which works best in the system is the one to buy and, if possible, different tubes should be tried.

Spot size at a particular light output is most important for scanning tubes where a large amount of light output is usually required. Electrons repel each other and as the number of the electrons in the beam is increased by increasing the beam current, the beam size, and consequently, the spot size, grows. The resolution given on most manufacturers' data sheets is at beam currents of one microamp or less. Incidentally, it is not always a good idea to reference spot size to beam current since some manufacturers employ anode aperturing where the aperture is internally connected to the anode. Because of this, it is not possible to accurately measure how much current is actually striking and exciting the phosphor.

Deflection defocusing is caused by:

(1) The change in electron path length with deflection angle, thus requiring a different focus field strength for each radial distance of the spot from center of the screen
(2) The non-uniformity of deflecting fields and electron motions
(3) The fact that when a roughly cylindrical beam meets a flat phosphor screen at an angle, the resulting figure is an ellipse.

The ellipse effect is quite negligible compared to change in path length and field non-uniformities. Problems with the latter two items can be compounded by astigmatism in the beam. The change in path length is usually handled pretty well by use of dynamic focus correction and relatively simple driving circuitry which computes the radial distance of the beam from center of the face and introduces the proper amount of focal length correction.

Field non-uniformity with beam astigmatism is the most difficult to handle. It is perhaps most expedient to incorporate a high quality deflection coil in the system. These high quality yokes are expensive, but they are designed to produce a uniform field which will minimize the defocusing effects inherent in the deflection coil. The added expense of a high quality yoke is usually negligible compared to the system cost. Static and dynamic astigmatism correctors are also available, but are some times difficult to drive with the proper waveforms.

Resolution and Basic Tube Geometry

Disregarding the intrinsic capabilities of different electron guns, there are certain basic guide lines to follow in selecting the general outline of a high resolution tube.

Figure 2 depicts a simple optical ray tracing diagram. In this case, the object A is the so-called cross-over point in the electron gun. The object A appears as the image B on the phosphor screen. The lens C is analogous to the focus coil. It is apparent that as the lens C is moved toward B, and the strength or focal length of the lens is readjusted, B will become smaller.

This is according to the formula:

$$\frac{x}{u} = \frac{y}{v}$$

where

x = object size
y = image size
u = object distance
v = image distance

[1] *John M. Constantine*, Two-Slit Spot Measurement, *7th National Symposium*, Society for Information Display.

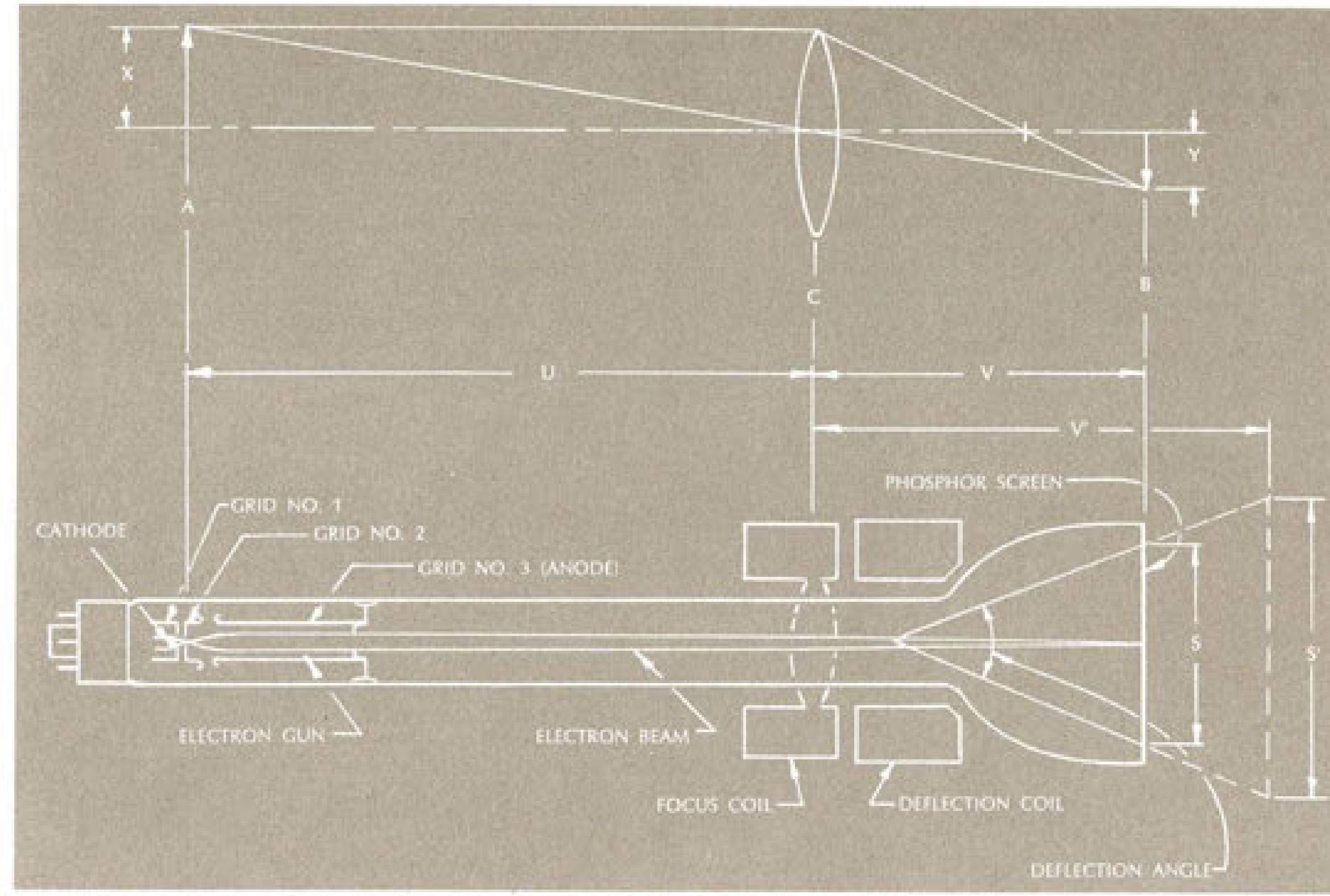

FIGURE 2

Thus, as the focusing element is moved closer to the screen, the spot size gets smaller. Obviously, for best resolution for any cathode ray tube, the focus element should be as close to the screen as possible without picking up stray coupling from the deflection coil.

For practical cathode ray tube designs, it is not possible to take full advantage of this demagnification. First of all, there is a requirement for a given trace width or screen area on the face of the tube. So, for a given trace width, as distance v is shortened, the deflection angle for the required screen area becomes larger, thus taxing available deflection power and giving rise to non-linearity and deflection defocusing problems.

Then why not increase distance u ? This is limited because the longer beam path length allows too much spreading in the beam and it has been shown that this results in aberrations in the beam.[2]

Also, one must bear in mind that the electrons do not act precisely like light rays. Some are traveling at different velocities and some are traveling sideways in the beam. Each electron also repels its neighbors thus setting a practical limit on how tight the beam bundle can be for a given anode voltage.

All of the foregoing indicates why, generally, the beam size seems to grow with the tube size. That is, if the deflection is held constant and the scan distance s is increased to s', then distance v is increased to v', thus making the optical reduction ratio more unfavorable. Also, one can see the trade-off which exists between deflection angle, screen size, and the resolution which can be achieved at the center of the screen.

PHOSPHOR SCREEN

Light Output

The question most often asked after "What is the spot size?" is "What is the light output?" For direct view applications, this is most commonly expressed in foot-lamberts since this unit is oriented to human vision. Ways of measuring include foot-lambert meters, such as the Weston 759, and spot brightness meters. The latter is preferred. When using the foot-lambert meter, it is well to specify proper use of the hood or cylinder which spaces the sensor from the face of the cathode ray tube. With the sensor against the tube face, without the hood, the reading will be approximately π times higher than with it.

For recording or scanning cathode ray tubes, the item of interest is radiant power out the front of the tube.[3] For gross estimates, foot-lamberts can be converted to radiant power if the luminous efficiency of the phosphor is known. Information which is available on phosphor efficiency can be misleading, especially for high resolution tubes where the screen is usually thin. Available figures usually do not take into account the effect on efficiency of various screen deposition methods or the portion of actual power radiated out the front of a cathode ray tube. Actual phosphor efficiency in radiated watts out the front of the tube, per watt of excitation, will vary considerably in different tubes as a function of anode voltage, screen thickness, the

[2] *Soller, Starr and Valley*, Cathode Ray Tube Display. *MIT Radiation Lab Series, No. 22, McGraw Hill, 1948, page 97.*

[3] *Leo Deiser*, Energy Transfer from CRT to Photo Sensitive Media. *Information Display, September-October, 1965.*

FIGURE 3: Cathode ray tube with a sub-mounted screen to reduce halo.

aluminum coating — if any, and the phosphor deposition method. As the screen is made thicker, it will reach its peak efficiency at a higher anode voltage. A thin screen at too high a voltage would allow the electrons to go on through without giving up maximum energy to the phosphor. The aluminum coating, if any, will affect the electron's energy and, of course, contribute to the light out the front of the tube through optical reflection.

With optimum anode voltage, various screen deposition methods and phosphor treatment will have a large affect on spot size. Larger particle sizes tend to have more efficiency and, in a thick layer, will produce the most efficient screen. Of course, this screen will not have good resolution. On the other end of the scale are evaporated phosphor techniques which produce very high resolution screens with poor light output. The high resolution tube manufacturer must compromise screen thickness and particle size to achieve the highest light output possible consistent with desired resolution.

Contrast

Contrast on a cathode ray tube, a typical example of which is shown in Figure 3, is degraded by spot halo which is caused by internally reflected light trapped inside the faceplate.[4] In flying spot scanner applications, this halo decreases signal-to-noise ratio and in recording applications, it reduces contrast.

There are five ways of attacking the problem:

(1) Decrease the transmission of the faceplate
(2) Use a transparent phosphor
(3) Increase the thickness of the faceplate
(4) Make the faceplate very thin
(5) Use a fiber optic faceplate.

Since halo light must pass through the face at least three times while the primary ray goes through only once, any decrease in faceplate transmission will have a marked effect on halo. There will, of course, be a sacrifice in light from the primary spot. Although some tubes have been available with low transmitting glass faces, the solution is not popular because of the reduced light output.

Transparent phosphors which are evaporated on the cathode ray tube faceplate have been mentioned as one solution to halo. Unfortunately, the phosphor types that can be used in this way are limited and the light output is usually quite low.

The faceplate can be increased in thickness to the point where the reflected light comes back to the phosphor plane

[4] *Zworykin and Morton*, Television, 2nd Edition. *Wiley, 1954, pages 415-425.*

out of the area of interest. Tubes using this approach are either not available or not well publicized.

The solution to the halo problem, which is actually finding its way into some systems, is to decrease the face thickness. Since a thin glass face cannot support the vacuum load, the phosphor is deposited on a very thin plate which is sub-mounted behind a regular thick faceplate. The disadvantage to this approach is the relative fragility of the sub-mounted glass which is usually in the neighborhood of only 0.020 in. thick.

Use of a fiber optic tube is probably the best, and also the most expensive, solution. The expense is particularly unattractive for larger tubes.

Phosphors

Although there are a few variations on the market, the two most popular phosphors for scanning and recording are P16 and P11, respectively. Although the output of P16 is in the ultra-violet and it generally ages under excitation to a lower light output,[5] its overall characteristics seem to continue to hold an edge over other newer fast decay phosphors. It would appear that P16 aging is a function of current and time only and it thus looks desirable to run P16 at higher anode voltages in order to obtain longer tube life. P16 is also used to expose UV activated dry process films such as photochromics[6] and Kalvar. Some effort is being directed toward increasing the efficiency of P16 for this use.

P11 makes a good, fine grain screen but it is more susceptible to contamination and when loaded too heavy, will saturate. The decay time of P11 also varies with loading.

For color scanning, P24 is used because of its broad spectrum and relatively fast decay.

Phosphor Blemishes

On a typical 5 in. tube, there are around 14 million, 1-mil square elements. In many applications, it is important that all, if not a very large percentage, of the phosphor area be free of blemishes that would affect performance on the system. Typical manufacturer's specifications divide the screen into quality areas — usually three concentric circles. The area near the center is the cleanest. Blemishes are usually defined as bright specks, dark specks, or color specks and their size is taken as the largest dimension or, often, a ratio of dimensions is specified. Inspection methods include visual observation, and actual scanning of the entire screen using a phototube with a sweep frequency that allows the phosphor to decay from element to element to a specified bandwidth. The size of the speck shows up as the height of a spike on the oscilloscope used to monitor the output of the phototube. This method is also used to evaluate phosphor noise.

Phosphor Noise and Uniformity

Phosphor noise is caused by variation in light from particle to particle or groups of particles. The noise usually is inversely proportional to spot size and, as the spot is run through focus by varying the focus strength, the noise will hit a peak.

Different screen deposition methods will produce varying amounts of noise. Settling of particles which are not classified or sized will usually produce the noisier screen. Phosphor noise can be measured by placing an appropriate phototube in front of the cathode ray tube on which is running a single line trace electronically or physically

[5] *Pfahnl*, Properties of Fast-Decay Cathode Ray Tube Phosphors. *Bell System Technical Journal, January, 1963.*
[6] *Dorion, Roth, Stafford, Cox,* CRT Phosphor Activation of Photochromic Film.

blanked for half the trace length. The noise is observed as "grass" on the step produced when the phototube output is observed on an oscilloscope and its percentage of the step can be measured. Select a sweep frequency slow enough so that phosphor decay will not mask the noise.

Phosphor non-uniformity shows up as a gradual change in light output or color over the entire screen. This is sometimes called shading and is easily observed with a phototube and oscilloscope.

The Faceplate

The cathode ray tube faceplate is actually part of the optical system and its quality should be commensurate. The faceplate glass is generally specified for optical quality with minimum seeds, bubbles, chill wrinkles, and uneven surface. In optical systems employing low f number lenses, the depth of focus is very short, thus requiring a high degree of flatness in the faceplate.

Screen Size

Although, as pointed out, spot size tends to grow with tube size, there is some net gain in resolution with the larger tube sizes. Aside from resolution, other advantages to larger screen sizes include reduced phosphor noise and reduced phosphor loading. Of course, the larger sizes are more expensive and usually require a more expensive lens.

For a given size at the film plane, the spot will cover more area on the phosphor plane with a larger cathode ray tube, than with a smaller one. Since phosphor noise is inversely proportional to spot size, noise with the larger tube will be less. Also, with a larger cathode ray tube, more phosphor area is utilized so that for phosphors which age, like P16, tube life will be longer.

Because of vacuum loading and the requirement for a truly flat face dictated by optical systems, the limit on tube size appears to be around 9 or 10 in. in diameter.

Stray Emission

Because of the intense electric fields which exist in a cathode ray tube gun, it is sometimes possible that there will be field emission from microscopic particles or surface irregularities in the lower electron gun structure. Sometimes there will be secondary electron emission from apertures in the gun. In the latter case, the secondary or "ghost spot" will be cut-off when the primary beam is cut-off. In the former case, a spot can be seen when the high voltage is on, regardless of electron gun bias level.

Existence of stray emission can, of course, have an adverse effect on cathode ray tube recording or scanning performance. Careful examination of the cathode ray tube screen in a darkened room will usually reveal this defect. Most cathode ray tube manufacturers have methods for eliminating this condition, should it arise.

Also, in the case of photo recording systems, don't forget that the glow caused by the cathode heater can sometimes fog the film.

Fiber Optic Tubes

Since fiber optic bundles have become available for sealing onto cathode ray tubes, many system designers are turning to high resolution fiber optic tubes to solve unique problems. The largest number of applications are those involving relatively insensitive dry-process films and high speed recording on conventional film.[7]

Up to the phosphor screen, the same comments contained in the rest of this article apply. The fiber optic plate

[7] *Fred L. Katzman*, Improving Ultra Fast Transient Recording Using Fiber Optic Cathode Ray Tubes. *Electronic Instrument Digest, October, 1966.*

itself and how it affects resolution, light output, etc., is discussed in the following paragraphs.

Generally, the principal advantage of a fiber optic face is additional light. The film to be scanned or exposed is laid directly on the tube face, thereby capturing a much larger percentage of the phosphor light than can be realized through a lens. The light gain over a typical conventional optical system is approximately 30. Because of this increase in light transferred to the film plane, it is possible to:

(1) Expose relatively insensitive dry-process films
(2) Increase the writing speed for high speed trace recordings
(3) Reduce beam current for conventional film emulsions, thus resulting in better spot size
(4) Reduce anode voltage, thus decreasing deflection power and total system power consumption.

Additionally, elimination of the lens makes the optical system more compact. Disadvantages are that it is no longer possible to use optical reduction to achieve a better spot size at the film plane, and the higher cost of the tube, although the latter disadvantage can be offset by the lens cost.

The numerical aperture, the type of glass, and the fiber size used in construction of the fiber optic plate determines the transmission efficiency and resolution of the plate.[8,9] Plates are readily available for sealing on to cathode ray tubes with a numerical aperture of .66 and 8μ pitch fibers. Limiting resolution for this kind of plate is around 60 1p/mm (0.3 mils). Plates with a limiting resolution of 100 1p/mm are available. The quality of fiber optic plates has improved markedly in the last year or so to the point where blemishes can be controlled well enough for most system applications.

Another use of fiber optic plates is for intrinsic correction of spot position linearity on the face of the cathode ray tube by curving the inside of the plate to the radius of deflection.[10] Experience so far has shown that electronic correction is usually a better way to go from the standpoint of cost and flexibility.

Fiber optic tubes may also be used with conventional optical systems or for direct view work where it is desired to enhance contrast by elimination of spot halo. On direct view displays, which require an overlay, parallax is also eliminated.

ELECTRONIC EQUIPMENT

General

The cathode ray tube can be no better than the equipment that drives it. Therefore, a high quality cathode ray tube will require high quality electronic equipment if the maximum yield is to be realized.

The major cathode ray tube driving components are:

(1) High voltage supply
(2) Electron gun supply
(3) Focus coil and/or focus supply
(4) Deflection coil and deflection amplifier.

The High Voltage Supply

Generally, the anode voltage should be as high as possible, taking into consideration:

(1) Tube rating
(2) Deflection power
(3) Environment

[8] *J. Wilbur Hicks and Paul Kiritsy*, Fiber Optics. *Glass Industry, April and May, 1962.*
[9] *Mosaic Fabrications, Bulletin Series 100.*
[10] *Litton type L-4198 Cathode Ray Tube.*

(4) Possible X-ray problems.

Because electrons repel each other, the smaller spot size will be achieved at lower beam currents. This means that if the user can run the tube at 30 kv instead of 20 kv the current required for the same brightness will be less, resulting in some reduction of the spot size, as long as the screen thickness is such that efficiency is not lost. It is also true that at higher voltages there is less tendency for the beam to spread in the first place due to the shorter time each electron remains in the field of its nearest neighboring electrons. A further advantage to higher voltages is that the decrease in beam current for a given brightness adds to the tube life, especially in the case of P16 phosphor.

It can now be seen that there is a trade-off of resolution with deflection power. For, as the anode voltage is raised, the beam becomes "stiffer" and requires more power in order to be deflected through a given angle. The deflection could be decreased to make up for a higher anode voltage but then, as previously pointed out, there may be a sacrifice in spot size.

Fortunately, new high power deflection amplifiers make it possible to use higher anode voltages while new insulating materials and potting techniques have reduced the hazard of shock.

High voltage supply regulation, hum and ripple specifications are very important for high resolution displays. Supposing a stationary focused spot is located on a cathode raye tube screen. Suppose further that this spot is deflected off center by several inches. Now, if the high voltage control is varied, the spot will be seen to move in toward the center of the tube if the anode voltage is increased, and out toward the edge if the voltage is decreased. Supposing now that the high voltage control is moved back and forth at a high frequency. A point will be reached where one will no longer be able to detect spot movement, but the spot will appear larger.

The spot will look larger as governed by the following formula:

$$\frac{dV}{V} = 2 \ Cos^2 \theta \ \frac{dD}{D}$$

where

D = distance of the spot from the center of the tube
θ = deflection angle of the spot (from center)
V = accelerating voltage

This formula can be used to calculate required high voltage supply hum and ripple characteristics for maximum allowable spot growth due to this effect. A typical example would be the allowable high voltage hum and ripple for a 5-in, 40° high resolution cathode ray tube.

The following assumptions are made:

(1) The spot size at the center of the screen is 0.001 in.
(2) Allowable growth due to the high voltage supply is 10% or 0.0001 in. at the screen edge
(3) The useful screen for 40° total angle deflection is 4¼ in or 20° for 2.125 in.
(4) Accelerating voltage is 25 kv.

$$\frac{dV}{V} = 2 \ Cos^2 \theta \ \frac{dD}{D}$$

Solve for dV:

$$dV = \frac{2 \ Cos^2 \theta \ dDV}{D}$$

$$= \frac{2 \ Cos^2 20^\circ \times 10^{-4} \times 25 \times 10^3}{2.125}$$

$$= 2.079 \text{ volts peak-to-peak}$$

Substituting again for allowable spot position error due to the high voltage supply, the formula can be used to calculate regulation and stability requirements for display linearity.

The Electron Gun Supply

In a tetrode type gun, the gap between the No. 2 grid and the anode forms an electrostatic focus lens that is part of the tube's electron optical system. For this reason, the G2 voltage supply should be reasonably well regulated. Changes in the G2 voltage will also cause changes in the drive characteristics of the gun thus modulating the beam current. In some gun designs, the G2 collects a relatively large amount of current. Check with the cathode ray tube manufacturer on G2 supply impedance.

The bias voltage should be well regulated to eliminate unwanted modulation of the beam current. In some cases, it is also advisable to use dc on the filament. Care should be exercised in modulating the cathode itself since a defocusing action is experienced on the phosphor screen due to the apparent change of distance u Figure 2.

The Focus Coil and Focus Supply

For best resolution, a high quality focus coil is required. Also, since the focus is a function of the current flowing through the coil, a well regulated current supply which matches the coil should be employed. It is further important that the coil be properly aligned for optimum spot size over the entire screen area. Good regulation and alignment is also required for electrostatic focus tubes. Note that alignment can not be readily adjusted after tube assembly for an electrostatic lens which is inside the cathode ray tube envelope.

There is a running argument in the industry on the relative merits of electrostatic vs. electromagnetic focus. Theoretically at least, electromagnetic focus is better, especially for higher current applications. On the other hand, electrostatic focus appears simpler and is favored where there is a high sensitivity to volume and weight.

The Deflection Coil and Deflection Amplifier

Although change in beam path length is the major contributor to deflection defocusing, it is also true that in many cases, poor resolution can be traced to non-uniformities in the deflecting fields. Thus, as was previous mentioned, only high quality deflection yokes should be used. The deflecting fields themselves can introduce astigmatism which is difficult to correct for, without a dynamic astigmatism corrector. It is reported to be more difficult for the deflection coil manufacturers to hold field uniformity with lower inductance yokes. It would thus appear that there is a trade-off in this respect between speed and resolution.

The trade-off which is possible between deflection power and resolution has been previously pointed out. It is also advisable to eliminate any hum in the deflection circuitry which can wobble the beam with the result of an apparently large spot size.

It is generally conceded that electromagnetic deflection is superior to electrostatic deflection for high resolution applications. This is so mainly because of the small deflection angles required for electrostatic deflection thus placing the focusing element further from the screen, the lower anode voltages required, and the non-uniformity of the fields in the electrostatic deflection region.

Since high resolution cathode ray tube screens are easily burned,[11] it is wise to provide some form of sweep failure protection.

[11] *W. R. Elliot,* Limitations on High Energy Cathode Ray Tube Beams With Regard to Phosphor Life. *6th National Symposium, Society for Information Display.*

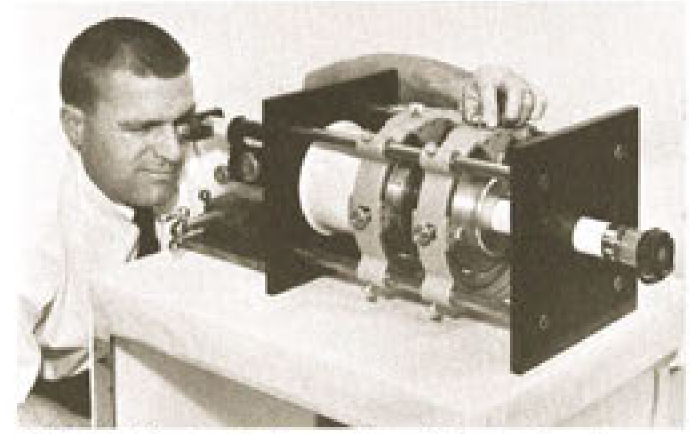

FIGURE 4: Aligning a high resolution cathode ray tube using a microscope.

Mechanical Equipment

In order to achieve minimum spot size, the electrical center of the focus coil and deflection yoke must coincide with the electrical center of the tube. The electrical centers and the mechanical centers of the coils and tubes are not necessarily coincident. The author, shown in Figure 4, is seen following the procedure described in the following material.

A relatively simple procedure will allow alignment of the electrical centers of the coils with the tube. This procedure calls for the ability to move the coils in a precise way with respect to the tube. The tube should be firmly fixed in a mount which also holds the focus coil and deflection coil. The method of holding the coils should be such that the coils can be adjusted in X translation, Y translation, pitch and yaw separately. Means of rotational and longitudinal adjustment is also a desirable feature.

It is essential that there should be no unwanted movement or vibration of the coils with respect to the tube while the tube is operating. This may cause spot wobble which will degrade resolution. Instructions for aligning the coils are available from tube and coil manufacturers.

A magnetic shield is another essential for high resolution displays. This is especially true if the tube is in an area where there are transformers or solenoids nearby. It takes only a very small movement (due to stray magnetic fields) to wobble a 0.001 in. beam to a 0.0015 in. beam, a change in resolution of 50%.

Some high resolution tubes today require a centering magnet or coil. Tubes which employ an aperture in the G3 barrel (see Figure 2) to achieve small spot size require a centering device to center the beam in the aperture. The centering device also centers the beam on the phosphor screen prior to alignment. Generally, it is desirable to avoid the use of a centering device since the magnetic field can introduce astigmatism on the beam. Electromagnetic centering coils are available which are reported to have a lesser effect on the beam uniformity.

The intrinsic, unfocused, undeflected, spot landing position on a typical 5 in, 40° tube is within a 5 mm radius from the mechanical center of the screen. The reason for the variation in spot landing position is that, as pointed out before, the electrical center and mechanical center of the tube do not necessarily coincide.

Most manufacturers will supply tubes with closer spot landing specifications for a premium. If a centering magnetic or coil must be used, some manufacturers require the magnet to be used over the gun, and some do not. There does not seem to be a hard and fast rule in this respect and the best advice is to do that which gets the required result.

Equipment for Fiber Optic Tubes

A special note is in order regarding fiber optic tubes. Each interstitial space between fibers on fiber optic plates is a potential weak point electrically speaking. That is, if a large voltage potential is placed across the plate as would be the case on a cathode ray tube, there may be an arc through the faceplate which will destroy the tube.

Because of this, fiber optic tubes should be run grounded anode. In many cases, grounded anode operation is convenient anyway, since it allows one to put his hands around the face of the tube without danger of shock; it reduces dust collection and facilitates coupling to the auxiliary plates on dual deflection tube types.

Video can be fed to the electron gun at the high negative potential through an rf coupling, a light diode coupler, or a coupling capacitor; the latter being the least desirable approach because of energy storage and poor dc response.

Stability

If careful attention is devoted to mounting configuration and power supply stability, the only remaining stability problem is a possible drift in amount of beam current caused by heating and subsequent shifting of the gun elements. If the system requires a steady light output and does not employ automatic brightness control,[12] it may be well to discuss drift with the prospective tube supplier.

Packaging

A trend in high resolution cathode ray tube applications today is toward the integrated tube package where the cathode ray tube, deflection yoke and focus coil are prealigned with the tube and potted inside a magnetic shield.

Some tubes are available with an intrinsic mounting ring on the face which is drilled and taped so the tube may be bolted into the optical system. The surfaces on the mounting ring are machined in such a way that when the tube is bolted in place, perpendicularity and concentricity of the faceplate to the center line of the optical system is assured.

The potted package is particularly popular in military systems. Other techniques are incorporated which prevent gun movement while undergoing shock and vibration.

The author acknowledges the help and encouragement of Dr. Joseph J. Stafford in preparing this paper.

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[12] *Fred C. Billingsley,* Processing Ranger and Mariner Photography. *SPIE Journal, April-May, 1966.*

Considerations in specifying display system CRT design objectives

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INTRODUCTION

Cathode ray tubes are used widely in many of today's information display systems. Interfacing the system to the observer, they not only portray a considerable amount of information, but also the quality of the system. It is imperative of course that the tube selected be designed for the ultimate in function for the type of system.

The designer must consider many factors in selecting the optimum tube for his application. No longer is he limited to a few "off-the-shelf" items. He has to consider such factors as size of display, deflection, and focusing method, sensitivity, resolution, brightness, power requirements, phosphor responses and receptors. Many of these may be in opposition to one another and the optimized tube is often "a compromise of many compromises"; or "a cathode ray tube can be peaked to near perfection of any of its specific capabilities providing the designer can accept the necessary trade-offs".

To assist the designer, this paper discusses the various parameters which must be considered to arrive at the composite cathode ray tube for a given information display system. Due to the interrelationship of the parameters, the optimum position the designer must take lies within the boundaries presented in Figure 1.

FACE SIZE AND TUBE LENGTH

One of the first parameters to consider in selecting a cathode ray tube for an information display system is the minimum screen area on which the information can be displayed. Available screen size however, is, in part, determined by the type of deflection method considered for the system: electrostatic or magnetic.

The primary factor for determining the deflection method used is the writing rate which the beam must experience during display periods. For rapid random access display, electrostatic deflection is normally used; i.e., writing rates in the order of a million inches per second are quite common. If the display can be written in a raster format, magnetic deflection can be utilized.

Historically, electrostatic tubes have generally been those that were originally designed for use in oscilloscopes. The majority of these were limited to round face types with diameters from 1 to 8 inches. In later years, several electrostatic tubes were designed with 10, 12, 16, and 19 inch diameter bulbs. In contrast, the magnetic deflection tubes have historically been those bulbs which have been designed for the TV entertainment field. Many of the display systems in operation today use bulbs identical to those used by the TV industry, and in part, a good share of the decision on which tube and which size to use rests solely on the availability of bulbs which were originally used for TV. It is true that many new bulbs have been designed and built in the small sizes, but for the large, magnetic deflection tube, the display system engineer must pick those bulbs which were previously used for TV. The alternate of designing a new bulb is generally considered economically unfeasible.

In general, the large size electrostatic tubes are round face types and the magnetic tubes are rectangular. Tube length also has to be considered with the aspect of display size versus deflection method. Magnetic deflection tube types can have much wider deflection angles than electrostatic types and can therefore be made shorter. The relative cost of magnetic versus electrostatic deflection circuitry may also be a factor.

Another factor to consider is availability. For example, some types designed for TV are becoming obsolete. The magnetic and electrostatic deflection tubes that are currently available with bulb diameters of 8 inches or greater are listed in Tables 1 and 2.

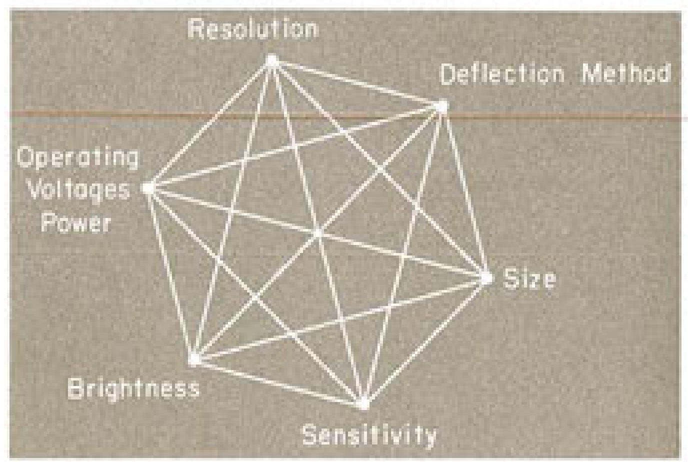

FIGURE 1: Interrelationship of CRT parameters.

TABLE 1: Available bulb sizes.

ELECTROSTATIC DEFLECTION:

10" Round	Length of tube approximately 20"
12" Round	Length of tube approximately 24"
16" Round	Length of tube approximately 28"
19" Round	Length of tube approximately 32"
8" Rect.*	. . . .
12" Rect.*	. . . .
14" Rect.*	. . . .
17" Rect.*	. . . .

*These types can be made available by using the same face plate panel as used on the magnetic deflection bulb.

TABLE 2: Available bulb sizes.

MAGNETIC DEFLECTION:

8" Rect.	90° Deflection	19" Rect.	92° Deflection
8" Rect.	110° Deflection	19" Rect.	114° Deflection
11" Rect.	110° Deflection	21" Rect.	72° Deflection
14" Rect.	90° Deflection	21" Rect.	90° Deflection
16" Round	60° Deflection	21" Rect.	110° Deflection
16" Rect.	114° Deflection	23" Rect.	92° Deflection
17" Rect.	70° Deflection	23" Rect.	114° Deflection
17" Rect.	90° Deflection	24" Rect.	110° Deflection
17" Rect.	114° Deflection	27" Rect.	90° Deflection

DEFLECTION SENSITIVITY

To properly consider deflection sensitivity with respect to tube design, it is essential to examine the formula for deflection in both electrostatic and magnetic fields. Correlating with Figure 2, the formulaes are:

Electrostatic Deflection

$$yd = \frac{L\ b\ Vd}{2\ a\ Vo}$$

Where: yd = deflection from center
L = the throw distance from deflection plate to screen
b = deflection plate length
Vd = deflecting potential
a = deflection plate spacing
Vo = beam potential

Magnetic Deflection

$$yd = K \frac{L\ b\ B}{\sqrt{Vo}}$$

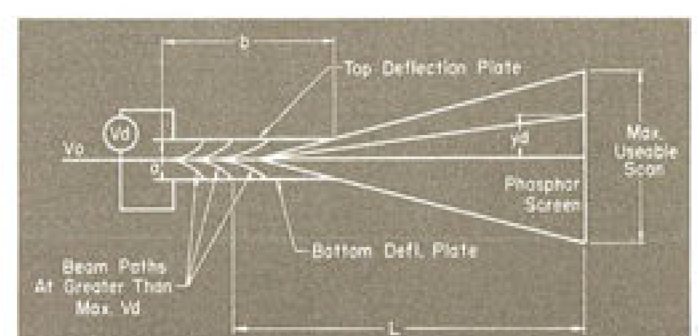

FIGURE 2: Electrostatic deflection.

Where: yd = deflection distance from center
K = constant
L = throw distance from yoke to phosphor
b = length of deflecting field
B = magnetic flux in glass
Vo = operating voltage of the beam

The formula for deflection in an electrostatic field reveals that if the tube is designed solely for sensitivity, length of both the tube (L) and its plates (b) must be long; spacing between the plates (a) small, and operating voltage (Vo) low. As the spacing between the plates (a) is reduced however, the usable scan is also reduced due to interception of the electron beam by the deflection plate. The designer must also consider that low beam potential (Vo) will result in reduced brightness and resolution. To conclude, in order to achieve high sensitivity employing electrostatic deflection, the tube selected would normally be a long, small diameter, low anode voltage type.

As shown in the applicable formula, deflection in a magnetic field is inversely proportional to the square root of the operating voltage (Vo) instead of directly proportional in an electrostatic field. If the designer decides to increase Vo for better brightness and higher resolution, deflection sensitivity is of course reduced.

In general, magnetic deflection tubes can operate at higher Vo and provide better brightness and resolution. However, of late, several electrostatic deflection tube designs have incorporated high voltages in the order of $E_{a2} = 10$ kv and $E_{a3} = 18$ kv and are approaching the resolution capabilities of the large screen magnetic deflection types.

If alphanumeric information is the prominent display feature of a system it is possible to have both electrostatic and magnetic deflection in one tube. This is done by placing two sets of deflection plates on top of the standard magnetic deflection gun. The electrostatic deflection permits the high speed character writing while the standard magnetic yoke positions the character. Character writing could also be accomplished using a separate low inductance writing yoke. In this case however, the tube is lengthened approximately 1½ inches to allow room for the writing yoke behind the primary positioning yoke.

A further hybriding of deflection and focusing can be accomplished by mounting the electrostatic deflection plates within the focusing element of a bipotential focusing gun. This arrangement provides higher resolution and allows the deflection plates to operate at the focusing voltage value. Since the Vo value for this type of deflection system is the focus voltage which may be 20% of the anode voltage, considerable improvement in deflection sensitivity for the electrostatic deflection plates can be achieved. The limitation of this design is the scan produced by the deflection plates which must be rather limited in order to retain sharp focus of the full character. The advantages of a hybrid tube of this sort are better deflection sensitivity and improved resolution. Character height however, will be limited to approximately ¼ inch on the face of the tube.

DEFLECTION DEFOCUSING

As a focused beam is deflected, either electrostatically or magnetically, the electron is acted upon as described in the formulaes presented in the discussion of deflection sensitivity. However, due to nonuniform fields at the entrance and exit of the deflection system, the electron beam experiences a premature crossover before arrival at the screen.

An electron beam has a finite width as it passes through the deflection plates. As shown in Figure 3, one plate is positive with respect to the other. Therefore, electrons in the border of the beam see different voltage gradient depending on its position across the beam. An electron at "a" is at a lower field than "b" and will therefore experience a greater deflection. This difference in deflection causes the beam to focus before it reaches the phosphor.

This premature crossover of the focused electron beam appears to be caused by too strong a focus lens. To counteract this, the focusing field must be weakened. For magnetic focus, the focus coil current would have to be reduced. In the electrostatic focus lens, the voltage gradient of the lens would have to be lowered. This is accomplished by increasing focus voltage; i.e., the difference between the anode and focus voltage is decreased.

All large screen deflection display tubes require dynamic correction of both focus and astigmatism electrodes to produce their full capability of resolution. In magnetic focus and deflection tube types, deflection defocusing or spot growth ratios are minimized by maintaining low deflection angles.

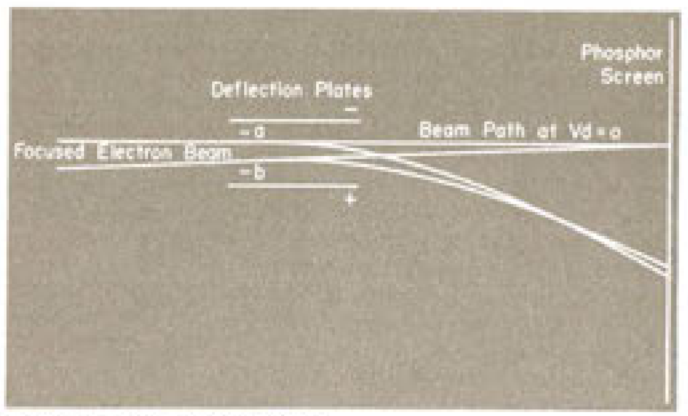

FIGURE 3: Deflection defocusing.

BRIGHTNESS

Screen brightness is basically determined by the power of the beam striking the phosphor. Better results are obtained from a low current, high voltage beam than from a high current, low voltage beam as the space charge effects in a high current beam tend to cause intolerable beam dispersion.

In general, brightness can be equated to beam potential (Vo). With magnetic deflection, the only factor to consider is that increased Vo requires greater deflection power. The desired higher Vo in electrostatic deflected tubes has led to the development of the post deflection accelerator. In this case, voltage on the phosphor (E_{a3}) is maintained at a high level while the gun and deflection plate systems are maintained at a low voltage E_{a2}. The compromise taken here is that the deflection plates can function in the low voltage field for maximum sensitivity, while the phosphor is maintained at a high voltage field for brightness. A one-step post deflection accelerator of this type is limited to a practical ratio value of 2:1. Instead of making the transition from the gun voltage to screen voltage in one discrete step, it is possible to lengthen this area out and put several discrete steps of slowly increasing voltages or a multiple band post accelerator. Such a tube can have a ratio of E_{a3} to E_{a2} value of approximately 4:1. A further peaking of this design is in the spiral accelerator tube type which has approached values as high as 8:1 (Figures 4, 5, and 6).

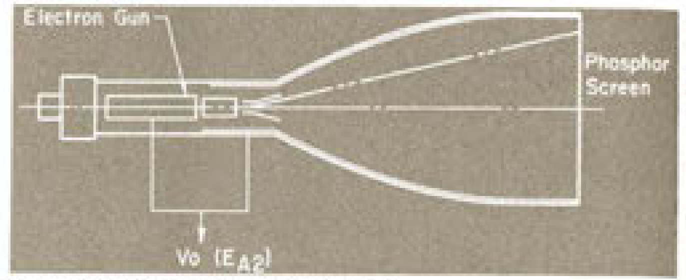

FIGURE 4: Monoaccelerator beam path.

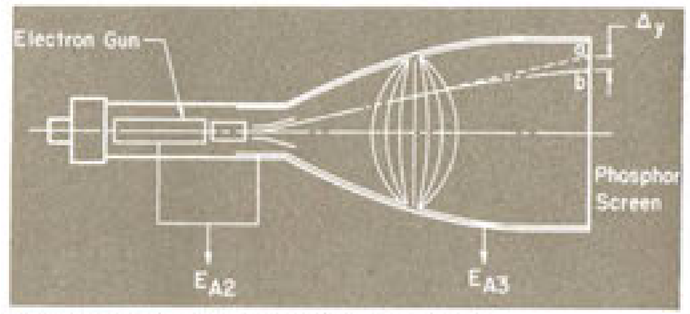

FIGURE 5: Single step post deflection beam path.

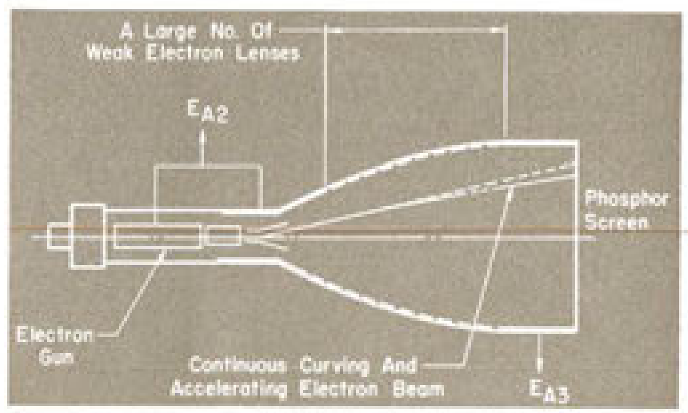

FIGURE 6: Spiral accelerator beam path.

PATTERN DISTORTION

Pattern distortion is an inherent characteristic of any electrostatic deflected cathode ray tube. Every electron lens that a beam has to pass through will contribute to distortion. This is also true of the E_{a3}/E_{a2} lens used in any form of post deflection accelerator even though the lens permits greater sensitivities and higher screen brightness.

It is shown in Figure 5 of the standard post deflection accelerator, that the addition of the E_{a3}/E_{a2} lens has caused the spot to move from point 2 to point b (Δy). As the amount of deflection (yd) increases so will Δy which means that if a square raster is to be displayed on the tube face, a greater value of Δy will be experienced in the corners of the square than on its axis.

To specify the maximum pattern distortion allowed, an inscribed square test is made. Two inscribed squares are used. The space between them delineates the maximum curving which the beam trace can exhibit. For any given pattern distortion level, higher ratio values of E_{a3}/E_{a2} can be obtained by means of the spiral post deflection acceleration design.

RESOLUTION

Resolution is that characteristic which defines the number of individual bits of information that can be displayed in a unit length on the tube face. Major contributing factors to resolution are the relationship of the image and object distances of the focus lens, anode voltage and gun design.

One of the easiest ways to visualize the effects of resolution is to consider the physical optics formulae:

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

$$M = \frac{q}{p}$$

Where: f = focal length
p = object distance
q = image distance
M = magnification

Figure 7 shows two tubes of equal length with one having a greater deflection angle. We would expect tube 1 to have the higher resolution and, due to the increased deflection angle, to have greater deflection focusing. In the case of magnetic focusing, it is possible to see that the magnetic focus coil is not an integral part of the electron gun and therefore, by placing the gun in a neck considerably further back from the face of the tube, the characteristics of magnification can be peaked for low magnification. By keeping the anode voltage above 10 kv and the ratio of $\frac{p}{q}$ to produce small magnification, resolutions of better than 1 mil can be achieved.

With electrostatic focusing, the focusing lens is an integral part of the electron gun and is mounted therefore on the same structure as the electron source. Since the electron gun contains both the electron source and the focusing field, there is a practical limitation in its length. In addition, the electrostatic lens is smaller, and the beam must be smaller to avoid spot growth due to abberations. Consequently, the electrostatic focus tubes, whether they have magnetic or electrostatic deflection, have less resolution capability than the magnetic focus types. Except for laboratory curiosities, almost all electrostatic deflection tubes incorporate electrostatic focus. It can be concluded that electrostatic deflection and electrostatic focus tubes cannot compete in resolution to the magnetic deflection, magnetic focus types. Referring to the formula for electrostatic deflection, if the term "L" (throw distance from the deflection plate to the screen) is to be long then the

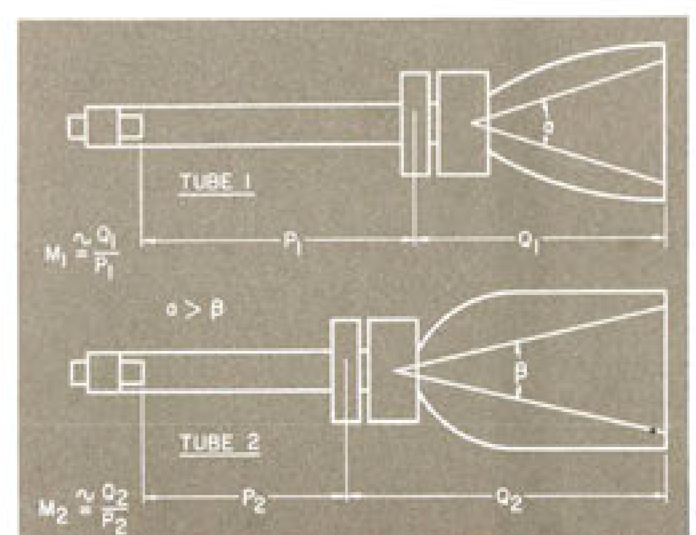

FIGURE 7: Relationship of image-object distances.

image distance automatically becomes very long, thus driving the magnification to rather high limits. Therefore, it is a limitation that high sensitivity tubes cannot be high resolution tubes also.

FOCUSING MEANS

Electron guns incorporating electrostatic focus break down into two discrete design types. The first type is often referred to as the unipotential electron gun at which the focus electrode generally operates near ground potential. The advantage of this type is the possible compact electron gun for small display types and the ease in finding available low voltage sources within the circuitry. The mechanical measurement of the tube, however, would show a rather high magnification figure. Therefore, the resolution of this type is generally limited.

The second type of electrostatic focus gun is referred to as the bipotential focus. The focus voltage of this type generally runs at approximately 20% of the anode voltage. It usually draws a percentage of the cathode current, but due to the increase in the diameter of the lens itself, it generally performs better than the unipotential focus and is usually used for higher resolution applications. If we examine the three types of focusing: magnetic, bipotential electrostatic, and unipotential electrostatic, we find that, for resolution purposes, magnetic focus is preferred. From the standpoint of spot growth with deflection, however, the magnetic focus gun is least preferred. Examination of a large screen, magnetic deflected, magnetically focus tube would show good resolution at the center, but rather poor center to edge distribution of resolution. On the other hand, a unipotential electrostatic focus, while not as sharp at the center, would appear to be more uniform in focus across the full width of the tube.

In the high resolution area, a considerable amount of interest of late has been placed in the bipotential electrostatic focus tube. Primarily, this is because a magnetic focus tube, while inherently having better resolution requires a complex setup and adjustment of the electrical axis of the focusing coil with respect to the electron beam. In the bipotential electrostatic focus tube, the focusing electrode is built into the tube and does not have to be aligned by the system engineer. However, a separate high voltage power supply is required for the focusing electrode. The power supply must have the capability of supplying sufficient current for the operation of the gun and be well regulated. Since the electron optics of the bipotential focus are an integral part of the electron gun, the electron guns are generally longer than the unipotential. The overall tube length for this type of device, however, is generally less than the magnetic focus tube.

POWER CONSIDERATIONS

A further compromise that must be considered in the case of the magnetic deflection types is neck diameter versus power and neck diameter versus resolution.

The values presented in the following table are for hypothetical magnetic deflection unipotential electrostatic focus cathode ray tubes of 90° deflection.

Neck Diameter	Gun Parts Diameter	Relative Resolution	Relative Deflection Power
1-7/16"	.520	100%	100%
1-1/8"	.395	75%	75%
.788"	.315	65%	55%

The values given in the table show that, as neck diameter decreases, the physical space left for the electron gun also decreases, and the relative resolution decreases to approximately 65%. This is because, as the electron gun parts diminish in size, the smaller diameter fields are prone to higher spherical abberation and the percentage tolerance of alignment becomes more critical. But, going to the smaller diameter neck will provide a useful gain in relative deflection power.

With regard to filament power for the electron gun, several variations in heater power combinations are available: 6.3 volts at 600 milliamperes (a standard heater for some time), 6.3 volts at 300 milliamperes and 12.6 volts at 150 milliamperes. The biggest gain for portable equipment is achieved with a recently developed low heater power assembly operating at 1.5 volts, 140 milliamperes maximum. With this new heater, when compared with the 6.3 volts, 600 milliamperes heater, a gain in heater power of approximately 16 is achieved. It will also provide the same life, emission and reliability obtained from the standard heater sizes.

PHOSPHOR SELECTION

The display tube phosphor must be selected on the basis of the receptors: the eye, film, or photo pickup device.

The human eye has a peak sensitivity near 5500 Å with good response down to blue (4500 Å) and up to red (6500 Å). Human factors may dictate selection on the basis of color alone or on historical response to TV (P4). If maximum brightness, in adverse conditions such as aircraft cockpit display, is uppermost, phosphor types P20 or P31 have proved useful.

Long persistence displays without going to storage tubes, continues to be limited to amber filtered P7 when viewed in normal ambient. However, to the eye, P12 or P19 will "hold" information longer if operated in darkness. High density displays which operate at low frame rates (15 frames per second) can make use of P12. Phosphor types P12, P19, P21, and P26 are all in the fluoride family and suffer from low efficiency and ease of phosphor burning. For medium frame rates, 30 frames per second, P28 has been useful. The published persistence figures of P28 have not been verified. P1, P2 in all its varieties and P4, P20 and P31 are all usable for general purpose displays.

For film recording, the selection of the phosphor is based on film color sensitivity and display speed. The phosphor decay must not fag the film. The phosphors used most often are variations of P11 which can be controlled to some degree in persistence from 10 to 200 µsec. to 10% of initial brightness. A vast number of films are available and considerable improvements have been achieved for high efficiency, high resolution (minimum diffusion in the phosphor) and low noise. P11 is a rugged phosphor, slow to burn, has a minimum of aging characteristics and well matched to a wide variety of film.

For photomultiplier pickup application, P16 has been widely used. It peaks at 3800 Å and decays to 10% of initial brightness in approximately 0.1µsec. It does burn readily, however, and has a marked aging characteristic.

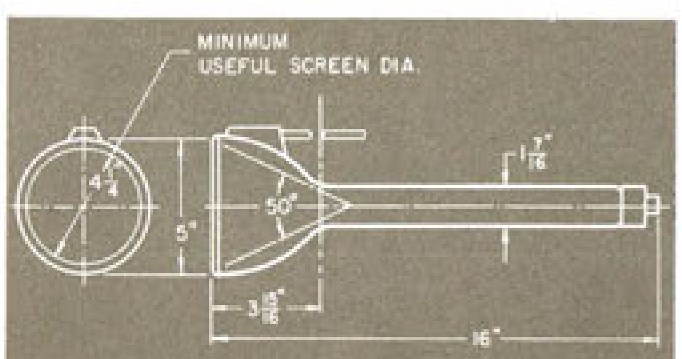

FIGURE 8: High resolution CRT.

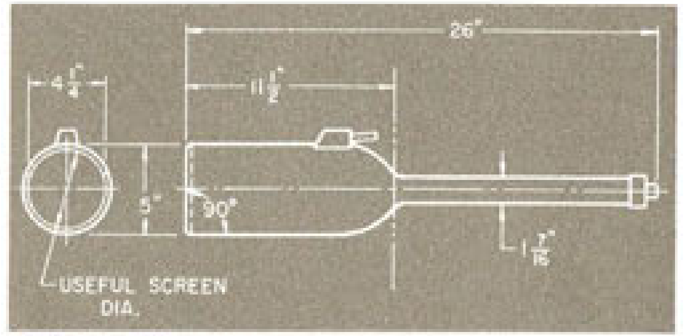

FIGURE 9: High resolution CRT with high deflection linearity.

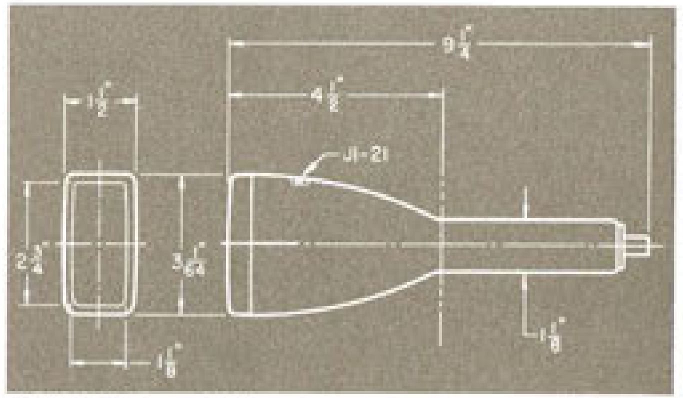

FIGURE 10: Compact CRT.

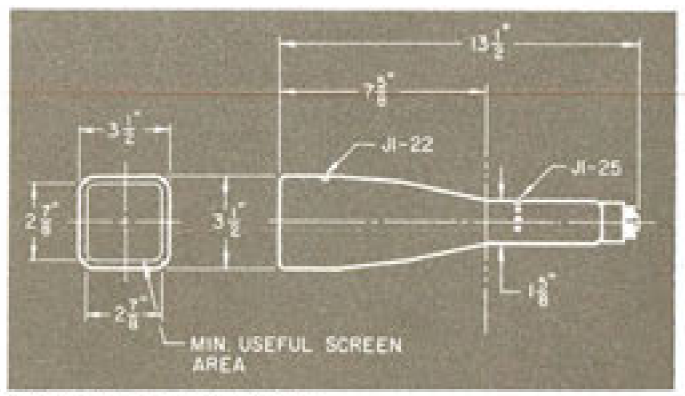

FIGURE 11: High sensitivity CRT.

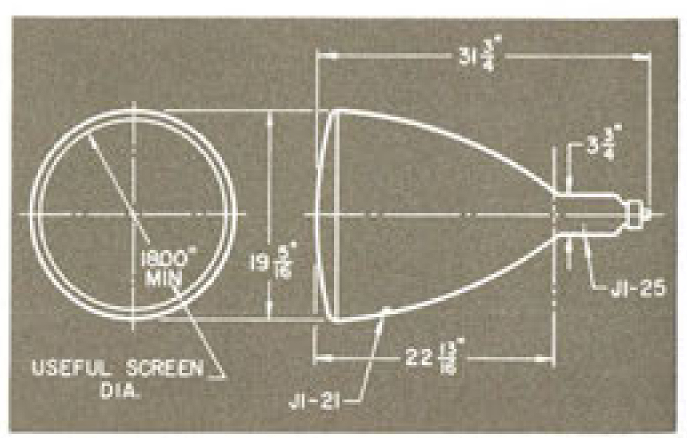

FIGURE 12: Large-screen CRT.

The curves usually shown for phosphor persistence are generally obtained from the EIA suggested technique of measurement on a pulsed spot. For visual application, this must be kept in mind since two widely differing sensors are involved.

While only a relatively few phosphors are listed, continuous effort is being made to produce more adequate types. Investigation continues for long persistence, rugged, efficient phosphors, and UV and infrared producing materials are also receiving much attention.

CONCLUSION

In this article, the designer is acquainted with the various factors that must be considered in cathode ray tube design. Each has been discussed not only independently, but in the interrelationship to other parameters which influence optimum tube design. Figures 8 through 12 are examples of typical designs presenting both desired "peaked" and necessary "compromised" parameters.

In selecting an optimum cathode ray tube for a display system, the designer must have: (1) an ideal tube in mind; (2) a knowledge of the features of the ideal tube that are most essential and those that can be compromised without significantly affecting system performance; and (3) a knowledge of how performance will be affected by changes in various tube parameters.

TYPICAL OPERATING CONDITIONS

Anode Voltage	20,000 Volts dc
Grid No. 2 Voltage	2000 Volts dc
Line Width	0.001 Inch

PEAKED:
1. Very long neck to funnel length; resolution of 0.001"

COMPROMISED:
1. Long tube length
2. High deflection angle
3. Corrected center to edge defocusing about 1:1.5

TYPICAL OPERATING CONDITIONS

Anode Voltage	20,000 Volts dc
Grid No. 2 Voltage	2000 Volts dc
Line Width	0.002 Inch

PEAKED:
1. High deflection linearity and minimum pin cushion
2. Minimum defocusing. Corrected center to edge defocusing better than 1:1.2.

COMPROMISES:
1. Deflection angle reduced to 16 degrees
2. Resolution down to 0.002"
3. Very long length

TYPICAL OPERATING CONDITIONS

Anode No. 2 Voltage	2000 Volts dc
Deflection Factors	
Deflection Plates 1-2	68 to 92 Volts dc/Inch
Deflection Plates 3-4	28 to 38 Volts dc/Inch
Line Width	0.65 mm Max.

PEAKED:
1. Very compact indicator
2. Minimum length
3. High vertical sensitivity less than 38 V/in. (by contrast, horizontal scan of 2¼" means horizontal sensitivity must go down to 92 V/in.)
4. Low heater power — for portable 'scope

COMPROMISED:
1. Only 1⅝" of vertical scan
2. High aspect ratio of face and extreme short length make it impractical to employ spiral accelerator

TYPICAL OPERATING CONDITIONS

Anode No. 3 Voltage	3000 Volts
Anode No. 2 Voltage	1000 Volts
Anode No. 1 Voltage for Focus	0 to 300 Volts
Deflection Factors	
Deflecting Plates 1-2	27 to 33 Volts dc/Inch
Deflection Plates 3-4	23 to 29 Volts dc/Inch
Line Width "A" at Ib3 = 10 µa	.45 mm Max.

PEAKED:
1. Low heater power uses 1.5 V/140 ma heater/cathode
2. High sensitivity — 30 V/in. both axes
   Spiral Accelerator — EA2 = 100 V for max. sensitivity and EA3 = 3000 V for max. light output
3. Short length for hand carried 'scope

COMPROMISES:
1. Added cost for low heater power
2. Only 2½" of useful scan
3. Line width only .45 mm

TYPICAL OPERATING CONDITIONS

Anode No. 3 (Post Accelerator) Voltage	18,000 Volts dc
Anode No. 2 Voltage	10,000 Volts dc
Grid No. 2 Voltage	500 Volts dc
Anode No. 1 Voltage for Focus	4800 to 5200 Volts dc
Deflection Factors	
Deflecting Plates 1-2	90 to 140 Volts dc/Inch
Deflecting Plates 3-4	90 to 140 Volts dc/Inch
Trace Width	
Center	0.025 Inch
Corners	0.040 Inch
Focus Correction	0 to 1000 Volts Max.
Astigmatism Correction	0 to 350 Volts Max.

PEAKED:
1. Large screen area
2. Fast random access, computer readout — 800,000"/sec. at 30 Hz.
3. High brightness of character at this writing rate
4. High resolution — trace width above is full stroke width of individual character
5. Minimum deflection defocusing

COMPROMISED:
1. Deep cabinet length
2. 18 KV required for brightness, EA3:EA2 ratio maintained low for deflection defocusing, therefore EA2 is high. Poor deflection sensitivity.
3. Requires full program correction of focus and astigmatism.

THE AUTHORS

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The display/control complex of the Manned Space Mission Control Center

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ABSTRACT

This paper describes the display/control system of the Mission Control Center at Houston and discusses the key technical decisions that had to be made in the selection, design, fabrication, and integration of the many diverse display subsystems required for support of flexible, complex missions and required to meet stringent schedule requirements.

INTRODUCTION

The Mission Control Center — Houston (MCC-H) is a large, powerful, and flexible command and control facility which directs Gemini and Apollo manned space flights. Its capacity is demonstrated by the fact that MCC-H contains 140 command consoles, most of which have two real-time high resolution CRT displays. These are supplemented by 350 larger CRT group displays, 7 large-screen projection television Eidophor displays, 5 seven-projector large-screen Xenon projection plotting displays, 10 large X-Y plotboards, 16 multi-channel chart recorders, 20,000 discrete events indicators, 6 television hard copy printers, and numerous digital readout displays of countdowns, elapsed times, Greenwich Mean Time, and system status. The flexibility can be appreciated by the fact that the same display system serves all types of Gemini and Apollo missions. The most dramatic demonstration of flexibility occurred in December, 1965. On only a few days' notice, the system was adapted to permit simultaneous control of the GT-7 mission and the GT-6 mission for space rendezvous, in addition to performing a full-scale Apollo mission simulation.

The physical size and arrangement of MCC-H is illustrated by the scale model shown in Figures 1, 2, and 3. The top of the model has been removed in Figure 1 to show the third floor of the control center. The large central room is the Gemini Control Center. It is surrounded by the Recovery Control Room, the Flight Dynamics Staff Support Room, the Vehicle Systems Staff Support Room, the Biomedical Staff Support Room, the Operations and Procedures Staff Support Room, the Network Staff Support Room, equipment rooms, service areas, weather room, and a Simulation, Checkout, and Training Control Room. The size may be appreciated by noting that the combined width of the group displays at the front of the Gemini Control Room is 60 feet, or 18.3 meters. Figure 2 shows the second floor of MCC-H. It is nearly identical to the third floor, except that the main control room controls Apollo missions; and the Recovery Control Room, network room, and weather room are not duplicated. Figure 3 shows the first floor containing the communications terminals, intercommunications central, data recording, real-time computers, and communications processing computers.

KEY DESIGN DECISIONS

There were five key design decisions made by Philco and NASA which permitted this system to have great power and flexibility:

First Key Decision

It was decided that the consoles should be truly modular. That is, any size panel which is a multiple of 1¾" high by 4¾" wide can be mounted in any position on

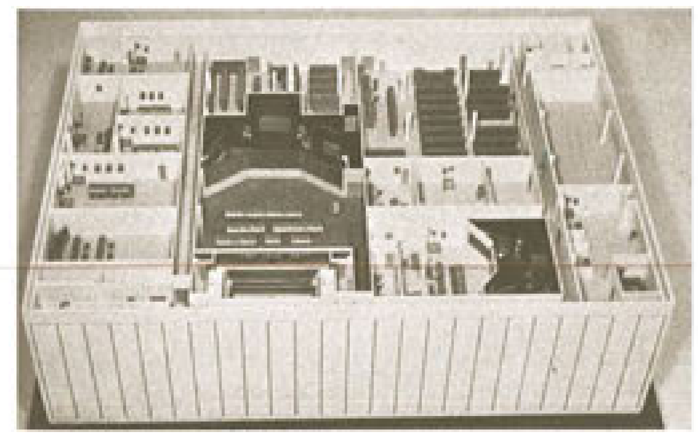

FIGURE 1: Mission Control Center — Houston, Gemini Control.

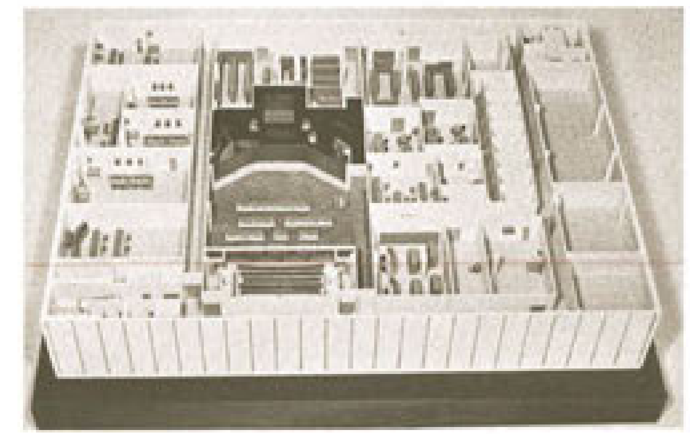

FIGURE 2: Mission Control Center — Houston, Apollo Control.

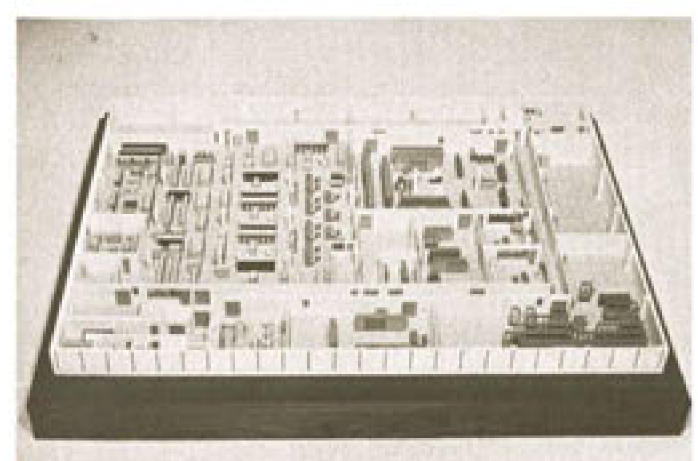

FIGURE 3: Mission Control Center — Houston, communications and computers.

FIGURE 4: Typical modular console.

FIGURE 5: Details of typical console arrangement.

the surface of the console (even over the boundary between bays). Each module connects to a flat ribbon cable long enough to reach any position on the front of the console. This permits complete console rearrangement in a matter of minutes to accommodate left-handed operators, new module types, or replacement of defective modules. It allows "sliding a new console shell" around the module in a single morning when a console is changed from a 3-bay, one-man console to a 4-bay, two-man console. It allows the operators and human engineers to rearrange controls and displays to optimize locations at essentially no cost. A typical result was that most operators selected a 3-bay, two-CRT console with the CRT's directly straddling what would normally be bay boundaries.

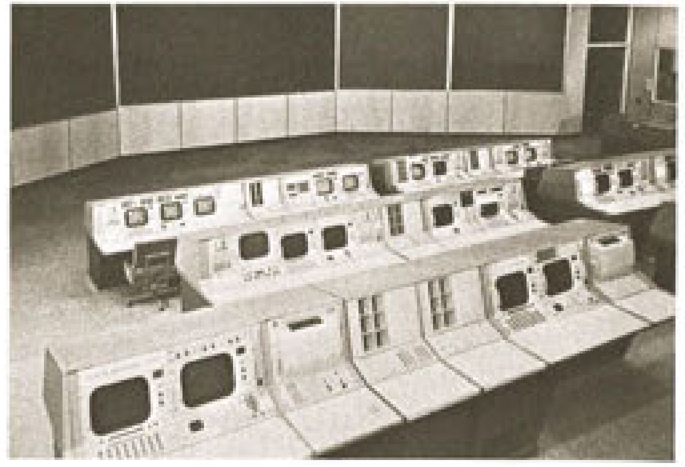

FIGURE 6: Gemini Control consoles.

Figure 4 shows the configure of a typical console. The drawer module is easily mounted at either left or right for operator convenience. Some drawer modules are on rollers to allow reference documents to be rapidly switched along with programmed console function changes and change of console operator. Figure 5 shows an actual console in position with two controllers. The variation in module sizes and locations can be seen. Modules can be any height which is an integral multiple of 1.75 inches (4.44 cm). Modules can be any width which is an integral multiple of 4.75 inches (12.06 cm). The variety of arrangements and modules can be seen from the photograph of the Gemini Control Room, Figure 6. This figure shows cathode ray tube displays, status lights, keyboards, control switches, and quieted

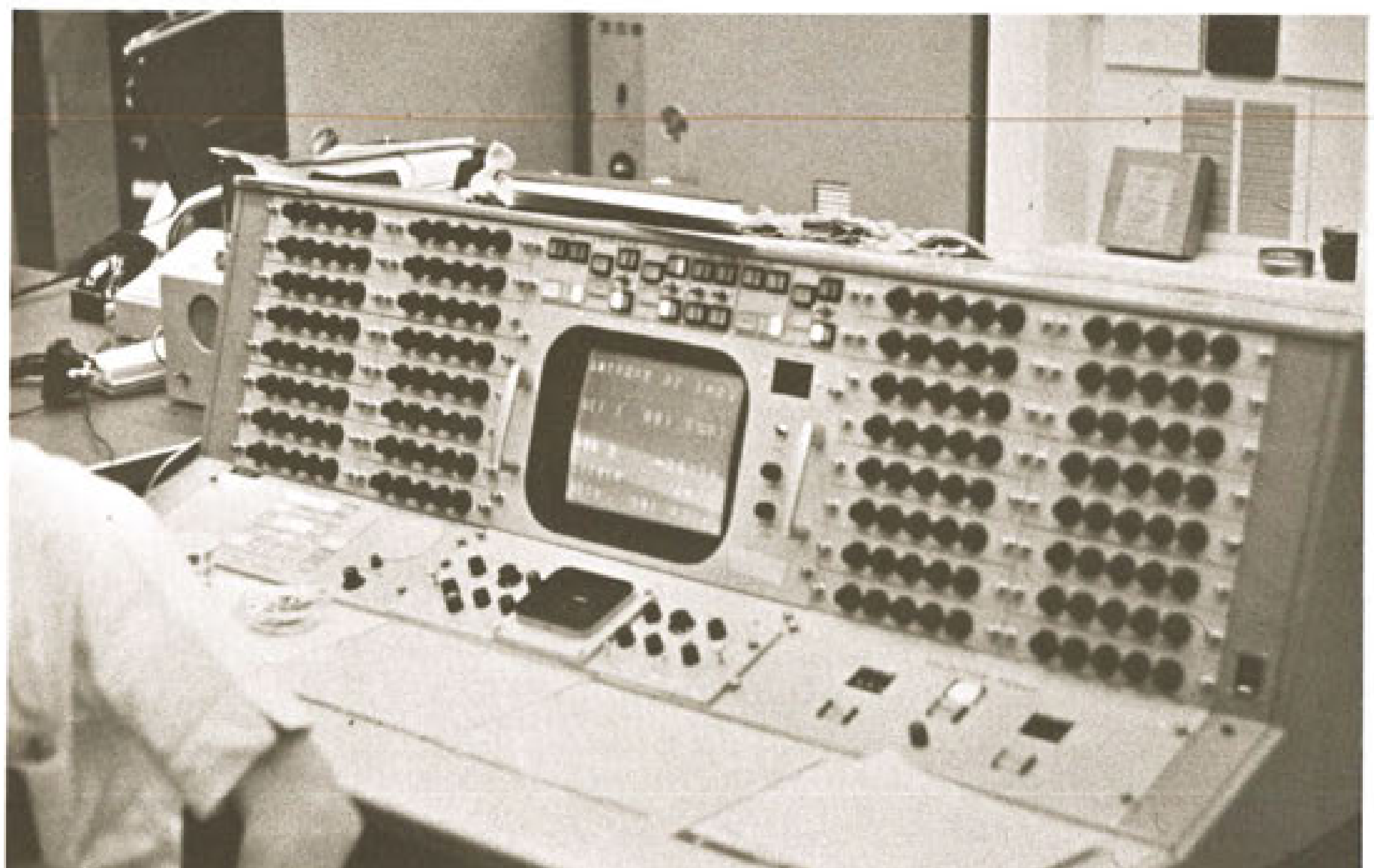

FIGURE 7: Video Engineer Console.

FIGURE 8: Vehicle systems staff support room.

printers mounted in modular consoles together with matching pneumatic tube terminals. Use of a number of small modules is illustrated by Figure 7, the Video Engineer's Console. Incorporation of multichannel chart recorders is shown in Figure 8, typical Vehicle Systems Staff Support Room consoles. Operation with a large communications status board is shown in Figure 9. Incorporation of control sticks, known in the U.S.A. as "joy sticks", to control pan-tilt and zoom of TV cameras monitoring X-Y plot-boards is shown in Figure 10, Flight Dynamics Staff Support Room Consoles.

Second Key Decision

It was decided that it should be easy to see over the consoles and that they be cool, silent, and as empty of equipment as possible. By using cool chassis design of all modules, no blowers or fans are required in consoles. Electromechanical devices have been eliminated from most consoles. Complex equipment is mounted in special equipment rooms and directly attended by trained maintenance and operation personnel. Thus, console users are rarely distracted from their tasks by repair of a display hardware problem. Typical electronic cabinets containing system electronics which tie the system together are shown in Figure 11. The particular cabinets shown contain a portion of the electronics to allow independent operation of over 20,000 status lights by the computers.

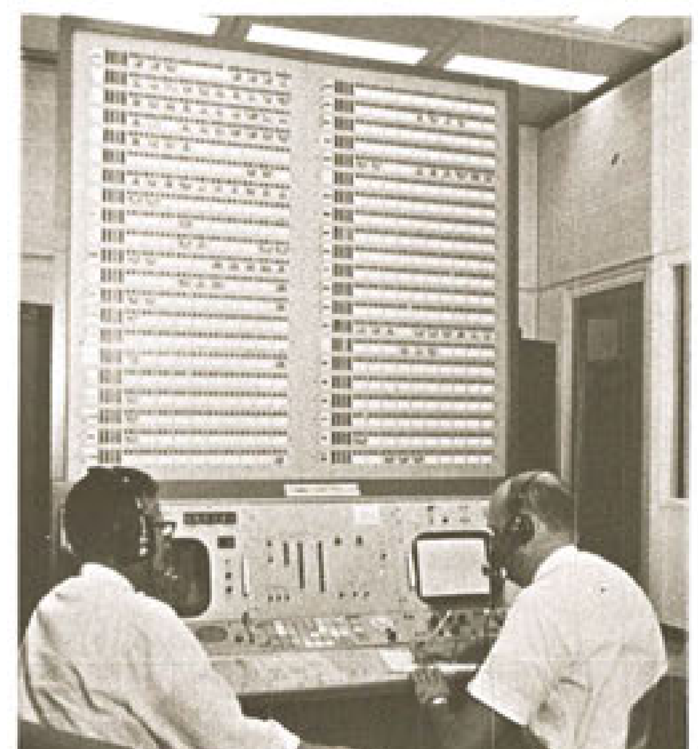

FIGURE 9: Communications status board and console.

Third Key Decision

Computer-generated television was chosen as the main source of display data. The beneficial effects of this decision are great. Actually, no one really appreciated just how valuable the benefits would be at the time the decision was made. In summary, the benefits are these:

1. The consoles are an order of magnitude cheaper and simpler than analog CRT consoles. A new console can be created merely by putting two television monitors in a sheet metal shell, together with a general-purpose control keyboard.

FIGURE 10: Flight Dynamics Staff Support Room.

2. The display distribution became extremely simple and inexpensive. Digital television display generators are selected on an "as available" basis by the computer. The computer also selects the proper crosspoint of a large video switch matrix to which all TV sources and all TV displays are connected. Thus, failure of any TV generator, monitor, or crosspoint has only a momentary effect until a spare unit is switched in. The entire display connection to a TV monitor can

FIGURE 11: Digital display driver cabinets.

be a single, small 75-ohm coaxial line. This flexible, quarter-inch-diameter line can be 1,000 feet long. It can mix with other cables in any manner without producing crosstalk problems.

3. Since TV monitors are so inexpensive, displays can be duplicated and continuously monitored for quality in special maintenance areas. This allows most display hardware malfunctions to be anticipated. They can then be corrected without console users even knowing that a potential problem existed.
4. Since the console and group displays can also directly use inputs from TV cameras and flying spot scanners, a number of powerful, yet inexpensive, display inputs became possible. Those implemented included zoom-lens TV cameras viewing: books, slides, papers, chart recorders, countdown clocks, plotting displays, and other console users. It should be of interest to note that TV cameras allow direct display on console CRT's of all manual backup displays.
5. The choice of television CRT's allows providing each

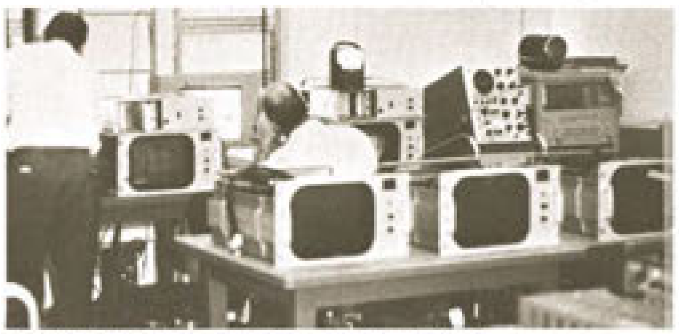

FIGURE 12: Precision television monitor checkout.

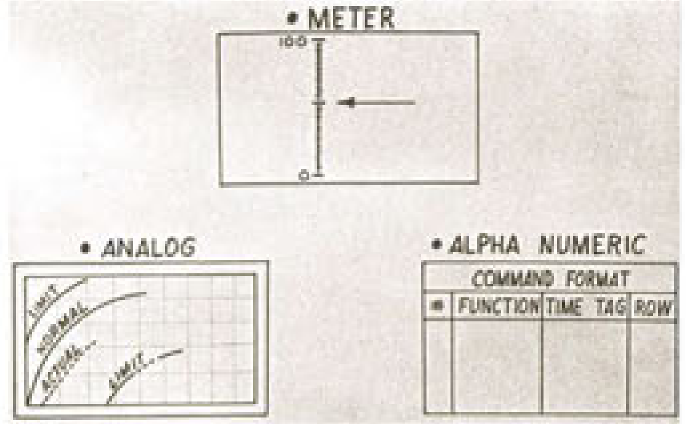

FIGURE 13: Types of computer-generated TV displays.

controller with a low-cost video polarity control switch to allow viewing black-on-white for high data content displays or white-on-black for low data content displays. The presence of a large number of white symbols on a black background dazzles and confuses most controllers. By choosing black on white, much more data can be simultaneously viewed. Conversely, if only a few symbols and vectors are displayed simultaneously, white on black is often preferred.

Figure 12 shows the precision 945 line television monitors with polarity reversal switches undergoing initial checkout in the MCC-H television maintenance area.

Fourth Key Decision

The displays are all designed so that the computer does

FIGURE 14: Three types of group display in use.

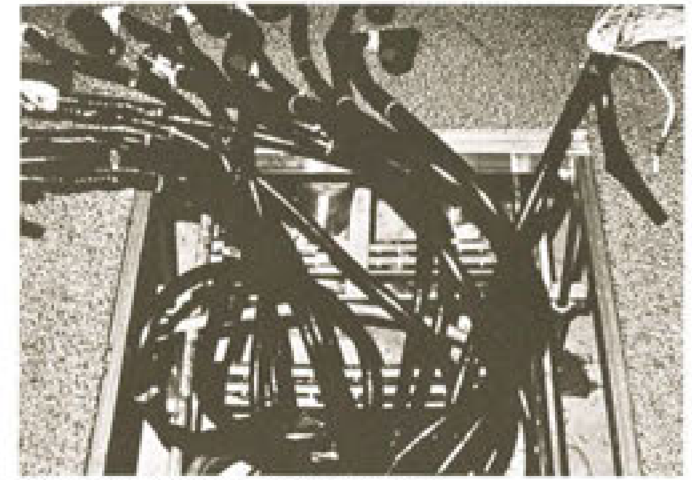

FIGURE 15: Control Room cable terminations.

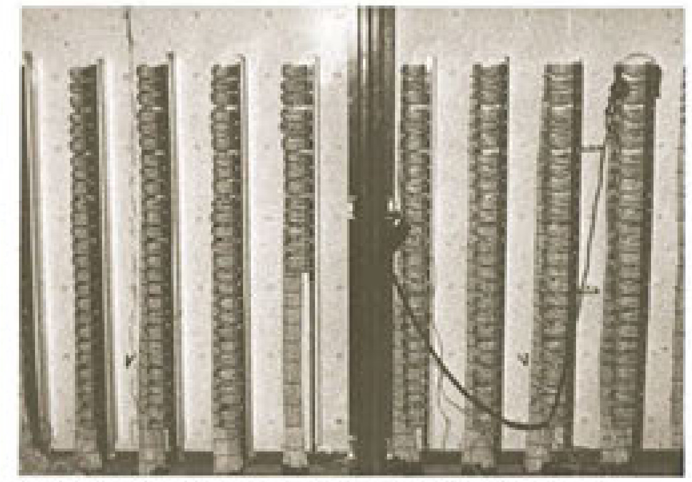

FIGURE 16: Cable termination cabinets; terminations complete.

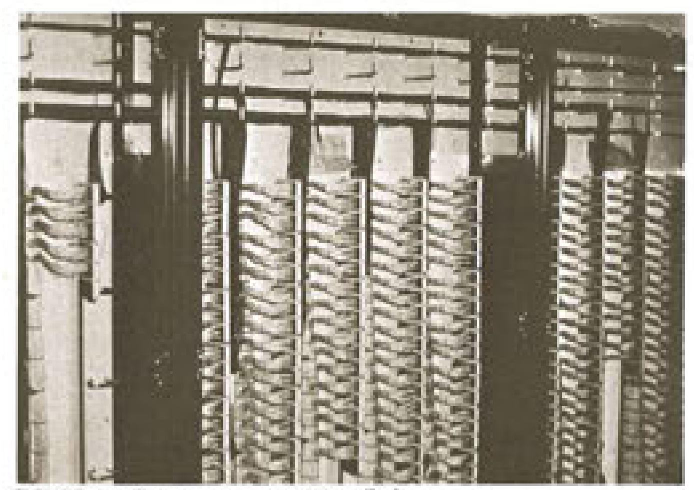

FIGURE 17: First cross-connects installed.

not have to generate display background data such as situation display maps, coordinate axes for graphs, columns and headings for tables, and scales for synthetic meter displays. Symbol and vector generation is implemented outside the computer. Thus, the computer has only to handle concisely-coded real-time dynamic data and single code words for background selection. The dynamic computer-generated data are automatically registered to the selected pre-stored background data by all displays. These include both television displays and analog plotting displays.

Figure 13 illustrates some typical types of display formats used. By these techniques, the display system relieves the computer of from 50% to 90% of the burden of display generation. Multiple meter displays can be seen on one projection television group display at the left in Figure 14. The colored projection plotting group displays are shown at the center and right undergoing functional tests. As can be noted from this figure, careful design of throw distances, screen positions, audience configuration, projector brightness, and screen material eliminates the "hot spots" often seen in rear projection displays. Yet, the contrast is excellent even with 30 foot candles of ambient light on all consoles.

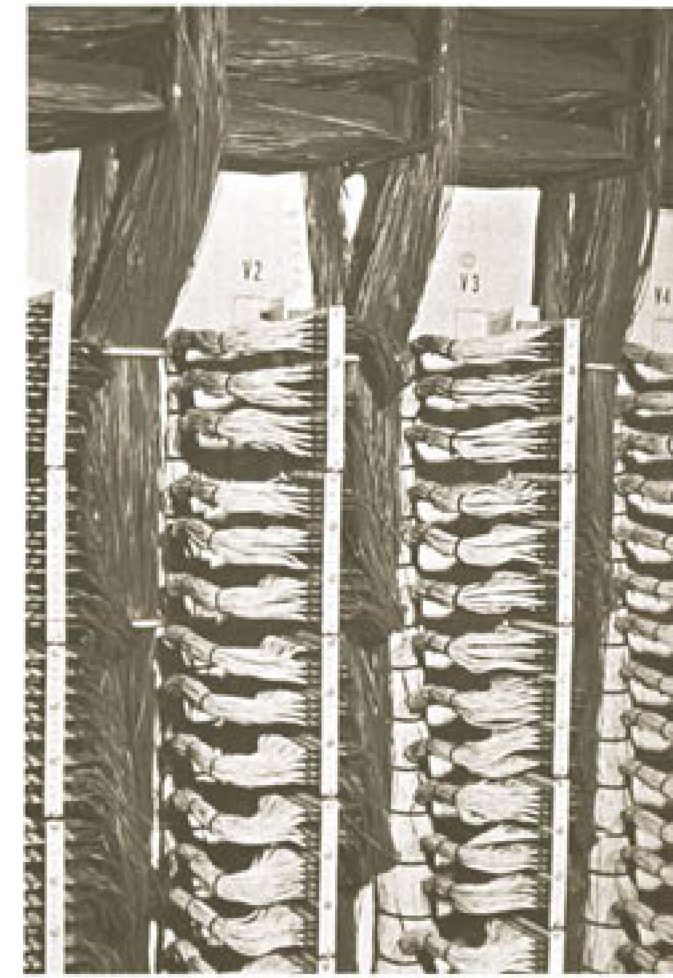

FIGURE 18: Cross-connects completed.

FIGURE 19: Making a change.

FIGURE 20: Gemini Control consoles in use.

Fifth Key Decision

It was decided that all digital data cables among system equipment cabinets and consoles should be identical and contain no "Y" branches. The five or six cables from each major item of equipment are brought to a wide, shallow central termination cabinet and terminated. All interconnections were made here using separate cross-connect wires terminated in taper pins. Very extensive system reconfigurations have been made in only a few hours or days merely by moving these easily accessible cross-connects. A big time advantage was realized because the entire cable plant was installed and terminated before the various equipment designs were final. When each piece of separately built hardware arrived at MCC-H, the set of standard cables with standard connectors was installed and waiting. A rapid matching of the final wire lists accompanying each "checked out" equipment provided the cross-connect list. As a result of this, plus good specifications, most interfaces exchanged data successfully the first day after installation. Subsequent system reconfigurations have similarly resulted in negligible cable problems, since cables never have to be reworked.

Figure 15 shows a set of standard cables for one console awaiting the installation in late 1963 of that console in the Gemini Control Room. Figure 16 shows the other end of the cables terminated in multi-hole taper pin blocks. Figure 17 shows the first group of cross connects (red wires) connecting display and control interface equipment to the consoles and to the computers. Figure 18 shows the interconnection completed. In Figure 19, a console reconfiguration is made by changing cross-connections. In normal operation, these cables are concealed by closed doors.

CONCLUSION

These five key decisions by Philco and NASA allowed this largest of all command and control centers to be in operation controlling a complex mission only 18 months after contract award. (Figure 20 shows consoles in use.) This control center will be able to be economically and rapidly reconfigured to meet rapidly changing Gemini and Apollo control requirements for years to come.

THE AUTHOR

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Using a standard television monitor as an alpha-numeric display

by STAN GRAHAM
Industrial Applications
Fairchild Semiconductor
Mountain View, California

SUMMARY

The system described was not built for manufacturing purposes, but only as a study to demonstrate the feasibility of using various families of integrated circuits in a television-type display system, and to gain some insight into the limitations of this type of system. With the advent of large scale arrays this type of system would be even more attractive for a low cost alpha-numeric display.

INTRODUCTION

The standard television monitor or domestic set, when used as an alpha-numeric display medium, has many technical and economic advantages over a cathode ray tube vector generator and charactron type units. The continuing low cost and availability of industrial television monitors permits the installation and expansion of displays at low costs. The deflection circuitry is already built into the monitor, requiring the display-system manufacturer to build only a digital system to produce the video and control signals needed. In addition to being inexpensive, this type of display system also requires a minimum of skilled maintenance. Trouble shooting in the control section is limited to "remove and replace" type maintenance, and at the receiver, to the normal adjustments of a home television set.

The domestic television receiver has not been fully utilized as an alpha-numeric display medium because of the requirement of a high-speed memory for format storage.

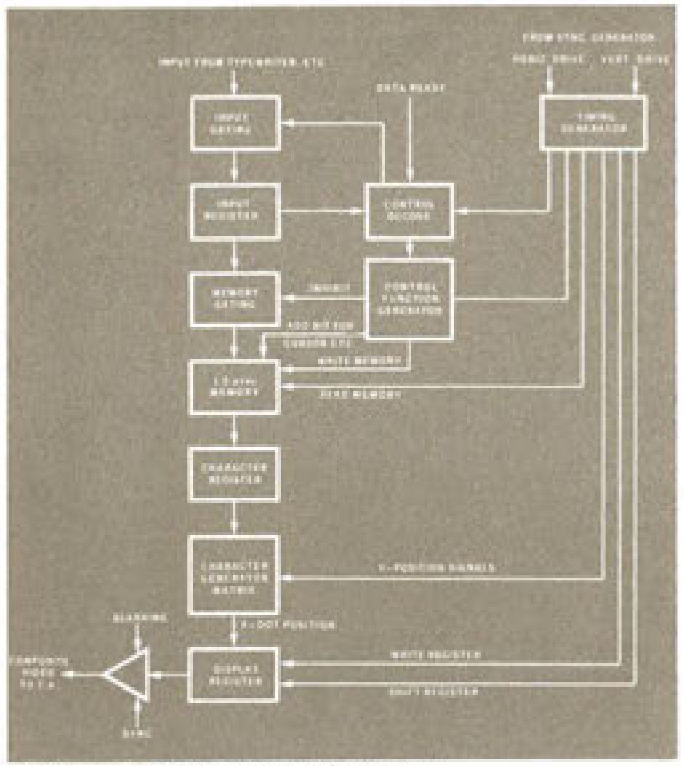

FIGURE 1: Block Diagram of Display System

Until recently, core memories of the necessary cycle time were quite expensive. Recently, however, memories of 1.5 microsec cycle time and better have dropped to approximately 10 cents a bit, and it is now possible to implement a very versatile display system, using core memories having random updating of multiple channels displayed on television monitors. (A block diagram of a typical system is shown in Figure 1.)

Display Characteristics

The displayed characters are in the form of a dot matrix. The actual matrix is decided upon by the display manufacturer, the most usual being a 5 x 7 (i.e. 5 dots horizontally by 7 dots vertically), although 9 x 9 and 9 x 11 are also used. Spacing between characters is usually of three dot duration giving, for 32 characters, a display time per character of 1.56 microsecs. This would display 32 characters in approximately 50 microsecs of the available 63.5 microsecs of the horizontal scan and would avoid distortion due to overscanning of the monitor. The system clock rate for a 9 x 9 or 9 x 11, both with three dot spacing, would be 8 mHz, and for a 5 x 7 with three dot spacing, 5.1 mHz. This is quite within the operating range of economical integrated circuitry, any of the families being suitable in the industrial package. The system clock has to be synchronized with the horizontal drive pulses of the television monitor. This is to ensure a "jitter" free display due to short term variations in the master oscillator, there being no need to incorporate a crystal controlled oscillator.

Most of the system does not have to operate at the clock frequency. This frequency only appears at the front end of the timing counters and at the output of the system. The remainder of the system works at a much slower rate (e.g. character rate for memory address signals is approximately 666K Hz). Two counters are required — one counting character position horizontally at 666K Hz and one counting vertical line position at 15.750K Hz. This latter counter is reset at the beginning of each frame by vertical drive from the television synchronization.

The method used to generate the video is as follows: "Y" signals, i.e. vertical timing signals corresponding to the particular display line, are generated. For a 9 x 9 dot matrix these would be "Y_0" through "Y_8'. These "Y" signals are "anded" with the code of the next character to be displayed. These functions are placed into a parallel to serial 10 bit shift register and, at display time, clocked out at 8 mHz. On completion of the character line display period, the next "X" dot decode, which in the display period has been read from memory and decoded, is read into the register. The time available to read memory, decode and place into the register is approximately 1.56 microsec. A 1.5 microsec cycle time memory has an access time in the order of 800 to 1000 nanoseconds, leaving 560 to 760 nanoseconds for decoding and setting the shift register. These speeds are well within the capabilities of TTL and DTμL. The system fabricated by Fairchild Industrial Applications used DTμL throughout and no problems were encountered due to propagation delay, etc.

Rounding of Characters

If the display screen is larger than 19", the actual dots forming the character can be seen and, although the characters are very readable, they may not be as aesthetically pleasing as the user requires. It may then be necessary to "round" or "smooth" the characters. This can be accomplished by making use of the interlacing fields of the standard television frame, at the cost of extra decoding circuitry. It now becomes necessary to detect and separate field "A" from field "B" and delay the dots on "B" relative to "A" (Figure 2). This is not quite as difficult as it first appears. The "rounding" of characters could be offered as an option to a standard system. (Example Figure 3) One method of producing delayed dots is to use a two-phase clock to drive the output register and select the phase according to which field the television scan is in. This makes a 5 x 7 dot matrix effectively 9 x 14 and a much more pleasing character shape can be generated. (Characters on a 9 x 9 matrix are demonstrated in Figure 4).

Register Output

The output of the register only requires mixing with synchronization and blanking signals, all produced by a standard television synchronization generator, to feed directly to the video amplifiers of the television monitor, since the output of the register is already in the form of black and white video — either black on white background or white

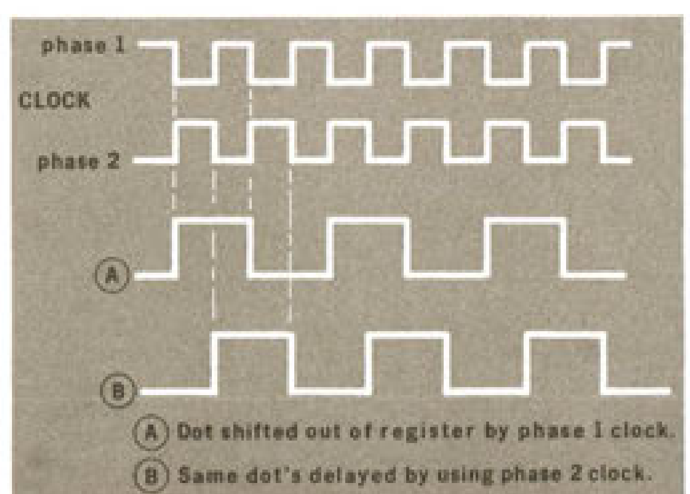

FIGURE 2: A. Dot Shifted out of Register by Phase 1 clock
B. Same dots delayed by using Phase 2 clock

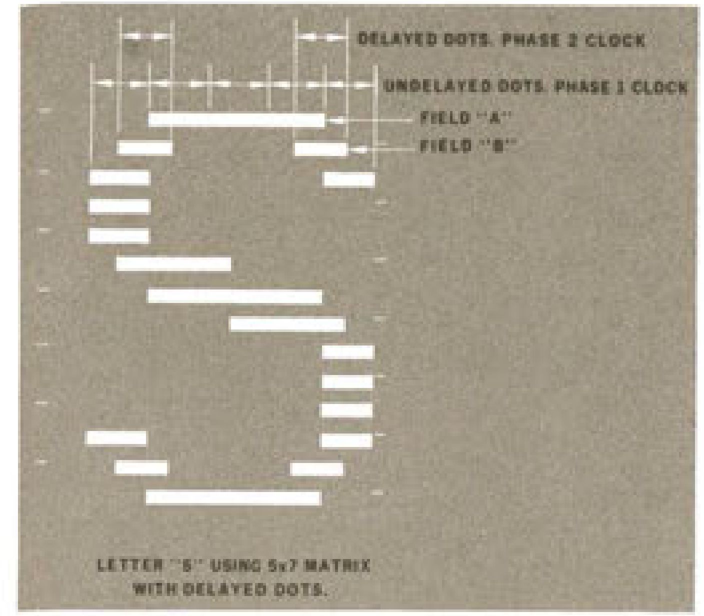

FIGURE 3: Rounding of Characters

on black background, depending upon from which side of the register the signal is taken. Grey scale can be added as an optional feature. By gating the output through various gates whose outputs are divided down, color can be accommodated in a similar fashion. If it is required to transmit the video over a greater distance than is possible with digital information, or give the monitor the capability of displaying several channels using only one cable, it is only necessary to modulate the signal in the same manner as the output of a television camera, no camera being used in the process, as is the case with a normal cathode ray tube type display. The information can also be passed, over shielded cable, as direct video where an existing closed circuit system exists, say, in an air-terminal.

Input of data to the system can be adapted to any rate within the confines of the memory cycle-time, i.e., typewriter, tape-reader, teletype or computer. This could be organized on a priority interrupt basis where several inputs are required. The interrupt would show as a blink or flicker on the display, unless it was arranged to occur only during the blank periods. Readout of memory for hard copy, or transmission via, say, a teletype line, could be accomplished by blanking the screen during transmission and re-enabling on completion, thus indicating to the operator that transmission was complete.

FIGURE 4: Characters on a 9 x 9 matrix

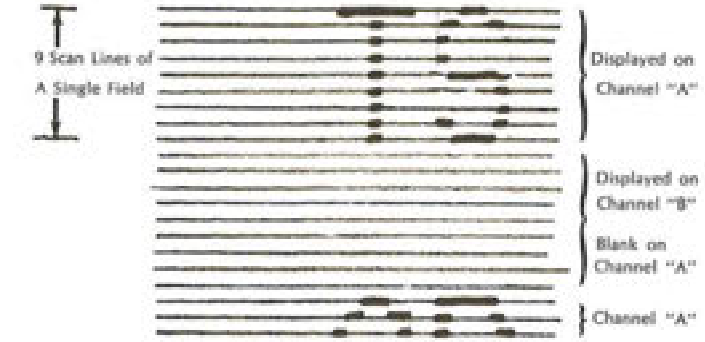

FIGURE 5: Method of displaying two channels simultaneously

CONCLUSION

The size of memory and number of generators is a function of system and channel size. For 16 lines of 32 characters, a standard 512 x 8 memory is required. The two extra bits could be used for parity check and/or underline, flashing or cursor. Two channels, of course, would require a 1024 x 8 bit memory, although 16 lines of 9 x 9 matrix characters could not be displayed. The method of displaying two channels simultaneously is shown in Figure 5. Channel A is interleaved with channel B, the spacing between display lines of a channel being the same as the character height — if the characters are 9 lines high, 9 lines are left between characters in the vertical direction. These 9 blank lines are used to display the information on the alternate channel. Four channels can be accommodated by the use of a 1024 x 16 bit memory — reading two channels in parallel and so on, up to maybe eight (1024 x 32) individual channels. Writing into the system now becomes more complex, as we have to be able to address a particular byte of memory. This could be accomplished by reading all 32 bits from memory, changing eight determined by the channel address and returning them to memory — thus making the effective system write time twice the memory cycle time, i.e. 3 microsecs.

It has been shown that using a television type display does not necessarily place any restrictions on the system's performance or capability. It is very attractive from a design point of view, due to the use of integrated circuits, and also from manufacturing cost point of view.

THE AUTHOR

STAN GRAHAM has been with Fairchild Semiconductor since September, 1966. He was educated in the Royal (English) Navy and holds an EE Degree from Manchester College of Science and Technology. He worked on computer digital design for Farranti in England before going on to R.C.A. (England) where he worked on automatic checkout systems. He moved to R.C.A. Montreal where he was project engineer for digital display systems. He is a member of Fairchild's Industrial Applications Department.

A flexible and versatile display for command and control: the BR-90

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—Ed.

ABSTRACT

The Bunker-Ramo Corporation's BR-90 (AN/FYQ-37) Visual Analysis Console was developed in conjunction with automatic information handling systems to provide rapid data display and operator communications with high-speed digital computers. System operators can query a computer by simple keyboard operations to selectively obtain information; this information when retrieved and transmitted to the console, is immediately displayed in textual or graphic form. In addition, the system operator can create his own displays off-line from the computer and subsequently up-date the computer information files or store the data for later use.

FIGURE 1: Model 90 (AN/FYQ-37) Console

INTRODUCTION

The BR-90 displays information on a cathode ray tube screen; all the necessary controls for the manipulation of this information are included as part of the display's control panel. The unit is complete as shown in figure 1; no additional equipment is required for operation.

In addition to the capabilities associated with conventional displays, the console has two unique features:

- photographic information stored on film slides is projected onto the phosphor surface of the CRT screen for simultaneous presentation with the electronically generated display. This is accomplished by optical projection through a clear glass port located in the rear of the CRT.
- the control of console functions resides in a program stored in the console's magnetic core memory. Console functions can be changed and added to by modifying this program.

The BR-90 is particularly suited for command and control systems where a number of requirements must be met including:

- digital computer information must be displayed in textual and graphic form.
- the console user must have the capability to operate on the displayed data and generate new displays.
- real-time communication with an associated computer system is desired.

CAPABILITIES

The console's capability to overlay electronic data on film slide backgrounds greatly improves the information content as compared to that provided by conventional CRT graphic displays. The film backgrounds, which can contain almost any amount of information desired, provide reference information that would otherwise be omitted or drawn electronically as gross outlines. Electronic generation of background data is not always practical because digital storage must be available for that purpose, and, since there is always a limit on the total amount of data that can be displayed on a CRT, a reduction in the quantity of dynamic information will be experienced.

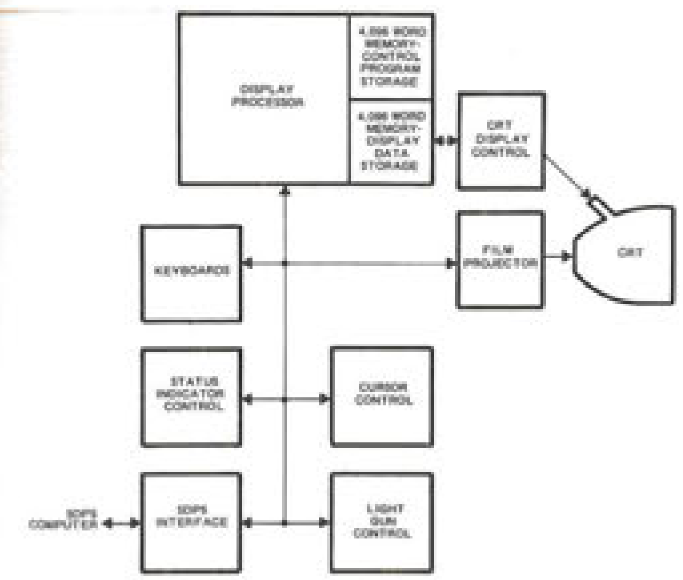


FIGURE 2: Simplified Functional Block Diagram of Console

The logical organization of the console is illustrated in the simplified block diagram of figure 2. The display processor contains an 8192 word, 12 bits per word, magnetic core memory. The memory is functionally divided into two portions; one half is dedicated to storage of the console program; the other to storage of data for display on the CRT.

Display data is read from memory in synchronism with the input power line frequency. If, for example, 60 cycle per second power is used, the display processor is interrupted every 1/60 of a second by a display interrupt, and one frame of display data (i.e., one pass through memory) is read to the CRT display control circuits. Between display frames, the processor services the remaining console devices represented by the blocks shown on the common data bus.

DISPLAYS

The type of information that can be displayed by the console is illustrated in figure 3. Displays can be generated at the console entirely off-line or they may be received as display data from the system computer. Any display can in turn be transmitted to the system computer including background slide identification.

The background map is a film slide which is projected onto the inside surface of the CRT through an optical port located at the rear of the tube on the central axis. The electronic data consists of alphanumerics and special symbols, vectors, circles and plotting points. The useable display area on the tube is 13.2 inches high by 13.2 inches wide. Because the image on the film slide is rectangular,

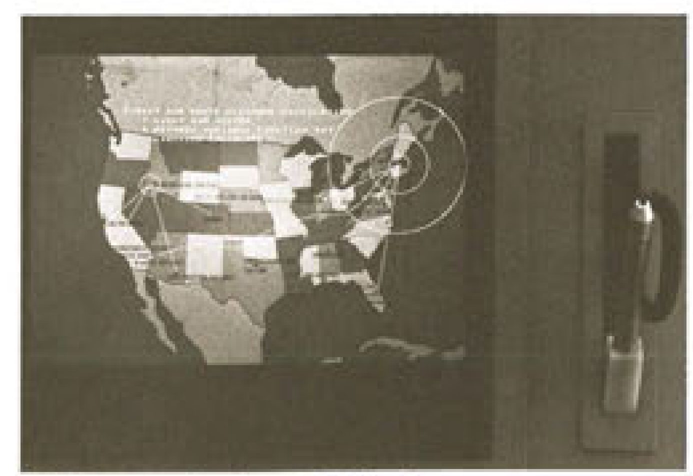


FIGURE 3: Type of Information Displayed

the complete height of the useable area is not filled by the projected image. However, electronic data can be written anywhere on the screen. The CRT uses P-4 phosphor, provides 20 foot lamberts of image brightness, and produces a blue-white color for electronic images. Visually the phosphor is white, providing a neutral color screen for the projection system.

A low-gain screen is necessary in any rear projections system to reduce what would otherwise be an uncomfortably bright area when looking directly at the display. This projector "hot-spot" has been considerably reduced on the BR-90's screen by a special process that produces a low gain projection screen without affecting the quality of the electronic display. The projection system produces a maximum brightness of 40 foot lamberts; since this is too high for normal viewing, brightness controls are provided.

A font of 63 alphanumeric symbols can be displayed in two adjustable sizes, vectors and circles and in two different stroke widths. Any element can be made to blink. Size, stroke width, and blinking are specified digitally as part of the display data stored in memory. Vector end points and circle centers are positioned at any one of 1.024 points in the horizontal (X) axis and 1.024 points in the vertical (Y) axis. The initial character of an alphanumeric or symbol group is positioned to the same resolution. Position data is specified digitally as 10 bit binary weighted numbers. The maximum amount of electronic data displayable on any CRT is a function of frame rate and deflection speed. At a frame rate of 60 cycles per second, any one of the following groups of displays would be a maximum allowable quantity on the BR-90:

(1) 2816 alphanumerics and special symbols.
(2) 115 circles.
(3) 444 connected vectors.
(4) 222 unconnected vectors.
(5) 444 plotting points or individually positioned symbols.

If these quantities are exceeded, the frame rate will automatically drop to 30 cycles per second. If 50 cycle per second input power was used, the above quantities would be increased by approximately 20 percent.

Console

Figure 4 shows the display and control surface of the console. The keyboard on the left side of the control panel is designed for communication with the system computer. Removeable overlays uniquely code the 30 keys and provide labels appropriate for each application. One hundred and twenty eight differently coded and labelled overlays can be used. With 128 overlays and 30 keys, over 3800 different digital messages can be transmitted to the external computer system. A group of twenty-five indicators on the left side of the screen panel, used to present system status information, are also labelled with changeable overlays. This overlay and the keyboard overlay can be a matched-pair, presenting labels with suitable terms for the problem being worked on. Individual lights under the overlays are controlled by commands received from the system computer.

The group of keys to the right of the computer communication keyboard are used for internal console control. The operator uses these keys to perform the various off-line display-generating and editing functions such as drawing lines and circles or deleting and copying information. Of particular importance is the fact that each one of these keys call up a program subroutine stored in the console memory to perform the indicated operation. The blank keys can be used for additional key assignments.

The typewriter keyboard is used to enter alphanumeric information onto the screen in a normal typewritten manner. The keyboard's alphanumeric layout is standard; special

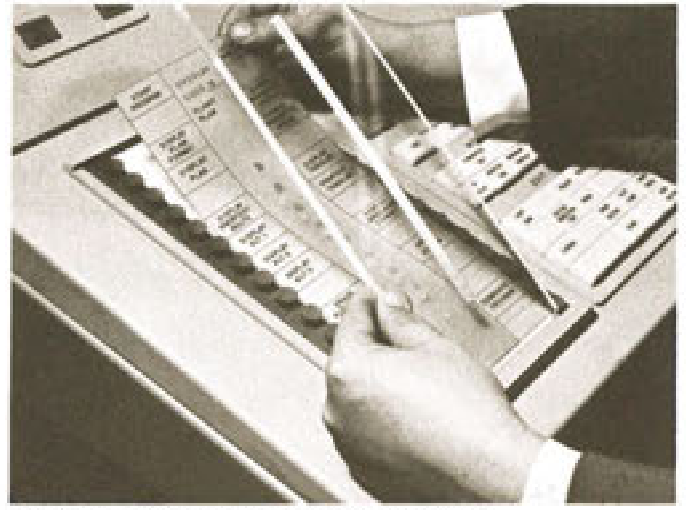


FIGURE 4: Display and Control surface of Console

symbols are typed from the keyboard by using the shift key. The keys just to the right of the typewriter keyboard are the "Marker" control keys and allow the operator to position typewriter keyboard entries on the screen. On the right side of the screen panel are the controls and indicators for the projection system. A light gun is used to select and identify electronic display elements to the console logic for editing purposes. Two switches are available for manual selection of 64 different circle sizes. Immediately below the circle size control keys is a cursor ball control. This is a manual control used to move a special cursor symbol (electronic cross-hairs) about the screen to locate position vectors, circles and symbols. The cursor symbol identifies positions on the screen in CRT coordinates.

Figure 5 is a close-up of the console keyboard showing the various off-line control functions that have been implemented for the first console application.

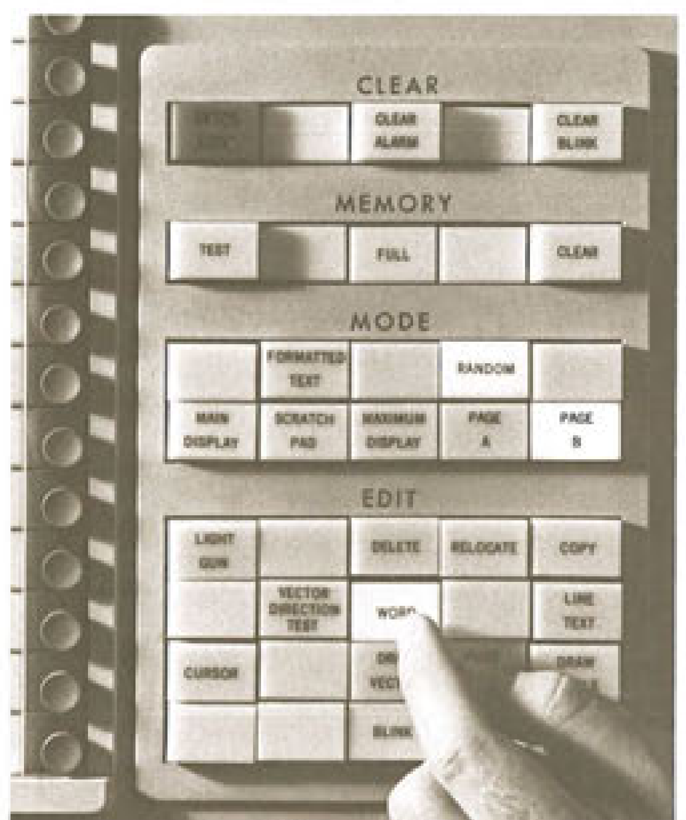


FIGURE 5: Console Control Keyboard

The "Clear Blink" key, used in conjunction with the light gun, stops electronic displays from blinking. The console has a continuous audible alarm that can be turned on by the system computer. The "Clear Alarm" key simply turns this off. The "Error/Reset" indicator, by illuminating and sounding a bell, informs the operator that he has performed a procedural error. The key labeled "Clear" is used to erase display data from console memory. The "Clear" function can be tested before permanently erasing data by using the "Test" key. The "Mode" keys provide both display mode and page selection control. The random mode is selected when graphic displays are to be generated.

The formatted text mode is used when only textual displays are required. Text data is displayed in a 44-row by 64-character-per-row format. Two display pages are available in either mode. For the random mode, display memory is divided into two equal-size pages, labeled Page A and Page B; each page holding 2048 words for display. In the formatted text mode, pages are labeled "Main Display" and "Scratchpad". In this particular application, the main display is 40 rows of characters; the scratchpad is the bottom 4 rows. The key labeled "Maximum Display" causes both pages in either mode to be displayed simultaneously. The divisions described here represent particular user requirements. Any form of page division can be accommodated within the 4096 words of display memory.

The edit keys indicate various conditions and provide control of the displays. The "Delete", "Relocate", and "Copy" keys perform the functions which the names imply. They are used with either the "Word" or "Line Text" keys to indicate the length of the message to be operated on. Vectors are drawn by using the "Draw Vector" key in conjunction with the cursor ball control to locate vector origin and terminal points on the screen. Circles are generated in the same manner using ball control to located circle centers. The "Cursor" key causes the cursor symbol to be displayed when operated. The "Wide Vector" keys will cause vectors or circles to be drawn with a wide stroke. The "Blink" key causes vectors and circles to blink when they are generated by the operator at the keyboard. The "Vector Direction Test" key blanks the first half of all vectors displayed indicating to the operator which end is the origin point and which end is the terminal point. The "Light Gun" indicator illuminates whenever a display element is light-gunned.

Figure 6 shows a close-up of the projector control keys and indicators. The console projection system allows automatic random selection of 70 mm black and white or full color slides from a 100-slide capacity magazine. The maximum slide select time is 10 seconds. No distortion of the image or special photographic techniques are employed in the preparation of slides. The image area on the slide is 2.1 inches by 3.0 inches. The system recognizes and operates with 5 machine coded magazines for a total system capability of 500 slides; however, only one magazine can be on the projector at one time. The numerals along the top of the panel identify the magazine in place and the slide being projected from that magazine — the first digit indicates the magazine and the last two digits indicate the slide manner. Slide select switches allow for manual selection of slides for viewing. The system computer can also select slides by transmitting a special command which includes the slide number. When a slide is selected from a magazine that is not in the projector, the console automatically retracts the magazine to an unloading position so that the operator can exchange magazines. The operator is given the proper magazine number and informed to change magazines by the indicators. The new magazine, when inserted, is automatically positioned to the proper slide position and the slide projected, the whole operation taking no more than 30 to 45 seconds. Storage space for five magazines is provided in the console cabinet.

FIGURE 6: Projector Control Keys and Indicators

Of particular interest is the group of nine keys shown in the center of the panel. These keys, when operated, magnify any one of nine overlapping quadrants of the slide to full screen size for a 2 times magnification. The electronic display also changes scale and centering to maintain registration with the magnified slide image. The precision of registration accuracy between the electronic information and the photographic information is 1% of screen width at full scale. Test patterns, test slides and operator adjustments are used for checking registration and making adjustments as required. The remaining keys provide brightness, focus, and projection lamp control.

The light gun, a manually operated device, is used to select alphanumeric characters, points, circles, or vectors for editing operations. When an element is light-gunned, it flickers at a discernable rate providing feedback to the operator. In addition to internal identification, any light gunned element can be identified to the system computer.

The circle size switches allow selection of 64 different diameter circles. The sizes range between 1/10-inch in

FIGURE 7: Full Slide display with electronic display overlayed

diameter to 6½-inches in diameter. Intermediate sizes vary between these two limits in equal increments.

Figures 7 and 8 illustrate the magnification feature mentioned above. Figure 7 is a normal full slide display with an electronic display overlayed. Figure 8 shows the center, left-hand quadrant of the display magnified to twice its size. The electronic image has changed scale and centering to maintain registration with the film image; however, the size of the characters and the continuous spacing of the characters has not been changed, only their overall position.

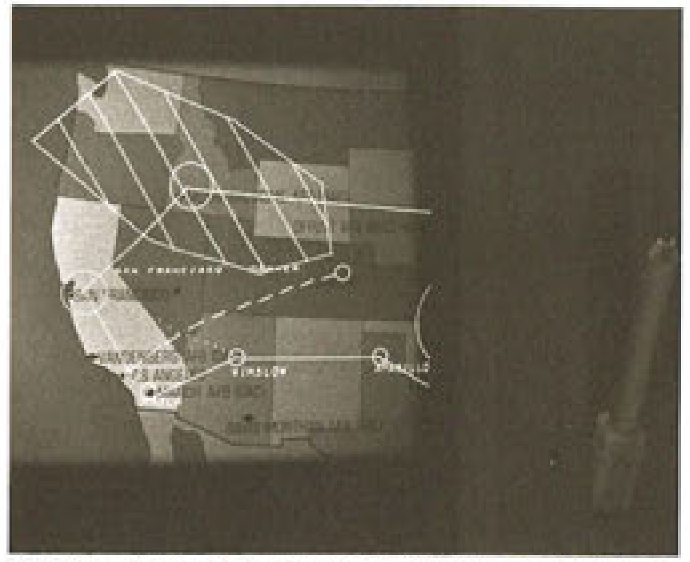


FIGURE 8: Center, left-hand quadrant of display magnified to twice its size

Applications

The console can be considered for a number of computer system applications. Computer communications are simplified by using the overlay keyboard to enter computer command and queries for data retrieval. Since the key functions can be labelled with the user's terminology, complicated codes and query languages need not be learned. Analysis of textual and graphic data can be performed using the intelligence and judgment of a human operator combined with the high speed computation capability of the system computer. Systems requiring rapid human comprehension of a changing geographical situation can be improved by photographic presentations of maps, aerial photographs, or charts combined with electronic generated images depicting the variable elements. Message handling and editing can be performed independently of the system computer. Different console operational programs can be prepared to allow users to experiment without any hardware modifications other than the changing of key labels.

Integrating the BR-90 console into a system requires both an electrical interface, which connects the console and the system computer, and a software interface. In a new system consideration should be given to the use of a channel that allows relatively high speed data rates. The console can, for example, transmit and receive 12-bit display words at a 250,000 word per second rate. Where a computing system already exists, the selection of a data channel is usually resolved by availability considerations. The software interface defines, in a more pertinent way, that manner in which the console and computer will function to satisfy the system requirement. A command structure must be established that allows the system computer to communicate with the console. The following list is typical of the type of commands the computer would send to the console:

Send status
Read display memory
Write display memory
Clear display memory
Set display mode
Select slide
Inhibit console interrupts
Set console lights

In turn, the console sends data to the computer, such as display data in response to a read display command, interrupt signals, overlay keyboard messages and status messages. The status message can include such items as:

Present display mode
Active page being displayed
Slide number being projected (and magazine number)
Cursor coordinates
Light gunned symbol address (in console memory)
Marker location (in console memory)

The command structure is reasonably flexible as far as the console is concerned since it is the console program that responds to the commands rather than wired logic.

CONCLUSION

The console uses a 12 bit word to define an X or Y coordinate, a circle and an alphanumeric symbol. The actual alphanumeric code within the 12 bit word is only 6 bits, and any coding system can be used to provide compatibility with the computer. The remaining bits of each word are used for control purposes and other features such as blink, blank, wide stroke, large size, etc.

Within the system computer, other functions must be performed such as the formatting of data for the console, operating on keyboard queries, controlling of console lights, etc. However, the techniques employed here, are outside the province of this discussion.

In summary, the BR-90 console displays electronic data in the form of vectors, circles, points, and alphanumeric which can be superimposed on film slide images projected onto the CRT screen through the rear of the cathode ray tube. The console is a stored program device that allows display functions to be changed without costly hardware modifications. In addition, different computer systems with varying data formats and interfacing features can be more readily accommodated because of this feature.

THE AUTHOR

FRANK J. BEACH is Manager of the Advanced Display Systems Group of the Information Technology Laboratory at The Bunker-Ramo Corporation, Canoga Park, California. He had been a Project Manager in the Data Display Department of TRW's Computer Division when that organization became part of the newly-formed Bunker-Ramo Corporation in 1964. For a time, he held the same position with the new company, and then was promoted to Department Manager of the Data Equipment Department. In this role, he assumed responsibility for the design, development and project management for military computers, peripheral equipment and display devices. Now, as Manager of the Advanced Display Systems Group, he provides customer application studies for display systems. Mr. Beach obtained a BA in Psychology from the University of New York in 1951, and went on to advanced studies in experimental psychology at the University of Arizona. Since, he has continued his education at the University of Southern California and Pierce College, where he has specialized in mathematics and electronics.

Characterization of light pen sensitivity

by TIMOTHY STUPAR
Information Control Corporation
El Segundo, California

INTRODUCTION

There is often confusion about what is meant by the term "sensitivity" as applied to light pens. This paper will discuss the salient phenomena and suggest definitions which may be interpreted unambiguously.

Phosphor Luminescent Action

The electronic structure of a phosphor is such that interstitial impurity atoms are contained which have the property that valence electrons may be excited to a metastable, high-energy state. Once excited, the electrons remain in this state until the addition of slightly more energy, which is usually thermal in origin, catalyzes a fall-back to normal; this fall may be accompanied by the emission of a photon.

If the excited electron is bound to the atom to which it was attached before excitation, the phosphorescent process is said to be monomolecular, whereas if the electron may wander through the lattice when in the excited state and fall down into an atom other than the one from whence it came, the process is said to be polymolecular. Examples of monomolecular phosphors include the alkali halides, while sulphide phosphors are polymolecular. As will be seen, these two processes give rise to different luminous decay characteristics.

Since the action which results in photon production is the return of an excited electron to the natural state, phosphor light output is proportional to the number of recombinations per unit time. In the monomolecular process, where the recombination probability for an excited electron is constant with time, the recombination rate will simply be proportional to the number of excited electrons.

The number of excited electrons in existence may be found by solving a differential equation containing two competing rates: a decrement due to thermal attrition of excited electrons and an increment due to the exciting agent, which is an electron beam in the present context. The rate of increment will be proportional to both the electron beam current density and to the number of excitable electrons which are unexcited.

Thus:

$$\frac{dN}{dt} = \eta J (M-N) - \alpha N \qquad (1)$$

where:

N = number of excited electrons
M = number of excitable electrons
J = beam current density
α = reciprocal of mean excited lifetime
η = excitation quantum efficiency constant

The solution of this equation is

$$N = \frac{\eta JM}{\eta J + \alpha} \left[1 - \epsilon^{-(\eta J + \alpha) t}\right] \qquad (2)$$

This equation represents the luminous build-up characteristic for monomolecular phosphors under electron bombardment, and holds true for t as small as $t \simeq 10^{-8}$ s

The decay characteristic is found by letting J = 0 in the differential equation, and solving:

$$N = N_0 \epsilon^{-\alpha t} \qquad (3)$$

where

N_o = number of excited electrons present at beam shut-off.

There is a useful similarity between phosphor action, and the action of a low-pass electrical filter.

The two equations which describe output voltage build-up and decay for a low-pass filter in response to a step function are:

$$E = E_0 \left[1 - \epsilon^{-\frac{t}{\tau}}\right] \qquad (4)$$

$$E = E_0 \epsilon^{-\frac{t}{\tau}} \qquad (5)$$

where

E_o = applied step amplitude

τ = filter time constant

Note that an arbitrarily high output voltage E may be obtained in an arbitrarily short time simply by making E_o, the applied step, large enough.

In equation (2), however, analogously increasing J does not have the same effect, since the quantity:

$$\frac{\eta JM}{\eta J + a}$$

approaches a limit, while the quantity

$$\frac{1}{\eta J + a}$$

which is analogous to τ in (4) and (5), becomes smaller with increasing J. Thus, a monomolecular phosphor may be regarded as a low-pass filter with the property that for large J, increasing the input signal amplitude results in decreasing the time constant rather than increasing the output signal amplitude. For small J, action is exactly like a low-pass electrical filter.

For polymolecular process phosphors, the build-up equation is much more complicated, since the decrement rate of excited electrons is proportional both to the number of excited electrons and to the number of electron vacancies. The differential equation then becomes, for polymolecular process phosphors:

$$\frac{dN}{dt} = \eta J (M-N) - a N^2 \qquad (6)$$

The square of the solution to this equation is the desired luminous build-up characteristic. This yields an implicit solution t = t(N) which is unwieldy; however, it can be shown that polymolecular process phosphors have in common with monomolecular process phosphors the properties of light output saturation and response time enhancement as a function of increasing beam current density.

The decay characteristic, however, is easily obtained when J = o:

$$N^2 = \frac{-N_0^2}{[1 + N_0 a t]^2} \qquad (7)$$

It is useful to lump together the various constants in this equation in order to put it in the following form:

$$I = \frac{I_0}{(1 + bt)^2} \qquad (8)$$

where

I = instantaneous luminous output

I_o = initial luminous output

b = decay constant

Analogously, (3) becomes

$$I = I_0 \epsilon^{-bt} \qquad (9)$$

Phosphor Brightness Ratio

It is often overlooked that while light pens respond to the instantaneous brightness of phosphor, the eye averages phosphor output. There is not, therefore, a one-to-one correspondence between apparent phosphor brightness and available light pen signal. A measure of the effectiveness of a phosphor for producing a light pen signal is given by R, defined as:

$$R = \frac{I_0}{I_A} \qquad (10)$$

where

I_o = initial phosphor brightness, as before

and

I_A = average brightness.

It is assumed that the excitation time is so short that the light given off in that time interval is negligible compared to the average. For the monomolecular case:

$$I_A = \frac{I_0}{T} \int_0^T \epsilon^{-bt} = \frac{I_0}{bt} \epsilon^{-bt} \Big/_0^T = \frac{I_0}{bT} \qquad (11)$$

for large T, and

R = bt

where T is the period between intensifications.

For the polymolecular case:

$$I_A = \frac{I_0}{T} \int_0^T \frac{dt}{(1+bt)^2} = \frac{-I_0}{bT(1+bT)} \Big/_0^T = \frac{I_0}{bT} \qquad (12)$$

for large T, and

R = bt

just as before, which indicates that b is a direct measure of available light pen signal from a phosphor, all other things being equal (spectral emission characteristic, etc.), regardless of whether the phosphor is monomolecular or polymolecular. Also indicated is the fact that light pen signal varies inversely with repetition rate of intensification.

It is apparent that the conditions that enhance light pen operation also work against optimizing the display for a viewer; for light pen operation, a fast phosphor and a low repetition rate is ideal, whereas a slow phosphor and a high repetition rate is desirable from the standpoint of the operator. Both ends can be achieved at once, however, by the use of composite phosphors which are a mixture of suitable slow and fast phosphors.

Light Pen Response Number

In light of the foregoing, it is meaningless to specify light pen sensitivity in terms of apparent brightness. An unambiguous measure of sensitivity is one in terms of luminous intensity change at a given wavelength; this number, along with the spectral sensitivity characteristic of the light pen, provides sufficient information to deduce performance under any given conditions of apparent brightness. To illustrate this, it is first necessary to relate luminous intensity to source brightness. As a model, consider a Lambertian spot of area Am^2 and with surface brightness of

$$B \frac{cd}{m^2}$$

It is desired to determine the luminous intensity $F \frac{lm}{m^2}$ at a point which is coaxial with the spot and at a distance of Dm.

Since one candela per square meter equals one lumen per square meter per steradian, the light emitted by the spot would be

$$AB \frac{lm}{sr}$$

if the spot were a point source radiating omnidirectionally. Since the spot is assumed a Lambertian source, the direction of maximum radiation will be coaxial with the source, and in that direction, be of twice the intensity as in the corresponding spherically distributed case. Thus, the light emitted within a small solid angle coaxial with the source is

$$2AB \frac{lm}{sr}$$

Since the solid angle subtended by a small area σ at a distance D from the origin is

$$\frac{\sigma}{2D^2} \text{ sr},$$

the total light falling on σ is

$$2AB \frac{\sigma}{2D^2} = \frac{AB\sigma}{D^2}$$

and the luminous intensity is

$$F = \frac{AB}{D^2} \frac{lm}{m^2} \qquad (13)$$

or

$$F = 2.919 \times 10^{-5} \frac{AB}{D^2} \frac{lm}{cm^2} \qquad (14)$$

where B is measured in foot-lamberts and length is measured in centimeters.

Before proceeding, it is further necessary to take into account the relative spectral efficiencies of the phosphor, the light pen, and the eye. If the light pen sensitivity is specified in $\frac{mw}{cm^2}$ at a given wave length, the spectral sensitivity characteristic S will of course have the units $\frac{mw}{cm^2}$ as a function of wave length. The spectral emission characteristic of the phosphor may be written as K • P, where K is a number having the units of $\frac{mw}{\cdot cm^2}$, and P is a unit-area function having the units of $\frac{1}{\text{wave length}}$. In this terminology, the total (all wave length) power given off by a phosphor in $\frac{mw}{cm^2}$, is:

$$\text{Total power} = K \int_0^\infty P d\lambda \qquad (15)$$

where

$$\int_0^\infty P d\lambda = 1$$

We introduce the term light pen response r, defined as

$$r = K \int_0^\infty \frac{P}{S} d\lambda \qquad (16)$$

This number, which is dimensionless, has the significance that when it is greater than one, the light pen responds. It also provides a measure of available signal margin.

If the eye responsivity characteristic in $\frac{lm}{mw}$ as a function of wavelength is E, then the luminous intensity F of the radiant signal due to a phosphor in $\frac{lm}{cm^2}$, is:

$$F = K \int_0^\infty EP \, d\lambda \qquad (17)$$

By eliminating K from (16) and (17), a relationship between luminous intensity and light pen response is obtained:

$$r = \frac{F \int_0^\infty \frac{P}{S} d\lambda}{\int_0^\infty EP \, d\lambda} \qquad (18)$$

Example

The preceding derivations can be used to deduce light pen performance from stated conditions of apparent brightness. In general, three quantities must be determined:

1) The instantaneous brightness as a function of apparent brightness, using (12).
2) The luminous intensity at the light pen, using (13) or (14).
3) The response, using (18).

As an example, consider the problem of determining the minimum brightness that a light pen will respond to, given the following conditions:

Phosphor:	P4
Spot Size:	30 mil diameter
Repetition Rate:	60 Hz
Light Pen Sensitivity:	$10^{-5} \frac{mw}{cm^2}$ @ 7000 Å
Light Pen Spectral Response:	Assumed constant from 3000 Å to 7000 Å, zero elsewhere.
Pen Position:	Four inches in front of spot

From (12), and since

b = .05 for P4,

R = (.05) (16,667) = 834

which indicates that the instantaneous brightness is 834 times the average.

Transposing (14) and taking into account the instantaneous brightness factor:

$$B' = \frac{F'(D')^2}{A'} = \frac{8.34 \times 10^2}{2.919 \times 10^{-5}} = 2.86 \times 10^7 \frac{F'(D')^2}{A'}$$

Noting that

$$(D')^2 = (4 \times 2.54)^2 = 113.2 \text{ cm}^2$$

and

$$A' = 3.14 \left[\frac{3 \times 10 \quad \times 2.54}{2}\right]^2 = 4.58 \times 10^{-3} \text{ cm}^2$$

$$B' = F' \frac{(2.86 \times 10^2)(1.132 \times 10^7)}{4.58 \times 10^{-3}} = 7.07 \times 10^5 F'$$

In (18), r is taken to equal 1, and the integral

$$\int_0^\infty \frac{P d\lambda}{S} = 10^5 \frac{cm^2}{mw}$$

since S is assumed constant. The integration

$$\int_0^\infty EP \, d\lambda$$

is performed graphically, yielding the number .42 $\frac{lm}{mw}$ for P4.

Thus,

$$F = .42 \times 10^{-5} \frac{lm}{cm^2}$$

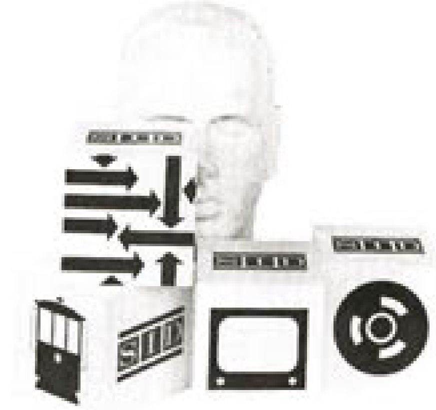
and

$$B = (7.07)(.42) \times 10^{-5} \times 10^5 = 3 \text{ ft. lamberts}$$

THE AUTHOR

TIMOTHY STUPAR is a Senior Staff member at Information Control Corporation, where he is in charge of Light Pen development and applications exploitation. Prior to joining Information Control Corporation, his activities included research on various opto-electronic phenomena under the auspices of the military agency ARPA. Mr. Stupar has been involved in the design and specification of display and film scanning systems since 1963.

Eighth National SID Symposium



San Francisco to Host Meeting May 24-26

Response to the 8th National Symposium of the *Society for Information Display*, at the Jack Tar Hotel, San Francisco, Calif., May 24-26, has been most gratifying. Theme of the Symposium is "Modern Technologies in Information Display."

According to Donald Cone *(Stanford Research Institute)*, Chairman, members of the Steering Committee have worked hard to guarantee a suitable framework for a challenging and stimulating meeting. Keynote address will be presented by Dr. Arthur L. Aden, Vice President and Director of Research and Development, Electro Optical Systems Inc. Speakers at the Banquet include John F. White, President of the National Educational Television Association, and Professor Charles Susskind, of the University of California.

PROGRAMMING

According to Dr. Joseph Stafford, *(Sequoia Instrument Co.)*, Vice Chairman for Arrangements, no formal plans have been made for a Ladies' Program. However, he states, the Symposium has been planned to coincide with Memorial Day to allow those who can to take advantage of the long weekend and fully explore the attractions of San Francisco. Host members' wives will be on hand to serve as guides and offer assistance to those who desire this service. Host chapter to the Symposium is the Bay Area Chapter, whose officers are Dr. Joseph Stafford, President; John Dusterberry, Vice President; and Jim Wurtz, Secretary/Treasurer.

EXHIBITS

According to Dale Fuller *(Lockheed)*, Symposium Exhibits Chairman, early exhibits registrants include Adams Associates, Inc.; Beta Instrument Corp.; CBS Laboratories; CELCO Inc.; Clare-Pendar Co.; Data Disc Inc.; Ferranti Electric Inc.; Gamma Scientific Inc.; Granger Associates; ITT Industrial Products; Litton Industries; Perfection Mica Co.; Polaroid Inc.; Thomas Electronics Inc.; Tung-Sol; and Video Color Corp.

Exhibit hours are 9:00 a.m. to 8:00 p.m. on Wednesday, May 24; 9:00 a.m. to 8:00 p.m. on Thursday, May 25; and 9:00 a.m. to 5:00 p.m. on Friday, May 26. Exhibits and technical sessions are conveniently located at the Jack Tar in adjacent areas on the same floor.

TECHNICAL EXHIBITS
(partial listing)

Adams Associates Inc.	Litton Industries
Beta Instrument Corp.	Perfection Mica Co.
CBS Laboratories	Polaroid Corp.
CELCO Inc	Raytheon Corp.
Clare-Pendar Co.	Stromberg Carlson Corp.
Data Disc Inc.	Sylvania Electric Products Inc.
Ferranti Electric Inc.	Thomas Electronics Inc.
Gamma Scientific Inc.	Tung-Sol
Granger Associates	Video Color Corp.
ITT Industrial Products	

EXHIBIT SCHEDULE

Wednesday, May 24	9:00 a.m. - 8:00 p.m.
Thursday, May 25	9:00 a.m. - 8:00 p.m.
Friday, May 26	9:00 a.m. - 5:00 p.m.

TECHNICAL PROGRAM

Jan Engel *(IBM Corp.)*, Technical Program Chairman, states that 8th *SID* Symposium Proceedings will be available at the Symposium to all *SID* members without charge. Others who wish may obtain them at $15 per copy, from Western Periodicals, North Hollywood, Calif.

Members of the Technical Program Committee include Calvin K. Clauer, *IBM Corp.*; Donald Cone, *Stanford Research Institute;* John Dusterberry, *NASA;* Lester Earnest, *Stanford University;* Robert Miner, *Ampex Corp.;* Phillip Rice, *Stanford Research Institute;* Ralph Seitle, *Philco-Ford Corp.;* Joseph Stafford, *Sequoia Instrument Co.;* Robert Wohl, *IBM Corp.;* and Jim Wurtz, *Litton Industries.*

Mr. Engel has announced plans for six sessions at which 30 technical presentations will be made. In addition, three short papers containing "Late News" will be presented at the fifth technical session, on Friday, May 26. The first paper is "Tactile Image Projection" by Carter Compton Collins, PhD; the second paper is "Motor Bearing Breakthroughs in Ultra High Speed Laser Beam Scanners" by Randy Sherman; third paper is "Real Time, Reduced Bandwidth Television System Employing Dot Interlace Techniques" by Edward S. Smierciak. These papers will appear in forthcoming issues of *Information Display*. Technical program is as follows:

PROGRAM

WEDNESDAY, MAY 24, 1967

8:00 a.m. - 8:00 p.m. — REGISTRATION OPEN

9:00 a.m. — WELCOME
Don Cone
Stanford Research Institute
Symposium Chairman

9:15 a.m. — KEYNOTE ADDRESS
Dr. Arthur L. Aden,
Vice President and Director
Research & Development,
Electro Optical Systems Inc.

10:00 a.m. - noon — TECHNICAL SESSION I

DISPLAY DEVICES

Organizer — Robert J. Wohl, IBM Corporation

Chairman — Thomas J. Carr, Aerospace Corporation

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

The Plasma Display Panel, invented at the University of Illinois, is a rectangular array of bistable gas-discharge cells which are insulated from exciting electrodes by thin panels. Combining properties of memory display, and high brightness in a simple structure, it is an effective, economical device for information display.

R. DuBois, Tung-Sol Division, Wagner Electric Corp. — *"A Low Cost Alpha-Numeric Display Device Requiring Negligible Switching Power"*

This paper describes a new display device — a small grid-controlled numeric readout which requires no beam deflection and which features single-plane character generation. Structural features required to meet the design problems posed by digital instrumentation are discussed, and the physical and electrical characteristics of the device are presented.

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

Magnetic fields may be used to control and position small magnetic particles to generate displays. These display devices may be made over a wide range of sizes, possess high visibility, have memory even in the absence of power and are of very high reliability, possessing intrinsic resistance to shock and vibration.

L. S. Yaggy, N. J. Koda, Vacuum Tube Products Division, Hughes Aircraft Co. — *"A Versatile High-Performance Scan Converter Storage Tube"*

Structure, modes of operation, and performance characteristics of a double-ended storage tube are described. Developed to accommodate extremely diverse inputs from multi-sensor displays, performance exceeds earlier tubes, and combines features of several: input-output isolation, non-destructive readout, high-speed, high-resolution, selective erasure, milliseconds to minutes continuously-adjustable decay, many halftone levels.

*Now with Electronics Division, Westinghouse Electric Corporation.

12:30 p.m. — LUNCHEON
Luncheon Address:
Professor Patrik Suppes
Stanford University

2:00 p.m. - 5:00 p.m. — TECHNICAL SESSION II

DISPLAY MATERIALS

Organizer — Jim E. Wurtz, Litton Industries Inc.

Chairman — E. M. Gardiner, The Boeing Company

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

Based on results of earlier work on Monochromatic Photochromic-CRT Displays, the USAECOM, Ft. Monmouth, New Jersey, awarded the National Cash Register Company a study contract to investigate the application of photochromics to color display.

The photochromic materials' properties and systems concepts pertinent to the construction of a feasible model color display are presented.

G. J. Chafaris, Electronics Laboratory, General Electric Co. — *"Surface Deformable Media as Applied to the Generation of Projection Command and Control Displays"*

This paper will deal with the application of surface deformable media, represented by thermoplastic and oil films, to the generation of large high brightness and high resolution projection displays. Specific applications of these media, currently under development, will be covered to illustrate the capability of these media as well as the performance specifications desired for future operational display equipment.

D. A. Morgan, T. J. Werner and W. H. Libby, Duplicating Products Division, 3M Company — *"Dry Silver Recording Materials for Display Purposes"*

The Dry Silver system is a new negative-operating photo-sensitive system which requires only moderate heating for development. High contrast images on either film or paper are produced with exposures as short as 5 foot candle seconds. Peak spectral sensitivity can range from the near ultraviolet throughout the visible spectrum and gamma can be controlled by heat development conditions. Extremely high resolution is another important feature of this system.

J. H. Fletcher, G. H. Dorion, American Cyanamid Co. — *"Improvement of Photochromic Film for Data Display"*

Continued research on the chemistry of photochromic materials and their incorporation into various types of plastic matrices has resulted in formulations having improved properties with respect to data display applications. In particular, photochromic materials of greater sensitivity and stability than those presently offered by Cyanamid will be described. These new materials should provide the electro-optical engineer with significantly increased latitude in the design of photochromic display systems.

J. S. Frost, Autonetics Division, North American Aviation, Inc. — *"An Inexpensive Color Technique for Color Electroluminescence Display"*

A dynamic color electroluminescent display suitable for a wide variety of applications has been developed. The common frequency-color characteristic of Zns: Cu, Cl phosphors, together with a separate Chromatic

FIGURE 1: San Francisco's skyline after dark; Telegraph Hill, topped by Coit Tower, looms above the Embarcadero. (Photo by San Francisco Convention & Visitors Bureau).

Bias source form the limits of output hues. Advantages of the system are simplicity and low cost, high brightness, and unimpaired resolution.

8:15 p.m. — SPECIAL EVENING SESSION
"Unusual Color Techniques for Displays"
Dr. Arthur Karp, Stanford Research Institute
Dr. Dieter P. Paris, IBM Corporation

THURSDAY, MAY 25, 1967

8:00 a.m. - 8:00 p.m. — REGISTRATION OPEN

9:00 a.m. - 12:00 noon — TECHNICAL SESSION III

DISPLAY SYSTEMS AND APPLICATIONS — I

Organizer — Robert A. Miner, Ampex Corporation

Chairman — To be announced

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

This paper will describe technical details of the IBM-Instructional Display Terminal. The general terminal description includes deflection and video circuits, CRT phosphor selection, character and image generator. The magnetic storage of video information, organization of the displayed data, and principles of the light pen will also be covered.

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

A need exists for an improved time-sharing display terminal to increase operating speed and eliminate rigid information formats.

This paper discusses the effort at Project MAC to define the elements of an improved terminal and to build experimental working hardware.

C. G. Beatty, Systems Development Div., IBM Corporation — *"Graphic Approach to Numerical Information Processing"*

An experimental program known as Graphic Approach to Numerical Information Processing (GATNIP) uses the computer to transform numerical data into graphs by selectively extracting numerical information from existing sequential files and summarizing it as a graph displayed on the IBM 2250. Automatic scaling and dynamic on-line plotting are provided.

W. D. Fuller, Information Systems Organization, Lockheed Missiles & Space Company — *"Physician-Machine Interface in a Hospital Information System"*

A terminal, called a "Video-Matrix Terminal," allows direct interaction between professional health care personnel and real-time information systems. This terminal, based upon a raster scan display, presents pages of medical terminology to the physician who selects terms, using a light pen, to assemble medical orders for patient management.

B. F. Jackson, D. Jackson, Link Group, General Precision Inc. — *"The Link Automated Microfilm Aperture Card Up-dating System" — Invited Paper*

Link, GPI, is constructing a system for computer-aided aperture card updating. The card is scanned and stored in digital form. An operator views a continuously updated display of this digital representation, modifying it with keyboard or light pen. The modified digital representation is then transferred onto another aperture card.

12:30 p.m. — LUNCHEON
Luncheon Address:
LCDR C. C. Drenkard, USN

2:00 p.m. - 5:00 p.m. — TECHNICAL SESSION IV

DISPLAY TECHNIQUES

Organizer — Philip Rice, Stanford Research Institute

Chairman — Ross Aiken, Electronix-Ten Inc.

C. N. Winningstad, Tektronix Inc. — *"The Simplified Direct-View Bistable Storage Tube in Computer-Output Applications"*

A brief application history, principles of operation and construction will be given. The advantages of this tube in comparison with memory-refreshed conventional cathode-ray tubes will also be given along with the limitations. This approach is most advantageous in applications involving large amounts of alphanumerics and/or graphics.

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

This display system uses dry-processed Kalvar film, exposed directly from a fiber optic cathode-ray tube, as its storage medium. The display system acquires its data from a small computer and data link to a large computer which contains the program data base. The information is presented on a 4 x 4 foot rear-projection screen and also as hardcopy from the same 70mm film frame.

R. C. LaFrance, S&ID, North American Aviation Inc. — *"16 Earth Orbit Film for the Apollo Mission Simulator"*

A strip film photograph of the most accurately detailed earth model today fulfills a requirement that cannot be satisfied with spacecraft photography. Out-the-window and telescope scenes are continuously generated for training the astronauts in the Apollo Mission Simulator. This paper covers the preparation and application of this film.

S. M. Stone
The Bayside Laboratory
General Telephone and Electronic Labs Inc.
"Experimental Multi-Color Real-Time Laser Display System"

A need exists for a real-time, multi-color, large-area information display system capable of high brightness, high intensity and high resolution. Lasers, with their high-intensity output at many possible wavelengths, and devices for modulating and deflecting laser beams have been utilized in the development of an experimental system.

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

This paper describes a technique of 3D display of electronically stored information. A CRT displays the data, and a stereo image of the display is photographically recorded in what is essentially real-time. The "hard copy" is then projected and viewed to obtain a 3D image virtually free of conventional distortions.

6:30 p.m. COCKTAILS (No Host)

7:00 p.m. BANQUET

Speakers:
John F. White, President
National Educational Television Association
Professor Charles Susskind

FRIDAY, MAY 26, 1967

9:00 a.m. - noon TECHNICAL SESSION V

DISPLAY EVALUATION

Organizer	C. K. Clauer, IBM Advanced Systems Development Division
Chairman	Prof. David A. Thompson, Stanford University

E. A. Schmidt
D. A. Naurath
Laboratory Department
U. S. Naval Missile Center
"Design and Development of a Prototype Photo-Optical Display Data Analyzer"

Airborne photographic recording systems have created requirements to develop analytical devices which will expeditiously enable observers to fully display and analyze in-flight information. A prototype radarscope photo-data analyzer was developed to resolve film analysis problems, investigate principles for quantifying and analyzing optical data on systems performance, and develop design characteristics.

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

A two-color (green, yellow) electroluminescent hover display was developed through several design phases. It was tested in a counter-balanced experiment by experienced pilots in a 6-degree-of-freedom VSTOL simulator. Seven dependent variables were recorded and the difference on each criterion between the EL and other types hover displays found to be statistically significant.

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

Several techniques developed for assessing the performance of large, multiple-user display systems containing time- and space-shared subsystems are described. The results of applying these techniques to analyzing the performance of such a system (the display/control system at NASA's Manned Spacecraft Center) under operational conditions are presented.

J. M. Ketchel
Kaiser Aerospace and Electronics Corporation
"The Effect of High Background Luminance Adaptation Levels on the Visibility of Electronic Displays"

A study was performed to determine the required brightness and contrast of a CRT display so that an observer subjected to very high ambient light levels can immediately identify a small target. It was found that much lower brightness and contrast levels than previously thought necessary are adequate under certain conditions.

T. Gold
Information & Communication Div., Sperry Gyroscope Co., Sperry Rand Corp.
"Analysis of Saturation and Reliability in a Shared Display System"

The utility of the windshield projection display for the pilot in low weather landing was evaluated in flight tests. The results indicate that pilots exhibit superior assessment and control capabilities with this display compared with panel instruments. The extent of this enhanced performance and its basis are discussed in detail.

2:00 p.m. - 5:00 p.m. TECHNICAL SESSION VI

DISPLAY SYSTEMS AND APPLICATIONS — II

Organizer	Robert A. Miner, Ampex Corporation
Chairman	To be announced

W. F. Miller, J. van der Lans
Stanford University
"System Design for CRT Film Scanning and Measuring"

A high precision cathode-ray tube operating under direct control of a general purpose computer is utilized to digitize data recorded on film. The film digitizer is treated like any other peripheral device by both user programs and development engineers while testing and debugging.

C. R. Dickens
Stanford Linear Accelerator Center, Stanford University
"Display Control of a CRT Film Scanning System"

Data-reduction systems with on-line film digitizers require extensive human interaction during initial setup.

As film reduction progresses, less interaction is required.

This paper describes a relatively simple display interaction structure to control such systems at the lowest level initially, relinquishing progressively this facility as the experiment continues.

E. T. Johnson
Systems Development Div.
IBM Corporation
"Graphic Output Adapter for Remote Plotting"

A graphic output adapter, drive over voice-grade lines, has been constructed for use on the IBM 1051/2741 typewriter terminal. The adapter drives a plotter or storage CRT, asynchronously; and draws points and X, Y, 45° vectors. It offers a potentially low-cost alternative to on-line display systems.

R. Winfield
Information & Communication Div., Sperry Gyroscope Co., Sperry Rand Corporation
"A Computer Controlled Multichannel CRT Television Symbol Generator"

An improved cathode-ray tube video signal generator is described; 40 switchable matrix segments form an alphanumeric composite target. Desired character shapes are formed by turning on only those elements forming the desired character.

Target beam scanning by television synchronous waveforms produces compatible television Z-axis video signals.

SID Activities

CHAPTER NEWS

The *Los Angeles Chapter* had a turnout of over fifty people at their March meeting. A field trip to System Development Corporation was preceded by dinner at the well renowned Bat Rack restaurant in Santa Monica. SDC's facilities for customer subscribed computer time shared services was demonstrated. Another interesting field trip was made to the Western Airlines Corporate offices and maintenance facility at Los Angeles International Airport. Again, fifty members were present to enjoy dinner and the tour. Although the eighth largest airline in size, Western lays claim to being the oldest airline in the world. Preceding the dinner, the L. A. chapter officers met to lay plans for the March 1968 Ninth National Symposium to be held in Los Angeles. Tentative decisions were reached regarding dates and key personnel. — Fred Smith, *Publicity*, L. A. Chapter.

The *Bay Area Chapter* has been very busy preparing for the 8th National *SID* Symposium which will be held at the Jack Tar Hotel in San Francisco, May 24-26, 1967. There has, however, been time in the last few months to hold some very interesting meetings. Mr. Cal Clauer of IBM, the Meeting Program Chairman, arranged a talk and demonstration on computer controlled teaching by Dr. Patrick Suppes of Stanford University. The latest meeting featured an extremely interesting presentation on color perception by Dr. Arthur Karp of Stanford Research Institute.

Nominated for next year's officers are John Dusterberry, NASA Ames Lab, President, Jim Wurtz, Litton Industries, Vice President, and Don Cone, Stanford Research Institute, Secretary-Treasurer. Don is presently Chairman of the 8th National Symposium. — Jim Wurtz, *Publicity*, Bay Area Chapter.

BOARD OF DIRECTORS MEETING

The *SID* Board of Directors met in New York on 22 March 1967. W. Bethke reported the results of the election. W. Bethke, President; P. Vlahos, Vice President; C. Machover, Secretary; F. Brown, Treasurer; J. Stafford, Western Regional Director; J. Snuggs, Southeastern Regional Director; R. Klein, Northeastern Regional Director; and R. V. Miller, Central Regional Director. The Board appointed B. Price to fill one year of the unexpired Northeastern Regional Term of F. Brown. Committee Chairmen for the coming year were appointed. These were: Membership, P. Damon; Nominating, Dr. Bairdain; Convention, F. Brown; Honors and Awards, J. Howard; Publications, L. Seeberger; Definitions and Standards, Dr. Crocetti; Publicity, A. Langer. The following were elevated to fellow; W. Ross Aiken, Dr. G. Dorion, S. Sherr, Dr. S. Deutsch. P. Damon received a certificate of citation for service to the Society. The establishment of the new *SID* Suite of offices at 654 North Sepulveda, Los Angeles, California 90049 — (213) 472-3550 was announced. Mrs. Sharon Satterfield was hired as Office Manager. Dr. H. Luxenberg continues as Executive Secretary.

A cash balance increase for the Society from $19,000 in 1965 to $27,800 in 1966 was reported. The Board passed the necessary resolutions to amend the Articles of Incorporation so that *SID* can be converted from a business league to a not-for-profit professional society. *SID* participation with other technical societies was discussed and it was announced that *SID* had been asked to provide a display session for the Fall Joint Computer Conference.

The display tutorial course tentatively scheduled with NYU in June 1967 has been cancelled. However, plans are underway for such a course to be sponsored in conjunction with Brooklyn Polytechnic in June 1968.

P. Damon reported that as of 31 January 1966 the Society had 1200 members.

The Board discussed two proposed amendments to the By-laws and voted to recommend the acceptance of these by the membership. One amendment would provide a slate of at least one candidate for each elective executive office and at least two candidates for each other elective office (instead of the current requirement of at least two candidates for each elective office). The other proposed amendment would allow the annual general business meeting to be conducted any time during the first five months of each fiscal year (instead of during the first two months of each fiscal year). A committee was established to study the suggestion of a New England Chapter that provisions be made to have the regional directors more directly represent chapter interests.

The next Board of Directors meeting is scheduled for the Eighth National Symposium in San Francisco on 23 May 1967.

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

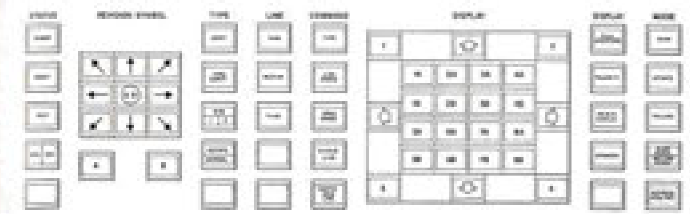
BEARCE, W. Scott—*Cardion Electronics, Inc.;* BET, Donald—*Autonetics;* BLOOMSBURGH, Ralph—*Philco-Ford;* CASTELLANI, Aldo—*Raytheon Co.;* CENNAMO, A.—*Xerox Corp.;* CLARK, Robert—*Argonne National Laboratory;* EDWARDS, Daniel—*Department of Defense;* GETTINGER, Ted, Jr.—*Honeywell Inc.;* GOTHAM, Fred—*Stromberg Carlson;* HILL, Richard—*General Electric Co.;* HOFER, Jack L.—*Litton Industries;* KAITZ, Marvin—*CRT Graphics;* KEEFFE, William—*CBS Laboratories;* KING, Joe—*Stromberg-Carlson;* STODDARD, Robert—*Sanders Associates;* LAZET, Andries—*National Defence Research Organization TNO;* LOELLBACH, Herman—*Chicago Aerial Industries;* BOTTICELLI, Robert—*CBS Laboratories;* MAHER, Frank—*Ritchie, Inc.;* REISER, James—*Hughes Aircraft Co.;* SCHUMACHER, Arnold—*Sanders Associates Inc.;* SMALL, Donald—*The Gerber Scientific Inst. Co.;* SPAK, Paul—*The Gerber Scientific Inst Co.;* STEARNS, Howard—*Binghamton, New York*

STUDENTS

OLSEN, Richard—*Penn. State University;* SOBOLEWSKI, Victor—*University of Adelaide (Australia);* ATWATER, James W.—*Heliodyne Corp.;* BERSSON, Betty—*New York University;* BENNETT, Richard—*Autonetics;* BRADBURY, Robert—*General Electric;* CHARLES, Daniel R.—*Compagnie Generale de Telegraphie Sans Fil (CSF);* DURST, James E.—*Sanders Associates;* GAGAN, Richard—*Wolf Research & Development Corp.;* GOOD, William—*General Electric;* KELLER, Dwain—*Dynair Electronics, Inc.;* MALLORY, Kenneth—*General Dynamics;* MOWER, Irving—*Federal Aviation Agency (NAFEC);* NOPANEN, Esko—*Corning Glass Works;* PARKER, Edgar—*Army Missile Command;* PUDER, Allen—*Pasadena, Calif.;* RUBENSTEIN, Seymour—*Sanders Associates;* STEPHENS, James—*Westinghouse Electric Corp.;* STIEFEL, Rudy—*Infotran Inc.;* SEIGEL, David—*Bolt, Beranek & Newman, Inc.;* STOUT, Robert—*Sanders Associates Inc.*

ID Readout

AUTOMATED MICROFILM APERTURE CARD UPDATING SYSTEM (AMACUS)



Control Console

This General Precision Inc., Link Group, Systems Division system will allow an operator to make additions and corrections to technical drawings and data sheets which have been stored on microfilm aperture cards. The revision work is accomplished electronically without the usual series of intermediate steps which involve the creation of a print from the film, updating the print manually and then finally photographing the print when the changes are completed. The filmed data on the aperture card is scanned with a high precision CRT flying spot scanner, and digitized for storage on a 30 Megabit magnetic drum. The entire drawing or selected portions will be presented on a display to an operator who will accomplish his revision work by means of a light pen and keyboard. These corrections will directly modify the digitally stored information on the drum and the new data will be presented immediately on the display for verification.

With the updating accomplished in this manner, the operator will be able to view the results of his work and when all necessary changes have been completed, the precision CRT system will create a new film recording. The newly created aperture card will be automatically processed and a second generation microfilm document card is then available. For the scanning and recording of the filmed data, Link is using a spot matrix of 6144 x 4096 bits.

To provide the flicker-free operators display, a second memory drum is incorporated. This display drum will handle 1.2 Megabits at 6000 RPM and provide a rate of 50 frames/second. Through the use of rear projection TV techniques, this electronic operators display will have a working area of 26 inches x 17 inches and a spot size of 3 mils. For the insertion of alphanumeric data by means of the typewriter, system performance will be of such speed that the new information will be stored and displayed as fast as the operator can turn his head to view the screen. Data erasure or insertion of a 15 place alphanumeric entry or an equivalent line length will take place in less than 5 seconds.

To insure system flexibility, a programmable central processor has been incorporated to control the system functions. This approach utilizing a DDP 116 will facilitate the addition of a second and third operator station. Optional equipment which has been included is the high speed multiply/divide function and a direct data channel.

CALL FOR PAPERS

A request for papers to be presented at the 1967 UAIDE annual meeting has gone out to more than 1,000 members. Technical papers for oral presentation of 20 to 25 minutes can cover hardware, software, application innovations and developments of graphic output generated on computer controlled display and recording devices. Output generated by cathode ray tubes is of particular interest. The meeting is set for October 16-19 at the Statler Hilton Hotel, Washington, D.C. Preliminary, one-paragraph abstracts of proposed papers must be sent to George E. Perez, Box 6749, Fort Davis Station, Washington, D.C. 20020 before July 15, according to UAIDE officials. Audio-visual equipment will be available for presentation of the papers. UAIDE, which stands for Users of Automatic Information Display Equipment, is a nationwide group of data processing personnel from organizations using equipment for recording computer-generated data in graphic or alphanumeric forms.

ACM SYMPOSIUM

A Symposium on the design and implementation of interactive systems for experimental applied mathematics will be held on August 26-28, 1967, just prior to the National ACM Conference, at the Sheraton-Park Hotel, Washington, D.C. Suggested topics for the sessions of the symposium include: Definition of interactive input languages, Construction of interpreters and compilers for interactive systems, Criteria for the evaluation of the performance of interactive systems, and Automation of numerical analysis. Deadline for submission of Papers is: Short Papers: Abstract (150 words) by August 1, 1967, and Long Papers: Full draft (less than 6000 words) by July 1, 1967. Further information may be obtained from Dr. M. Klerer, Columbia University, Hudson Laboratories, Dobbs Ferry, New York.

DESIGN COURSE ON AUTOMATIC TEST EQUIPMENT

A five-day summer course will be given July 24-28 on "Built-In Test Equipment for the Maintenance of Complex Electronic Systems" at the United Engineering Center, 345 East 47 St., N.Y. The course is sponsored by New York University's School of Engineering and Science in conjunction with the operations of Project SETE (Secretariat to the Electronic Test Equipment Co-ordination Group) which is a scientific information center operated by and for various U.S. Government agencies. David M. Goodman, Senior Research Scientist, is the Project Director. The program is divided into three main parts: the first reviews the history and state-of-the-art in Automatic Test and Checkout as it pertains to both DoD and NASA; the second provides details on transducers, multiplexers, and display devices applicable to built-in test; and the third describes electronic systems which typify the most recent applications of built-in test. Further information may be obtained from David M. Goodman, New York University, 401 W. 205th St., NY, N.Y. 10034, (212) 584-0700, Ext. 776.

ELECTRONIC EYE FOR GUIDED WEAPON

A small television camera tube is being made by R.C.A. for use as the electronic "eye" of the Nation's first TV-guided tactical weapon, the Navy-developed air-to-surface "Walleye" weapon. Navy and Air Force tactical aircraft will be equipped with the weapon. The Martin Marietta Corp., which fabricates Walleye, recently gave RCA a multi-million dollar production order for vidicon tubes, a substantial number of which have been delivered by RCA's plant at Lancaster, Pa. The vidicon is mounted in a compact television camera behind a glass window in the nose of the Walleye weapon. After a pilot fins his target, he locks the weapon on its objective. Once Walleye is released, the electronic sight takes over and homes on the target.

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1967 NATIONAL ACM CONFERENCE

More than 120 technical papers have been submitted and are being reviewed by committeemen of the 20th annual conference in Washington of the Association for Computing Machinery, according to Solomon Rosenthal, general chairman. Approximately 55 papers will be selected for presentation before the ACM meeting August 29-31 at the Sheraton Park Hotel. Three thousand members are expected to attend the technical sessions and view the 80-plus exhibits provided by commercial organizations concerned with computer development and usage, Rosenthal said. This year's conference theme is "Past Is Prologue," to emphasize the accelerating growth and influence of the computer and sophisticated information-processing techniques. The technical papers have already passed the first hurdle in screening, the review by the scientists in charge of each session. The papers now are being studied by the program committee, which is headed by Dr. Jack Minker, technical director, Auerbach Corp., Arlington, Va. According to Dr. Minker, the papers on hand fall roughly into one or more of three areas: (1) Historical perspective, with surveys of computer technology indicating landmark accomplishments, significant contributors, and related implications; (2) Important recent developments/applications, including the meanings of these accomplishments; and (3) Present trends and probable future developments — what impact these might have.

CARTOGRAPHIC SCANNER

The first automatic scanning device which converts maps into binary data for computer processing has been announced by IBM, Kingston, N.Y. Called a cartographic scanner, the experimental device was developed and built in conjunction with the Canadian government. It is now being used in Ottawa to help handle data in a computer-based information system being developed for effective land resource development. The scanner has a motor which turns a large drum which measures 16 in. x 50 in. Vacuum pressure holds a specially-prepared map around this drum. In preparing source or original maps for scanning, a stylus traces eight-mil lines on white opaque plastic sheets. Only boundary lines are traced. The result is a map with a white background and transparent boundary lines. As the drum rotates, an eight-channel optical scan head travels a spiral path over the face of the drum. Each fiber optic channel covers a four-mil square area, and is pulsed at four-mil increments. Solid state photo sensors are used in each channel. When a map has been scanned completely, the tape unit shuts off, the scan head automatically returns to the starting position, and the map can be removed.

INQUIRY MODULES FOR COLLEGE

"Inquiry Modules" that use personal TV screens to link individual students with a library of information pre-recorded on video and audio tapes will be added to the Learning Center at Brevard Junior College. The equipment is being provided by Raytheon Co., Lexington, Mass. At a single booth, a student may watch educational television, closed circuit TV, video-taped TV courses and programs, and even commercial TV. He may also listen to tape-recorded language lessons and other instructional materials, tape-recorded music in stereo, or FM radio. All of the college's resource materials will be available instantly by dialing the appropriate reference number. The equipment includes a selector panel with telephone-type dial, a video monitor, and a headset with stereo earphones and microphone. The installation will be completed by Educational Systems Development Inc., Winter Park, Fla. Other booths are equipped with microfilm readers and rear-screen projection cabinets for 8-millimeter film and slides or film strips.

BELOCK INSTRUMENT CORP., Long Island, N.Y. has changed its name to APPLIED DEVICES CORP. The change has been approved by the stockholders and the firm is now listed on the American Stock Exchange as ADE . . . GORN CORP., Stamford, Conn., has announced receipt of a $200,000 initial order from the BOEING CO. for digital readout mach/airspeed indicators, manufactured by SMITHS INDUSTRIES LTD. They are intended for use in Boeing 707's, 727's and 737's, with the first units to be installed during the last quarter of this year . . . FAIRCHILD SPACE AND DEFENSE SYSTEMS, div. of FAIRCHILD CAMERA AND INSTRUMENT CORP., L.I., N.Y., has received a $230,000 production contract for ruggedized oscilloscopes. The contract, from the US Navy Aviation Supply Office, is for an unspecified number of the transistorized test instruments designed especially for military applications . . . HUGHES VACUUM TUBE PRODUCTS DIVISION, Oceanside, Calif., has announced that it is no longer engaged in the manufacture of a regular line of digital measuring and display instruments. The firm is now concentrating on the field of special displays for computer, educational and similar applications.

TECHNICAL OPERATIONS INC., Burlington, Mass., has recently been awarded two patents for techniques improving the efficiency of lasers. One patent covers a system for coupling lasers together in an optical antenna array that could be used in long-distance communications. The second covers a passive laser Q switch, a device which holds back coherent light emission until a ruby laser stores enough energy to generate a burst of power in the multi-megawatt range . . . GRANGER ASSOCIATES of Palo Alto, Calif., has received an initial production order for 10 TV camera systems from the Ampex Corp. The $100,000 plus order is a follow-on to development work the firm has been conducting.

BUNKER-RAMO CORP., Canoga Park, Calif., has been awarded a $170,000 contract by the office of the Army's Assistant Chief of Staff for Intelligence in Washington, for evaluation of applicability of modern systems analysis and data processing techniques to selected areas of the Army's intelligence network. Six problem areas of Army intelligence work have been selected, and after evaluation one of these areas will be chosen for an in-depth study to demonstrate the validity of the systems analysis approach . . . COMPUTER APPLICATIONS INC., N.Y., has opened a new office in Palo Alto, Calif. The office has been established to handle the company's expanding volume of computer programming work in California and to help serve new clients in the Rocky Mountain area, including Utah, Nevada and the Dakotas . . . Formation of an Information Systems Marketing Division by the MOSLER SAFE CO., N.Y., has been announced by William A. Marquard, Jr., exec. v/p. Mosler introduced its Selectriever Information Retrieval System in May, 1966; more than $1.25 million in orders has already been received.

A contract for $111,750 has been awarded to HOPPMAN CORP., Springfield, Va., for installation of a Visual Display and Voice Recording System at US Strike Command Hdqtrs, MacDill AF Base, Fla. The system will update equipment used in command briefing rooms and provide for recording and transcribing of both telephone and microphone audio signals at the headquarters . . . LEAR SIEGLER INC., Santa Monica, Calif., has acquired INTERNATIONAL ACADEMY INC., headquartered in the Washington, D.C. area, which operates schools offering courses in computer programming, operations and applications . . . ESSCO INC., a company devoted solely to software marketing and service, has established permanent quarters in Walnut Creek, Calif. ESSCO is a subsidiary of EDMAP INDUSTRIES INC.

TECHNICAL OPERATIONS INC., Burlington, Mass., has recently been awarded two patents for techniques improving the efficiency of lasers. One patent covers a system for coupling lasers together in an optical antenna array that could be used in long-distance communications. The second covers a passive laser Q switch, a device which holds back coherent light emission until a ruby laser stores enough energy to generate a burst of power in the multimegawatt range . . . GRANGER ASSOCIATES of Palo Alto, Calif., has received an initial production order for 10 TV camera systems from the Ampex Corp. The $100,000 plus order is a follow-on to development work the firm has been conducting . . . GENERAL TELEPHONE & ELECTRONICS CORP., New York, and ULTRONIC PRODUCTS INC., Pennsauken, N.J., recently announced that a GT&E subsidiary, SYLVANIA ELECTRIC PRODUCTS INC. has been negotiating a plan for the acquisition of Ultronic Systems. Under the terms of the plan, GT&E would issue one share of $50 par, 5% convertible preferred stock in exchange for 5 shares of US common stock, except for the 178,390 common shares already owned by Sylvania . . . An electronic display system that presents the stock ticker in book page format was installed by the BUNKER-RAMO CORPORATION, New York, in the new offices of E. F. HUTTON & CO. INC., N.Y. The installation is the first of its kind in New York City.

SYSTEMS ENGINEERING LABORATORIES INC., Fort Lauderdale, Fla., received a $200,000 contract for the delivery of an SEL 840A Computer. A closed loop system, the 840A will be linked to a simulated cockpit of a North American Aviation Inc. T2-B aircraft. The procurement was from GOODYEAR AEROSPACE CORP. for the NAVAL TRAINING DEVICES CENTER, Orlando, Fla. . . . The USAF ELECTRONIC SYSTEMS DIVISION announced that a request for a proposal issued in July 1966 for electronic data processing equipment to be installed in the NATIONAL WEATHER RECORDS CENTER has resulted in the non-selection of equipment. Since this announcement, new proposal requirements, modifications of the original, were issued . . . DISCON CORPORATION, Ft. Lauderdale, Fla., has acquired and will produce and market the DIGIGATOR line of digital readouts and associated decoder/driver modules previously manufactured by MICROPHYSICS INC., Westbury, N.Y. Discon reports that production is already under way on the more popular displays and modules; the complete line will be available to the market within a short time.

ALPHA GRAPHICS ENTERPRISES, a newly organized company providing a magnetic tape to microfilm conversion service, is now in full operation with headquarters in El Segundo, California. The service is built around the Stromberg Carlson SC 4020 Micro Recorder System that offers the unique capability of producing charts, graphs and reports at high speeds directly onto microfilm from magnetic tape input. The system eliminates many steps normally required for microfilm production. Charts, graphs, pictorial plots and perspective views are produced to extreme accuracy on the SC 4020 Micro Recorder . . . FAIRCHILD SPACE AND DEFENSE SYSTEMS, Paramus, N.J., is providing slow scan television monitors for the Apollo program. The units, the first of which have recently been delivered to NASA, will be installed at ground and shipboard receiving stations of the Manned Space Flight Network throughout the world. The equipment will be used to display television pictures transmitted to earth from Apollo spacecraft. In the early stages of the flight, photographs of the astronauts and the instrument panels will be displayed. Later, after the astronauts transfer to the lunar excursion module, photographs of the moon itself will be returned.

ID Products

Data Coupler

Anderson Jacobson, Mountain View, Calif., offers the ADC 260 Acoustic Data Coupler, a device for sending and receiving data between a remote terminal and a computer using any ordinary telephone desk set and phone line. It is used typically with a Model 33 or 35 Teletypewriter but can also be used with any machine or display which can operate with a 103A Dataphone. Used with a Teletypewriter, the combination is said to provide a remote computer terminal which can easily be wheeled from one room to another wherever an ordinary telephone is available. Coupling with the telephone system is acoustic both into and out of the telephone system, assuring compatiblity with telephone handsets of various magnetic field configurations. No direct connection to telephone equipment is required. Operation is independent of signal level, above a required minimum, and no adjustment is required.

Circle Reader Service Card No. 56

Deflection Amplifiers

Beta Instrument Co., Newton Upper Falls, Mass., has announced a new family of deflection amplifiers, Models DA113, DA114, and DA115. These all silicon solid state modular packages are said to feature high deflection performance characteristics at low cost. They are DC coupled operational-type difference amplifiers and are designed for application in any cathode ray tube or storage tube display system employing magnetic deflection. The units are said to be capable of supplying plus or minus 2.5, 4.5, and 8.0 amperes of deflection current respectively to a directly-coupled deflection coil. The modules have two identical channels of power amplification — one for X deflection and one for Y deflection.

Circle Reader Service Card No. 57

Multiple Switch

American Zettler Inc., Costa Mesa, Calif., offers Series T-596 multiple switch. The device features six PDT contacts in less than one sq in.; overall depth behind panel is 1.5 in. Square buttons can be mounted in tight parallel rows to form a block. All contacts are said to be inside a plastic housing, which provides protection against penetration of foreign particles. The firm claims that no lubricant is needed as metal parts rub against nylon.

Circle Reader Service Card No. 58

Vacuum Tube Readout

Industrial Electronic Engineers Inc., Van Nuys, Calif., has announced a single-plane, Vacuum Tube Readout. The tube, a 10 Gun CRT, possesses an electron projection system that is said to display characters with clarity and brightness onto a fluorescent screen. Easily viewed under direct sunlight, features are said to include powerless control grid switching, low power consumption (approx. 300 milli watts), and small grid swing.

Circle Reader Service Card No. 59

Miniature Indicators

Alco Electronic Products Inc., Lawrence, Mass., offers a numeric readout indicator. Illuminated ¾ in. digits are indicated on an engraved lucite plate which is edge lighted by a new type, long-life incandescent lamp. The figures are marked as a series of white dots and are clearly displayed. Function of the lamps is to provide life up to 30,000-50,000 hours. They are said to be soldered in place to eliminate improper contact problems. Type 2181 or 2182 lamps are physically mounted in odd and even sectors. Narrow width of the indicators is said to allow for more numeric readouts to be displayed and installed in limited space areas. Overall size is 2½ in. high x ¾ in. wide.

Circle Reader Service Card No. 60

Space Control

D.E.C. Associates, Los Alamitos, Calif., offers Model 612, an addition to the firm's line of Opti-Man Space Control Centers. The model, designed as a tool holder, measures 10 x 19 x 5½ in. and weighs 2 lb. All tool holders and parts compartments are within the user's normal reach pattern in contoured tiers to provide a quick natural grasp of tools and parts. All models are molded of polyethylene plastic and are said to be chip and rust proof and resist acids, alkalis, paints and stains of all types.

Circle Reader Service Card No. 61

Plotting System

California Computer Products Inc., Anaheim, Calif., offers the Model 835 electronic digital plotting system, which is said to add a new dimension to the concept of digital plotting. The high-speed, fully-incremental digital plotting system provides a CRT plotter with provision for photographic recording, and operates at about 300 times the plot speed of the electro-mechanical pen-on-paper plotters.

Circle Reader Service Card No. 62

Button Switch

Transistor Electronics Corp., Minneapolis, Minn., has developed a new subminiature pushbutton switch, the SBS Series, to conserve panel space on instruments, computers, data processing, industrial control, and missile guidance systems. The unit's body measures only 0.360 in diameter by 0.468 in. long. It mounts from the rear with a knurled nut in a 1/4 in. hole on mounting centers as close as 3/8 in. It will fit 1/16 in. to 3/16 in. thick panels. The switch is said to be rated for one million cycles of operation while carrying its full rated design current of 100 ma at 115VAC, non-inductive load. Gold finished brass turret terminals are electrically isolated from the switch body. Plastic pushbuttons are offered in seven different colors and may be hot stamped with one character up to 1/8 in. high. Operating and storage temperature range is from —40 deg to +65 deg. at 95% humidity, maximum.

Circle Reader Service Card No. 63

High Precision System

Brower Laboratories Inc. Westboro, Mass., offers the 131 Lock-In Voltmeter, a new device for measuring very weak radiant energy. Depending upon the detector, the system operates over the entire spectrum from ultraviolet to far infrared. The device is used in laboratories for spectro-chemical analysis, detector evaluations, measurement of filter transmissions, and for reflectivity measurements. It is designed to function directly with any monochromator, light source, or detector. The company supplies a full line of accessories including beam splitters, choppers, chart recorders, synchroscopes, ratio measuring systems, and maintains a technical staff to provide assistance in customer applications.

Circle Reader Service Card No. 66

Binary Encoder System

Baldwin Electronics Inc., Little Rock, Arkansas, offers a small size parallel natural binary encoder system which uses a Baldwin photoelectric absolute position, direct reading, single turn encoder with a lamp life in excess of 50,000 hours. The system has a capacity of 11-bits per turn, outputs compatible to most D.T.L. and T.T.L.I.C. Logic and requires only two supply voltages including the lamp voltage.

Circle Reader Service Card No. 67

Light Pen

Information Control Corp., El Segundo, Calif., offers a new high sensitivity light pen. Through the use of a phototransistor as the light sensing element, the fiber-optic bundle usually employed in such devices has been eliminated, which is said to have resulted in a unit lighter in weight and not requiring high voltages. Designated Model LP-200, the pen also features a touch-sensitive actuator which has no moving parts. In order to permit the device to see light, the operator touches a metallic band placed where the index finger naturally falls during an operation.

Circle Reader Service Card No. 68

TV Disc Recorder

General Electrodynamics Corp., Garland, Texas, offers a television disc recorder said to be capable of recording on one disc up to 1,000 individual pictures. The selection and instant display of any desired frame on one or more standard television monitors is done by dialing a 3-digit number as on a telephone. The recorder is the nucleus of several new GEC product lines whose markets will be banks, insurance companies, and other commercial enterprises. Information can be stored on the recorder indefinitely. Both recording and erasure can be performed automatically by pressing the appropriate button on a remote control push button control box.

Circle Reader Service Card No. 69

Tandem Typing

A four-in. square electronic attachment is said to double the output of MATE, Milgo Electronic Corp.'s Automatic typing equipment. The new accessory, Bi-Type, attaches to a MATE reader, the memory device for the typing system. Two electric typewriters with a Bi-Type attachment operate simultaneously, at speeds up to 150 wpm. One operator can produce over 300 original typewritten sheets in one day, according to the company.

Circle Reader Service Card No. 70

Miniature Display

Bowmar Instrument Corp., Fort Wayne, Indiana, offers a new miniature readout which is operated directly from digital computer codes, eliminating from the display any mechanical or analog-to-digital assemblies, drives or servos. Wholly electrical, the DA3300 Logicator is said to incorporate any solid state modules required for interfacing with BCD, LBC, or any other available digital signal information. The package is available with from three to eight 12-position readout drums, and contains its own gating circuits, time-sharing capability, data storage and suppression circuits. Drums are internally backlighted, adjustable for any dark or bright environment. The 0.2 in. high characters are white on black fields, but are translucent for typical red display in darkness.

Circle Reader Service Card No. 81

Pushbutton Controls

Unimax Switch Div., Maxson Electronics Corp., Wallingford, Conn., has announced a new line, the Unimax LPB Series 9. It consists of four-lamp lighted panel controls designed to meet the requirements of MIL-S-22885. Features include single screw mounting, two-step relamping and factory-installed internal lamp bussing. The line is offered with customized messages in a wide range of display styles and color coding. They are available with two, three or four pole momentary or alternate action switching. The switches are of modular design. An added feature is an ordering system which permits the switches to be chosen by component groups, whether for a complete assembly or for a separate subassembly.

Circle Reader Service Card No. 82

Strip Printer With Take-Up Spooler

Clary Corp., San Gabriel, Calif., offers the AN-16 Strip Printer, which utilizes "on-the-fly" printing techniques as used in large online computer output printers. The mechanisms have been reduced to five functional sub assemblies. Complete unit with electronics has been miniaturized to easily install in instrument panels of large systems where hard copy data recording is required. The unit weighs 5½ lb and occupies 200 cubic in.; it was designed to meet applicable sections of Mil-E-5400 and Mil-1-26600. Printed information is presented serially to the operator at up to 25 characters per second with a selection of 64 characters; printer can be adapted to accept any parallel 6 line BCD code at several interface logic voltage options requiring low driving currents limited by the 5 K ohm input impedance.

Circle Reader Service Card No. 83

Display Line

A new line of position displays, Vu-Point II, has been introduced by Remex Electronics, Hawthorne, Calif., a unit of Ex-Cell-O Corp. Vu-Point II is a sealed unit utilizing integrated circuitry. Readout is obtained through display tubes framed by a black panel for maximum contrast. Size and weight of the units is said to allow installation in a variety of locations to facilitate convenient viewing. The Displays are said to be applicable to almost any manually operated and/or numerically controlled machine tool. Applications also are being made to inspection and layout equipment.

Circle Reader Service Card No. 84

Miniature Switches

Alcoswitch, Lawrence, Mass., offers a new double pole ON-ON-ON miniature switch. They are designed to have "on" positions at opposite ends of the lever throw with an active Center position. They are available in three series: Premium E Series, Standard MST Series, and Mustang Series with 15/32 in. hole. Current ratings are 6 Amps at 125 VAC, MST Series 3 Amps at 115 VAC.

Circle Reader Service Card No. 85

Digitizer

DATA Technology Inc., Watertown, Mass., offers a coordinate digitizer with a resolution of 0.005 in. and accuracy of ±0.001 in. The unit is intended primarily for use as an Image Plane Digitizer, as well as for Graphical Digitizing. Positioning is accomplished by means of steel scales ruled with 500 lines per inch and mounted on the carriage-way in the X axis and along the slide-arm in the Y axis. Linear incremental encoders are coupled in the X and Y axes to produce 2000 bi-directional counts per inch of travel. Resultant position is displayed in six digits.

Circle Reader Service Card No. 86

Socket

Augat Inc., Attleboro, Mass., has announced test sockets which have large chamfered entry holes that guide component leads into sockets. Pin circles match those of IC's; wiping gold-plated contacts are said to assure low contact resistance after 100,000 insertions. The teflon body is designed for "push-fit" installation. Continuous operating temperatures up to 150 deg may be attained; the sockets are available in 3, 4, 6, 8, 10 and 12 contact arrangements.

Circle Reader Service Card No. 87

Hi-Q Deflection Yoke

CELCO, Mahwah, N.J., offers the YA Deflection Yoke, designed for ⅞ in. neck CRTs with 52, 70, or 90 deg deflection angles. It is available as a yoke and in combination with a pincushion corrector or a centering device, or both. The Front Flare is said to eliminate borderline neck shadow and glass envelope interference problems. The special high Q ferrite core is claimed to provide high sensitivity in resonant drive circuits.

Circle Reader Service Card No. 88

Film Processor

A machine that processes CRT recording film at up to 30 in. per minute, and permits access moments after processing, has been developed by Mark Systems Inc., Santa Clara, Calif. Called Model 1200 Rapid Access Film Processor, the machine accepts any 35mm films used in CRT cameras. Semi-archival quality is said to be achieved without post-processing. Up to 2400 ft of film can be processed with one loading of commercially available, high-energy chemicals. Two units make up Model 1200. A chemical supply module houses the necessary processing chemicals (developer, clearing solution, rinse solution) and pumping apparatus. Devices for transporting, processing, and storing the film are contained in a processor module. The modules are connected by short lengths of cable and plastic tubing.

Circle Reader Service Card No. 89

Solid State EL Instrument

Aerospace Products Research Corp., Santa Monica, Calif., has developed a low-power, solid-state, digital-computer-driven, electroluminescent (EL), multimode digital display. The instrument was developed for NASA's Ames Research Center for use in laboratory simulations. The unit, the Vertical Scale Indicator Model VSI-DSP, is a bargraph that can, on computer command, be transformed into a pointer or marker. Automatic scaling, a flasher-warning mode, and parameter title indicator for multimode operation are included in the instrument. A constant light output for the lifetime of the display is said to be provided by automatic brightness control.

Circle Reader Service Card No. 90

Indicator Lights

Circon Component Corp., Santa Barbara, Calif., offers a new line of Bug Eye shaped indicator lights. Offered in 24 different shapes, including stars, circles, diamonds and squares, the indicators are said to provide message flexibility through various shapes and colors of lens. They are 29/32 in. overall length, with a barrel diameter of 3/8 in., and are furnished in incandescent and neon, in single and double contact models. They can also be used to replace existing lamps.

Circle Reader Service Card No. 91

Digital Drafting System

Benson-Lehner, Van Nuys, Calif., has announced a new digital drafting system which operates at speeds over 700 in. per minute, with an overall system accuracy of 0.002-in. Resolution is 0.001 in. The DDS is designed specifically for automated drafting, numerical control, configuration lofting, engineering fabrication and artwork masters used in stacking of integrated circuits and wafer-thin components, as well as other production engineering requiring exact registration and ultra-close tolerances.

Circle Reader Service Card No. 92

Display Converter

Pacific Measurements Inc., Palo Alto, Calif., offers two new CRT Display Converters. The basic converter enables a recorder to provide a large, precisely scaled plot of a CRT display. It is an interface device which fits between any oscilloscope and X-Y or strip chart recorder. The first new device, the PM 1001-02, enables the instrument to operate properly with curve tracers. New circuitry senses the absence of a sampling pulse which causes the pen-lift relay to energize and the retrace circuit to cycle. The device senses the end of the CRT trace, lifts the recorder pen and initiates retrace. An additional control allows the operator to set the recorder vertical start point even though the CRT trace starts after the first vertical graticule line.

Circle Reader Service Card No. 93

Film Viewer

Northrop Corp.'s Nortronics Div., Palos Verdes, Calif., offers a film viewer which magnifies images up to 70 times for precision interpretation and evaluation of film. The Model-100 uses the zoom lens for continuous variable magnification between the 3 to 70 times ranges, and provides close-up study of any part of any frame. Suggested applications include: reconnaissance imagery analysis; field map evaluation and preparation; meteorological satellite photo evaluation; geophysical surveys and studies; and photointerpretation training. Data on film rolls up to 1000 ft long, between 70-mm and 9½ in. wide can be accepted, and all types of film can be handled, such as infrared, thin or standard base, or radar sensor film.

Circle Reader Service Card No. 94

Television Camera

A new solid-state television camera for continuous operation in untended locations and under extreme environmental conditions has been introduced by Raytheon Co., Lexington, Mass. The RGS-20 camera is a commercially-available version of a similar camera developed for monitoring hazardous areas and for information transfer in the nation's space program. It is said to be well adapted to military and industrial security installations, and to process observation in difficult areas such as high temperature areas in foundries. Measuring 5½ in. in diameter by 10 in. long, the camera is said to have a minimum horizontal resolution of 800 lines.

Circle Reader Service Card No. 97

Binary Input Display

Industrial Electronic Engineers Inc., Van Nuys, Calif., offers a total display package utilizing Silicon Controlled Rectifiers as the basic solid state component. Accepting a binary input, a 1 in. message is automatically projected on the viewing screen. Operating on a rear projection principle, the display unit is said to be one half the cost of comparable equipment. Requiring an eight line input (BCD Code), the display utilizes ten outputs to drive ten lamps with a twelve output option available. External voltage is required for the logic circuit as well as for the lamps. All of the SCR units are designed with forbidden code rejection. Should an improper code be applied, a blank viewing screen is indicated.

Circle Reader Service Card No. 98

Radar Simulator

Canoga Electronics Corp., Chatsworth, Calif., offers a new Video Target Simulator designed for use as first echelon field maintenance equipment. The Model MRP-180 Radar Signal Simulator is one of the latest in a family of video target simulators designed for servicing tactical aircraft exercising terrain-avoidance and air-to-ground radar modes. The MRP-180, which generates simulated air-to-ground video targets and range marker targets for use with monopulse radar systems, is said to feature sum, bi-polar difference and MRI video pulses whose widths and slopes vary as a function of range and grazing angle for use in the maintenance and calibration of the latest terrain-following radar systems; video pulse characteristics are continuously varied over a dynamic range of 300 to 1.

Circle Reader Service Card No. 99

Map and Chart Digitizer

Calma Co., Santa Clara, Calif., has introduced its Model 480 Digitizer, a device for reducing analog graphical data from large maps and charts to digital magnetic tape for computer processing and analysis. It is said to feature Variable Interval Programmed digitizing, a solution to the limitation on graphical data reduction speed imposed by the relatively low speed of available output devices. As the operator manually traces the graphical data with a stylus, the movements of the stylus are converted to digital signals for recording on the output (computer-compatible, 7-channel, 556 bpi) magnetic tape recorder. The VIP digitizing system allows an overall maximum digitizing speed of 937 in. per minute with a resolution of 0.005 in. Accessories are available to permit reduction of data from projected 16mm, 35mm, and 70mm film images, paper tape output, direct interface to an IBM 1130 computer.

Circle Reader Service Card No. 100

New Literature

VALVES BULLETIN. Walworth-Aloyco Ball Valve Div., N.Y., offers a new 4-page bulletin describing their stainless steel screwed end ball valves for 960 WOG service. Bulletin 55-661 includes illustrations, drawings, pressure/temperature charts, dimensions and parts lists for valves ranging in size from ¼ to 2 in. Valves feature reinforced TFE in seats and floating ball design for tight closure, fire safe construction through stem, seat and body and locked in stem construction as safety against blow-out. The bulletin offers a listing of Walworth-Aloyco manufacturing and administrative facilities, warehouses and sales offices in the US and overseas.

Circle Reader Service Card No. 102

THE V8 STORY. Agnew-Higgins Inc., Garden Grove, Calif., offers a 95-page book descricing a modular blower-filter unit for laminar flow clean rooms. Case histories of how major aerospace companies have constructed their own laminar flow clean room from the initial design stage right through to final check-out and operation are included. The book contains 50 pages of illustrations in the form of photographs, charts and diagrams.

Circle Reader Service Card No. 103

MULTIPLE SWITCHES. A 4-page, 2 color brochure on the Series T-596 multiple switches is available from American Zettler, Inc., manufacturer of relays, switches, and other electromechanical components. Switches described feature both square and round button types, either illuminated or non-illuminated. Schematic drawings of the switches are included, as are socket diagrams, suggested panel layouts, and a table of switch characteristics.

Circle Reader Service Card No. 104

STYLE RECORDERS. A new short form catalog in file folder form listing the complete line of XY and Omnigraphic™ style recorders is offered by Houston Omnigraphic Corp. Included are several new products, including the new 6400 line of XY and XYY' recorders, Incremental Plotters for use with computers and other incremental output devices, digital plotting systems. The catalog includes condensed technical descriptions, specifications and prices.

Circle Reader Service Card No. 105

PILOT LIGHT CATALOG. Industrial Devices Inc., Edgewater, N.J., offers a new 4-page brochure on its mini-slide pilot lights, light assemblies, individual sockets, multi-socket strips and short slide-base lamps. Complete details are provided on connections, mounting and assembly, along with all dimensional data. Highlighted is the new Model 2800 Series Pilot Light Assembly, which features round, light diffusing screw-in lenses in a variety of colors.

Circle Reader Service Card No. 106

SWITCH CATALOG. Trompeter Electronics Inc., Chatsworth, Calif., offers a new Catalog M-4, which describes the firm's line of coax, twinax and triax matrix and multi-pole, multi-throw switches. The items are used for switching and/or programming, video data and RF signals, as used in TV computers, telemetry, and other data transmission systems.

Circle Reader Service Card No. 112

MEMORY BROCHURE. A 10-page illustrated brochure describes the fastest random-access large-scale memory system available, with access and cycle times of 300 and 650 nanoseconds, respectively, and a storage capacity of over 1 million bits: 16,384 words of up to 84 bits. Called the Nanomemory™ 650, the system is intended for real time or high speed computers and checkout systems. It is manufactured by Electronic Memories, Hawthorne, Calif., who offer the brochure.

Circle Reader Service Card No. 113

WORD INDICATORS. Master Specialties Co., Costa Mesa, Calif., offers a new 16-page catalog detailing the company's line of "Push-to-Relamp" miniature, illuminated word indicators for aircraft, aerospace, ground support, as well as industrial and commercial equipment. The catalog is called "Series 4000 and 5000 Push-to-Relamp Catalog No. 2026."

Circle Reader Service Card No. 114

SHORT ARC LAMPS. Complete specifications of the new PEK M914, M915 and M916 forced-air cooled lamp housings are included in a new two-page data sheet offered by PEK Labs Inc., Sunnyvale, Calif. Included is an outline drawing of the lamp housing, showing dimensions and location of components, controls and options. A transmission characteristics chart shows performance of the unit with and without the optional ultra-violet filter.

Circle Reader Service Card No. 115

SWITCH CATALOG. The Digitran Co., Pasadena, Calif., offers their 54-page thumbwheel switch catalog. It includes descriptions of all Digiswitch and Miniswitch units with complete technical data on each, truth tables showing codes and electrical output configurations, dimensional sketches, standard performance specifications, new revised prices, order blanks and typical applications.

Circle Reader Service Card No. 116

TAPE SYSTEMS. Ampex Corp., Redwood City, Calif., offers a new quick-reference brochure, No. CO26, which offers a brief description of the full line of Ampex digital tape transports and tape memory systems, which feature single-capstan design.

Circle Reader Service Card No. 117

CAPABILITIES BROCHURE. Proficiency in the field of specialized optical instrumentation is the subject of a new "Capabilities Profile" offered by the Lenox Instrument Co., Philadelphia, Pa. The 8-page booklet describes the company's design capabilities, manufacturing facilities, and many of the optical devices devised by the firm.

Circle Reader Service Card No. 121

TECHNICAL BULLETIN. Syntronic Instruments Inc., Addison, Ill., offers Advance Technical Bulletin No. 66-6, which describes two new shielded scan-converter deflection yokes, designed for 1½ in. neck diameter scan-converter storage tubes. Types C-5060 and C-5065 are said to provide a precision magnetic field by proper distribution and insertion.

Circle Reader Service Card No. 122

SHIELDED CHAMBER. Magnetic Shield Division, Perfection Mica Co., Chicago, offers Data Sheet 184, which illustrates and describes a new portable Netic Co-Netic shielded chamber. The chamber is used for convenient performance test evaluation of magnetically sensitive components or small systems where unavoidable magnetic fields exist.

Circle Reader Service Card No. 123

BULLETIN. Shelly Associates, El Segundo, Calif., offers Bulletin 66-040, which describes the firm's new TR-100 Decimal to Visual Translator, a high reliability module for translating decimal code into accurately energized seven-bar display segments.

Circle Reader Service Card No. 124

LAMP CATALOG. A new condensed lamp catalog that describes its line of lamps for low voltage lighting uses is offered by Hudson Lamp Co., Kearny, N.J. The incandescent lamps listed include miniature, sub-miniature, and micro-miniature styles. Ready-reference tables give specification data such as lamp no., style of base and bulb, as well as voltage, current, candlepower and life ratings.

Circle Reader Service Card No. 125

DATA SHEETS. Transistor Electronics Corp., Minneapolis, Minn., offers data sheets No. 543 and No. 544, which describe the firm's self-contained transistorized digital readouts. They are said to cost an average 30% less than fully enclosed models with identical electrical characteristics. According to the firm, such savings are possible because of new design principles which reduce assembly time.

Circle Reader Service Card No. 126

BOLD SYSTEM. The BOLD (Bibliographic On-Line Display) system for automated document storage and retrieval is described in a new brochure offered by System Development Corp., Santa Monica, Calif. The BOLD user, located at a station equipped with teletypewriter and CRT display, communicates with the computer, using a language approximating everyday English, to receive data from a stored document collection. The brochure lists the features of BOLD, which include: a browse capability, patterned after features found in conventional libraries; a search capability, and instant display of document numbers, titles, authors and abstracts.

Circle Reader Service Card No. 127

on the move

Memorex Corp., Santa Clara, Calif., has opened a new district office in Houston, Texas, and has named C. ARNOLD SCHLINKE as sales engineer for the Houston area, according to EDWARD S. SEAMAN, VP/marketing. Schlinke was most recently employed as an account representative in the Honeywell Inc. Computer Control Dept.

J. M. WRIGHT has been appointed VP/marketing for Interstate Electronics Corp., Anaheim, Calif., according to ALFRED V. GANGNES, president. Wright was formerly director of marketing for ITT Federal Laboratories.

ROBERT H. CRANSHAW has joined Raytheon Co. as special programs marketing manager for the firm's Equipment Division, Waltham, Mass. He was formerly with General Electronic Laboratories as vice president/general manager of their military division.

H. J. SMEAD has been appointed to the office of president of Teledyne Systems Co., according to GEORGE A. ROBERTS, president of Teledyne Inc., Hawthorne, Calif. Dr. Smead, also a corporate vp, has been general manager of the Systems' activity at Teledyne since 1963 and has had 13 years of experience in the electronic controls industry.

GEORGE P. RAYMOND has been appointed president of Raymond Engineering Laboratory Inc., Middletown, Conn., according to an announcement made by the Board of Directors; also elected were LINCOLN THOMPSON as chairman of the board and chief executive officer, and DONALD E. DONNELLY as vice president and treasurer. Mr. Raymond is the third member of his family to serve as president of the firm, which was founded by his father in 1938.

JAMES J. GORDON has rejoined the staff of LEL division of Varian Associates, Copiague, N.Y. He will be responsible for all engineering covering new designs, production problems, and the preparation of bids and proposals.

M. N. INGRISANE JR. has been appointed administrative assistant to president ROBERT BAWER, Radiation Systems Inc., McLean, Va. Ingrisano is responsible for the company's public relations program and the development of corporate communications techniques. He was formerly with Melpar Inc., as manager of marketing communications.

Information Displays Inc., Mt. Vernon, N.Y. has named DAVID L. PELTZ to the new post of product manager, according to CARL MACHOVER, IDI's vp/sales. Peltz will have major responsibility for the firm's growing line of computer controlled display equipment and systems.

Informatics Inc., Sherman Oaks, Calif., has announced the opening of a Boston office. RICHARD KAYLOR, vice president of the Northeast Region, stated that the new facility will be managed by MIKE LIPP and will serve the upper New England area. The firm specializes in the design, analysis, programming and implementation of on-line computer-based systems. The firm has also announced appointment of HERBERT JACOBSOHN as director/file management systems.

GEORGE M. BENAS JR., vp/marketing, National Co. Inc., Melrose, Mass., has announced the appointment of MATTHEW L. SPITZER as product manager, digital systems. In this newly created position, Spitzer will be responsible for marketing of digital systems and related equipment. Prior to joining National, Spitzer was product manager of the digital equipment group at General Dynamics/Electronics in Rochester, N.Y.

The appointment of DR. WILLIAM E. GLENN as staff scientist, CBS Laboratories, Stamford, Conn., has been announced by DR. PETER C. GOLDMARK, president and director of research of the Laboratories. Dr. Glenn is the holder of many patents in the field of electronics, and is known throughout the world for his pioneering work in thermoplastic information recording systems.

Electronic Memories, Hawthorne, Calif., has appointed RICHARD J. DADAMO to the new position of manager of core products. He will be responsible for all facets of the firm's ferrite core product line. The cores are used in memory devices for commercial and government applications. Dadamo was formerly general manager of Tek-Devices Ltd., the firm's wholly owned subsidiary.

JAMES J. PALERMO has been appointed vp/manufacturing, at Numex Corp., Waltham, Mass. He has full responsibility for the firm's production and quality control efforts for their products, consisting of electro-mechanical decoding displays and counting modules.

HAMILTON T. HOLT has been elected president of HITCVO, Gardena, Calif. He succeeds ROBERT M. DAISS, who has been both chairman and president, and will continue as chairman and chief executive officer.

ROLLA H. TAYLOR has been appointed product manager for Scott Testers Inc., a subsidiary of the Bendix Corp., Providence, R.I. The appointment was announced by DAVID C. SCOTT JR., president and general manager. Taylor will be responsible for coordinating Scott's engineering activities with the needs of the materials testing markets.

TAYLOR

STEVENS

VAN M. STEVENS JR. has been appointed corporate advertising manager for Raytheon Co., Lexington, Mass. He will plan and implement advertising and promotional programs as an integral part of the company's overall public relations activities. Stevens has been advertising manager for Raytheon's Components Division since 1965.

Astrodata Inc., Anaheim, Calif., has announced three new executive appointments. WALLACE E. RIANDA has been elected chairman of the board of directors and chief executive officer. THOMAS ALLINSON was elected president and a director, and GRANVILLE K. HERSHEY JR., was elected treasurer.

PETER V. BELLINO JR., has been assigned marketing liaison responsibilities in the Eastern US for Motorola's Government Electronics Division instrumentation products line. CARL P. NIERZWICKI, director of marketing, announced that Bellino will retain his present position of senior representative, and will continue representing Motorola with industrial contractors and some government agencies in the greater N.Y. area.

C. GORDON MURPHY, division president, has announced the appointment of HERMAN S. DICHTER as director of Advanced Airborne Command and Control Systems at the Data Systems division of Litton Industries, Van Nuys, Calif. Dichter was previously associated with Hughes Aircraft Co., where his most recent assignment involved management of the Tow-Wire Guided Anti-Tank Weapons System Program.

The appointment of CARL M. KLUG to the technical staff of h nu systems inc., Menlo Park, Calif., has been announced by H. G. HEARD, vp/technical director. Klug was previously with the American Optical Co. and Perkin-Elmer. The firm is a subsidiary of the Ohio Steel Foundry Co., Lima, Ohio.

REAR ADMIRAL SAMUEL FRANKEL (USN Ret.) has been named manager of System Development Corp.'s Technical Information Systems Department, Santa Monica, Calif., it was announced by DR. THOMAS C. ROWAN, SDC vp/manager of the Advanced Systems Division. Adm. Frankel is responsible for SDC's contractual operations and work in library systems, documentation systems, natural language data systems, and information systems in support of science and technology.

The Board of Directors of D. B. Milliken Co., Arcadia, Calif., has named THEODORE H. TRUESDELL president. He was formerly First vp of the company. DONALD B. MILLIKEN, formerly president and chairman of the board, will continue as chairman of the board.

ANDREW J. FORSTER has been appointed corporate manager of Management Information Systems at Electronic Associates Inc., West Long Branch, N.J. Forster will direct the development and implementation of computer-oriented information systems for management planning and control functions within the company. Prior to joining EAI, Forster was an associate with the Computer Systems Division of Booz, Allen and Hamilton Inc.

ROBERT B. FORSYTH has joined Union Carbide Corp.'s Carbon Products Division, New York, as applications manager in the advanced materials department. He will concentrate his efforts on Thornel graphite yarn and other carbon and graphite textile materials used primarily by the aerospace industry. For the past 15 years, Forsyth has been with Owens-Corning Fiberglas Corp.

MICHAEL V. BURRIDGE, commercial manager for Radio Engineering Laboratories, L.I., N.Y., has been named director of marketing, according to FRANK A. GUNTHER, REL president. Burridge will be responsible for coordination of all marketing activities, including military and commercial sales for domestic and international customers.

Computing and Software Inc., Panorama City, Calif., has announced the appointment of FRANK D. RUSSELL as general manager of its Biodata Division, located at Edwards, Calif. He was most recently data systems supervisor at C & S Maryland Division, Greenbelt, Md.

The appointment of DR. C. THOMAS GOLDSMITH to head the newly formed systems and analysis section for the Paramus operation of Fairchild Space and Defense Systems division of Fairchild Camera and Instrument Corp. has been announced by FRANKLIN I. BOLNICK, director of engineering. Dr. Goldsmith will head a group which develops concepts and preliminary designs of systems, performs systems synthesis and analysis, conducts experimental studies for the company and the government, and engages in applied research.

DR. GILBERT KASKEY has been named to the newly-created position of director of systems for Sperry Rand Corp.'s UNIVAC Data Processing Centers Division, Philadelphia, Pa., according to an announcement by FRANCIS A. ROWE, general manager of the division. Dr. Kaskey will be responsible for systems and application development and other activities concerned with increasing the service capabilities of the Data Processing Centers Division.

GEORGE FLINT, manager of the Central California Coast Chapter of the National Electrical Contractors Association has reported that EARL D. COYNE, formerly head of the Montana N.E.C.A. chapter, has been appointed director of public and labor relations. Coyne was manager of the Montana chapter for nine years; he previously was with General Foods Corp. for eight years.

WILLIAM H. MYERS has been appointed manager/marketing department, RCA Television Picture Tube Division, New York, it was announced by H. R. SEELEN, division vp/general manager. Myers will be responsible for the overall marketing activities for RCA television picture tubes. He joined RCA in 1930 at the Harrison, N.J. tube plant.

ROBERT H. SCHERER has been appointed vp/general manager of Control Data Corp.'s Space and Defense Systems Group, Minneapolis, Minn. During the past 13 years Scherer has held several key positions in the Federal Government. Since 1963, he has been assistant director for command and control in the Office of the Director of Defense Research and Engineering (Department of Defense).

EDWARD MEAGHER, vp/marketing, has announced three new appointments by the Semiconductor and Receiving Tube Division of Amperex Electronic Corp., Slatersville, R.I. E. ALVIN RICH has been named marketing manager, Industrial and Military Sales, and CARLO J. SABETTI has been promoted to product manager, Instrument Control and Data Processing. WALTER F. BOSSE has been named product manager, Entertainment Tubes.

EDGAR A. POST has been appointed to the newly-created position of program mgr. for aviation products at Granger Associates.

JOHN STONE has been named chief research and development engineer for Parker Seal Company, Culver City, Calif., according to PAT PARKER, president. Stone will be responsible for all R&D activities of the main Parker plant as well as the facilities in Los Angeles, Kentucky and Mexico City.

THOMAS E. FLANNIGAN, a Northrop employee since 1953, has been named vp/marketing and planning in Northrop Corp.'s Ventura Division, according to GEORGE F. DOUGLAS, corporate vp/general manager.

DR. ROBERT MORRIS PAGE, who built the first pulse radar system for the detection of aircraft by radio, retired as director of research for the Naval Research Laboratory, Washington, D.C., ending nearly 40 years' service with the Laboratory.

RONALD W. LACKIE has been appointed contracts mgr. for Philco Corp.'s Aeronutronic Div. Tactical Weapons Systems. R. T. WISE will assume Lackie's former position as contracts mgr. for Re-Entry and Space Systems.

DR. WILLIAM HAYWARD PICKERING, dir. of the Jet Propulsion Laboratory of the California Institute of Technology, has been decorated with the "Commander" of the order of merit of the Italian Republic, in recognition of his cooperation with the International Institute of Communications in Genoa.

LLOYD THOMPSON has been appointed dir. of Military Escape System Technologies at Weber Aircraft, a div. of Walter Kidde & Co. Inc., assuming the position of the late WALLACE ZIEGLER.

ROBERT N. JOHNS, mgr. of Advanced Logistics, MSSD, Douglas Aircraft Co., Santa Monica, Calif., has been named the recipient of the 8th Annual Greer Award by the National Security Industrial Association in recognition of his contribution to Department of Defense (DOD) product support systems.

DONALD J. MURPHY has been appointed VP/Operations and KENDAL I. DAZEY has been appointed VP/Finance for Applied Technology Inc., Palo Alto, Calif., it was announced by DR. WILLIAM E. AYER, president.

Sustaining Members

ADAMS ASSOCIATES, Bedford, Massachusetts

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BENSON-LEHNER CORP., Van Nuys, California

BUNKER-RAMO CORPORATION, Canoga Park, California

BURROUGHS CORPORATION
Defense, Space & Special Systems Group, Paoli, Pa.

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

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

CONRAC DIVISION, Giannini Controls Corp.
Covina, California

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

HUGHES AIRCRAFT COMPANY
Vacuum Tube Products Div., Oceanside, California

ITT FEDERAL LABORATORIES
A Division of International Telephone and Telegraph Corp.
Nutley, New Jersey

LING TEMCO VOUGHT
Military Electronics Division, Dallas, Texas

RAC 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

TELEVISO ELECTRONICS DIVISION
Doughboy Industries, Wheeling, Illinois

Correspondence

IN PRAISE OF ID

The staff of *Information Display* has been very helpful in providing requested information. For this, I thank you very much.

The magazine, along with *SID* Technical Proceedings, has provided me a very solid technical foundation for my work in the field of group displays. The appropriate articles are excellent reference material and the advertisements provide a ready source for vendor data. In short, I find the magazine very valuable.

DAVE FYFFE
General Dynamics Convair
San Diego, Calif.

SERIF VS. SANS-SERIF

It always saddens me to see a respected, responsible, and otherwise competent publication fall prey to the current compulsion of a misguided school of art directors and their camp followers in designing an entire format around the worst possible of all type styles for pure readability, namely, the sans serif faces.

Optima is a beautiful European type face of the modern school and can create unusually attractive results through judicious use and handling. But let's not spoil its inherent beauty by consigning it to a long, working text. That's like having a taut racing horse harnessed up to a farmer's plow, with equally unfortunate results.

Serifs play an extremely vital role in reading. They provide the minute distinctions in letter formation and configuration that enable the brain (through the medium of the eye) to recognize the specific identity of each letter and, in turn, the words. The greater the ease in recognition, the more comfort one experiences in reading — and vice versa. We call letters with serifs "Roman" letters. They have been with us now for several centuries but have been refined over the years by generations of type designers. Refinements are still going on by the type houses.

The chairman of publications for your society says in his editorial of your January issue that "*Information Display* is a communications medium." I agree and I would hope you would not interpose any handicaps between yourself and your reader in making it the best possible communications medium. He says further "Let's put more of our communicating skill to work within the society." This can be done most expeditiously by dropping sans-serif type in your magazine. Advertisers want a good medium in which to advertise. This is one reason why I take this initiative in writing to publishers.

I'd love to see you really live up to the truest implications of your name!

ROBERT C. HEYDA
Vice President
Caroe Marketing, Inc.
Briarcliff Manor, N.Y.

(Before ordering conversion to Optima type, the staff of Information Display *carefully researched the points raised by Mr. Heyda. Result: Optima provided readability and density (no. of characters per line) comparable or superior to any serif typeface. It is interesting to note that* Life Magazine, *which is designed for the largest possible audience, has extensively employed Optima in recent months. Readers possessing nonsubjective evidence to the contrary are urged to communicate with* ID *— Ed.)*

ID USEFUL

Sir:

We have followed the development of *Information Display* with great interest and have found it very useful to our company. I feel that you are making a significant editorial contribution to a growing field.

Your recent editorial on labor-management relations was well worth reading.

John L. Selover
Granger Associates
Palo Alto, California

INFORMATION REQUESTED

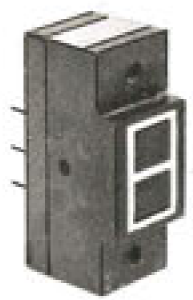
Please advise the availability and price covering "Binary to Decimal decoding system using Neon Lamps and a photoconductor Matrix," by Marvin Willrodt, as described in Nov/Dec. '66 Information Display.

J. W. BELL
Bell Engineering
Knoxville, Tenn.

(Mr. Bell and other ID readers interested in product particulars are invited to contact the author directly at Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif. 94304. — Ed.)

DiGiCATOR T.M.


SERIES 13


SERIES 16

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Delivery time on certain models of the TEC CRT Display System is as close as October 1. Now is the time to talk over your system's needs. Call Floyd. Or send for information.

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ID Advertisers

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