

whatever your computer says...

SELF-SCAN® SAYS IT BEST

PANEL DISPLAYS

ABCDEFGH

16/18 Character Position Panel, 5 x 7 Dot Matrix, Characters 0.4" High.
Available as numeric only or alphanumeric panel with 64-character format.

PQRSTUVWXYZ12345

32/37, 80 Character Position Panel, 5 x 7 Dot Matrix, Characters 0.2" High.
Alphanumeric panel with 64-character format.

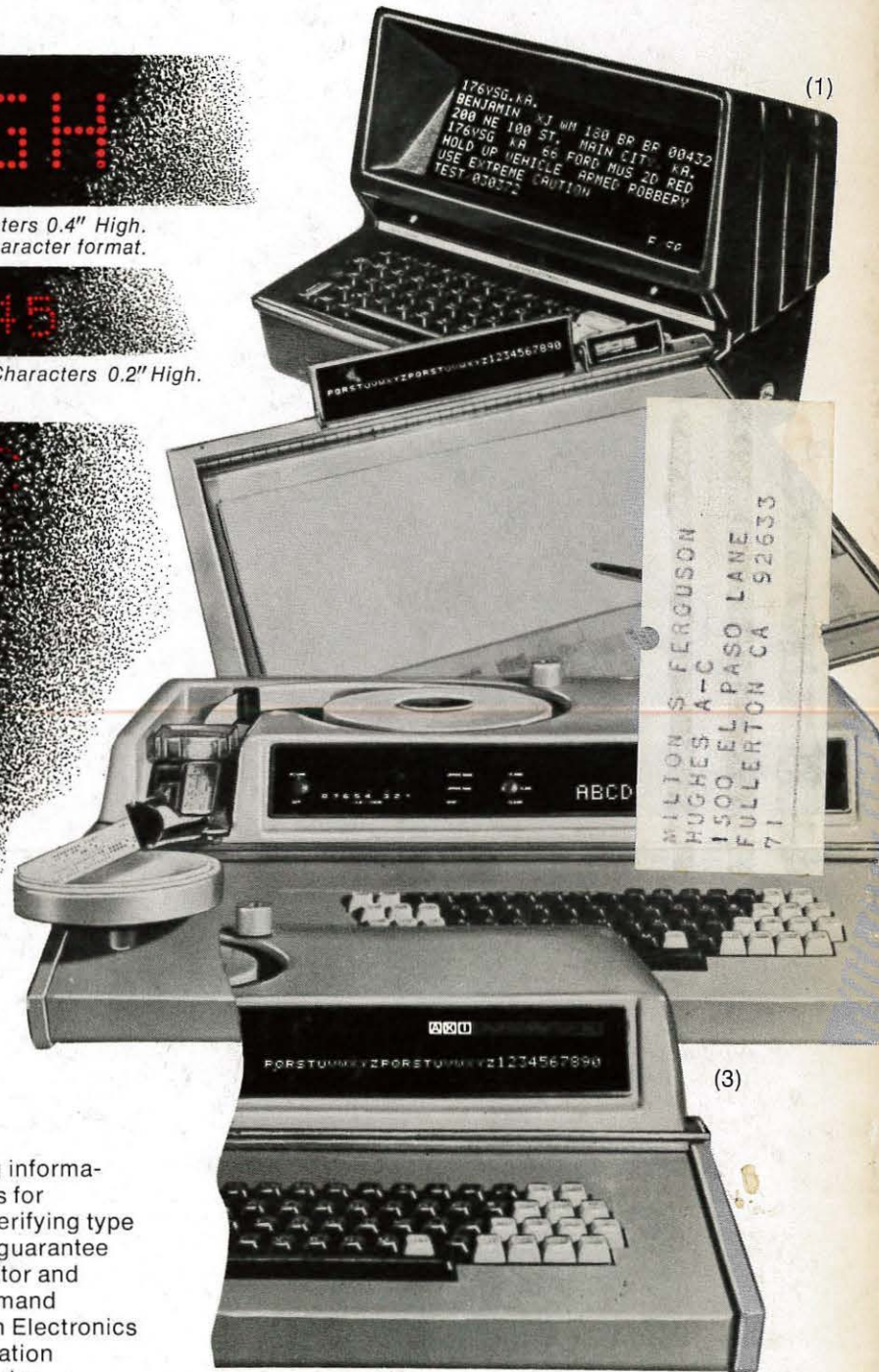
SELF-SCAN

NOW IN 256
FOR COMM
WITH ALL
ABCDEF
123456789
@~(30)

SELF-SCAN Panel Display Subsystem, 256 Character
Capacity, 5 x 7 Dot Matrix, Characters 0.25" High.
64-character format, available with all drive electronics
including memory, character generator, and timing.

Whether it's a police officer in a patrol car requesting information on a suspect, an architect specifying coordinates for plumbing fixtures in a new building, or a type setter verifying type for a mail-order catalog, SELF-SCAN panel displays guarantee the most accurate transfer of data between the operator and the computer. If you need a computer display and demand error-free communications, follow the lead of Kustom Electronics (1) in Chanute, Kansas; Science Accessories Corporation (2) in Southport, Connecticut; Automix Keyboards (3) in Bellevue, Washington, and the many other SELF-SCAN panel display users. Have a Burroughs salesman demonstrate his "terminal in a briefcase." You'll see why the SELF-SCAN panel display is the most effective man/machine interface device available today.

Burroughs Corporation, Electronic Components Division,
Plainfield, New Jersey 07061. (201) 757-3400.



Circle Reader Service Card No. 25

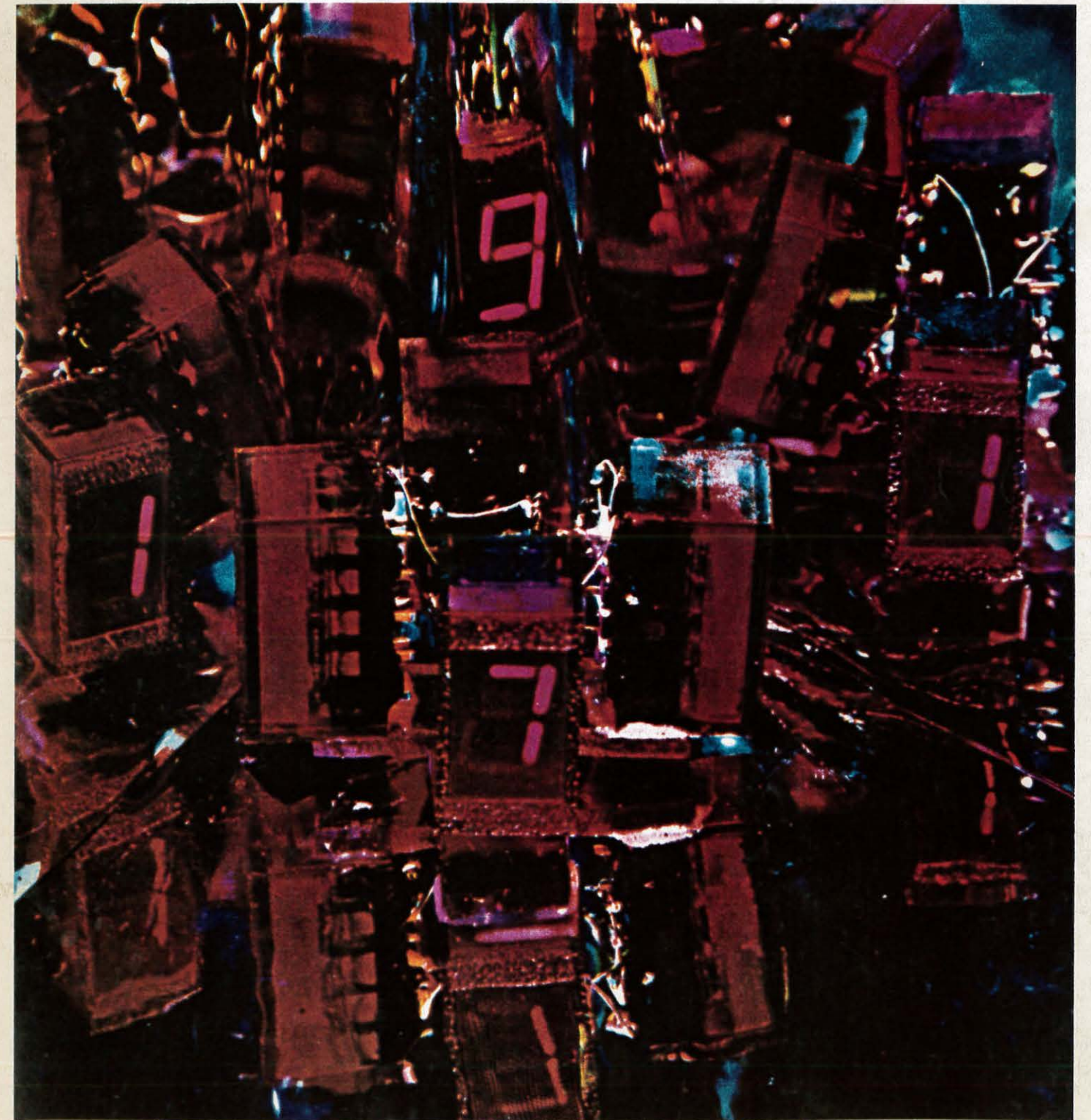
Burroughs



Volume 9 Number 6 November/December 1972

Information Display

The Journal of Data Display Technology



A Technology Publishing Corp. Publication



NEW FAITHFULS

The Setchell Carlson reputation for QUALITY and RELIABILITY is demonstrated over and over in every S.C. Electronics monitor and monitor/receiver with features such as plug-in circuit modules (pioneered by S.C. to assure operating dependability and ease of maintenance); 100% solid-state circuitry for maximum stability, long-life, low power drain, and a minimum of heat; up to 640 lines horizontal resolution; and regulated circuitry that provides extremely stable operation while preventing raster size or brightness deviations due to line voltage fluctuations.

Available in a broad line of screen sizes, Setchell Carlson products lack only one thing... a high price. Whatever the application, broadcasting, CCTV, Medical training, industrial TV applications, custom remote installations, industry, education, or many others, Setchell Carlson has the monitor you need.

Ask about them today at your nearest S.C. Electronics dealer, or write for full information and descriptive literature.

ALSO ASK OR WRITE FOR INFORMATION AND FULL-COLOR LITERATURE ON OUR QUALITY COLOR MONITORS.



SC ELECTRONICS, INC.
A SUBSIDIARY OF AUDIOTRONICS CORPORATION
530 5th AVE. N.W. ST. PAUL, MINNESOTA 55112
PHONE (612) 633-3131

Circle Reader Service Card No. 1

Published bimonthly by Barrington Publications, Inc., at 825 S. Barrington Ave., Los Angeles, Calif. 90049. Controlled circulation paid at Los Angeles, Calif. SUBSCRIPTIONS for U.S., its territories, possessions, and Canada \$20 per year. Foreign countries \$40 per year.

Volume 9 Number 6 November/December 1972

Information Display

The Journal of Data Display Technology

Table of Contents

Articles and Features

A SIMPLIFIED GRAPHICS LANGUAGE FOR MINI COMPUTERS	9
<i>D. Elms</i>	
Consideration of prior art and current developments in the growth of a drafting language designed to run on a small computer of the type used to control automatic drafting machines.	
A STORAGE OSCILLOSCOPE WITH PLASMA DISPLAY PANEL	14
<i>S. Umeda and Teruo Tuba</i>	
A storage type YT display apparatus with plasma display panel is described and problems for practical use are discussed.	
CUMULATIVE INDEX: 1964-1972, By Title and Author	17

Departments

EDITORIAL: The Graphics Are Here	7
SHOW COVERAGE: Shows of interest	27
ID PRODUCTS: Innovations from many firms	28
ADVERTISERS	30

The Cover

In this photograph, 1/4-in. light-emitting displays are arranged in a mirrored chamber to depict "1971." The digits are composed of arrays of light-emitting diodes. Abstract photo courtesy of Fairchild Camera and Instrument Corp.

MOONLIGHTER



The Sykes 2220 Cassette Tape Controller receives, stores and transmits data between terminals and communications lines all day long. Then after you've gone home, it keeps on working, taking advantage of lower telephone line rates. It does this by means of remotely issued commands.

Some of its other virtues are:

Versatility

- EIA or TTY current loop interface.
- One or two transport versions.
- Search capability—locate records in an average of 12 seconds.
- Multiple switch-selectable baud rates—up to 1800 baud asynchronous and up to 5400 baud synchronous.
- Variable record lengths.
- Unattended remote operation or keyboard control.
- Full editing capability plus copying and certifying.

Reliability

- Uses Cassette Tape Transports of time-proven design.
- MTBF in excess of 3000 hours.
- Data reliability field-proven to be up to 10⁹.

Economy

- Low unit price
- Liberal OEM discounts.
- No programming—simple installation.

Write or call for your free copy of the Sykes 2220 Cassette Tape Controller brochure and start moonlighting today.

SYKES

SYKES DATATRONICS INC. ®
375 ORCHARD STREET
ROCHESTER, NEW YORK 14606
(716) 458-8000 TELEX 97-8326

Circle Reader Service Card No. 2

INFORMATION DISPLAY, November/December 1972

5

WE HAVE A PROBLEM

...dammit!

Chances are, you've been receiving Information Display bimonthly — and without charge — for quite a few years. You've read solid, informative articles relating to major data display developments...news about people, projects and products...reports on forthcoming seminars and industry events...signed editorials by Rudolph L. Kuehn, a founder and first president of the Society for Information Display...and page after page of "meaty" material dealing directly with your professional interests.

But we can't continue.

Our "no charge" efforts (even with advertising to ease the financial sting) must now be terminated. We *must* ask you to pay for your 1973 subscription; the Nov/Dec issue is the last one we can send you free.

It hurts to give you a message like this. You've been a loyal reader over the years; if we didn't *have* to ask you to pay, we would never even bring up the subject. But we have no choice.

How much are we talking about? Normally, domestic subscriptions are \$20 per year. But if you give us your OK now we'll chop that down to \$15 per year, a substantial reduction. And you'll be getting better, more informative issues of Information Display than ever.

Will you take us up on this offer (which ends Feb. 1, 1973)? We can sure use your help. And you can continue to get uninterrupted value from Information Display.

Thank you,

The Staff of Information Display

PROBLEM SOLVED. Yes, I want to keep getting Information Display. Continue sending it to me at the special low rate of \$15 per year.

Name _____ Company _____
Address home () or company () _____
City _____ State _____ Zip _____
() Check enclosed () Bill me.

Mail to Problem Dept., Information Display, 825 S. Barrington Ave., Los Angeles, Calif. 90049.

This offer expires Feb. 1, 1973.

Information Display

Published bimonthly by
Barrington Publications Inc.
825 S. Barrington Ave. (213) 826-8388
Los Angeles, Calif. 90049

[Correspondence regarding feature articles, advertising, reprints and nonmembership subscriptions should be directed to the above address.]

EDITORS & PUBLISHERS . . . Martin Waldman
Hal Spector
EDITORIAL CHAIRMAN R.L. Kuehn
EDITORIAL COORDINATOR . . . B. Atchison
FEATURE EDITORS
T. Simkins C. Schmidt
M. Farley M. Wood
PRODUCTION MANAGER . . . C. Camburn
CIRCULATION MANAGER . . . P. Goldberg
BUSINESS MANAGER S. Graham
ADVERTISING Donald Meeker

CLOSING DATES—Editorial closing date is first of month preceding month of issue. Advertising closing is first of month preceding month of issue.

CHANGE OF ADDRESS notices should be sent promptly; provide old mailing label as well as new address; include ZIP code or postal code. Allow two months for change.

SUBSCRIPTIONS for U.S., its territories, possessions and Canada: \$20 per year; \$35 for two years; \$45 for three. Single copy price, \$4.00. Foreign countries: \$40 per year; \$70 for two years; \$90 for three years. Complaints concerning nonreceipt of magazines must be made within four months of issue mailing date.

EDITORIAL CONTRIBUTIONS must be accompanied by stamped return envelopes and will be handled with reasonable care; however, publishers assume no responsibility for safety of artwork, photographs or manuscripts. Every precaution is taken to ensure accuracy, but the publishers cannot accept responsibility for the correctness or accuracy of the information supplied herein or for any opinion expressed.

Guide to Contributors

1. Copy is to be typed, double spaced, on white paper.
2. Number manuscript pages consecutively.
3. Arrange material in sequence: first cover page containing your name and title of paper, summary page next, followed by manuscript, and ending with reference page in which previously numbered references are identified.
4. Refer to graphs, diagrams, illustrations in text as Figure 1, Figure 2, etc. Identify material on back, and include your name.
5. Send recent "mug shot," wearing business suit with shirt and tie. Please write your name on back of picture.
6. Enclose recent and brief resume, listing educational background, job affiliations and titles, professional accomplishments, and professional/technical membership.

©1972 BY BARRINGTON PUBLICATIONS INC. ALL RIGHTS RESERVED. REPRODUCTION IN WHOLE OR PART WITHOUT WRITTEN PERMISSION IS PROHIBITED.

CONTROLLED CIRCULATION POSTAGE
PAID AT LOS ANGELES, CALIFORNIA

Editorial



The graphics are here

Although we ordinarily reserve this space to comment upon the shortcomings and required improvements in our chosen field, this time we would like to express some satisfaction with the increasing appearance of moderate cost graphic terminals. For those who may not be aware of the product announcements in the past year or two, it should come as a pleasant surprise that graphics are truly here in price ranges that open the door to nearly any application. One need only peruse the advertisements or attend any of several equipment exhibits to recognize that the state of the display art has made a significant advance.

Even more than color, reasonably-priced graphic terminals open the door to countless applications which are limited only by the imagination. With graphics within the reach of smaller purses, there is the lurking danger of early setbacks due to inadequate application and field engineering such as that which still besets computers and alphanumeric terminals on occasion. Fortunately, there are indications that adequate support is, and will be, available from the manufacturer. This too bespeaks of the growing maturity in the display industry. At the same time, any tendency towards complacency on the part of the establishment is likely to be offset by the infusion of new blood which is in plentiful evidence.

As we approach the fourth year of this decade, we can look ahead with the expectation that man will be even better served by his machines through the efforts of the display community.

R.L. Kuehn

POLACOAT
LENSCREEN
REAR PROJECTION SCREENS

GLASS

Many users choose glass because of its durability, ease of cleaning, maximum scratch resistance and stability.



ACRYLIC

Preferred in specific instances, acrylic is break-resistant and lightweight.



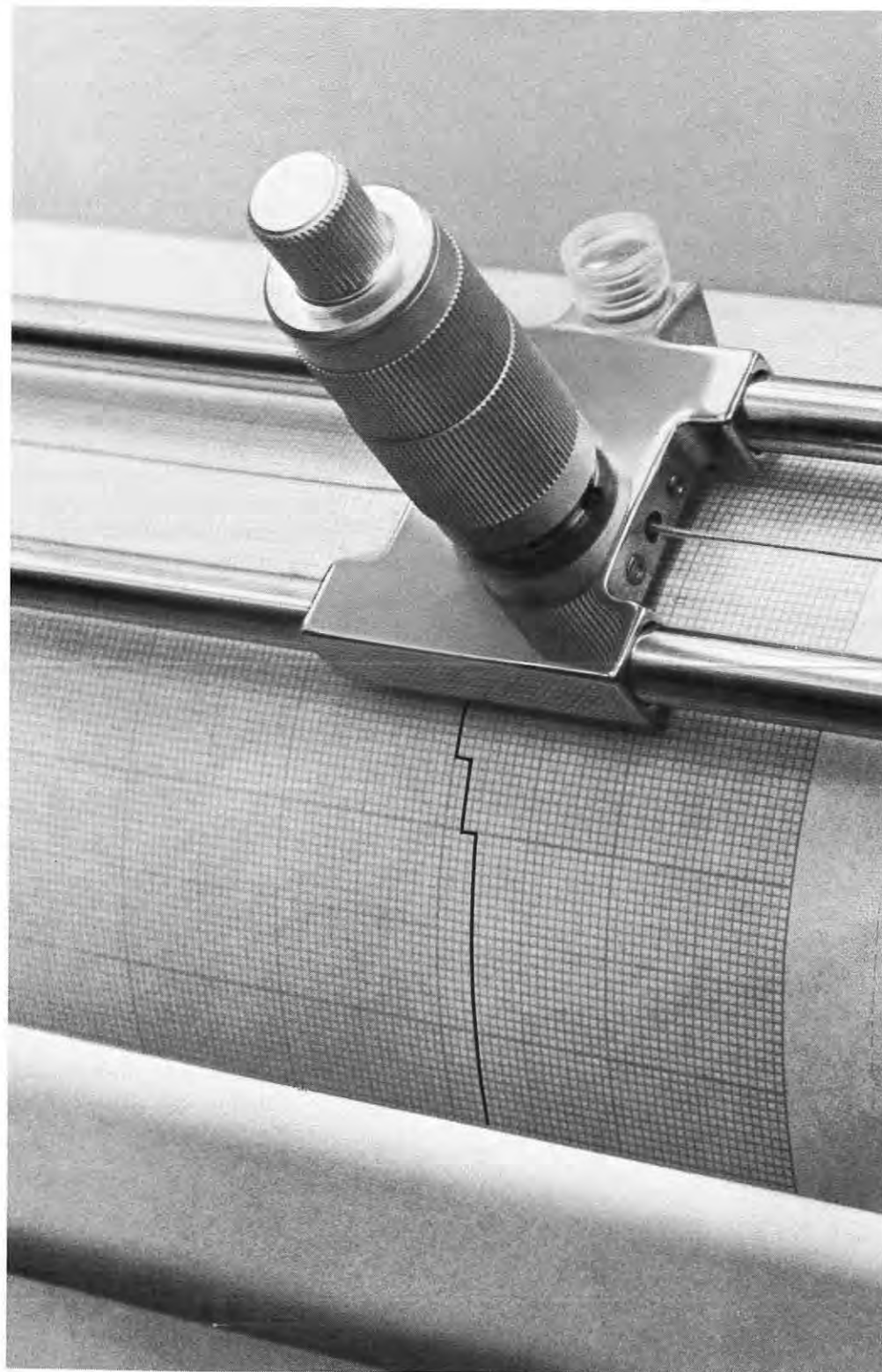
LENSCREEN
REAR PROJECTION SCREENS
OFFER YOU:

- Selection of Gain Ranges
- Excellent Resolution
- Moisture Resistance
- A variety of thicknesses
- Custom cut sizes
- Neutral gray
- Choice of colors
- Polished or No-Glare finish
- Hy-Dur finish available

Technical Assistance and
Data Available upon Request

POLACOAT, Inc.
9750 CONKLIN RD.
CINCINNATI, OHIO 45242

COMSTOC[®] papers and films. No hop, no skip, no jump.



When you're doing computerized plotting, a skipping pen is the last thing you want.

Or lines that blot. Or dumbbell. Or ink that dries improperly. Or plotting that reproduces poorly.

K&E took care of all that. Developed COMSTOC papers and films. With specially engineered surfaces, precision alignment, and precision inking.

End of trouble.

But we went further. We created all kinds of grid options—not just standard grids, but special grids, reverse side printing, matching colors, etc.

And then we formulated different grades of media for specific jobs. So we offer translucent paper, natural tracing paper, and parentized tracing paper (with an engineered drafting surface for fast, clean erasures, or additional drafting requirements). As well as HERCULENE[®] films (for permanent records and sharp reproduction). And scribe and peelable films for coordinatographs.

We'll also supply pens, inks, and pen cleaners—all specially designed to eliminate plotting problems.

And if you need special media, grids, or formats, we'll make them for you in 1, 2, 3, 4, or 5 colors. And repeats up to 54". Talk to your K&E representative. Or contact Keuffel & Esser Co., 20 Whippany Road, Morristown, N.J. 07960.

KEUFFEL & ESSER CO.



A simplified graphics language for mini computers

DUANE ELMS

Abstract

In the past, input to high quality automatic drafting machines was generated by large general purpose computers. These computers, while very powerful and very fast, have generally been inaccessible to drafting room personnel. This inaccessibility has resulted in several problems including long turn-around time, high cost of error correction, and lack of local control. To alleviate these problems, a drafting language was written which was designed to run on a small computer of the type used to control automatic drafting machines. This language provides a drafting room tool that is easy to use, works on local equipment, and allows easy error correction. This paper considers both prior art and current developments as related to the above situation.

Introduction

In the past ten years, automatic drafting technology has advanced considerably. Unfortunately, development of usable application software for this type of equipment has lagged far behind hardware development (see Figure 1). Due to this, only the largest companies with their large computing facilities have been able to take full advantage of automatic drafting techniques. Without suitable applications software for generating input for the machines, a small company simply cannot afford the high computational overhead required by today's graphics oriented software.

Graphics oriented programs have been written, but almost all of these require relatively large computer systems to be effective. As an example, the APT language, although not specifically designed for automatic drafting machines, does have post processors available which allow the output of the APT program to be input to automatic drafting equipment. The full APT system, however, requires a computing facility that only

the largest of organizations can support. Companies that have this computing power generally have it located at some distance from the drafting machine.

There are other software systems with provision for output for an automatic drafting machine. Many of these, however, are proprietary packages used particularly in aerospace, automotive, and tire design and development. There are also other software systems used mainly for design that have facilities for output in a form usable with automatic drafting equipment. The structural design program, STRUDL, often has drafting subroutines associated with it as do other design programs like ADAPT, COGO, and AUTOMAP.

A large portion of the graphics oriented software development has been oriented toward interactive CRT display systems. Great strides have been made in software in this particular area. Unfortunately, few of the software advances are applied to the hard copy graphics area. An example of software in this area would be IBM's GSP (Graphics Subroutine Package) language. GSP is a collection of Fortran subroutines designed to implement the data structure and interface between IBM's S-360 computers and their 2250 interactive CRT console.



Figure 1: Automatic drafting equipment.

© 1972 by Barrington Publications Inc. All rights reserved. Reproduction in whole or part without permission is prohibited.

INFORMATION DISPLAY, November/December 1972

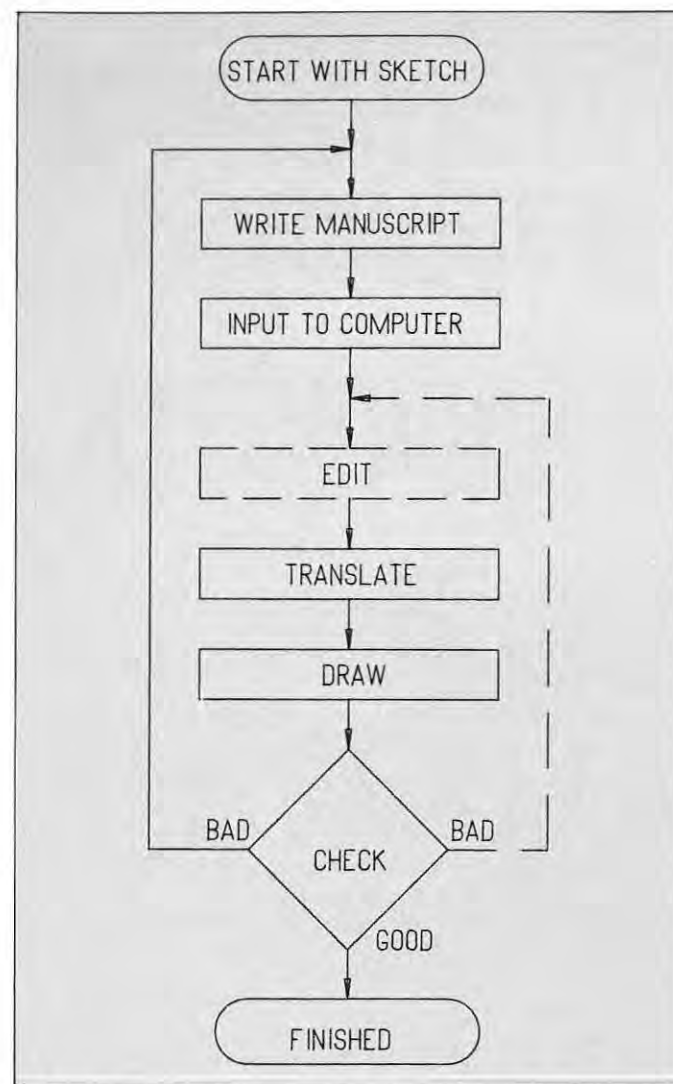


Figure 2: Showing the process of producing a drawing using a manuscript language.

There has been some work done in the area of manuscripting languages for hard copy graphics. An example of one of these languages is the Ortho-Action language developed by Numerical Control and Computer Services. This language is an extension of their highly successfully N/C language, Action, and features extensive geometric capability.

There are several drawbacks to many of the programs available. There are generally long learning curves associated with most of these programs. This is due to the complexity of the programs, a situation which tends to push manuscript cost up. Many of them are oriented toward card input. This tends to lead to columnar formatting requiring special forms for accurate manuscript preparation. As mentioned before, these programs usually require large computers for efficient execution. These computers tend to be located remote to the automatic drafting equipment raising other problems like turn-around time and scheduling.

Motivation for a Local Language

To determine how to eliminate some of the above problems, consider the process of producing a drawing using a manuscript language. This process is flow charted in Figure 2. There are in general five, and sometimes six, basic steps

involved. The first step is to write the manuscript using as a reference either a sketch or concept. This manuscript is then input in some manner into the computer. At this point, some languages allow an editing stage to take place. Next the input is translated and the output produced. This output is then drawn and checked. If the drawing is correct, the job is over, otherwise modification must be made to the manuscript. In languages without the editing feature, this requires going back to the beginning of the flow chart. If editing is a feature of the language, it is necessary to return only to the editing step to correct the manuscript.

From the flow chart, one can notice areas where the efficiency of the operation could be impaired. For example: if the language is too complex, the writing time of the manuscript could be longer than necessary. If the editing feature is not available, then the error correction process becomes more involved and costly. If the turn-around time between the completion of the manuscript and the receipt of the drawing information is too long or unpredictable, problems in both error correction and scheduling result. In general, the time required to actually draw the drawing and check the results will be small in comparison to the rest of the process. Improvements in these areas are beyond the scope of this effort.

The UDRAFT-8 Language

In consideration of the above, the Universal Drafting Machine Corporation developed the UDRAFT-8 language which is a software system consisting of two basic parts. Both parts operate in a mini computer of the type used to control many of the automatic drafting machines. The first portion of the system is a full text editor with which it is hoped to solve problems in input and error correction. The second portion of the system is the language translator. This program implements the statements of the language and is directed at solving problems of manuscript cost, computing costs, and turn-around time.

The UDRAFT-8 language is currently implemented on a 4K DEC PDP-8 computer equipped with a high-speed paper tape reader and handler, a high-speed paper tape punch, and an ASR 33 teletype.

The advantages of a language which uses only the control computer of the automatic drafting machine are obvious. This capability eliminates the scheduling problem for the drafting room supervisor. He is no longer dependent on long queues or low priority at the remote computer for turn-around time, and he can schedule the translation of his programs around his known equipment loads.

Text Editor

The text editor of the UDRAFT-8 software system is a complete line oriented text editor. The program can accept as many as 3,000 characters into its buffer for processing at one time. This is the equivalent of approximately 250 average UDRAFT-8 statements or the equivalent of one full single spaced typewritten page. The editor automatically assigns line numbers to the input information and automatically updates these line numbers when any changes are made in the buffer. Once the buffer is filled, editing can proceed as would be expected.

The editor is constructed in a way that allows input from the tape reader or the teletype. This feature allows the operator to prepare manuscript tapes off-line on any teletype while the automatic drafting machine is busy and then, when there is time available, to enter them into the editor buffer via the tape

reader for correction. Additions to the contents of the buffer can be made at any time using the APPEND and INSERT features of the editor. The operator also has the capability of deleting lines from the buffer. The CHANGE command allows whole lines to be modified at once while the REPLACE command allows single characters to be changed. At any time the operator may LIST part or all of the contents of the buffer and may also direct the editor to punch the contents of the buffer onto paper tape via the high-speed punch. The output of this operation will be an ASCII tape of the contents of the buffer. This ASCII tape can then be listed on a teletype off-line for further error checking. Since there is no format restriction on the input data to the editor, the editor may be used for applications other than UDRAFT-8 manuscript checking. A list of editor commands appears in Figure 3.

Once the UDRAFT-8 manuscript has been input to the editor buffer and the operator is satisfied that all obvious errors have been eliminated through the editing process, the operator may have the editor check the statement structure of the contents of the buffer. The editor will then check the buffer contents starting with the first character in the buffer and continuing until either the buffer is empty or an error is encountered. If an error is detected, the editor enters the CHANGE mode and waits for the operator to correct the error. At this time, the editor also searches the macro table of contents in order to make sure that there are no calls for macros that don't exist and also to add the macro search code to the manuscript. When the statement structure check has been completed successfully, the manuscript can be translated with no errors in output due to incorrect statement structure.

One other feature of the editor is the ability to construct the necessary input to the macro library and table of contents. This feature enables the operator to include his own macros in the macro library with a minimum of effort.

Translator

The second and most important part of the UDRAFT-8 language system is the translator. This program accepts the input manuscripts and produces the information required by the automatic drafting machine for the production of drawings. The translator produces as output a paper tape punched in EIA code specifically formatted for automatic drafting machines.

```

FILL BUFFER
APPEND TO BUFFER
INSERT LINES
LIST LINES IN BUFFER
DELETE LINES IN BUFFER
CHANGE LINE
REPLACE CHARACTERS
PUNCH CONTENTS OF BUFFER
GENERATE LEADER
CANCEL COMMAND ENTRY
CHECK STRUCTURE
GENERATE MACRO LIBRARY DATA
  
```

Figure 3: Editor commands.

```

MOTION STATEMENTS
MOVE
DRAW
VECTOR
ARC
DOT
PRINT
ARO
PARAMETER STATEMENTS
START
END
HIGH
LENGTH
WIDTH
LINK
RETURN
MACRO CALL STATEMENT
USE
  
```

Figure 4: UDRAFT-8 commands.

The translator decodes and produces output based on statements in the UDRAFT-8 language. This language is both simple and powerful, assets which lead to short learning curves and low manuscript costs. A list of available statements is shown in Figure 4.

Motion Producing Statements

The motion producing statements are the working statements of the language. It is these statements which actually produce the drawing. The MOVE statement allows positioning of the pen at any specified point on the drawing without drawing a line. The DRAW statement draws to the specified point. The DRAW statement, can, as can other motion statements, optionally generate dash lines, phantom lines, or center lines. The VECTOR statement is also used to generate straight line motion, but its motion is specified by a magnitude and direction rather than a point.

Circular motion is generated by either the ARC or DOT statements. The first is used to generate portions of circles; the second is used to generate complete circles of specified radius centered on the current pen position.

Annotation is accomplished using the PRINT statement. This statement cannot only generate the necessary codes for drawing alphanumeric but can also position the annotation with respect to any definable point. In addition, the annotation can be left, right, or center justified. Optional underlining or overlining is also available in the PRINT statement. One other motion statement which falls into the category of special symbol generation is the ARO statement. This statement allows the generation of arrowheads with ease. The programmer simply specifies the direction in which he wants the arrowhead to point.

Parameter Modification and Mode Change Statements

In addition to the statements that produce motion, there is a need for statements to input information to the translator. The most apparent of these are the START and END statements which establish the initial drawing parameters and stop the processing respectively. Other parameter modification statements are the HIGH statement which sets the alphanumeric height, the TOLERANCE statement which sets the

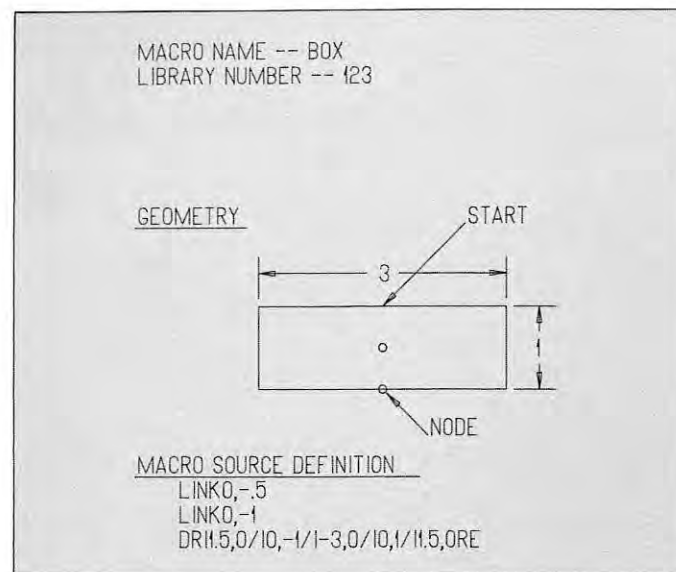


Figure 5: A typical macro and its definition.

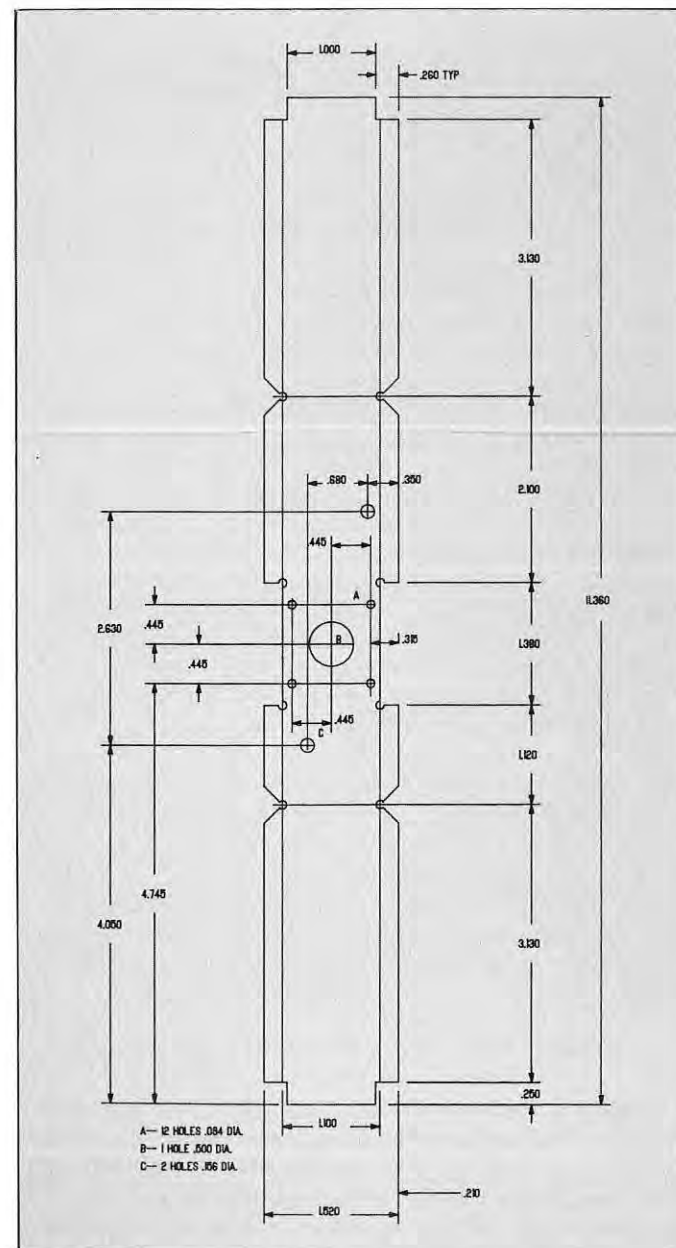


Figure 6: Sheet metal drawing.

chord height tolerance for circular motion, and the LENGTH and WIDTH statements which set the arrowhead size. The INSERT statement allows the insertion of any arbitrary codes into the output of the translator. Two other statements, which are associated with the macro capability of the language described below are the LINK statement and the RETURN statement. The LINK statement allows the definition of attachment points within a macro definition. The RETURN statement transfers translation control back to the main program upon exit of a macro.

Macro Capability

The UDRAFT-8 language is a macro oriented language. This means that in addition to the usual instructions associated with manuscripting languages, the ability of calling drawing subroutines is also provided. These macros, which can be thought of as small sub-drawings or predefined symbols, may be placed at any arbitrary position on the drawing. They may also be both scaled individually in each axis and rotated about their starting point. Data describing a macro instance, a unique usage of the macro in the drawing, may be stored and recalled at a later time in order to position other drawing elements in appropriate relation to the macro.

The macro is stored as a UDRAFT-8 source image in the macro library. This library may contain as many as a thousand separate macros and is accessed via the high-speed paper tape reader. A macro is defined by first defining the attachment points using the LINK statements and then describing the macro geometry using standard UDRAFT-8 statements.

The ability of the macro definition to contain attachment points or nodes is of great value. A specific macro instance may be assigned an integer code which will allow future statements in the manuscript to address the data associated with the placement and orientation of the instance. If this can be done, then a point can be defined by specifying the macro instance code and the number of the attachment point associated with the specific macro. This allows other statements of the language to reference points associated with macros with ease. These points could otherwise be extremely difficult to define. Particular examples of potential uses of this feature are the placing of annotation in relation to symbols and the interconnection of elements in schematic type drawings.

The USE statement is the macro call statement and allows full usage of the macro capability. The USE statement can define not only the point at which the macro is to be placed, but can also specify individual x and y axis scale factors, a rotation about the start point and an instance number for later use in the program. Figure 5 illustrates a typical macro along with its definition.

Application and Examples

There are many varied applications for the UDRAFT-8 language. In addition to producing both schematic and mechanical drawings, the language can be used for making additions to existing drawings. This capability would allow the draftsman to take advantage of the quick turn-around time of the language to complete a drawing, rather than force him to re-submit the drawing for complete retranslation by a large computer.

Other applications would be in the area of making small details and parts drawings (see Figure 6). Sheet metal drawings, inspection templates, etc. are also important areas where the language would be useful. This would be particularly so if the automatic drafting machine were equipped with a scribing

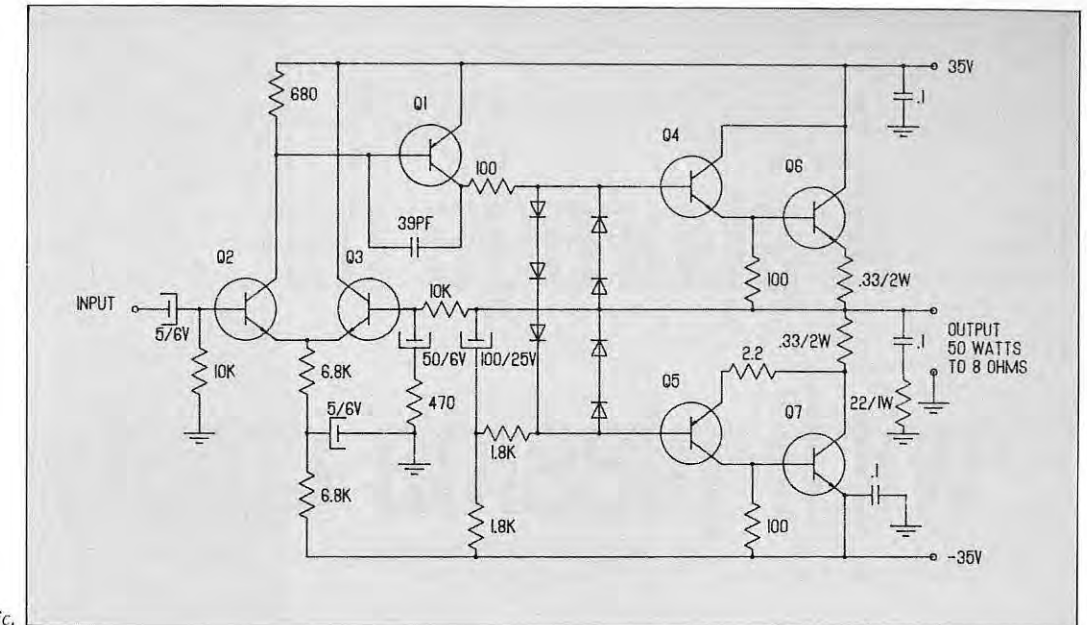


Figure 7: Electronic schematic.

head. This would allow the scribing of the layout directly on the material eliminating costly layout in the production area.

The production of schematic drawings is another area where the UDRAFT-8 language is particularly effective. The capability of calling and positioning macros significantly enhances this application. As can be seen by the structure of the flow chart in Figure 2, and the electronic schematic in Figure 7, there is a great deal of similarity in all forms of schematic

type drawings. This enables several features of the language to be extremely effective when applied to these problems.

The manuscript example shown in Figure 8 contains all the necessary information for the production of the flow chart in Figure 2. As can be seen, information is supplied to the translator in an extremely compact yet readable form. This particular manuscript illustrates the use of the macro call, the ARO statement, the annotation capability along with other features of the language. When one examines the structure of the flow chart and the amount of information necessary to construct it, the power of UDRAFT-8 becomes increasingly apparent.

Conclusion

In view of the many drawbacks currently suffered by most methods of preparing input data for automatic drafting machines, the UDRAFT-8 language represents an advance in the capability of the local tools available in automatic drafting facilities. Although somewhat limited by the power of the hardware available, the language has both a powerful but straight forward command structure and a generous facility for error correction. Development is being continued on this language to add capability that will increase both the scope and application of the language. In particular, the areas of dimensioned drawings and geometric definitions will receive attention as will increased geometric potential.



Duane Elms is a Systems Engineer with Universal Drafting Machine Corp., Cleveland, Ohio. He is responsible for the development of the UDRAFT series of languages along with computer oriented graphic techniques. Prior to joining UDM in 1969, Mr. Elms gained experience in numerical control and systems design as Project Engineer for the Bunker-Ramo Corp. He received his B.S.E.E. degree from Case Institute of Technology and has done graduate work in systems and computer graphics at both Brooklyn Polytechnical Institute and Case Institute.

```
S0,0H.2LE.2W.06TOL.001
USED1"START"(003)PRCI0,-.45"START WITH SKETCH"
MOA0,-.65DRI0,-.5AR0270AR00
DRI-2,0USED10"NODE"(007)MOI2,0DRI0,-.5AR0270
USES1.5D1"BOX"(001)PRCN1,9"WRITE MANUSCRIPT"
MON1,6DRI0,-.5AR0270USES1.5D1"BOX"
(001)PRCN1,9"INPUT TO COMPUTER"
MON1,6DRI0,-.5AR0270AR0180DRDI2,0USED11"NODE"
(007)MOI-2,0DRI0,-.5AR0270
DRDI1.5,0/DI0,-.5/DI-3,0/DI0,.5/DI1.5,0
PRCI0,-.35"EDIT"MOI0,-.15DRI0,-.5AR0270
USES1.5D1"BOX"(001)PRCN1,9"TRANSLATE"
MON1,6DRI0,-.5AR0270
USES1.5D1"BOX"(001)PRCN1,9"DRAW"
MON1,6DRI0,-.5AR0270
USED1"TEST"(006)PRCN1,11"CHECK"
/N1,7"BAD"/N1,6"GOOD"/N1,5"BAD"
MON1,3MOI0,-4DRI0,-.5AR0270
USE"START"(003)PRCI0,-.5"FINISHED"
MON1,2DRI-1,0/N10,1
MON1,4DRDI1,0/DNI1,1
MOA0,0IN"MO2"END
```

Figure 8: Manuscript example with all the information necessary for production of the flow chart in Figure 2.

A storage oscilloscope with plasma display panel

**an approach
to practical
problems**

SHOZO UMEDA and TERUO TUBA

Abstract

A storage oscilloscopic display employing a plasma display panel with inherent memory is described. Constant luminance even with nonrepetitive phenomena is obtained. The panel employed has 128 x 128 cells with a pitch of 0.6 mm developed by Fujitsu Laboratories Ltd. in Japan. Writing speed is reported to be 50 μ s per picture element.

Introduction

The Plasma Display Panel (PDP), invented at the University of Illinois, is a crossed grid gas discharge device having a narrow gas space between orthogonal electrodes covered with thin dielectric material. In the presence of a sustaining power source, each cross point can represent a picture element with memory. Gas discharge is initiated selectively in a cell by a writing pulse. Light is emitted during every half cycle of the sustaining wave providing a display of constant luminance until an erase signal is received. The characteristics of a PDP suggest its application to storage oscilloscopes, one mechanization of which is described in the following paragraphs.

Performance

The panel used is constructed with a grid of 150 x 150 electrodes having a pitch of 0.6 mm and an effective area of 90 x 90 mm. In both axes, 128 of the 150 lines are employed for addressable electrodes. The firing potential is about 150 V and

the minimum sustaining voltage is approximately 120 V. The display color of the panel is the typical orange-red of a neon-rich gas discharge. Figure 1 is an external view of the panel.

The panel may be driven in either a single sweep or repetitive mode. Vertical signals are amplified with a bandwidth of dc to 5 MHz (-3dB). Two vertical input channels are provided which can be displayed independently, alternately or combined algebraically. Erase time is $25\text{ }\mu\text{s}$ per picture element, although it is anticipated that a few μs per frame will be possible. An erase pulse is regularly applied to a line prior to a write pulse. Maximum access time is $50\text{ }\mu\text{s}$ or twice that of writing time.

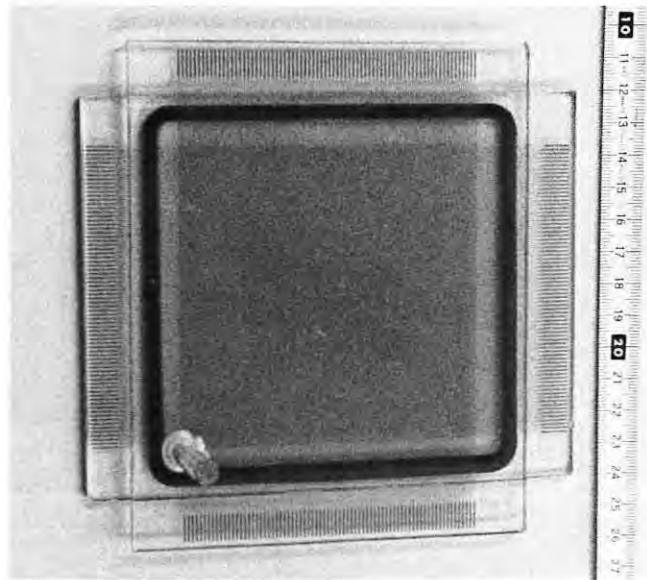


Figure 1: External view of a panel containing 22500 cells (150 x 150). Upper scale shows the size in mm.

With the use of the block and timing diagrams in Figures 2 and 3 the performance of the PDP oscilloscope, or YT* display, can be described. In the single sweep mode, the triggering signal causes a flip-flop to change state and switch on the time base oscillator. The signal to be displayed is sampled, held and converted from an analog value to a 7-bit digital equivalent. During this sequence the vertical line at which new data is to be written is designated by the time base counter and is erased.

Write pulses are fed to the vertical coordinate specified by the 7-bit signal and to the time coordinate at which erasing had just been accomplished. In this way, voltage coincidence is established to fire a cell at the selected YT cross point. After writing as described, the value 1 is added to the time base counter. Then the same sequence is repeated at new pulse intervals from the time base oscillator.

When 128 points are written, the value of the time base counter is fixed at 127 so that no further counting or resetting can occur. The scanning mode flip-flop is reset to 0. Thus a single sweep display on the 128 x 128 PDP has been completed. Figure 4 illustrates a single sweep display of a damped oscillation in an LCR network.

In the repeat sweep mode the time base counter is reset at every value of 127 and restarted by a trigger signal producing a display like that of a conventional oscilloscope. Multi-recording of phenomena is easily accomplished by inhibiting the generation of all erasing pulses. Figures 5 and 6 are examples of multi-recording.

Panel Excitation

Voltage wave forms applied to selected Y and T electrodes and a selected cell of the panel are illustrated in Figure 7. The

*YT refers to an XY display where $X = T$, or the usual time-based oscilloscopic format.

shaded areas designate the erase and write pulses. The other pulses are present for the purpose of providing sustaining excitation to the PDP. Erase pulses must effectively drive the addressed electrode to sustaining potential for a shorter duration. Write pulses, however, exceed in amplitude the firing voltage of the cell.

Neon-filled plasma display panels require sustaining frequencies less than about 50 kHz. Consequently a maximum writing speed of 20 μ s per picture element is a reasonable limit. If a half-cycle of a repetitive pattern requires 10 picture elements to be displayed with adequate definition, then the upper frequency becomes 2.5 kHz. One hundred elements along the time axis can only represent phenomena having periods greater than 2 ms. Consequently, equipment using the inherent PDP memory will be most useful where relatively slow phenomena are encountered as in medical, biological or mechanical fields.

Another mechanization of the PDP employs a semiconductor memory to buffer high-speed signals. In this way waveforms as fast as 100 nanoseconds per picture element can be

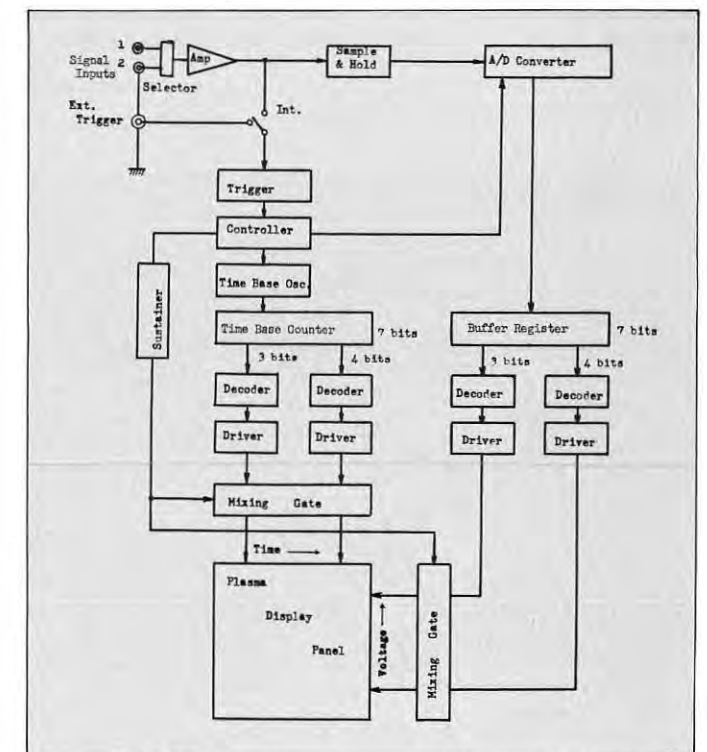


Figure 2: Block diagram of a storage oscilloscope with PDP.

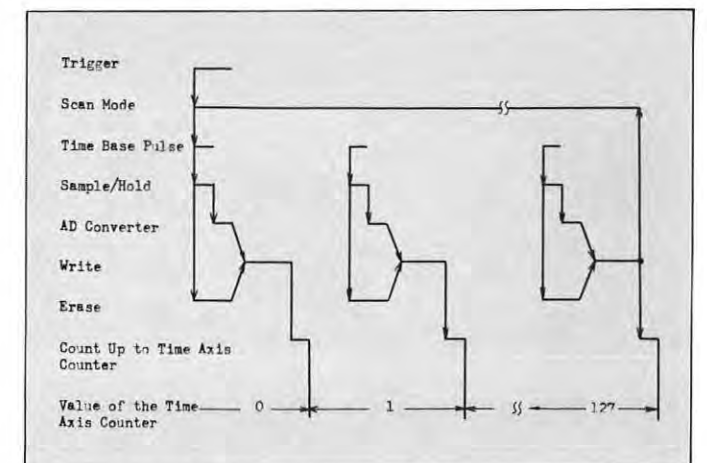


Figure 3: Timing chart in a single sweep mode.

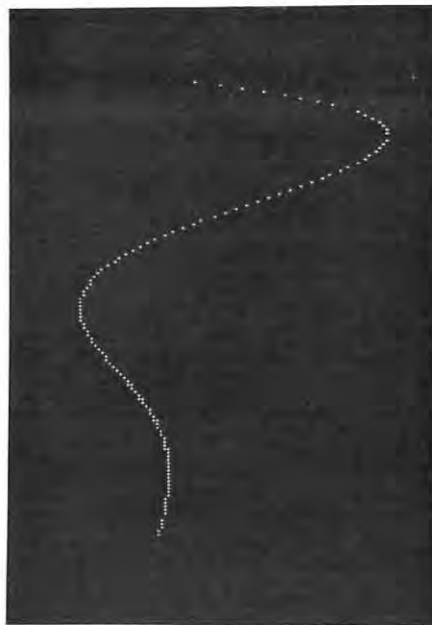


Figure 4: A single sweep mode display of a damped oscillation by LCR network is memorized and displayed on PDP. Horizontal: 12.5 ms full scale. (Reduction 53%)

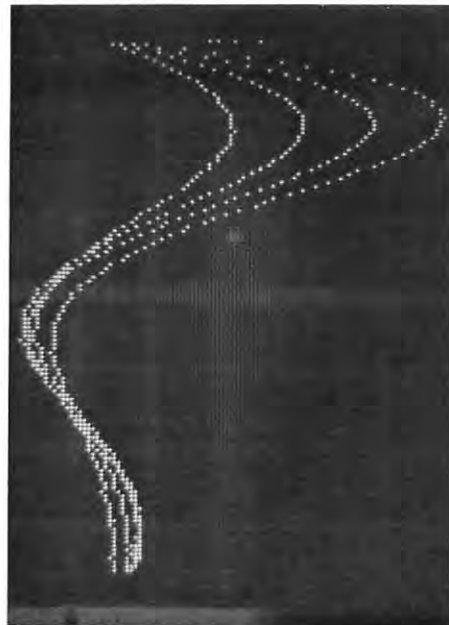


Figure 5: Four sets of damping oscillation waveforms are accumulated in one display panel. Horizontal: 12.5 ms full scale. (Reduction 53%)

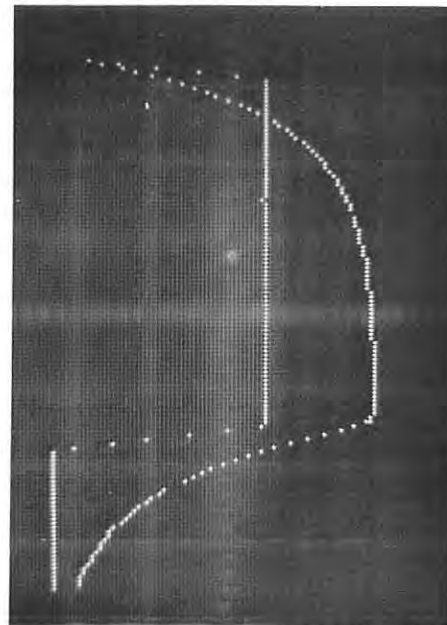


Figure 6: An accumulating recording of a rectangular wave and its amplified output. Horizontal: 12.5 ms full scale. (Reduction 53%)

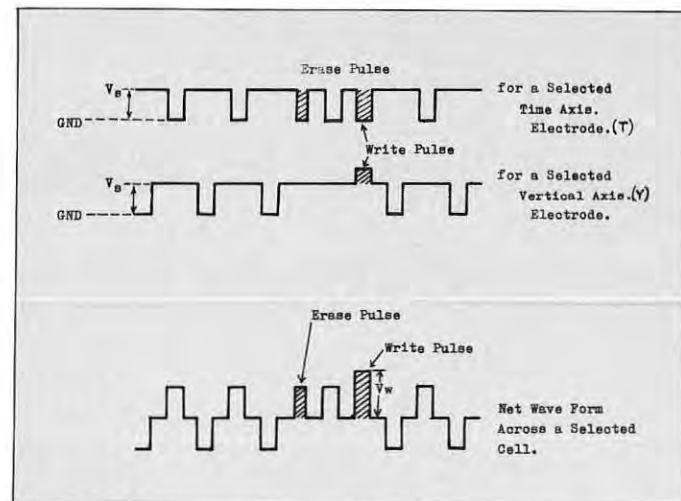


Figure 7: Driving waveforms at the display panel employed in the storage oscilloscope.



Figure 8: External view of the memoryscope with the developed plasma panel, named PLASMASCOPE.

readily displayed with a continuously sustained bright image. Since digital memories are commonly available, a digital device like a PDP can display patterns more effectively than an analog CRT unit.

Power Consumption

Although applied voltage in a plasma display is on the order of 150 V, the discharge current per cell is only about 100 μ A. With a duty cycle of 1/50 at 50 kHz, for example, the sustaining power is 300 μ W per cell, about 40 mW per line (containing 128 cells) and 5 watts per 128 x 128 cell matrix. Approximately one-tenth of the full discharging power is lost at the sustainer to flow displacement current to the capacitive load of the panel.

Discharging power consumed at a continuous write address is only on the order of 200 μ W, assuming that addressing is point by point every 20 μ s. Because of such low addressing power consumption, highly compact low-cost driving circuits are feasible.

A photograph of the PDP storage oscilloscope described in this paper is shown in Figure 8.

Acknowledgments

The authors are indebted to the Director, Dr. Kojima, Vice-Director, Dr. Owaki, Manager Takashima, Chief Nakayama and members of the Electron Devices Laboratories of Fujitsu for their support in the development described herein.

Bibliography

Slottow, H.G. "The Plasma Display Panel — Principles and Prospects," IEEE Conference on Display Devices, December, 1970. ■

Shozo Umeda and Teruo Tuba are with the Electron Devices Laboratory of Fujitsu Laboratories Ltd., Okubo-Cho, Akashi, Japan.

Cumulative index offered



This cumulative index is presented to *INFORMATION DISPLAY* readers who may desire to refer to previously published technical papers. Articles are listed by title (key word), author and date from Volume 1, Number 1 (September/October 1964) through the current issue (Volume 9, Number 6).

It is anticipated that all subsequent year-end issues of *INFORMATION DISPLAY* will include an updated cumulative index.

Readers interested in obtaining specific articles or back-issues (while they last) are invited to communicate directly with the Journal's publication office: Information Display, 825 So. Barrington Ave., Los Angeles, California 90049.

BY TITLE

A

- API TRAINING OPERATIONS EVALUATION, Russell Paquette, Volume 6, Number 5, September/October 1969
- AIR FORCE DISPLAY TECHNIQUES, SOME PRAGMATIC CONSIDERATIONS INFLUENCING THE SELECTION OF, Edmund J. Kennedy, Volume 2, Number 4, July/August 1965
- AIR TRAFFIC CONTROL, RADAR DIGITAL PROCESSING AND DISPLAY SYSTEM FOR, J. Rennie, A. Hamilton and J. Moffett, Volume 6, Number 4, July/August 1969
- AIRBORNE SENSOR DISPLAY REQUIREMENTS AND APPROACHES, G.K. Slocum, W.C. Hoffman and J.L. Heard, Volume 4, Number 6, November/December 1967
- AIRCRAFT DISPLAYS, GAS DISCHARGE TECHNIQUES FOR, Phillip Story, Volume 7, Number 5, May 1970
- ALPHA-NUMERIC DISPLAY, AN, Kenneth Barber, Volume 7, Number 6, June 1970
- ALPHANUMERIC DISPLAY, TWO-COLOR, K.C. Adam, Volume 7, Number 7, July 1970
- ALPHA-NUMERIC DISPLAY, USING A STANDARD TELEVISION MONITOR AS AN, Stanley Graham, Volume 4, Number 3, May/June 1967
- ALPHA-NUMERIC READOUT DEVICE, A LOW COST GENERAL PURPOSE, R.T. Raago, Volume 6, Number 3, May/June 1969
- ALPHA-NUMERIC SYMBOLS, THE RELATIVE LEGIBILITY OF LEROY AND LINCOLN/MITRE, Diana J. Showman, Volume 4, Number 2, March/April 1967

© 1972 by Barrington Publications Inc. All rights reserved. Reproduction in whole or part without permission is prohibited.

- APOLLO MISSION SIMULATOR, SIXTEEN EARTH-ORBIT FILM FOR THE, R.C. LaFrance, Volume 6, Number 3, May/June 1969
- ARCHITECTURAL DESIGN, A FLEXIBLE COMPUTER GRAPHIC SYSTEM FOR, Roger C. Wood and Philip Hendren, Volume 5, Number 2, March/April 1968
- ARCHITECTURE, COMPUTER GRAPHIC DISPLAYS IN, Allen Bernholtz, Volume 3, Number 2, March/April 1966
- AUTOMATIC ARTWORK GENERATION, David Rager, Volume 6, Number 6, November/December 1969
- AUTOSTEREOSCOPIC THREE DIMENSIONAL DISPLAY, AN, W. Richard Stover, Volume 9, Number 1, January/February 1972

B

- BIMAT PROCESSING, HARDWARE FOR, Robert P. Mason, Volume 4, Number 2, March/April 1967
- BINARY TO DECIMAL DECODING SYSTEM USING NEON LAMPS AND A PHOTOCONDUCTOR MATRIX, Marvin Willrodt, Volume 3, Number 6, November/December 1966

C

- CRT, A MULTIBEAM, D.L. Say, Volume 7, Number 5, May 1970
- CRT, CURRENT-SENSITIVE, SINGLE-GUN COLOR, Thomas E. Sissneros, Paul A. Faeth, Joseph A. Davis, and Edwin H. Hilborn, Volume 7, Number 4, April 1970

CRT DESIGN OBJECTIVES, CONSIDERATIONS IN SPECIFYING DISPLAY SYSTEM, A.D. Johnson and D.G. Cowden, Volume 4, Number 3, May/June 1967

CRT DISPLAY SYSTEM, ANAGLYPH STEREOSCOPIC, John Wolvin, Volume 6, Number 3, May/June 1969

CRT GRAPHIC DISPLAYS, FAMILY OF COMPUTER-CONTROLLED, Carl Machover, Volume 3, Number 4, July/August 1966

CRT GRAY SHADES, DISCERNIBILITY OF, John Volkoff, Volume 8, Number 6, November/December 1971

CRT PHOSPHOR ACTIVATION OF PHOTOCHROMIC FILM, G. Dorion, R. Roth, G. Cox and J. Stafford, Volume 3, Number 2, March/April 1966

CRT TO PHOTSENSITIVE MEDIA, ENERGY TRANSFER FROM, Leo Beiser, Volume 2, Number 5, September/October 1965

CRT SPOT MEASUREMENT TECHNIQUES, DYNAMIC, George W. Gonyou and Edward M. Sawtelle, Volume 6, Number 4, July/August 1969

CRT WRITE RATE VS BANDWIDTH STUDY, Alfred Pletz Jr., Volume 9, Number 4, July/August 1972

CATHODE RAY TUBE DISPLAYS, THE PERCEPTION OF FLICKER IN, Rodger Elmo Turnage, Jr., Volume 3, Number 3, May/June 1966

CATHODE RAY TUBE DISPLAYS, A PLASTIC VIRTUAL INFINITY LENS SYSTEM FOR LARGE APERTURE, W.V. Goodell and P.D. Woodson, Volume 5, Number 6, November/December 1968

CATHODE RAY TUBE, REACTION OF CONTRAST ON A, Olegs Goncarovs, Volume 7, Number 2, February 1970

CATHODE RAY TUBES FOR THE SYSTEM DESIGNER, HIGH RESOLUTION, Jim E. Wurtz, Volume 4, Number 3, May/June 1967

CHARACTER FONT DESIGN ON A GRAPHIC DISPLAY, I. Bruce Damerell, Volume 5, Number 2, March/April 1968

COCKPIT DISPLAY: USERS VS. MAKERS, Carolyne Arnoldy, Volume 8, Number 4, July/August 1971

COLOR DISPLAY, THE APPLICATION OF PHOTOCHROMICS TO, W.A. Stein, Volume 6, Number 3, May/June 1969

COLOR ELECTROLUMINESCENT DISPLAY, AN INEXPENSIVE TECHNIQUE FOR, John Frost, Volume 6, Number 5, September/October 1969

COLOR OUTPUT GENERATION SYSTEM, James H. Dinwiddie and Robert C. Mullens, Volume 2, Number 1, January/February 1965

COLOR TELEFILM RECORDING, Stephen P. Robinson, Volume 9, Number 5, September/October 1972

COLOR TELEVISION DISPLAY, A DIGITAL INTERACTIVE, David Rutland, Volume 7, Number 8, September/October 1970

COLOR TUBES DETERMINING WHITE FIELD BALANCE, J.P. O'Donnell and R.Q. Vogel, Volume 7, Number 4, April 1970

COLOR VISION, R.L. Kuehn, Volume 2, Number 5, September/October 1965

COMMAND AND CONTROL, THE BR-90, A FLEXIBLE AND VERSATILE DISPLAY FOR, Frank J. Beach, Volume 4, Number 3, May/June 1967

COMMAND AND CONTROL, A HIGH-PRECISION DISPLAY SYSTEM FOR, Herbert C. Hendrickson, Volume 4, Number 4, July/August 1967

COMMAND AND CONTROL DISPLAY SYSTEM FOR NORAD, THE, Karl J. Zimmer, Volume 4, Number 5, September/October 1967

COMMAND CONTROL SYSTEMS, DISPLAY REQUIREMENTS ASSESSMENT FOR, Rudolph L. Kuehn, Volume 3, Number 6, November/December 1966

CATV CONVERTERS, DESIGN AND USE OF, Patrick R.J. Court, Volume 8, Number 2, March/April 1971

CATV IN THE 70's, John W. Atwood, Volume 8, Number 3, May/June 1970

COMPUTER DRIVEN DISPLAYS SPEED EVALUATION OF CARRIER AIRCRAFT LANDINGS, John Rommel and L. Arthur Hoyt, Volume 4, Number 1, January/February 1967

COMPUTER-GENERATED DISPLAY SYSTEMS, CONCEPT FOR DESIGN AND IMPLEMENTATION OF MOBILE, Paul Horowitz, Volume 3, Number 4, July/August 1966

COMPUTER GRAPHICS AND MANUFACTURING, R.D. Carlson, Volume 6, Number 1, January/February 1969

COMPUTER OUTPUT MICROFILMING, Don Avedon, Volume 8, Number 1, January/February 1971

COMPUTERIZED DISPLAY MAINTENANCE, A.R. Goodwin and R.F. Tigue, Volume 6, Number 2, March/April 1969

COMPUTERS, AN EVOLUTIONIST LOOKS AT, Garrett Hardin, Volume 6, Number 1, January/February 1969

CONSOLE DESIGN, GRAPHIC AIDS FOR, J.L. Hanna and Dr. F.H. Ireland, Volume 6, Number 5, September/October 1969

D

DATA DISPLAY IN BUSINESS AND INFORMATION SYSTEMS, Daniel Teichroew, Volume 2, Number 6, November/December 1965

DATA DISPLAY TECHNOLOGY, A LOOK AT FUTURE MANAGEMENT, Raymond E. Bernberg, Volume 2, Number 1, January/February 1965

DATA SOURCE AUTOMATION — AN EXPANDED ROLE FOR THE CRT, OFF-LINE, Harold A. Kirsch and James T. Longineau, Volume 7, Number 6, June 1970

DATAPLOT: A SYSTEM FOR ON-LINE GRAPHICAL DISPLAY OF STATISTICAL DATA, William A. Watson, Volume 4, Number 4, July/August 1967

DICHROIC FILTERS AND ADDITIVE COLOR DISPLAYS, Edward F. Rizy, Volume 3, Number 4, July/August 1966

DIODES, LIGHT EMITTING, William T. Otsuka, Volume 6, Number 7, July/August 1969

DISPLAY AND CONTROL SYSTEM, THE JPL SPACE FLIGHT OPERATIONS FACILITY, Albert S. Goldstein, Volume 1, Number 2, November/December 1964

DISPLAY, CHALLENGES FOR, Arthur L. Aden, Volume 4, Number 6, November/December 1967

DISPLAY CHARACTERISTICS, QUANTITATIVE MEASURES OF, H.R. Luxenberg and Q.L. Bonness, Volume 2, Number 4, July/August 1965

DISPLAY DEVICE FOR INFRARED IMAGE, Thomas Maloney, Volume 6, Number 1, January/February 1969

DISPLAY FOR AIRCRAFT APPLICATIONS: A DEVELOPING CRISIS, AN ASSESSMENT OF, John H. Kearns and William F. Swartz, Volume 8, Number 2, March/April 1971

DISPLAY FOR COMPUTER PROCESSED DATA, A MULTI-TONE, L.C. Kohlenstein, L.G. Knowles and W.A. Yates, Volume 7, Number 3, March 1970

DISPLAY INPUTS, REAL-TIME ANALOG, James G. Rogers, Volume 7, Number 7, July 1970

DISPLAY LUMINANCE MEASUREMENT, PHOTO SENSOR PROBLEMS IN, Royal H. Akin, Volume 2, Number 1, January/February 1965

DISPLAY SCREEN SIZE AND RESOLUTION BASED ON PERCEPTUAL AND INFORMATION LIMITATIONS, THE DETERMINATIONS OF, Glenn E. Whitham, Volume 2, Number 4, July/August 1965

DISPLAY SCREEN WITH CONTROLLED ELECTROLUMINESCENCE, A, Herman Graff and Richard Martel, Volume 2, Number 5, September/October 1965

DISPLAY STANDARDS, THE STATE OF, Sol Sherr, Volume 8, Number 2, March/April 1971

DISPLAY SYSTEM, SELECTING THE PROPER, Lorenzo S. Childress, Volume 8, Number 3, May/June 1971

DISPLAY VISIBILITY, THE EFFECTS OF HIGH INTENSITY LIGHT ADAPTATION ON ELECTRONIC, J. Ketchel, Volume 6, Number 3, May/June 1969

DISPLAYS FOR GROUP VIEWING, CAPACITY AND OPTIMUM CONFIGURATION OF, Helmut Weiss, Volume 3, Number 6, November/December 1966

DISPLAYS FOR PROCESSING AND DISTRIBUTION OF PICTORIAL MATERIAL, HIGH RESOLUTION, A.C. Gay, Volume 6, Number 4, July/August 1969

DISPLAYS, PAPERS AND LIGHTING, A.C. Stocker, Volume 1, Number 1, September/October 1964

DOCUMENT RETRIEVAL, INTERACTIVE DISPLAYS FOR, H. Borko and H.P. Burnaugh, Volume 3, Number 5, September/October 1966

E

EDUCATIONAL SYSTEMS FOR THE 1970's, MODEL, Edmund M. Pease, Volume 7, Number 7, July 1970

EL DESIGNS FOR SPACE AND MILITARY APPLICATIONS, BASIC, R.W. Christensen and W.R. McKiernan, Volume 4, Number 2, March/April 1967

ELECTRO-OPTIC THREE DIMENSIONAL DISPLAYS, H. John Caulfield, Volume 4, Number 4, July/August 1967

ELECTROLUMINESCENCE — AN APPRAISAL FOR AVIONIC DIS-

INFORMATION DISPLAY, November/December 1972

PLAY APPLICATIONS, Donald J. Pizzicara, Volume 3, Number 2, March/April 1966

ELECTROLUMINESCENT/THERMOCHROMIC HYBRID DISPLAY, Hans B. Bullinger, Volume 6, Number 5, September/October 1969

ELECTRON OPTICS OF VIDICONS, J.R. Leaman, Volume 7, Number 2, February 1971

ENTROPY, DISPLAY WITH, Charles Halsted, Volume 5, Number 1, January/February 1968

F

FACSIMILE RECORDER, EXPERIMENTAL, CRYSTAL-MODULATED, Arthur S. Warner, Volume 6, Number 1, January/February 1969

FILM SYSTEMS FOR DATA DISPLAY AND COMPUTER INTERLOCK, ULTRARAPID, Maxwell A. Kerr, Volume 3, Number 6, November/December 1966

G

GRAPHIC DISPLAY SYSTEMS, IBM'S, Russell J. Houldin, Volume 3, Number 5, September/October 1966

GRAPHIC SET FOR ASCII USING A 7X9 DOT PATTERN, A, Allen G. Vartabedian, Volume 8, Number 6, November/December 1971

GRAPHICAL DISPLAY UNIT FOR A SMALL DIGITAL COMPUTER INSTALLATION, A SIMPLE, Peter Berger, Laszlo Nemeth, and James Rillings, Volume 7, Number 4, April 1970

H

HARD COPY PRINTOUT FROM CRTs, DRY PROCESS MATERIALS FOR, Jim E. Wurtz, Volume 6, Number 2, March/April 1969

HARD-COPY SYMBOLS, THE SIZE AND CONTRAST OF, A.C. Stocker, Volume 3, Number 4, July/August 1966

HOLOGRAMS AS DISPLAYS, APPLICATIONS OF, B.P. Hildebrand, Volume 5, Number 2, March/April 1968

HOLOGRAPHIC DISPLAYS, REQUIREMENTS FOR, A.D. Jacobson, Volume 7, Number 9, November/December 1970

HOLOGRAPHY AND DISPLAY, Jerald V. Parker, Volume 3, Number 3, May/June 1966

HOLOGRAPHY IN AN AIRBORNE DISPLAY SYSTEM, T.J. Harris, R.S. Schools, G.T. Sincerbox, D. Hanna and D. DeLay, Volume 7, Number 4, April 1970

I

ILLUMINATION, THE DISTRIBUTION OF, A.C. Stocker, Volume 5, Number 2, March/April 1968

IMAGE DISSECTOR CAMERA, A NEW APPROACH TO SPACECRAFT SENSORS, THE, Gilbert A. Branchflower and Edward W. Koenig, Volume 5, Number 2, March/April 1968

IMAGE TRANSMISSION SYSTEMS, EXPERIMENTAL EVALUATION OF THE RESOLUTION CAPABILITIES OF, D.R. Knudson, S.N. Teicher, J.F. Reintjes and U.F. Gronemann, Volume 5, Number 5, September/October 1968

IMAGES TRANSMITTED FROM OBSERVATION SATELLITES, PROCESSING OF, Rudolph L. Kuehn, E.R. Omberg and Gail D. Forry, Volume 8, Number 5, September/October 1971

INDIUM OXIDE, TRANSPARENT, CONDUCTIVE COATINGS OF, F.H. Gillery, Volume 9, Number 1, January/February 1972

ID FIELD AS IT EXISTS TODAY, THE, Ruth M. Davis, Volume 1, Number 1, September/October 1964

INFORMATION DISPLAY, A CLASSIFICATION OF, John K. Bates, Volume 3, Number 2, March/April 1966

INFORMATION HANDLING SYSTEMS, VOICE RESPONSE AND VISUAL DISPLAY TECHNIQUES FOR ON-LINE, Emik A. Avakian and F. Walter Jenison, Volume 1, Number 2, November/December 1964

INFORMATION STORAGE AND RETRIEVAL SYSTEM, Charles A. Steinberg, Volume 7, Number 2, February 1970

INFORMATION SYSTEMS 1968-1970; DISPLAY REQUIREMENTS OF THE INTEGRATED MANAGEMENT, Peter James and Donald L. Dittberner, Volume 1, Number 2, November/December 1964

INFORMATION DISPLAY, November/December 1972

INTEGRATED DISPLAYS FOR MULTICREW MILITARY AIRCRAFT, John Frost and Norman F. Sullivan, Volume 9, Number 2, March/April 1972

INTERACTIVE GRAPHICS FOR FIGHTER PILOT TRAINING, USING, Kevin J. Kinsella and Andrew J. Matthews, Volume 9, Number 2, March/April 1972

J

JTM-CRT MEANS OF SETTING PRINTERS' TYPE ELECTRONICALLY, Joseph T. McNaney, Volume 5, Number 2, March/April 1968

K

KEYBOARD DATA, GENERATION OF STATISTICALLY CONTROLLED, Jon Thorson, Volume 5, Number 3, May/June 1968

L

LARGE SCREEN DISPLAYS, OPTIMAL VISUAL CHARACTERISTICS FOR, William H. Ton, Volume 6, Number 4, July/August 1969

LASER COLOR TV PROJECTION DISPLAY SYSTEM, AN EXPERIMENTAL, Samuel M. Stone, John Schlafer and Vernon J. Fowler, Volume 6, Number 1, January/February 1969

LASER DISPLAY — A LARGE-SCREEN, REAL-TIME, DISPLAY TECHNIQUE, THE, Charles E. Baker and Anthony D. Rugari, Volume 3, Number 2, March/April 1966

LASER DISPLAY SEMINAR, Mid-Atlantic Chapter of S/D, Volume 5, Number 3, May/June 1968

LASER DISPLAYS, VISION AND LASERS: HUMAN FACTORS OF, John D. Gould and Walter L. Makous, Volume 5, Number 6, November/December 1968

LASER HEAD-UP DISPLAYS: ALIGNMENT AND TEST BY, Gerald F. Marshall, Volume 6, Number 2, March/April 1969

LIGHT PEN SENSITIVITY, CHARACTERIZATION OF, Timothy D. Stupar, Volume 4, Number 3, May/June 1967

LIGHT PEN VERSATILITY, OBTAINING, James T. Locascio, George L. Karanza and John J. Dalton, Volume 4, Number 6, November/December 1967

LOGIC CHARACTER GENERATOR FOR USE IN A CRT TEXT DISPLAY, A, P.A.V. Thomas and W.E. Mennie, Volume 9, Number 2, March/April 1972

M

MAGNETIC DISC RECORDING FOR TELEPRODUCTION AND ANIMATION, Anthony Poulett, Volume 7, Number 9, November/December 1970

MAN, MACHINE AND THE SYSTEM — DESIGN STUDIES CONTINUE AT FAA FOR BETTER COMBINATION, Fred Pickett, Volume 4, Number 6, November/December 1967

MANNED SPACE MISSILE CONTROL CENTER, THE DISPLAY/CONTROL COMPLEX OF THE, Herbert C. Hendrickson, Volume 4, Number 3, May/June 1967

MAP DISPLAY, THE CASE FOR THE MOVING, S.N. Roscoe, Volume 4, Number 5, September/October 1967

MICROELECTRONIC CHARACTER GENERATOR EMPLOYED IN COMPUTER DISPLAY PROCESSOR, Samuel Davis, Volume 3, Number 4, July/August 1966

MICROFILM COMMUNICATION, DIGITAL METHODS OF — PARTS I AND II, Ian H. Mallender, Volume 8, Number 3, May/June 1971

MICROFILM COMMUNICATION, DIGITAL METHODS OF — PART III, Ian H. Mallender, Volume 8, Number 4, July/August 1971

MICROFILM COMMUNICATION, DIGITAL METHODS OF — PART IV, Ian H. Mallender, Volume 8, Number 5, September/October 1971

MONOCHROME TV PROJECTORS, PRACTICAL CONSIDERATION IN OPERATING, Michael L. Chater, Volume 7, Number 6, June 1970

MULTI-SENSOR — TWO APPROACHES, DISPLAYS, M.D. Marsh, Volume 3, Number 5, September/October 1966

N

NAVIGATION-DISPLAY INTERFACE, MAN AND THE, David B. Nicholson, Volume 2, Number 4, July/August 1965

O

ORTHICON SYSTEMS, COMPARISON OF IMAGE DEGRADATION IN PHOTOGRAPHIC AND IMAGE, Walter E. Woehl, Volume 5, Number 1, January/February 1968

OPTICAL CHARACTER RECOGNITION, J. Braunbeck, Volume 9, Number 3, May/June 1972

P

PHOTOCHROMIC GLASS — A NEW TOOL FOR DISPLAY SYSTEM DESIGNERS, Ben Justice and F.B. Leibold, Jr., Volume 2, Number 6, November/December 1965

PHOTOMETRIC UNITS, H.R. Luxenberg, Volume 2, Number 3, May/June 1965

PHOTOPLASTIC FILM MULTI-COLOR, DISPLAY, J.E. Bigelow, Volume 6, Number 5, September/October 1969

PHOTOSENSORS, CHARACTERISTICS OF, G.T. Nagy, Volume 4, Number 2, March/April 1967

PHOTOTYPESETTERS, DIAGNOSTIC PROGRAMS FOR VIDEO-COMP, G.A. Maymon, Volume 6, Number 6, November/December 1969

PHOTOTYPESETTING, COMPUTER AND MICROFILM COMBINED IN, H.E. Haynes, Volume 9, Number 3, May/June 1972

PLASMA DISPLAY — A DIGITALLY CONTROLLABLE, HIGH BRIGHTNESS DISPLAY WITH AN INHERENT MEMORY, THE, R.H. Willson, Volume 5, Number 6, November/December 1968

PLASMA DISPLAY HARMONIC PHASE SELECTION, K. Owake, S. Umeda, T. Toba and T. Hirose, Volume 7, Number 5, May 1970

PLASMA DISPLAY PHASE SELECT, P.E. Oberg and G.F. Sauter, Volume 6, Number 2, March/April 1969

PLOTTERS: ONE WAY TO GO — UP! — PART I, Carolyne Arnoldy, Volume 8, Number 5, September/October 1971

PLOTTERS: ONE WAY TO GO — UP! — PART II, Carolyne Arnoldy, Volume 8, Number 6, November/December 1971

PLOTTING VS. OTHER FORMS OF READOUT, Eugene G. Smith, Volume 6, Number 2, March/April 1969

PROJECTION, WIDE-SCREEN SLIDE, Helmut Weiss, Volume 1, Number 1, September/October 1964

PROJECTION WITH FISHEYE CAMERA LENSES, William H. Alburty, Volume 7, Number 3, March 1970

PROMENADE — AN INTERACTIVE GRAPHICS PATTERN-RECOGNITION SYSTEM, D.J. Hall, G.H. Ball, D.E. Wolf and J.W. Eusebio, Volume 5, Number 6, November/December 1968

R

RAND TABLET: A MAN-MACHINE GRAPHICAL COMMUNICATION DEVICE, THE, M.R. Davis and T.O. Ellis, Volume 4, Number 4, July/August 1967

REAR PROJECTION SCREENS: A DESIGNER'S VIEW, J.T. Miller, Volume 9, Number 3, May/June 1972

RECORDERS, INTENSITY-MODULATED, Harold Klipper, Volume 3, Number 1, January/February 1966

RECORDING MATERIALS FOR DISPLAY PURPOSES, DRY SILVER, D.A. Morgan, T.J. Werner and W.H. Libby, Volume 6, Number 3, May/June 1969

RECORDING MEDIA, H.R. Luxenberg and R.L. Kuehn, Volume 3, Number 5, September/October 1966

RESOLUTION CHARACTERISTICS, SIMPLIFIED METHODS FOR DETERMINING DISPLAY SCREEN, Roger S. Walker, Volume 5, Number 1, January/February 1968

RESOLUTION, VIDEO BANDWIDTH AND FRAME TIME, John R. D'Aiuto, Volume 6, Number 1, January/February 1969

S

SCAN CONVERTER TUBES AND THEIR APPLICATIONS — PART

I, G.T. Nagy, Volume 2, Number 2, March/April 1965
SCAN CONVERTER TUBES AND THEIR APPLICATIONS — PART II, G.T. Nagy, Volume 2, Number 3, May/June 1965

SCANNING TECHNIQUES WITH LIGHT BEAMS, G.T. Nagy, Volume 3, Number 3, May/June 1966

SEC CAMERA TUBES, D.D. Doughty, Volume 7, Number 9, November/December 1970

SIMULATION FILMS, COMPUTER GENERATED, Bruce Cornwell, Volume 8, Number 1, January/February 1971

SOLID STATE ELECTRON TUBE FOR THE PICTUREPHONE SET, A, E.J. Gordon, Volume 5, Number 3, May/June 1968

SPACE VEHICLE DISPLAY SYSTEM, METHODOLOGY FOR THE DEFINITION OF A, Neil J. Arntz, Volume 3, Number 1, January/February 1966

SPOT SIZE OF A SCANNED CRT DISPLAY, OPTIMUM, H. Weiss, Volume 6, Number 6, November/December 1969

STEREOPTICS WITHOUT GLASSES, STANDARD THEATRE — Part I, Robert B. Collender, Volume 9, Number 4, July/August 1972

STEREOPTICS WITHOUT GLASSES, STANDARD THEATRE — PART II, Robert B. Collender, Volume 9, Number 5, September/October 1972

STEREOPTIPLEXER — COMPETITION FOR THE HOLOGRAM, THE, Robert B. Collender, Volume 4, Number 6, November/December 1967

STEREOSCOPIC MOVIE SYSTEM WITHOUT GLASSES, TRUE — PART I, Robert B. Collender, Volume 5, Number 4, July/August 1968

STEREOSCOPIC MOVIE SYSTEM WITHOUT GLASSES, TRUE — PART II, Robert B. Collender, Volume 5, Number 5, September/October 1968

STORAGE TUBE, HIGH RESOLUTION MULTI-COLOR, Phillip P. Damon, Volume 3, Number 6, November/December 1966

STORAGE TUBE PARAMETERS, APPLICATIONS GUIDE TO DISPLAY, F.N. Ingham, Volume 2, Number 5, September/October 1965

SURVEILLANCE MAPS, DIFFERENCE MEASUREMENTS IN AUTOMATIC PHOTOINTERPRETATION OF, Anthony Paolantonio, Volume 6, Number 2, March/April 1969

SYMBOL FORMATION ON LEGIBILITY, EFFECTS OF PARAMETERS OF, Allen G. Vartabedian, Volume 7, Number 5, May 1970

T

TAPE RECORDING OF REDUCED-BANDWIDTH TELEVISION SIGNALS, HIGH DENSITY, Philip Balaban, Volume 4, Number 1, January/February 1967

TELEPHONE SYSTEM PROVIDES TOTAL PRISON COMMUNICATIONS, NEW SECURITY ALARM, Vernon L. Pepersack, Volume 5, Number 2, March/April 1968

TELEVISION COMPATIBLE CHARACTER GENERATOR, A, S.N. Baron, Volume 9, Number 4, July/August 1972

TELEVISION RESOLUTION, MEANS FOR IMPROVING APPARENT, Edwin H. Hilborn and Lloyd E. Stevenson, Volume 4, Number 5, September/October 1967

TELEVISION LEGIBILITY, STUDIES IN — A REVIEW OF THE LITERATURE, Donald A. Shurtleff, Volume 4, Number 1, January/February 1967

TELEVISION, LEGIBILITY REQUIREMENTS FOR EDUCATIONAL, Alan S. Neal, Volume 5, Number 4, July/August 1968

TV SYSTEMS, THE APPLICATION OF VIDICON IN MODERN, R.E. Johnson, Volume 7, Number 3, March 1970

TERMINAL, A NEW TIME SHARING — PART I, G.K. Melga and D.R. Steinberg, Volume 7, Number 8, September/October 1970

TERMINAL, A NEW TIME SHARING — PART II, G.K. Melga and D.R. Steinberg, Volume 7, Number 9, November/December 1970

THREE-DIMENSIONAL DISPLAY: ITS CUES AND TECHNIQUES, THE, Petro Vlahos, Volume 2, Number 6, November/December 1965

THREE-DIMENSIONAL PICTURES WITHOUT GLASSES, CINE-TRON: APPARENT, Alvin M. Marks, Volume 6, Number 2, March/April 1969

TIME SHARED DISPLAY, A COMPUTER, Stephen B. Gray, Volume 3, Number 1, January/February 1966

TRIANGULAR WAVEFORM SYNTHESIZER FOR CHARACTER GENERATION, Roger T. Stevens Sr., Volume 7, Number 1, January, 1970

INFORMATION DISPLAY, November/December 1972

TRICOLOR CARTOGRAPH — A DISPLAY SYSTEM WITH AUTOMATIC COLORING CAPABILITIES, THE, W.J. Kubitz and W.J. Poppelbaum, Volume 6, Number 6, November/December 1969

TWO-COLOR DISPLAY SYSTEM, John Frost, Volume 3, Number 1, January/February 1966

TYPEWRITTEN WORDS, THE RELATIVE LEGIBILITY OF UPPER-CASE AND LOWERCASE, Glenn C. Kinney and Diana J. Showman, Volume 4, Number 5, September/October 1967

V

VACUUM TUBE READOUT WITH TEN GUNS, SHAPED BEAM AND DECIMAL INPUT, SINGLE PLANE, Donald Gumpertz, Volume 4, Number 4, July/August 1967

VALVE STUDY, SOLID STATE LIGHT, Edward J. Calucci, Volume 2, Number 2, March/April 1965

VEHICULAR TRAFFIC CONTROL SYSTEM OF THE POST-1970 ERA, INFORMATION DISPLAY IN A, Edith Bairdain, Volume 2, Number 3, May/June 1965

VIDEO (ANALOG) SCAN CONVERTER, A QUEUING MODEL FOR A, Thomas W. Gay Jr., Volume 7, Number 1, January 1970

VISUAL SIMULATION, Paul T. Kaestner, Volume 4, Number 2, March/April 1967

VISUAL SPACE PERCEPTION, A MATRIX FORMULATION OF, Homer B. Tilton, Volume 4, Number 1, January/February 1967

BY AUTHOR

A

ADAM, K.C., Two-Color Alphanumeric Display, Volume 7, Number 7, July 1970

ADEN, ARTHUR L., Challenges for Display, Volume 4, Number 6, November/December 1967

AKIN, ROYAL H., Photo Sensor Problems in Display Luminance Measurement, Volume 2, Number 1, January/February 1965

ALBURTY, WILLIAM H., Projection with Fisheye Camera Lenses, Volume 7, Number 3, March 1970

ARNOLDY, CAROLYNE, Cockpit Display: Users vs. Makers, Volume 8, Number 4, July/August 1971

ARNOLDY, CAROLYNE, Plotters: One Way to Go — Up! — Part I, Volume 8, Number 5, September/October 1971

ARNOLDY, CAROLYNE, Plotters: One Way to Go — Up! — PART II, Volume 8, Number 6, November/December 1971

ARNTZ, NEIL J., Methodology for the Definition of a Space Vehicle Display System, Volume 3, Number 1, January/February 1966

ATWOOD, JOHN W., CATV in the 70's, Volume 8, Number 3, May/June 1971

AVAKIAN, EMIK A. (with JENISON, F. WALTER) Voice-Response and Visual-Display Techniques for On-Line Information-Handling Systems, Volume 1, Number 2, November/December 1964

AVEDON, DON, Computer Output Microfilming, Volume 8, Number 4, January/February 1971

B

BAIRDAIN, EDITH, Information Display in a Vehicular Traffic Control System of the Post-1970 Era, Volume 2, Number 3, May/June 1965

BAKER, CHARLES E. (with RUGARI, ANTHONY D.), The Laser Display — A Large Screen, Real-Time Display Technique, Volume 3, Number 2, March/April 1966

BALABAN, PHILIP, High Density Tape Recording of Reduced-Bandwidth Television Signals, Volume 4, Number 1, January/February 1967

BALL, G.H. (with HALL, D.J., WOLF, D.E., and EUSEBIO, J.W.), Promenade — An Interactive Graphics Pattern-Recognition System, Volume 5, Number 6, November/December 1968

BARBER, KENNETH, An Alpha-Numeric Display, Volume 7, Number 6, June 1970

BARON, S.N., A Television Compatible Character Generator, Volume 9, Number 4, July/August 1972

INFORMATION DISPLAY, November/December 1972

C

CALUCCI, EDWARD J., Solid State Light Valve Study, Volume 2, Number 2, March/April 1965

CARLSON, R.D., Computer Graphics and Manufacturing, Volume 6, Number 1, January/February 1969

CAUFIELD, H. JOHN, Electro-Optical Three Dimensional Displays, Volume 4, Number 4, July/August 1967

CHATER, MICHAEL L., Practical Consideration in Operating Monochrome TV Projectors, Volume 7, Number 6, June 1970

CHILDRESS, LORENZO S., Selecting the Proper Display System, Volume 8, Number 3, May/June 1971

CHRISTENSEN, R.W. (with McKIERNAN, W.R.), Basic EL Designs for Space and Military Applications, Volume 4, Number 2, March/April 1967

COLLENDER, ROBERT B., Standard Theatre Stereoptics Without Glasses — Part I, Volume 9, Number 4, July/August 1972

COLLENDER, ROBERT B., Standard Theatre Stereoptics Without Glasses — Part II, Volume 9, Number 5, September/October 1972

COLLENDER, ROBERT B., The Stereoptiplexer — Competition for the Hologram, Volume 4, Number 6, November/December 1967

COLLENDER, ROBERT B., True Stereoscopic Movie System Without Glasses — Part I, Volume 5, Number 4, July/August 1968

COLLENDER, ROBERT B., True Stereoscopic Movie System Without Glasses — Part II, Volume 5, Number 5, September/October 1968

CORNWELL, BRUCE, Computer Generated Simulation Films, Volume 8, Number 1, January/February 1971

COURT, PATRICK R.J., Design and Use of CATV Converters, Volume 8, Number 2, March/April 1971

COWDEN, D.G. (with JOHNSON, A.D.), Considerations in Specifying Display System CRT Design Objectives, Volume 4, Number 3, May/June 1967

COX, G. (with DORION, G., ROTH, R., and STAFFORD, J.), CRT Phosphor Activation of Photochromic Film, Volume 3, Number 2, March/April 1966

D

D'AUTO, JOHN R., Resolution, Video Bandwidth and Frame Time, Volume 6, Number 1, January/February 1969

DALTON, JOHN J. (with LOCASCIO, JAMES T., and KARANZA, GEORGE L.), Obtaining Light Pen Versatility, Volume 4, Number 6, November/December 1967

DAMERELL, J. BRUCE, Character Font Design on a Graphic Display, Volume 5, Number 2, March/April 1968

DAMON, PHILLIP P., High Resolution Multi-Color Storage Tube, Volume 3, Number 6, November/December 1966

DAVIS, JOSEPH A. (with FAETH, P.A., SISNEROS, T.E., and HILBORN, E.H.), Current-Sensitive, Single-Gun Color CRT, Volume 7, Number 4, April 1970

DAVIS, M.R. (with ELLIS, T.O.), The Rand Tablet: A Man-Machine Graphical Communication Device, Volume 4, Number 4, July/August 1967

DAVIS, RUTH M., The ID Field as It Exists Today, Volume 1, Number 1, September/October 1964

DAVIS, SAMUEL, Microelectronic Character Generator Employed in Computer Display Processor, Volume 3, Number 4, July/August 1966

DeLAY, D. (with HARRIS, T.J., HANNA, D., SINCERBOX, G.T., and SCHOOLS, R.S.), Holography in an Airborne Display System, Volume 7, Number 4, April 1970

DINWIDDIE, JAMES H. (with MULLENS, ROBERT C.), Color Output Generator System, Volume 2, Number 1, January/February 1965

DITTBERNER, DONALD L. (with JAMES, PETER), Display Requirements of the Integrated Management Information Systems, 1968-70, Volume 1, Number 2, November/December 1964

DORION, G., (with COX, G., ROTH, R., and STAFFORD, J.), CRT Phosphor Activation of Photochromic Film, Volume 3, Number 2, March/April 1966

DOUGHTY, D.D., SEC Camera Tubes, Volume 7, Number 9, November/December 1970

E

ELLIS, T.O., (with DAVIS, M.R.), The Rand Tablet: A Man-Machine Graphical Communication Device, Volume 4, Number 4, July/August 1967

EUSEBIO, J.W. (with BALL, G.H., HALL, D.J., and WOLF, D.E.), Promenade — An Interactive Graphics Pattern-Recognition System, Volume 5, Number 6, November/December 1968

F

FAETH, PAUL A. (with DAVIS, J.A., SISNEROS, T.E. and HILBORN, E.H.), Current-Sensitive, Single-Gun Color CRT, Volume 7, Number 4, April 1970

FOWLER, VERNON J. (with STONE, SAMUEL M., and SCHLAFFER, JOHN), An Experimental Laser Color TV Projection Display System, Volume 6, Number 1, January/February 1969

FROST, JOHN, An Inexpensive Technique for Color Electroluminescent Display, Volume 6, Number 5, September/October 1969

FROST, JOHN (with SULLIVAN, NORMAN F.), Integrated Displays for Multicrew Military Aircraft, Volume 9, Number 2, March/April 1972

FROST, JOHN S., Two-Color Display System, Volume 3, Number 1, January/February 1966

G

GAY, A.C., High Resolution Displays for Processing and Distribution of Pictorial Material, Volume 6, Number 4, July/August 1969

GAY, THOMAS W. JR., A Queuing Model for Video (Analog) Scan Converter, Volume 7, Number 1, January 1970

GILLERY, F.H., Transparent, Conductive Coatings of Indium Oxide, Volume 9, Number 1, January/February 1972

GOLDSTEIN, ALBERT S., The JPL Space Flight Operations Facility Display and Control System, Volume 1, Number 2, November/December 1964

GONCAROV, OLEGS, Reaction of Contrast on a Cathode Ray Tube, Volume 7, Number 2, February 1970

GONYOU, GEORGE W., Dynamic CRT Spot Measurement Techniques, Volume 6, Number 4, July/August 1969

GOODELL, W.V. (with WOODSON, P.D.), A Plastic Virtual Infinity Lens System for Large Aperture Cathode Ray Tube Displays, Volume 5, Number 6, November/December 1968

GOODWIN, A.R. (with TIGUE, R.F.), Computerized Display Maintenance, Volume 6, Number 2, March/April 1969

GORDON, E.J., A "Solid State" Electron Tube for the Picturephone Set, Volume 5, Number 3, May/June 1968

GOULD, JOHN D. (with MAKOUS, WALTER L.), Vision and Lasers: Human Factors of Laser Displays, Volume 5, Number 6, November/December 1968

GRAFF, HERMAN (with MARTEL, RICHARD), A Display Screen with Controlled Electroluminescence, Volume 2, Number 5, September/October 1965

GRAHAM, STANLEY, Using a Standard Television Monitor as an Alpha-Numeric Display, Volume 4, Number 3, May/June 1967

GRAY, STEPHEN B., A Computer Time-Shared Display, Volume 3, Number 1, January/February 1966

GRONEMANN, V.F. (with KNUDSON, D.R., REINTJES, J.F., and TEICHER, S.N.), Experimental Evaluation of the Resolution Capabilities of Image Transmission Systems, Volume 5, Number 5, September/October 1968

GUMPERTZ, DONALD, Single Plane Vacuum Tube Readout with Ten Guns, Shaped Beam and Decimal Input, Volume 4, Number 4, July/August 1967

H

HALL, D.J. (with BALL, G.H., EUSEBIO, J.W., and WOLF, D.E.), Promenade — An Interactive Graphics Pattern-Recognition System, Volume 5, Number 6, November/December 1968

HALSTEAD, CHARLES, Display with Entropy, Volume 5, Number 1, January/February 1968

HAMILTON, A. (with MOFFETT, J., and RENNIE, J.), Radar Digital Processing and Display System for Air Traffic Control, Volume 6, Number 4, July/August, 1969

HANNA, D. (with HARRIS, T.J., SINCERBOX, G.T., SCHOOLS, R.S., and DeLAY, D.), Holography in an Airborne Display System, Volume 7, Number 4, April 1970

HANNA, J.L. (with IRELAND, DR. F.H.), Graphic Aids for Console Design, Volume 6, Number 5, September/October 1969

HARDIN, GARRETT, An Evolutionist Looks at Computers, Volume 6, Number 1, January/February 1969

HARRIS, T.J. (with HANNA, D., SINCERBOX, G.T., SCHOOLS, R.S., and DeLAY, D.), Holography in an Airborne Display System, Volume 7, Number 4, April 1970

HARSH, M.D., Multi-Sensor Displays — Two Approaches, Volume 3, Number 5, September/October 1966

HAYNES, H.F., Computer and Microfilm Combined in Phototypesetting, Volume 9, Number 3, May/June 1972

HEARD, J.L. (with HOFFMAN, W.C., and SLOCUM, G.K.), Airborne Sensor Display Requirements and Approaches, Volume 4, Number 6, November/December 1967

HENDREN, PHILIP (with WOOD, ROGER C.), A Flexible Computer Graphic System for Architectural Design, Volume 5, Number 2, March/April 1968

HENDRICKSON, HERBERT C., The Display/Control Complex of the Manned Space Missile Control Center, Volume 4, Number 3, May/June 1967

HENDRICKSON, HERBERT C., A High-Precision Display System for Command and Control, Volume 4, Number 4, July/August 1967

HILBORN, EDWIN H. (with DAVIS, J.A., SISNEROS, T.E., and FAETH, P.A.), Current-Sensitive, Single-Gun Color CRT, Volume 7, Number 4, April 1970

HILBORN, EDWIN H. (with STEVENSON, LLOYD E.), Means for Improving Apparent Television Resolution, Volume 4, Number 5, September/October 1967

HILDEBRAND, B.P., Applications of Holograms as Displays, Volume 5, Number 2, March/April, 1968

HIROSE, T. (with OWAKE, K., UMEDA, S., and TOBA, T.), Plasma Display Harmonic Phase Selection, Volume 7, Number 5, May 1970

HOFFMAN, W.C. (with HEARD, J.L., and SLOCUM, G.K.), Airborne Sensor Display Requirements and Approaches, Volume 4, Number 6, November/December 1967

HOROWITZ, PAUL, Concept for Design and Implementation of Mobile, Computer-Generated Display Systems, Volume 3, Number 4, July/August 1966

HOULDIN, RUSSELL J., IBM's Graphic Display System, Volume 3, Number 5, September/October 1966

HOYT, L. ARTHUR, (with ROMMEL, JOHN), Computer Driven Displays Speed Evaluation of Carrier Aircraft Landings, Volume 4, Number 1, January/February 1967

I

INGHAM, F.N., Applications Guide to Display Storage Tube Parameters, Volume 2, Number 5, September/October 1965

IRELAND, DR. F.H. (with HANNA, J.L.), Graphic Aids for Console Design, Volume 6, Number 5, September/October 1969

J

JACOBSON, A.D., Requirements for Holographic Displays, Volume 7, Number 9, November/December 1970

JAMES, PETER (with DITTBERNER, DONALD L.), Display Requirements of the Integrated Management Information Systems, 1968-70, Volume 1, Number 2, November/December 1964

JENISON, F. WALTER (with AVAKIAN, EMIK A.), Voice-Response and Visual-Display Techniques for On-Line Information-Handling Systems, Volume 1, Number 2, November/December 1964

JOHNSON, A.D. (with COWDEN, D.G.), Considerations in Specifying Display System CRT Design Objectives, Volume 4, Number 3, May/June 1967

JOHNSON, R.E., The Application of Vidicons in Modern TV Systems, Volume 7, Number 3, 1970

JUSTICE, BEN (with LIEBOLD, F.B., JR.), Photochromic Glass — A New Tool for the Display System Designers, Volume 2, Number 6, November/December 1965

K

KAESTNER, PAUL T., Visual Simulation, Volume 4, Number 2, March/April 1967

KARANZA, GEORGE L. (with DALTON, JOHN J., and LOCASCIO, JAMES T.), Obtaining Light Versatility, Volume 4, Number 6, November/December 1967

KEARNS, JOHN H. (with SWARZ, WILLIAM F.), An Assessment of Display for Aircraft Applications: A Developing Crisis, Volume 8, Number 2, March/April 1971

KENNEDY, EDMUND J., Some Pragmatic Considerations Influencing the Selection of Air Force Display Techniques, Volume 2, Number 4, July/August 1965

KERR, MAXWELL A., Ultrarapid Film Systems for Data Display and Computer Interlock, Volume 3, Number 6, November/December 1966

KETCHEL, J., The Effects of High Intensity Light Adaptation on Electronic Display Visibility, Volume 6, Number 3, May/June 1969

KINNEY, GLENN C. (with SHOWMAN, DIANA J.), The Relative Legibility of Uppercase and Lowercase Typewritten Words, Volume 4, Number 5, September/October 1967

KINSELLA, KEVIN J. (with MATTHEWS, ANDREW J.), Using Interactive Graphics for Fighter Pilot Training, Volume 9, Number 2, March/April 1972

KIRSCH, HAROLD A. (with LONGINEAU, JAMES T.), Off-Line Data Source Automation — An Expanded Role for the CRT, Volume 7, Number 6, June 1970

KLIPPER, HAROLD, Intensity-Modulated Recorders, Volume 3, Number 1, January/February 1966

KNOWLES, L.G. (with KOHLENSTEIN, L.C., and YATES, W.A.), A Multi-Tone Display for Computer Processed Data, Volume 7, Number 3, March 1970

KNUDSON, D.R. (with GRONEMANN, U.F., REINTJES, J.F., and TEICHER, S.N.), Experimental Evaluation of the Resolution Capabilities of Image Transmission Systems, Volume 5, Number 5, September/October 1968

KOENIG, EDWARD W. (with BRANCHFLOWER, GILBERT A.), The Image Dissector Camera, A New Approach to Spacecraft Sensors, Volume 5, Number 2, March/April 1968

KOHLENSTEIN, L.C. (with KNOWLES, L.G., and YATES, W.A.), A Multi-Tone Display for Computer Processed Data, Volume 7, Number 3, March 1970

KUBITZ, W.J. (with POPPELBAUM, W.J.), The Tricolor Cartograph — A Display System with Automatic Coloring Capabilities, Volume 6, Number 6, November/December 1969

KUEHN, R.L., Color Vision, Volume 2, Number 5, September/October 1965

KUEHN, R.L. (with LUXENBERG, H.R.), Recording Media, Volume 3, Number 5, September/October 1966

KUEHN, R.L., Display Requirements Assessment for Command and Control Systems, Volume 3, Number 6, November/December 1966

L

LaFRANCE, R.C., Sixteen Earth-Orbit Film for the Apollo Mission Simulator, Volume 6, Number 3, May/June 1969

LEAMAN, J.R., Electron Optics of Vidicons, Volume 7, Number 2, February 1971

LIEBOLD, F.B., JR. (with JUSTICE, BEN), Photochromic Glass — A New Tool for the Display Systems Designers, Volume 2, Number 6, November/December 1965

LIBBY, W.H. (with MORGAN, D.A., and WERNER, T.J.), Dry Silver Recording Materials for Display Purposes, Volume 6, Number 3, May/June 1969

LOCASCIO, JAMES T. (with DALTON, JOHN J., and KARANZA, GEORGE L.), Obtaining Light Pen Versatility, Volume 4, Number 6, November/December 1967

LONGINEAU, JAMES T. (with KIRSCH, HAROLD A.), Off-Line Data Source Automation — An Expanded Role for the CRT, Volume 7, Number 6, June 1970

LUXENBERG, H.R., Photometric Units, Volume 2, Number 3, May/June 1965

LUXENBERG, H.R. (with BONNESS, Q.L.), Quantitative Measures of Display Characteristics, Volume 2, Number 4, July/August 1965

LUXENBERG, H.R. (with KUEHN, R.L.), Recording Media, Volume 3, Number 5, September/October 1966

M

MACHOVER, CARL, Family of Computer-Controlled CRT Graphic Displays, Volume 3, Number 4, July/August 1966

MAKOUS, WALTER L. (with GOULD, JOHN D.), Vision and Lasers: Human Factors of Laser Displays, Volume 5, Number 6, November/December 1968

MALLENDER, IAN H., Digital Methods of Microfilm Communication — Parts I and II, Volume 8, Number 3, May/June 1971

MALLENDER, IAN H., Digital Methods of Microfilm Communication — Part III, Volume 8, Number 4, July/August 1971

MALLENDER, IAN H., Digital Methods of Microfilm Communication — Part IV, Volume 8, Number 5, September/October 1971

MALONEY, THOMAS, Display Device for Infrared Image, Volume 6, Number 1, January/February 1969

MARKS, ALVIN M., Cinetron: Apparent 3-Dimensional Pictures Without Glasses, Volume 6, Number 2, March/April 1969

MARSHALL, GERALD F., Head-Up Displays: Alignment and Test by Laser, Volume 6, Number 2, March/April 1969

MARTEL, RICHARD (with GRAFF, HERMAN), A Display Screen with Controlled Electroluminescence, Volume 2, Number 5, September/October 1965

MASON, ROBERT P., Hardware for Bimat Processing, Volume 4, Number 2, March/April 1967

MATTHEWS, ARNOLD J. (with KINSELLA, KEVIN J.), Using Interactive Graphics for Fighter Pilot Training, Volume 9, Number 2, March/April 1972

MAYMON, G.A., Diagnostic Programs for Videocomp Phototypesetters, Volume 6, Number 6, November/December 1969

McKIERNAN, W.R. (with CHRISTENSEN, R.W.), Basic EL Designs for Space and Military Applications, Volume 4, Number 2, March/April 1967

McNANEY, JOSEPH T., JTM-CRT Means of Setting Printers' Type Electronically, Volume 5, Number 2, March/April 1968

MEGLA, G.K. (with STEINBERG, D.R.), A New Time Sharing Terminal — Part I, Volume 7, Number 8, September/October 1970

MEGLA, G.K. (with STEINBERG, D.R.), A New Time Sharing Terminal — Part II, Volume 7, Number 9, November/December 1970

MENNIE, W.E. (with THOMAS, P.A.V.), A Logic Character Generator for Use in a CRT Text Display, Volume 9, Number 2, March/April 1972

MILLER, J.T., Rear Projection Screens: A Designer's View, Volume 9, Number 3, May/June 1972

MOFFETT, J. (with HAMILTON, A., and RENNIE, J.), Radar Digital Processing and Display System for Air Traffic Control, Volume 6, Number 4, July/August 1969

MORGAN, D.A. (with LIBBY, W.H., and WERNER, T.J.), Dry Silver Recording Materials for Display Purposes, Volume 6, Number 3, May/June 1969

MULLENS, ROBERT C. (with DINWIDDIE, JAMES H.), Color Output Generating Systems, Volume 2, Number 1, January/February 1965

N

NAGY, G.T., Scan Converter Tubes and Their Applications — Part I, Volume 2, Number 2, March/April 1965

NAGY, G.T., Scan Converter Tubes and Their Applications — Part II, Volume 2, Number 3, May/June 1965
 NAGY, G.T., Scanning Techniques with Light Beams, Volume 3, Number 3, May/June 1966
 NAGY, G.T., Characteristics of Photosensors, Volume 4, Number 2, March/April 1967
 NEAL, ALAN A., Legibility Requirements for Educational Television, Volume 5, Number 4, July/August 1968
 NEMETH, LASZLO (with BERGER, PETER, and RILLINGS, JAMES), A Simple Graphical Display Unit for a Small Digital Computer Installation, Volume 7, Number 4, April 1970
 NICHINSON, DAVID B., Man ... and the Navigation-Display Interface, Volume 2, Number 4, July/August 1965

O

OBERG, P.E. (with SAUTER, G.F.), Plasma Display Phase Select, Volume 6, Number 2, March/April 1969
 O'DONNELL, J.P. (with VOGEL, R.Q.), Color Tubes Determining White Field Balance, Volume 7, Number 4, April 1970
 OTSUKA, WILLIAM T., Light Emitting Diodes, Volume 6, Number 4, July/August 1969
 OWAKE, K. (with TOBA, T., UMEDA, S., and HIROSE, T.), Plasma Display Harmonic Phase Selection, Volume 7, Number 5, May 1970

P

PAOLANTONIO, ANTHONY, Difference Measurements in Automatic Photointerpretation of Surveillance Maps, Volume 6, Number 2, March/April 1969
 PAQUETTE, RUSSELL, API Training Operations Evaluation, Volume 6, Number 5, September/October 1969
 PARKER, JERALD V., Holography and Display, Volume 3, Number 3, May/June 1966
 PEASE, EDMUND M., Model Educational Systems for the 1970's, Volume 7, Number 7, July 1970
 PEPERSACK, VERNON L., New Security Alarm Telephone System Provides Total Prison Communications, Volume 5, Number 2, March/April 1968
 PICKETT, FRED, Man, Machine and the System — Design Studies Continue at FAA for Better Combination, Volume 4, Number 6, November/December 1967
 PIZZICARA, DONALD J., Electroluminescence — An Appraisal for Avionic Display Applications, Volume 3, Number 2, March/April 1966
 PLETZ, ALFRED JR., CRT Write Rate vs Bandwidth Study, Volume 9, Number 4, July/August 1972
 POPPELBAUM, W.J. (with KUBITZ, W.J.), The Tricolor Cartograph — A Display System with Automatic Coloring Capabilities, Volume 6, Number 6, November/December 1969
 POULETT, ANTHONY, Magnetic Disc Recording for Teleproduction and Animation, Volume 7, Number 9, November/December 1970

R

RAAGO, R.T., A Low Cost General Purpose Alpha-Numeric Readout Device, Volume 6, Number 3, May/June 1969
 RAGER, DAVID, Automatic Artwork Generation, Volume 6, Number 6, November/December 1969
 REINTJES, J.F. (with GRONEMANN, U.F., KNUDSON, D.R., and TEICHER, S.N.), Experimental Evaluation of the Resolution Capabilities of Image Transmission Systems, Volume 5, Number 5, September/October 1968
 RENNIE, J. (with HAMILTON, A., and MOFFETT, J.), Radar Digital Processing and Display System for Air Traffic Control, Volume 6, Number 4, July/August 1969
 RILLINGS, JAMES (with BERGER, PETER, and NEMETH, LASZLO), A Simple Graphical Display Unit for a Small Digital Computer Installation, Volume 7, Number 4, April 1970
 RIZY, EDWARD F., Dichroic Filters and Additive Color Displays, Volume 3, Number 4, July/August 1966
 ROBINSON, STEPHEN P., Color Telefilm Recording, Volume 9, Number 5, September/October 1972

ROGERS, JAMES G., Real-Time Analog Display Inputs, Volume 7, Number 7, July 1970
 ROMMEL, JOHN (with HOYT, L. ARTHUR), Computer Driven Displays Speed Evaluation of Carrier Aircraft Landings, Volume 4, Number 2, January/February 1967
 ROSCOE, S.M., The Case for the Moving Map Display, Volume 4, Number 5, September/October 1967
 ROTH, R. (with COX, G., DORION, G., and STAFFORD, J.), CRT Phosphor Activation of Photochromic Film, Volume 3, Number 2, March/April 1966
 RUGARI, ANTHONY D. (with BAKER, CHARLES E.), The Laser Display — A Large-Screen, Real-Time Display Technique, Volume 3, Number 2, March/April 1966
 RUTLAND, DAVID, A Digital Interactive Color Television Display, Volume 7, Number 8, September/October 1970

S

SAUTER, G.F. (with OBERG, P.E.), Plasma Display Phase Select, Volume 6, Number 2, March/April 1969
 SAWTELLE, EDWARD M., Dynamic CRT Spot Measurement Techniques, Volume 6, Number 4, July/August 1969
 SAY, D.L., A Multibeam CRT, Volume 7, Number 5, May 1970
 SCHLAFFER, JOHN (with FOWLER, VERNON J., and STONE, SAMUEL M.), An Experimental Laser Color TV Projection Display System, Volume 6, Number 1, January/February 1969
 SCHOOLS, R.S. (with HARRIS, T.J., SINCERBOX, G.T., HANNA, D., and DeLAY, D.), Holography in an Airborne Display System, Volume 7, Number 4, April 1970
 SHERR, SOL, The State of Display Standards, Volume 8, Number 2, March/April 1971
 SHOWMAN, DIANA J., The Relative Legibility of Leroy and Lincoln Mitre Alphanumeric Symbols, Volume 4, Number 2, March/April 1967
 SHOWMAN, DIANA J. (with KINNEY, GLENN C.), The Relative Legibility of Uppercase and Lowercase Typewritten Words, Volume 4, Number 5, September/October 1967
 SHURTLEFF, DONALD H., Studies in Television Legibility — A Review of the Literature, Volume 4, Number 1, January/February 1967
 SINCERBOX, G.T. (with HARRIS, T.J., HANNA, D., SCHOOLS, R.S., and DeLAY, D.), Holography in an Airborne Display System, Volume 7, Number 4, April 1970
 SISNEROS, T.E. (with DAVIS, J.A., HILBORN, E.H., and FAETH, P.A.), Current-Sensitive, Single-Gun Color CRT, Volume 7, Number 4, April 1970
 SLOCUM, G.K. (with HEARD, J.L., and HOFFMAN, W.C.), Airborne Sensor Display Requirements and Approaches, Volume 4, Number 6, November/December 1967
 SMITH, EUGENE G., Plotting vs. Other Forms of Readout, Volume 6, Number 2, March/April 1969
 SOCIETY FOR INFORMATION DISPLAY, MID ATLANTIC CHAPTER, Laser Display Seminar, Volume 5, Number 3, May/June 1968
 STAFFORD, J. (with COX, G., DORION, G., and ROTH, R.), CRT Phosphor Activation of Photochromic Film, Volume 3, Number 2, March/April 1966
 STEIN, W.A., The Application of Photochromics to Color Display, Volume 6, Number 3, May/June, 1969
 STEINBERG, CHARLES A., Information Storage and Retrieval System, Volume 7, Number 2, February 1970
 STEINBERG, D.R. (with MEGLA, G.K.), A New Time Sharing Terminal — Part I, Volume 7, Number 8, September/October 1970
 STEINBERG, D.R. (with MEGLA, G.K.), A New Time Sharing Terminal — Part II, Volume 7, Number 9, November/December 1970
 STEVENS, ROGER T., SR., A Triangular Waveform Synthesizer for Character Generation, Volume 7, Number 1, January 1970
 STEVENSON, LLOYD E. (with HILBORN, EDWIN H.), Means for Improving Apparent Television Resolution, Volume 4, Number 5, September/October 1967
 STOCKER, A.C., Displays, Papers, and Lighting, Volume 2, Number 2, September/October 1964
 STOCKER, A.C., The Size and Contrast of Hard-Copy Symbols, Volume 3, Number 4, July/August 1966
 STOCKER, A.C., The Distribution of Illumination, Volume 5, Number 2, March/April 1968
 STONE, SAMUEL M. (with FOWLER, VERNON J., and SCHLAFFER, JOHN), An Experimental Laser Color TV Projection Display System, Volume 6, Number 1, January/February 1969

STORY, PHILLIP C., Gas Discharge Techniques for Aircraft Displays, Volume 7, Number 5, May 1970
 STOVER, W. RICHARD, An Autostereoscopic Three Dimensional Display, Volume 9, Number 1, January/February 1972
 STUPAR, TIMOTHY D., Characterization of Light Pen Sensitivity, Volume 4, Number 3, May/June 1967
 SULLIVAN, NORMAN F., (with FROST, JOHN), Integrated Displays for Multicrew Military Aircraft, Volume 9, Number 2, March/April 1972
 SWARTZ, WILLIAM F. (with KEARNS, JOHN H.), An Assessment of Display for Aircraft Applications: A Developing Crisis, Volume 8, Number 2, March/April 1971

T

TEICHER, S.N. (with GRONEMANN, U.F., KNUDSON, D.R., and REINTJES, J.F.), Experimental Evaluation of the Resolution Capabilities of Image Transmission Systems, Volume 5, Number 5, September/October 1968
 TEICHROEW, DANIEL, Data Display in Business and Information Systems, Volume 2, Number 6, November/December 1965
 THOMAS, P.A.V. (with MENNIE, W.E.), A Logic Character Generator for Use in a CRT Text Display, Volume 9, Number 2, March/April 1972
 THORSON, JON, Generation of Statistically-Controlled Keyboard Data, Volume 5, Number 3, May/June 1968
 TIGUE, R.F. (with GOODWIN, A.R.), Computerized Display Maintenance, Volume 6, Number 2, March/April 1969
 TILTON, HOMER B., A Matrix Formulation of Visual Space Perception, Volume 4, Number 1, January/February 1967
 TOBA, T. (with OWAKE, K., UMEDA, S., and HIROSE, T.), Plasma Display Harmonic Phase Selection, Volume 7, Number 5, May 1970
 TON, WILLIAM H., Optimal Visual Characteristics for Large Screen Displays, Volume 6, Number 4, July/August 1969
 TURNAGE, RODGER ELMO, JR., The Perception of Flicker in Cathode Ray Tube Displays, Volume 3, Number 3, May/June 1966

U

UMEDA, S. (with OWAKE, K., TOBA, T., and HIROSE, T.), Plasma Display Harmonic Phase Selection, Volume 7, Number 5, May 1970

V

VARTABEDIAN, ALLEN G., A Graphic Set For ASCII Using A 7X9 Dot Pattern, Volume 8, Number 6, November/December 1971
 VARTABEDIAN, ALLEN G., Effects of Parameters of Symbol Formation on Legibility, Volume 7, Number 5, May 1970
 VLAHOS, PETRO, The Three-Dimensional Display: Its Cues and Techniques, Volume 2, Number 6, November/December 1965
 VOGEL, R.Q. (with O'DONNELL, J.P.), Color Tubes Determining White Field Balance, Volume 7, Number 4, April 1970
 VOLKOFF, JOHN, Discernibility of CRT Gray Shades, Volume 8, Number 6, November/December 1971

W

WALKER, ROGER S., Simplified Methods for Determining Display Screen Resolution Characteristics, Volume 5, Number 1, January/February 1968
 WARNER, ARTHUR S., Experimental, Crystal-Modulated Facsimile Recorder, Volume 6, Number 1, January/February 1969
 WATSON, WILLIAM A., Dataplot: A System for On-Line Graphical Display of Statistical Data, Volume 4, Number 4, July/August 1967
 WEISS, HELMUT, Wide-Screen Slide Projection, Volume 1, Number 1, September/October 1964
 WEISS, HELMUT, Capacity and Optimum Configuration of Displays for Group Viewing, Volume 3, Number 6, November/December 1966
 WEISS, H., Optimum Spot Size of a Scanned CRT Display, Volume 6, Number 6, November/December 1969
 WERNER, T.J. (with LIBBY, W.H., and MARGON, D.A.), Dry Silver Recording Materials for Display Purposes, Volume 6, Number 3, May/June 1969



FREE YOKE SELECTION KIT
 Information you need to know about selecting and specifying a precision yoke for your CRT display. Indicates the interaction between circuitry, CRT and yoke. Includes an application checklist to simplify your work. Send for your kit.

SYNTRONIC INSTRUMENTS, INC.
 100 Industrial Road Addison, Ill. 60101 (312) 543-6444

syntronic

Circle Reader Service Card No. 5

CATHODE RAY TUBES

WE OFFER YOU TECHNICAL ABILITY FOR ANY SPECIAL CRT AND DISPLAY SYSTEM

CRT
 FIBER OPTIC FACE
 BACK PORTED
 MONOSCOPES
 HIGH RESOLUTION
 CUSTOM GEOMETRIES
 PHOSPHOR SCREENS
 ELECTRON OPTICS.

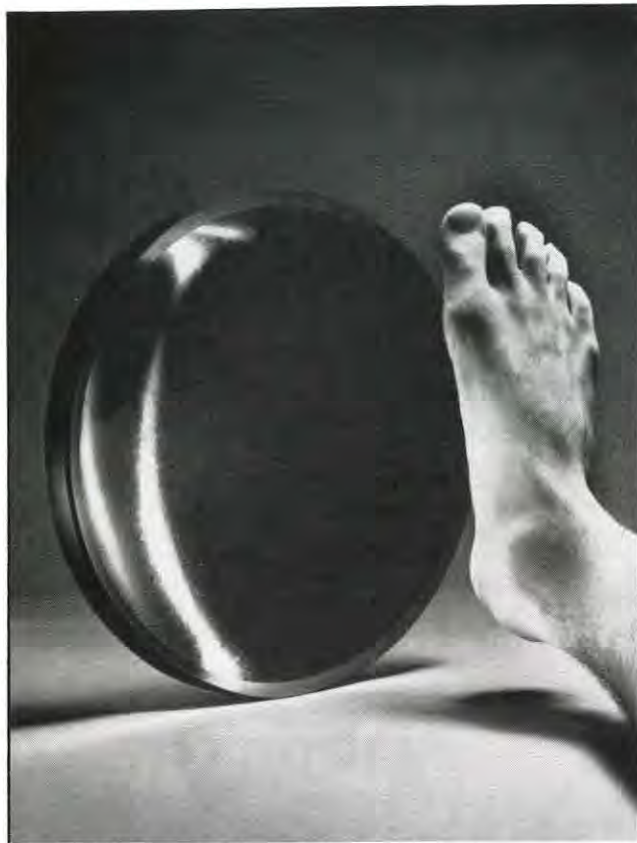


SYSTEMS
 FLYING SPOT SCANNERS,
 MONITORS, FIBER OPTIC
 PRINTERS, DATA TERMINALS.

**DESIGN — DEVELOPMENT —
 PRODUCTION — TUBES AND
 SYSTEMS.**

M. SADOWSKY S. CARLISLE P. KEEGAN

**SPECIAL PURPOSE
 TUBE COMPANY**
 14746-C RAYMER ST., VAN NUYS, CA. 91405
 Tel. (213) 989-4610



BENDIX MAKES FIBER OPTIC FACEPLATES AS BIG AS A FOOT.

And as clear as a crystal.

Our configurations range from 3" to 12". Our options range from increased contrast to hard copy and off-axis filter characteristics. And our turn-around time ranges from fast to wow.

Which means that our applications range from video displays to business machine readouts to cockpit annunciators to advanced facsimile equipment... most anything that needs clearing up.

Ask us for details. We'll hot foot them right out to you.

Contact: The Bendix Corporation, Electro-Optics Division, Marketing Department, Galileo Park, Sturbridge, MA 01518. (617) 347-9191.



- WHITHAM, GLENN E., The Determination of Display Screen Size and Resolution Based on Perceptual and Information Limitations, Volume 2, Number 4, July/August 1965
- WILLRODT, MARVIN, Binary to Decimal Decoding System Using Neon Lamps and a Photoconductor Matrix, Volume 3, Number 6, November/December 1966
- WILLSON, R.H., The Plasma Display — A Digitally Controllable, High Brightness Display with an Inherent Memory, Volume 5, Number 6, November/December 1968
- WOEHL, WALTER E., Comparison of Image Degradation in Photographic and Image Orthicon Systems, Volume 5, Number 1, January/February 1968
- WOLF, D.E. (with BALL, G.H., HALL, D.J., and EUSEBIO, J.W.), Promenade — An Interactive Graphics Pattern-Recognition System, Volume 5, Number 6, November/December 1968
- WOLVIN, JOHN, Anaglyph Stereoscopic CRT Display System, Volume 6, Number 3, May/June 1969
- WOOD, ROGER C. (with HENDREN, PHILIP), A Flexible Computer Graphic System for Architectural Design, Volume 5, Number 2, March/April 1968
- WOODSON, P.D. (with GOODELL, W.V.), A Plastic Virtual Infinity Lens System for Large Aperture Cathode Ray Tube Displays, Volume 5, Number 6, November/December 1968
- WURTZ, JIM E., High Resolution Cathode Ray Tubes for the System Designer, Volume 4, Number 3, May/June 1967
- WURTZ, JIM E., Dry Process Materials for Hard Copy Printout from CRT's, Volume 6, Number 2, March/April 1969

Y

- YATES, W.A., A Multi-Tone Display for Computer Processed Data, Volume 7, Number 3, March 1970

Z

- ZIMMER, KARL J., The Command and Control Display System for NORAD, Volume 4, Number 5, September/October 1967



...best source for CRTS for all commercial, industrial, and military applications

COMPUTER DISPLAY CONSOLES
CHARACTER READERS & FILM SCANNERS
DESK TOP CALCULATORS
HEAD-UP, RADAR AND OTHER AVIONICS
DISPLAYS FOR SEVERE ENVIRONMENTS
RESERVATION COUNTER TERMINALS
HIGH RESOLUTION PHOTORECORDING
AND PHOTOCOMPOSITION SYSTEMS
MEDICAL ELECTRONICS MONITORS
PROJECTION AND SIMULATION SYSTEMS
OSCILLOSCOPES & STUDIO EQUIPMENT
AIR TRAFFIC CONTROL AND
GROUND SUPPORT DISPLAYS

THOMAS ELECTRONICS, INC.

110 RIVERVIEW DRIVE WAYNE, N.J. 07470 / Telephone: 201-696-5200 / TWX: 710-988-5836 / Cable: TOMTRONICS

Circle Reader Service Card No. 8

INFORMATION DISPLAY, November/December 1972

SHOW COVERAGE

1972 IEEE International Electron Devices Meeting

The Annual Technical Meeting of the Electron Devices Group will be held at the Washington Hilton Hotel in Washington, D.C., December 4-6, 1972. This meeting will emphasize aspects of research, development, design and manufacture of electron devices. Specific areas to be covered include: device technology, integrated electronics, solid state devices, imaging, storage, information processing, display devices, lasers and other opto-electronic devices, microwave and power tubes.

For further information contact Roland H. Haitz, Technical Program Chairman, Hewlett-Packard Associates, 620 Page Mill Road, Palo Alto, Calif. 94304.

Display Update '73

The 5th Annual One-Day Technical Conference of the Society for Information Display, *Display Update '73*, will take place in San Diego, Calif., at the Sheraton Inn-Airport on Friday, December 8, 1972. Richard Thoman, Chairman, hopes that by holding the conference on the Friday following the Western Joint Computer Conference they can attract to San Diego many of the computer fraternity. Mr. Gerald Chandler, chairman of papers selection, says the response to the call for papers has been more than he expected and he looks forward

to an excellent and interesting program. There will be morning, luncheon and afternoon sessions. A guest speaker will address the luncheon meeting. For advance copies of the program and registration, please contact Harold P. Field, Conference Publicity Chairman, c/o Gamma Scientific Inc., 3777 Ruffin Road, San Diego, Calif. 92123.

1973 National Computer Conference

A call for papers has been issued for the 1973 National Computer Conference and Exposition to be held June 4-8 in the New York Coliseum. According to Conference General Chairman Dr. Harvey L. Garner of the University of Pennsylvania, the NCCE brings together at one time and in one place all of the interests of the data processing community on a once-a-year basis.

Deadline for submission of advance abstracts: December 31, 1972. Deadline for completed papers: February 1, 1972. For information concerning the conference or manuscripts please contact: Dr. Carl Hammer, Chairman, Science and Technology Program, c/o Univac, 2121 Wisconsin Avenue, N.W., Washington, D.C. 20007. Telephone: (202) 338-4958; R.W. Bemer, Chairman, Methods and Applications Program, c/o Honeywell Information Systems, P.O. Box 6000, Phoenix, Ariz. 85005. Telephone: (602) 993-2569.

DEFLECTION YOKES

THE BEST YOKE FOR YOUR DISPLAY

FASTEST SPOT RECOVERY
Spot recovery times to 0.1% in less than 2 microseconds.

LOW RESIDUAL MAGNETISM
Residuals as low as 0.005%. Lower on your special order.

HIGH Q FERRITE STATORS
High sensitivity yokes for both resonant, direct drive.

ULTRA HIGH RESOLUTION Deflectors
Low astigmatism with a minimum spot growth.

HI SENSITIVITY LOW L12
High efficiency with minimum deflection driving power.

MAGNETIC WRITING YOKES
High sensitivity character yokes. Frequencies to 30 MHz.

LOW COST TERMINAL YOKES
For computer terminals, airline or stock price displays.

DIRECT VIEW STORAGE CRTs
Maximum information obtained by use of low driving power.

SEND FOR THE NEW CELCO YOKE GUIDE LISTING OVER 175 TYPES. FIND THE ONE YOKE FOR YOUR SPECIAL DISPLAY APPLICATION.

CONSTANTINE ENGINEERING LABORATORIES COMPANY
70 Constantine Dr., Mahwah, N.J. 07430 Tel. 201-327-1123 TWX: 710-988-1018

INFORMATION DISPLAY, November/December 1972

Circle Reader Service Card No. 9

27

Recent display advances left you behind?

No need to let this happen with the information available in RECENT ADVANCES IN DISPLAY MEDIA Vols. II & III

The newest display advances are covered in these two fact-filled volumes that pick up where Volume I left off . . . and it sold out completely!

Now they're ready to mail, and they're filled with a wealth of up-date reports to help every engineer, systems designer and display user in selecting appropriate components and systems . . . and in comprehending new theories and techniques.

Authored by a number of top computer display experts, these all-new volumes represent the most pertinent, authoritative and up-to-date source of information on computer terminals; character line and curve generators; memory discs; digital printers and plotters; CRT's; over-all system considerations; and more.

With the wealth of information available here, you can keep ahead of the technology avalanche that threatens to bury many of today's engineers. *Recent Advances in Display Media, Vols. II & III* are available singly, or together at a special price.

And remember, business and professional books are tax deductible (authority: Treas. Reg. 1.162; I.R.C. 162), so act now and start making use of these valuable books to advance your company and your career!

Complete satisfaction guaranteed! Immediate refund available on 10-day return privilege . . . we pay postage both ways.

Ready NOW! at this special price!

Vols. II & III, ordered together, only \$34.95

Please send VOLS. II & III together _____ for only @ \$34.95

Please send _____ copies of Recent Advances, VOL. II @ 20.00

Please send _____ copies of Recent Advances, VOL. III @ 20.00

Check, Cash or Money Order enclosed (amount) _____

Please bill my company in advance (amount) _____

My name is _____

Company name is _____ P.O. No. _____

Mailing address _____

City _____ State _____ Zip _____

Date _____ Signature _____

Please send this coupon, with check payable to:

TECHNOLOGY PUBLISHING CORP.

825 S. Barrington Ave., Los Angeles, Calif. 90049

(Calif. residents add 5% sales tax)



ID Products

Cathode Ray Tube

Gencom Div. of Emitronics Inc., Plainview, N.Y., is marketing an EMI GGO phosphor cathode ray tube which is an electro-magnetically focused and deflected film cathode ray tube, type MX71. It is designed for both positive and negative color film scanning. It uses a non-solarizing faceplate having a neutral density tint for improved contrast and flare reduction, says the company. Both surfaces are optically flat and parallel. The GGO phosphor has a broad spectral emission peaking at 520 nm. EMI photomultipliers for use with this tube are type 9656F for blue and green channels, and type 9598A for the red channel.

Circle Reader Service Card No. 10

Projection Readouts

Three random access readouts, featuring a single lamp projection system and single black-and-white or color film reticle, are now available from Major Data Corp., Costa Mesa, Calif., for visual display use in control systems, electrical and electronic equipment, data systems, land/sea/air vehicles, vending machines, security, teaching machines, medical and scientific instrumentation and switching equipment applications. Designated the Major 16/32/64 (depending on number of messages), the readout contains necessary electrical, electronic and mechanical components to properly position (index) the film reticle in front of the projector lamp for display on the image screen. The company reports that the units are capable of displaying any standard or custom message, in any language, that can be photographically placed on film.

Circle Reader Service Card No. 11

Video Amplifier

Gould Inc., Data Systems Div., Newton, Mass., introduces an all-silicon, solid-state video amplifier for use in cathode ray tube and storage



display systems that require video modulation up to a bandwidth of 10 Mc. Two models are available, model VA2548 has a linear output vs input characteristic. Output is expressed as $E_o = KE_i$. It accepts positive-going input signals, and provides positive-going output signals superimposed on a variable dc level (G_1 bias) for complete electronic beam control. Model VA2549 has a similar feature and it incorporates gamma correction to yield a linear light output vs input video signal characteristic.

Circle Reader Service Card No. 12

Television Projector

General Electric, Syracuse, N.Y., introduces a light valve, large-screen color TV projector,

COMPUTER GRAPHICS INPUT TERMINAL

If you need a sensible, economical, accurate and easy to operate graphic digitizing terminal, we at the H. DELL FOSTER CO. would like to talk to you about the RSS-4 DP/S-R Computer Graphics Input Terminal.



The basic system includes the following standard features:

- A 36" X 42" digitizing area. (Larger tables are available.)
- Rotary optical encoding system.
- .001" digitizing resolution.
- $\pm .001$ " digitizing accuracy and repeatability.
- Six digits and sign in each axis.
- Area measurement capability with the Digital Planimeter.
- X-Y scaling capability.
- ASR-33 Teletype and interface for recording capability. (Other recording devices and interfaces are available.)
- A basic system price under \$10,000.

Let us give you further details on this second half of the computer graphics story at H. DELL FOSTER CO. Call us. Let's talk about it.

H. DELL FOSTER CO.

San Antonio Office
14703 Jones - Maltzberger Road
P.O. Box 32581
San Antonio, Texas 78216
Telephone: 694-3476 Area Code 512

Circle Reader Service Card No. 13

INFORMATION DISPLAY, November/December 1972

model PJ500. According to G.E., by using the light valve which operates with a single electron beam and optical path, the unit provides registration of colors, while offering contrast and resolution. The projector operates with a maximum of 8000 V, eliminating the possibility of x-ray emission from the system. The unit accepts either RGB or NTSC encoded video signals.

Circle Reader Service Card No. 14

Laser System

RCA, New York, N.Y., has released an advanced laser image transmission system that both transmits and receives images from a variety of sensing devices as well as original photographic copy. The device can transmit and reproduce, almost instantaneously, images from photographic film and such sensors as high-resolution TV cameras, multispectral scanners and laser scanners, with more than 25,000 lines resolution on a five-by-five-in. format, reports the company. The system can be used to transmit and record pictures from the wide range of sensing devices such as those carried on satellites and aircraft as well as those used in ground stations. The system is designed to transmit up to 7500 lines per s. Images may be transmitted one frame at a time or in a continuous strip. Operators can adjust the resolution, film size and scan rate of the laser image transmission system to make it compatible with other systems which have narrower bandwidths and slower transmission speeds.

Circle Reader Service Card No. 15

Photo-Optical Analyzer

An updated version of the L-2 224-A 16 mm photo-optical data analyzer has been introduced by L-W Photo Inc., Van Nuys, Calif. The



company reports that speeds of 1-2-3-4-6-8-12, plus 16 and 24 frames per second, are provided. The data reduction screen is a replaceable sheet with numbered x-y coordinates and circle degree calibration for frame-by-frame plotting of selected image information. Plots and calculations may be made directly on the screen and stored with the film for future study. Reverse side of screen is clear matte white for normal viewing.

Circle Reader Service Card No. 16

Storage Tubes

Thomson-CSF, Paris, France, has made available a TH 8803 storage tube which is a single-ended design in a 2-in.-diameter vidicon configuration, that provides a limiting resolution performance of 4300 TV lines per diameter. It can store 16 millions of bits in the digital form,

LARGE FLATBED DIGITAL PLOTTER

The H. DELL FOSTER CO. is proud to introduce the newest member of its fine computer graphics team, the RSS-700 Automatic Digital Plotting System.



Check these qualifications against those of any other plotting system:

- D.C. printed circuit motor drive with digital optical encoder feedback to simulate stepping motors with variable step size.
- Many real-time mathematical calculations hard-wired in the system controller to appreciably reduce computer time.
- Operational software included in system price.
- Complete add-on graphic digitizing capability.
- 42" X 72" plotting surface.
- .0005" resolution.
- $\pm .001$ " accuracy and repeatability.
- Numerous, optional I/O devices.
- Basic system price - under \$50,000.

Sound like a useful addition to our team? We think so too. For more detailed information, contact us at the address or number below. We'd like to really get into it with you.

H. DELL FOSTER CO.



San Antonio Office
14703 Jones - Maltzberger Road
P.O. Box 32581
San Antonio, Texas 78216
Telephone: 694-3476 Area Code 512

Circle Reader Service Card No. 17

29

or the equivalent in the full TV gray-scale image form, for more than 20 min under continuous readout scanning operation, according to the company. The tube has an erasing capability by means of a gun design (Thomson-CSF patent). Two TV frames are sufficient to erase the whole surface down to the noise level of a good amplifier. Because the display function is separated from the storage system, the user can selectively edit the stored image or zoom in on any portion of the image.

Circle Reader Service Card No. 18

Display/Memory Units

Owens-Illinois Inc., Toledo, Ohio, is presenting a display device called the Digivue display/memory unit. The unit is capable of providing



computer or keyboard-driven illuminated displays of any combination of letters, numbers,

graphics and symbols. Installed in business offices, the basic functions of the devices are to display sections of given materials on file in computer-based mass storage or to enter new materials, letters, documents or reports. According to OI, the materials could be circulated electronically for approvals and enable the typist or her boss to check the displayed text for factual and typographical correctness and style.

Circle Reader Service Card No. 19

LED Indicator

TEC Inc., Tucson, Ariz., announces a LED indicator, designated the L-1031 series. According to the company, the unit is suited for use on closely-spaced circuit boards. The black, glass-filled nylon holder has two gold-flashed brass terminals that solder directly to the PCB. Molded standoff on the holder permit flux washing of PCBs without trapping dirt. The unit has low-current circuitry and was designed to resist shock, vibration and extreme temperature changes.

Circle Reader Service Card No. 20

CRTs and Components

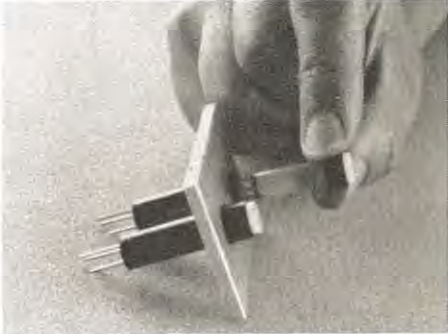
Amperex Electronic Corp., Hauppauge, N.Y., a subsidiary of North American Philips Corp., N.Y., has announced a series of matched sets of CRTs and associated deflection components for use in video terminals. The matched sets consist of the CRT, a deflection coil, a horizontal output transformer and a linearity control. Typical of the matched sets available is the one engineered around the 12VANP4, a 12-in. diagonal,

110° deflection CRT having a white phosphor in a rim-bond-reinforced bulb. According to Amperex, the matching deflection coil, horizontal output transformer and linearity control are available as a single package to support this CRT.

Circle Reader Service Card No. 21

Panel-Mount Socket

A panel-mount socket is now available from Data Display Products, Los Angeles, Calif. According to DDP, the socket is designed for use with



the fan-in series panel lights and may also be used with their line of LEDs, incandescent, and neon ¼ in. diam panel indicators. The socket terminals are .025 in. sq, gold-plated, wire-wrap posts. The socket can be mounted in the panel as closely as ½ in. centers by using a push-on retaining nut and by using a neoprene washer between the panel and retaining ring to avoid rotation of the unit in the hole.

Circle Reader Service Card No. 22

VIDEO STORAGE



Simple, low cost way to give your displays stop-action and four other competitive advantages—all in one small package.

Introducing the Hughes Model 639 video storage unit. A complete electronic image memory system. With all the circuitry, power and controls built-in to make your displays versatile exhibitions.

It stores alphanumeric, graphic, and pictorial data. With high resolution, high-speed writing capability, selective updating and fast erasure. It converts slow-scan and x-y information to TV format.

It integrates signals (automatically enhancing weak or low light images). It speedily processes and

stores input signals for conversion into TV displays for the medical, management, law enforcement, and many other applications.

If you need close-up images, there's a zoom control, with a positioning joystick. And because it's flexible, it can be customized to star in any graphic display system.

Write for new brochure:
2020 Oceanside Blvd., Oceanside, CA 92054.
Or call: (714) 757-1200.

HUGHES

HUGHES AIRCRAFT COMPANY
INDUSTRIAL PRODUCTS DIVISION
IMAGE DEVICES

Advertisers

Burroughs Corporation	..... Back Cover
CELCO/Constantine Engineering Laboratories Company	..... 27
Bendix Corporation/Electro Optics Division	..... 26
H. Dell Foster Company	..... 29
Hughes Aircraft Company	..... 30
Keuffel & Esser	..... 8
Polacoat Incorporated	..... 7
RCA Electronic Components	..... 31
SC Electronics Incorporated	..... 2
Special Purpose Tube Company	..... 25
Sykes Datatronics Incorporated	..... 5
Syntronic Instruments Incorporated	..... 25
Thomas Electronics Incorporated	..... 26

Meet RCA's new family of silicon target storage tubes—sister products of the SIT camera tube used on the moon

Here's the new storage tube line — with performance levels enhanced by a silicon target — you've been waiting for. Designed for a wide variety of TV display applications, these devices are extensions of the silicon technology used in the Apollo 15 camera tube.

RCA-C22041 is typical of this family of single-ended, non-destructive readout storage tubes with silicon target. Use it and the companion tubes in such diverse applications as frame freeze, low-light-level TV signal enhancement, information storage and retrieval, picture transmission over

phone lines, specialized graphic display terminals, and buffer memories for document retrieval systems.

Designed to operate over a wide range of input and output rates in a variety of operating modes, the RCA family of silicon target storage tubes includes:

Type	Dia. Inches	Resolution Lines	Deflection Method	Reading Duration Mins.
C22041	1	1200	M	5
C22045	1½	1700	M	10
C22047	1	1200	M	10

For consistent high quality and reliability in your display systems, look into RCA's new silicon target storage

tube line. For more information, see your RCA Representative. For technical data on type C22041, write: RCA, Commercial Engineering, Section 86 K /ZD1, Harrison, N.J. 07029. International: RCA, 2-4 rue du Lièvre, 1227 Geneva, Switzerland, or Sunbury-on-Thames, U.K., or P. O. Box 112, Hong Kong.

RCA Electro Optics