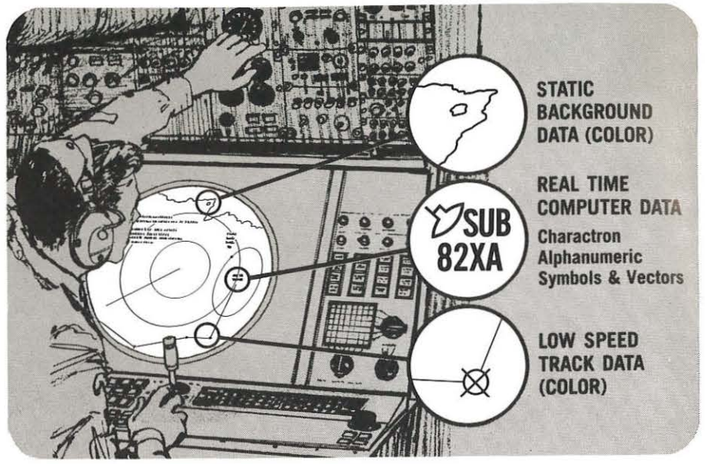
Volume 4 Number 4 *July/August 1967*

Information Display

Journal of the Society for Information Display

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

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



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

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

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

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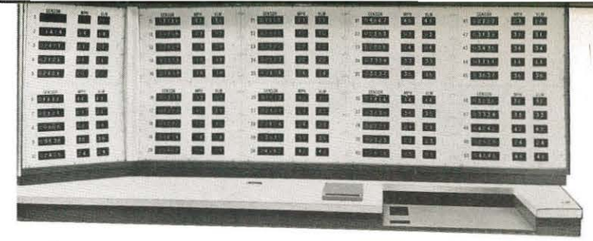
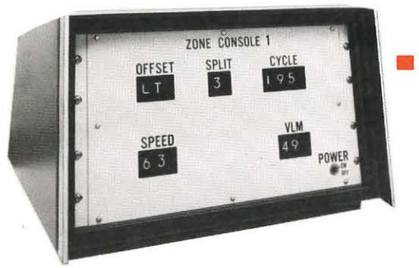
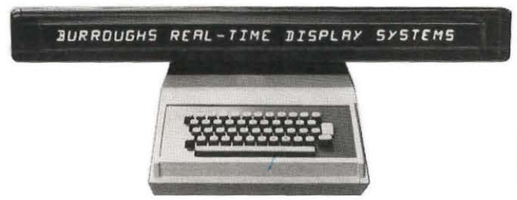


experience counts ...and spells to produce information display systems





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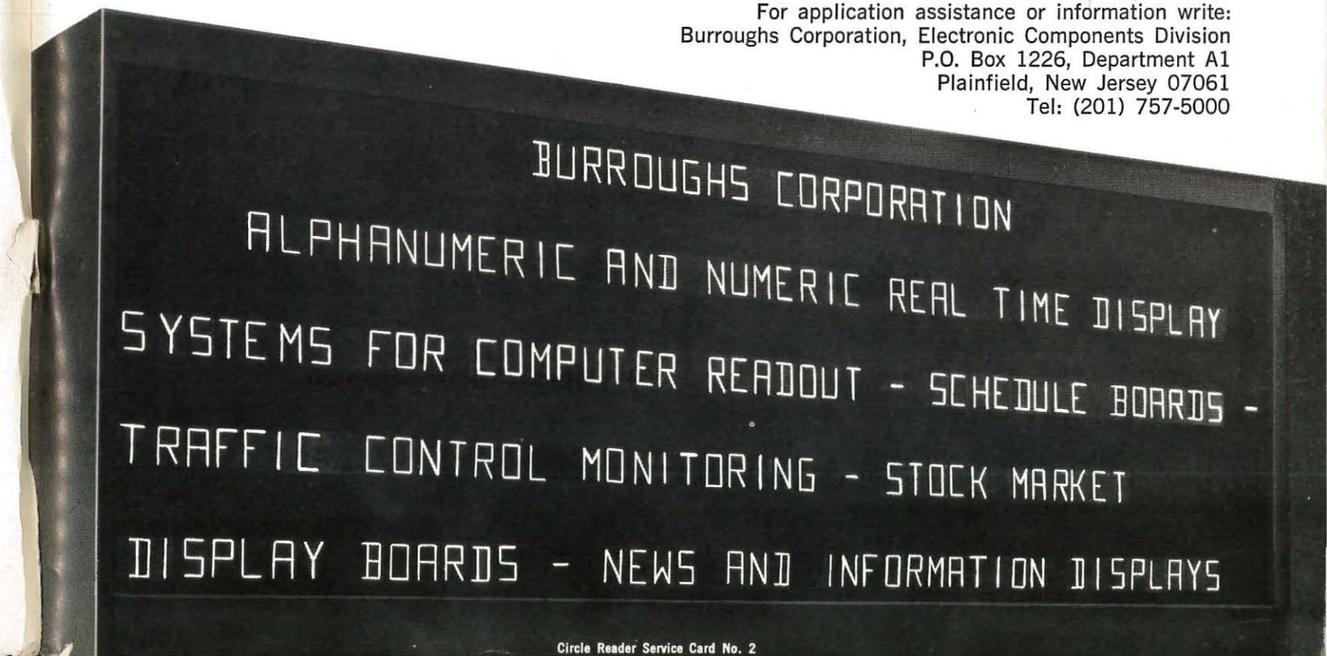

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Volume 4 Number 4 July/August, 1967

Information Display

Journal of the Society for Information Display

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the cover

Sitting placidly amidst the myriad abstract of display capabilities, the depicted 10 Gun CRT can project single-plane readouts in green, red or blue. It was recently unveiled by Industrial Electronic Engineers Inc., of Van Nuys, Calif.
Photography by Glen Otto and Sam Woods.

INSTANT DISPLAY

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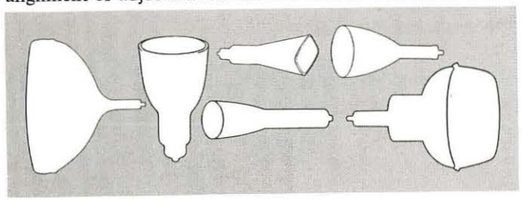

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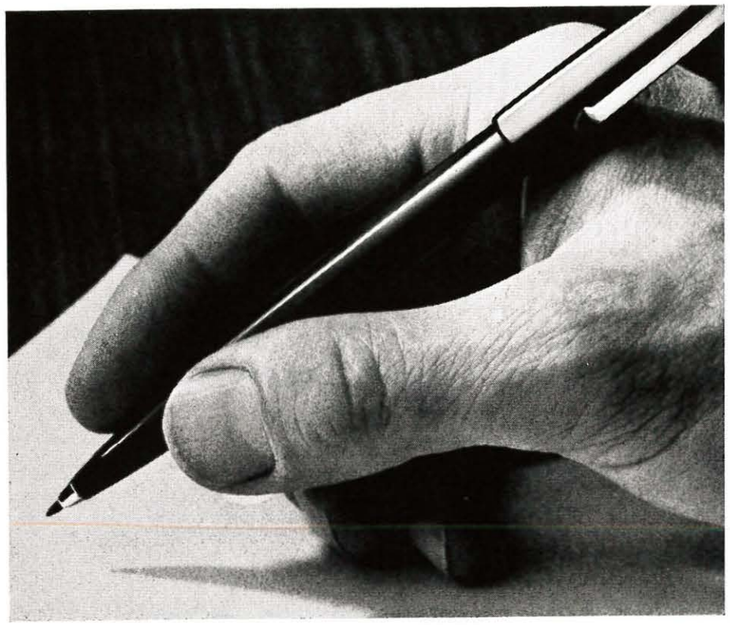

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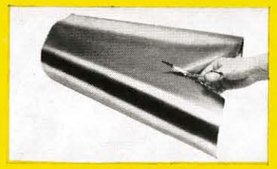

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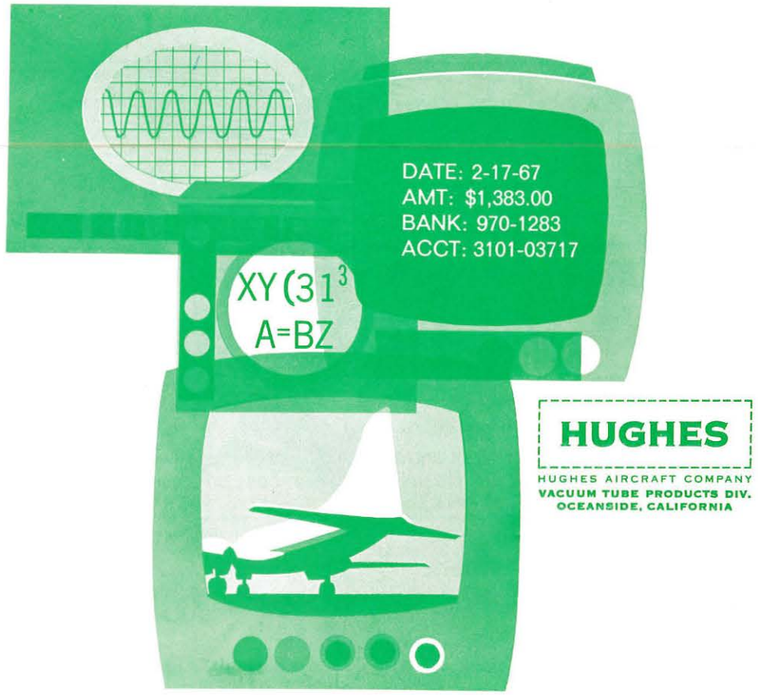

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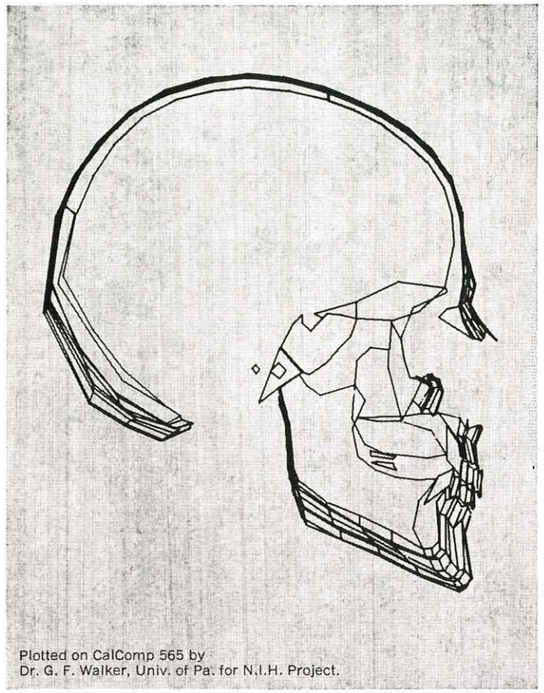

Plotted on CalComp 565 by
Dr. G. F. Walker, Univ. of Pa. for N.I.H. Project.

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Effective Information Display— 8th National SID Symposium Postscript

Preliminary statistics for the most recent *SID* symposium comprise some of the raw materials that a professional society administration customarily uses to evaluate the effectiveness of its convention activities. Figures reflect both the technical and financial health of a symposium, and often represent a rather delicate balance between the program and committed facilities on one side and the attendance and public response on the other. Thus, by plugging in the correct dollar amounts for the various items, we can determine at a glance whether we're in the black or whether we've lost our shirt! While initial results should not cause concern for the solvency of either the society or the symposium, nor concern for having exhausted technical topics of interest to its membership, some interesting data has come to light which casts considerable doubt on the validity of using just figures to assess the effectiveness of a symposium.

Members have been concerned about this problem, but possibly for the first time at the 8th National Symposium, some data evolved that warrant further discussion. Basically, the question is this: As participants in an information display symposium, how effectively are we displaying information? Are we, like the proverbial children of the shoemaker, running around barefooted, or are we indeed by example and ingenuity pushing ahead in the very field in which we claim to be experts?

After having been criticized at some of our previous symposia for the inadequacies in our audiovisual aids, the Steering Committee of the 8th Symposium attempted to overcome at least some of the hardware problems. We are glad to report that all projection equipment performed adequately and no slides smoldered. But as sometimes happens, even the best equipment does not function effectively if the software is inadequate. With the hope of encouraging the 8th Symposium authors to do an improved job of programming their audiovisual aids, the Symposium "Software" (Program) Committee:

- provided the authors with "Effective Lecture Slides," a pamphlet prepared by Eastman Kodak Co.,
- announced that a special cash award would be presented to the author(s) with the best (based on quality

of information transfer) associated audiovisual aids,

- selected three qualified judges who attended the technical sessions. These judges were not affiliated with *SID* or any organization that contributed a paper to the 8th National Symposium. They were:

  Harry De Voto, Chief, Graphics and Exhibits Branch, NASA, Ames Research Center.

  Richard E. Ingalls, Administrative Assistant, Audiovisual Center, San Francisco State College.

  Butler Lampson, Assistant Professor of Electrical Engineering and Computer Science, University of California.

The judges were instructed to evaluate the audiovisual aids on the basis of the quality of effective information transfer rather than artistic value.

Confident in having done its homework, the committee looked forward with anticipation to the symposium and was indeed gratified to see a very marked improvement in the quality of both slides and movies presented in conjunction with the technical program. However, the committee was astounded to obtain the three judges' reports at the end of the symposium. Each was to give his choice for 1st place, 2nd place, and honorable mention awards. They came up with nine names — not a single duplication!

Consider the probability P of choosing nine papers at random from the 28 regular technical papers without a single duplication:

$$P = \frac{\binom{28}{3}}{\binom{28}{3}} \frac{\binom{25}{3}}{\binom{28}{3}} \frac{\binom{22}{3}}{\binom{28}{3}}$$

where the conventional notation $\binom{n}{r} = \frac{n!}{(n-r)!\ r!}$ is used. Thus, P = 0.330. Even if the selection were to be made at random, at least one duplication should have been found!

A meeting of the embarrassed judges was called, not particularly to come up with a single winner, but primarily to learn what actually happened. Did the judges really attend the symposium? What yardsticks did they actually use? How did they rate the various papers? What weight was given to parameters of unequal significance? Several of the comments made at this meeting should be of interest to the society.

Before the meeting got underway, each of the judges was asked what two most important yardsticks were used by them in evaluating the audiovisual aids used at the 8th National Symposium. Immediately, the mystery was heightened even more, because the judges were practically unanimous in their choice of evaluating criteria. Most important, they felt, was clarity and readability. Second was relevance or pertinency of the material to the subject of the talk. Closely related to this second point was how effectively the slide (movie, etc.) focussed on the key point the author attempted to make. A strong runner up was a group of comments all of which related to the technique used by the speaker in in the presentation of his slides. Some examples:

- Handling the light pointer.
- Cuing of slides. Some speakers used their slides as cue cards.
- Reading the slides. Some speakers had their backs to the audience.

In the subsequent very interesting discussion, the judges elaborated considerably on the three basic topics:

- Clarity
- Relevance
- Technique

They brought up enough material to compose a basic text on the subject. They also indicated that they went to considerable detail in actually evaluating each of the regular papers on all three parameters, giving somewhat greater weight to the first two.

In their criticisms of papers that lost points, they agreed that first were those authors that failed to heed the advice of the Kodak pamphlet and simply produced slides which were photographs of the figures used in the text of the Proceedings. Generally, these were the poorest slides. Some authors used inadequate judgement in selecting their slides. Thus, two judges agreed that, if one of the authors would have simply not shown two of his slides, they both would have given him the No. 1 rating. The author's slides were all excellent except for the two 'superfluous' slides, added apparently only as an afterthought. Partly as a result of this, the author received a No. 2 rating by one judge and no rating by the other. The judges also felt that several speakers lost points in their 'distracting ways' of explaining otherwise good slides.

One aspect, the judges agreed, they did not equitably consider, and that was the question of how complicated the phenomenon or point to be shown was in relation to the audiovisual aid actually used. They agreed that to make a slide of a complex feature is more difficult than to make a slide of a simple one. In order to judge this aspect, they would practically have to be experts in all the fields in which papers were presented and this, of course, is impossible. This point was raised by the judges in defending their own choice of winners, and since they are all men of their convictions, we still have three 1st place winners. Thus, the cash prize (which has been doubled in size) will be shared equally by the authors of three papers:

The Plasma Display Panel — A New Device for Information Display and Storage (B. M. Arora, D. L. Bitzer, H. G. Slottow, R. H. Wilson.)

A Low Cost Alpha-Numeric Display Device Requiring Negligible Switching Power (R. du Bois.)

A Low Cost Graphic Display for a Computer Time-Sharing Console (R. H. Stotz, T. B. Cheek.)

The other six papers selected by the judges were authored by W. D. Fuller, E. T. Johnson and J. Ketchel (for 2nd place) and C. G. Beatty, D. A. Naurath and E. A. Schmidt, and C. N. Winningstad (for 3rd place).

In conclusion we may emphasize that this experience points to an area of information-display technology which may well be worth further consideration by the society. In the meanwhile, future symposium organizers might be tempted to select only one judge to avoid problems with the choice of a contest winner. We felt that the choice of three independent judges, while not producing a single winner, helped to highlight one key problem area in our field of Information Display.

JAN M. ENGEL,
Chairman, Program Committee
Eighth National Symposium *SID*.

THE AUTHOR

JAN M. ENGEL, a charter member of the San Francisco Bay Area Chapter of SID, was chairman of the Program Committee for the Eighth National Symposium.

As an advisory physicist, affiliated with the Advanced Technology Group of the IBM Systems Development Division in San Jose, he is interested in the development of novel solid-state and electron-beam devices. He is a Fellow of the Physical Society (London), senior member of the IEEE, a members of the American Physical Society, AIP, RESA, and other organizations. He is also the Editor of the (IEEE) Group on Electron Devices Newsletter.

Dataplot: A system for on-line graphical display of statistical data

by WILLIAM A. WATSON
Systems Effectiveness Department
Bunker-Ramo Corp.
Canoga Park, California

This paper was presented at the 7th IEEE Symposium on Human Factors in Electronics, Minneapolis, Minn. The work reported was sponsored in part by the Rome Air Development Center under Contract No. AF30(602)-3536 with the Bunker-Ramo Corporation.—Ed.

ABSTRACT

The Dataplot Subsystem is one of a number of software packages in the Bunker-Ramo On-Line System. It was designed to provide the user with the capability for generating a variety of statistical graphs based upon file data. Dataplot was developed out of the conviction that the usefulness of such descriptive graphical methods as genuine cognitive tools has heretofore been limited by the sheer effort they entail. The system was designed to relieve the operator of the necessity for making trivial decisions, but to still provide ample opportunity for manual intervention.

INTRODUCTION

The Dataplot system described herein is one of a number of software packages available to a user of the Bunker-Ramo On-Line System. Briefly, this system consists of a BR-85 Display Console — the primary operator interface, a BR-133 medium-sized computer, an Input-Output Controller, up to four magnetic tape units for bulk data storage, and various peripheral devices such as input typewriter and card reader (see Figure 1). A dataphone interface permits a remote user (also using a BR-85 display console) to interact with the computer.* Future plans call for the addition of a BR-90 display console (with rear-ported CRT to permit simultaneous display of photographic and dynamic data), disc storage and a small table top display unit. While this system is truly on-line, it is not currently time shared, a feature to be added with disc storage.

The software packages available to a user consist of (1) an assembler language oriented around the console's display function and pitched to the level of the professional programmer, (2) a retrieval oriented compiler language for use by the non-professional programmer, (3) a mathematical system of the Culler-Fried variety, (4) a system for generating and displaying objects in three dimensional space, (5) a system for manipulating free text information and, (6) Dataplot. In order to change between systems, the user replaces

FIGURE 1: The Bunker-Ramo On-Line Experimental Center

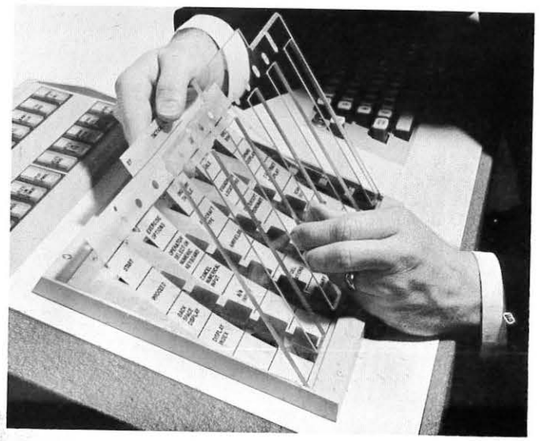

FIGURE 2: Changing overlaps on the BR-85 Display Console

*Currently being used by personnel of the Rome Air Development Center.

one plastic overlay with another (see Figure 2). These overlays are keyed in such a way as to change the functional meaning of each button as well as its label.

Dataplot was developed to provide the on-line operator with the capability for rapidly displaying statistical data in graphical form. It grew out of the conviction that the usefulness of such methods as genuine cognitive tools has been heretofore limited by the sheer amounted effort they require. In many applications, graphs are used primarily to summarize and communicate what the user already knows rather than as probes of data to reveal latent meaning. Their heuristic potential has thus been largely unrealized. The Dataplot system was designed to provide the operator with as simple an interface as possible consistent with the flexibility he requires. Much of the simplicity is achieved by relieving the operator of minor decisions, by making reasonable presumptions regarding what it is he wants to see and in what form he wants to see it.

THE USER'S OVERLAY

Figure 3 illustrates the display console overlay that is used by the operator for the purpose of graph generation. The column of buttons on the far right is used for entering new data into the three data operands X, Y, and Z. The fourth column of buttons is used to enter a variety of graph titles. The three columns on the far left are used for the purpose of composing the graphical display request message. Four basic types of graphs are available; frequency distribution, mean line graph, sum line graph and simple X, Y plot. These are shown in the first column. Variations of these four basic types may be selected by activating one or more of the buttons in columns two and three. When the graph has been fully specified, the "execute display request" button is activated, at which time the computer will generate the graph requested.

Disregarding the fact that most graphs may be displayed as a bar chart, variation between fifteen and twenty different types of graphs may be requested for a given set of data. The action of the display request is to compile a list of programs from the set of approximately ninety which constitute the entire system. During graph generation each program so compiled is executed in turn.

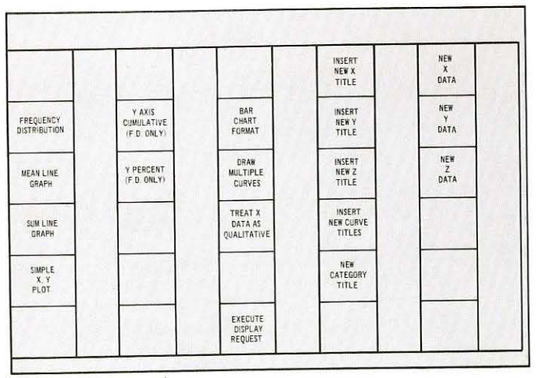

FIGURE 3: The data plot overlay

Graph Generation: The Frequency Distribution

Suppose the user has found some data that he would like to display graphically. The first step is to clear the display screen and type that data onto the screen as shown in Figure 4. These data, taken from an almanac, represent the life expectancy at birth for residents of 37 major countries throughout the world.

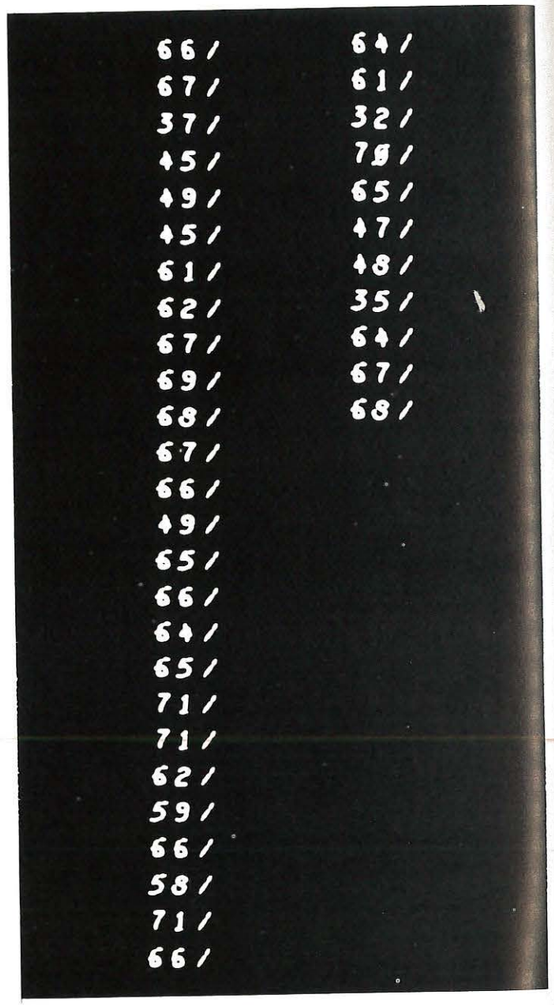

FIGURE 4: Life expectancy figures typed onto display screen for insertion as new X data

These members conform to certain restrictions placed upon any data to be processed by Dataplot. Such numbers must be positive integers and can assume a value no larger than 16,384. Each number is terminated by a slash. These data are entered into the computer by selecting the "new X data" button. A simple frequency distribution of these data is requested by depressing the "frequency distribution" button followed by an "execute display request." The first thing that the computer does is to generate the X axis base line (see Figure 5). The highest and lowest X scores are determined. Based upon the range, the computer determines the interval size of the X axis categories and the number of categories to be represented. In general, the computer will attempt to generate a graph with between 10 and 20 categories and will select a convenient interval

FIGURE 5: Generation of the X axis

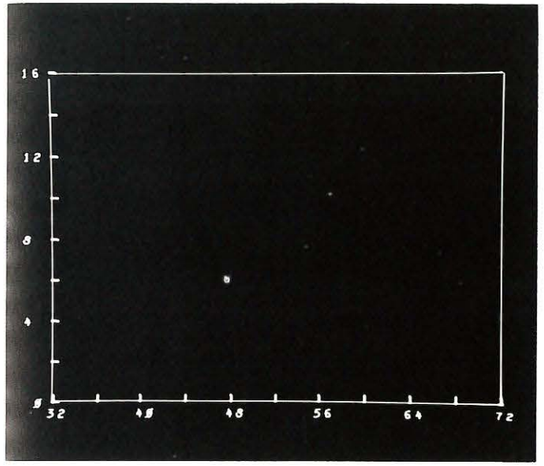

FIGURE 6: Addition of the Y axis and chart boundaries

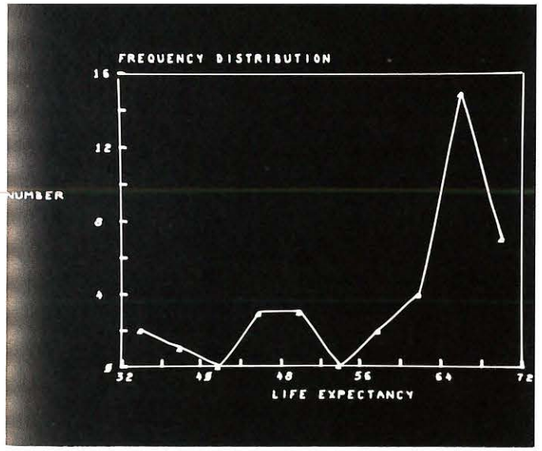

FIGURE 7: Addition of the curve and titles

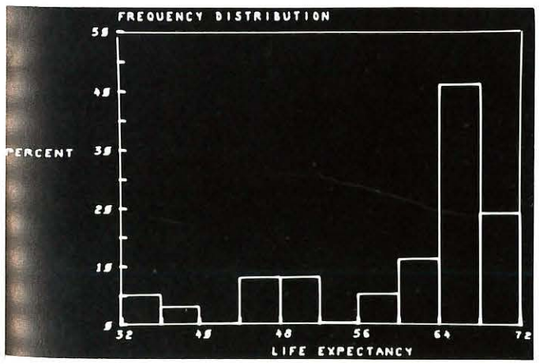

FIGURE 8: A percentage bar chart variation

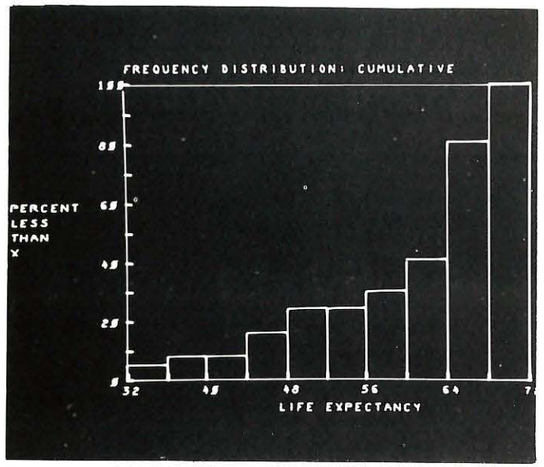

FIGURE 9: A cumulative variation

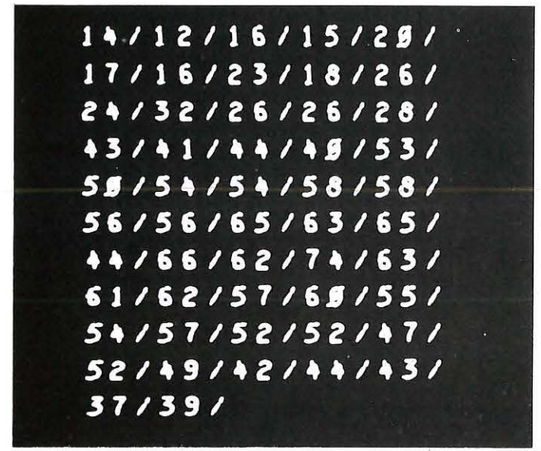

FIGURE 10: Hypothetical ice cream sales figures entered as Y data

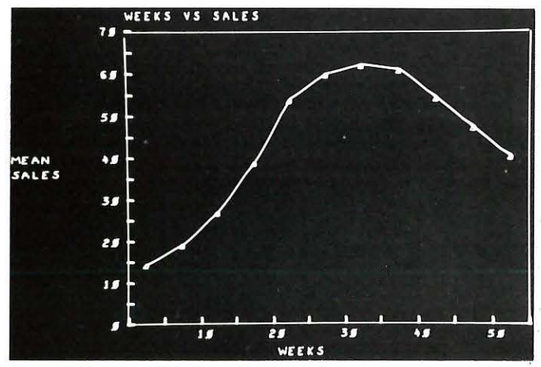

FIGURE 11: A simple mean line graph

size from a table of preferred values. The computer then tallies the number of scores falling within each interval. The highest tally provides the basis for scaling the Y axis (see Figure 6). Again, a convenient interval size is chosen

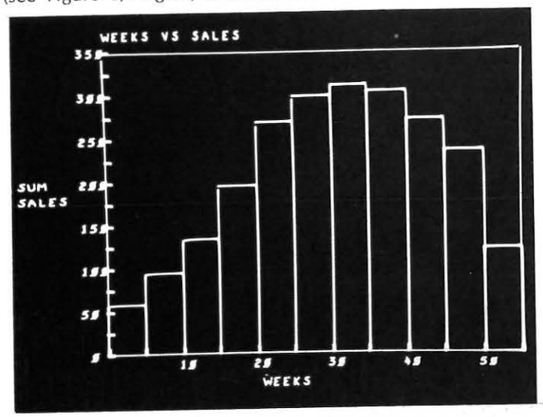

FIGURE 12: A sum line graph in bar chart line format

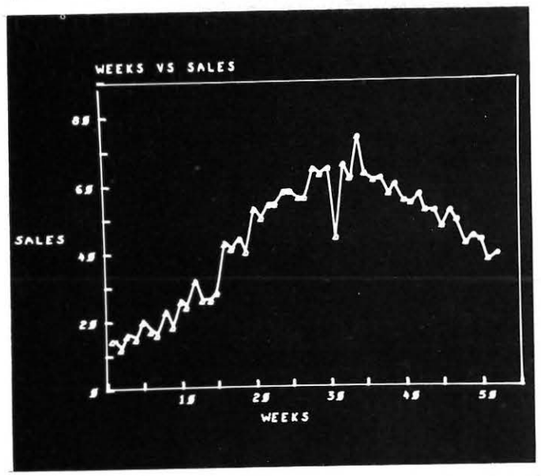

FIGURE 13: A simple X, Y plot showing weekly functions

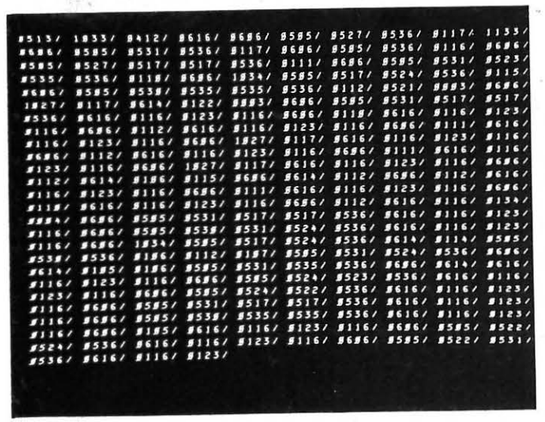

FIGURE 14: A program listing entered as X data (entire program not shown)

as well as a convenient number of scale marks. Once the X and Y scales have been generated the screen coordinates for each tally are determined and the curve displayed (see Figures 7). Note that provision has been made for additional space between the highest plot and the top of the graph. The final step is to add the appropriate titles (also Figure 7). Figures 8 and 9 show two variations of the same data. The curve shown in Figure 8 was requested by depressing: "frequency distribution," "Y = percent," "bar chart," "execute display request." The cumulative distribution shown in Figure 9 was requested by adding "Y axis cumulative" to the previous request.

Other Types of Line Graphs

Frequency distributions require only one set of data, X data. In order to generate a mean line graph, a sum line graph, or a simple X, Y plot, both X and Y data are required.

Suppose an executive of an ice cream company wants to review his sales record over the previous year. He first types the numbers from 1 through 52 onto the CRT and enters these as "new X data," each number corresponding to one week of the previous year. He then types onto the screen the data shown in Figure 10. Each number here represents the sales figure for a given week during the year. He must be careful to type these numbers in the same order that the weeks were entered in order to maintain the correct association between X and Y data values. The sales data are entered into the computer by depressing the "new Y data" button. He is now ready to request a graph. By depressing "mean line graph" and "execute display request," a curve of the type shown in Figure 11 will be generated. This graph displays his mean weekly sales for successive five week intervals throughout the year. Should he want to know what his total sales figures were for each of these five week intervals, he would request the sum line graph shown in Figure 12. This display was requested by depressing "sum line graph," "bar chart format" (optional), "execute display request." Should our hypothetical executive want to know how sales fluctuated on a week to week basis, he could request a simple X, Y plot as shown in Figure 13. This type of graph plots raw, unaveraged data. The dip in the curve might have been the result of a cold snap during the previous summer.

Treating Data Qualitatively

In each of the examples illustrated previously the X data values have been treated as quantitative scores. The Dataplot

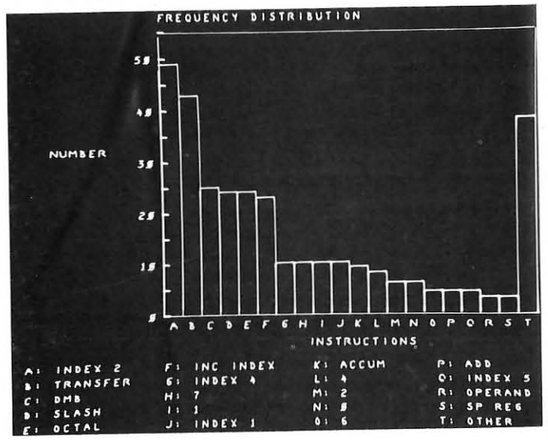

FIGURE 15: A qualitative frequency distribution of the program listing

user has the option of treating X data in a qualitative fashion, i.e., where each number is treated as unique and unscaled. Figure 14 is a program listing. Each 4 digit number is the octal representation of a computer instruction in the assembly level language; 614 = accumulator, 117 = index register 1606 = transfer, etc. This program listing may be entered into the computer as X data in the same manner as previously described. By depressing the "frequency distribution" button, "bar chart format," "treat X data as qualitative," and the "execute display request" button, a graph of the type shown in Figure 15 will be produced. Each category on the X axis of this graph corresponds to a unique number in the program listing just shown. These categories have been ordered from the most, to the least frequent (with the exception of the other category). The graph shows that the number corresponding to "index register 2" occurred 49 times in the program, the most frequently used instruction. This was followed by "transfer," "DMB" (display buffer), etc. The final result is a kind of program profile.

Multiple Curve Graphs

In order to generate multiple curve graphs, the user must load Z data into the computer. A maximum of 5 curves is permitted. Suppose that the user, the dean of a hypothetical college, wants to determine the relationships between age, salary, and academic rank at his institution. He first types onto the screen the age of each faculty member and enters this as "new X data." After clearing the screen he then types a salary figure for each faculty member onto the screen, all the while being careful to maintain the correct order. This is entered as "new Y data." Finally, a number corresponding to the academic rank of each faculty member is typed onto the screen (1 = assistant professor, 2 = associate professor, 3 = professor). These numbers are entered as "new Z data." The user is now able to request a graph relating age to academic rank by selecting "frequency distribution," "draw multiple curves," "execute display request." This results in a graph like that shown in Figure 16. In the generation of this graph, only the X and Z data have been used, the salary data being ignored for the moment. By selecting "mean line graph," "draw multiple curves," "execute display request," a graph is produced which uses the data from all three data operands X, Y, and Z (see Figure 17).

Figures 18 and 19 show two other examples of multiple curve graphs; the latter in a bar chart format.

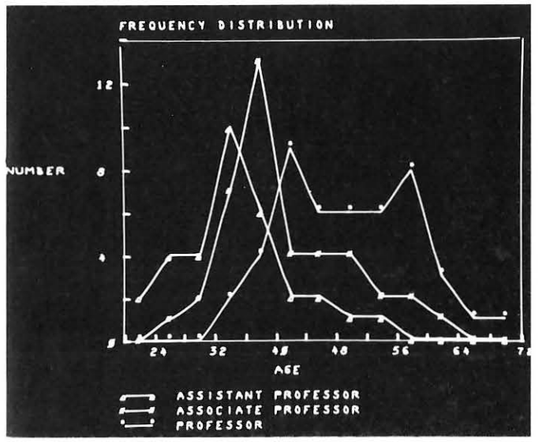

FIGURE 16: A multiple curve frequency distribution

Without the luxury of color coding or shading, multiple curve bar graphs occasionally appear confusing, particularly if the data are unsystematic and the number of categories is large.

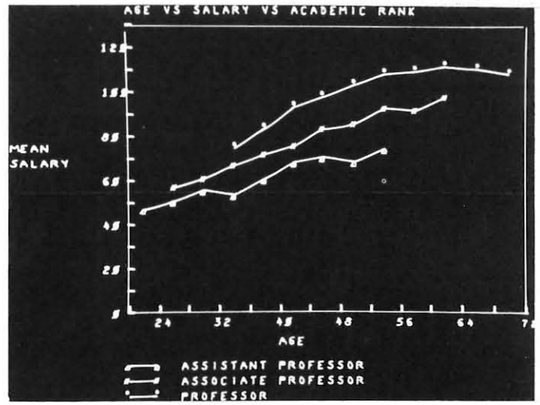

FIGURE 17: A multiple curve mean line graph

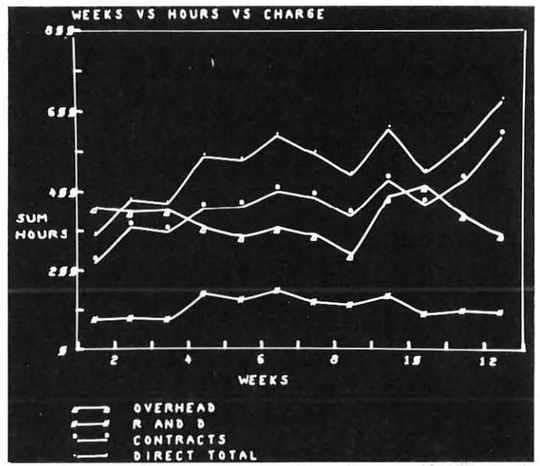

FIGURE 18: A multiple curve sum line graph

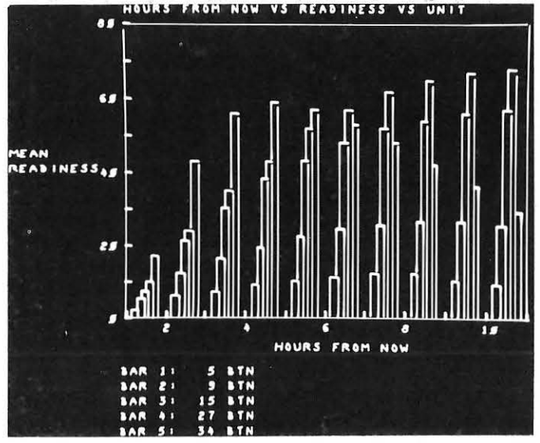

FIGURE 19: A multiple curve graph in bar chart format

Loading Data With the Compiler

Entering data into operands by typing numbers onto the CRT surface is a relatively laborious process, particularly where the number of data values is large. The on-line compiler language permits the user to extract data from existent files and to load it correctly into operands under program control. It will even load titles automatically. Figure 20 shows a program to perform this function. This type of program is written by using a different console overlay. Each time a button is pushed, an English-like statement appears on the screen indicating to the operator the current state of the program. "Restart" and "write program" ready the system for the operations to follow. In this program, File 3 is a gazetteer of data about villages in South Vietnam. It contains such items as the village name, population, area, and location, etc. The program instructs the computer to enter the village population figures into the X data operand and to load the village area figures into the Y data operand. Since the population figures for some of the villages are too large to be accepted by Dataplot, they are all divided by 100 first. Figures 21 and 22 show two graphs of data loaded in this manner. In the program shown, all population and area figures are loaded indiscriminately. By writing a more complex program, the user could load selected portions of the total data base by specifying various and/or conditions. For example, the user could instruct the computer to load data only for those villages located within a certain area and/or for those villages whose name begins with the letter "A".

The curve shown in Figure 21 could have been truncated by requesting that population data for only small villages (ex. below 200) be loaded.

The compiler system thus represents a powerful adjunct to Dataplot's inherent capabilities.

FIGURE 20: A compiler program for loading file data automatically preparatory to generating a graph

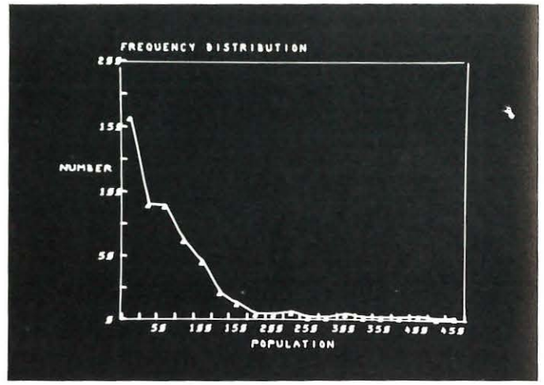

FIGURE 21: A frequency distribution based upon data loaded via compiler program shown above

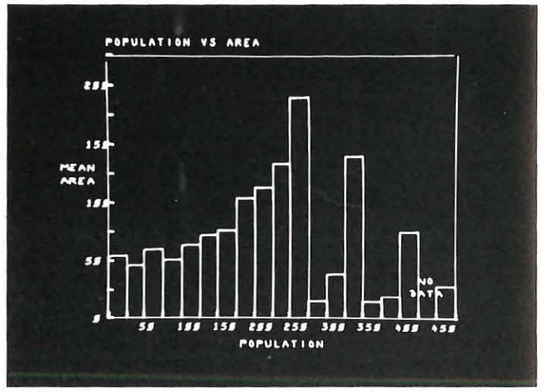

FIGURE 22: A mean line graph based upon compiler-loaded data

THE AUTHOR

WILLIAM ARTHUR WATSON is a member of the technical staff of the Systems Effectiveness Department of The Bunker-Ramo Corporation. Currently, he is attached to the company's ADSAF Project (Automatic Data Systems within the Army in the Field) which is assisting the 7th Army in Heidelberg, Germany, in specifying an operational data handling system for use by all U.S. field armies. While at Bunker-Ramo's headquarters in Canoga Park, California, Dr. Watson has been exploring techniques for improving man-machine communications, particularly as they are applied to problems encountered in the intelligence community. Formerly, he directed the personnel subsystem development for the command and control portion of the Mobile Mid Range Ballistic Missile Program. DATAPLOT, a system for graphical display of statistical data as described in this article, was developed by Dr. Watson while he was assisting in the development and evaluation of the Bunker-Ramo experimental on-line program. Dr. Watson obtained his doctorate in Psychology from the University of Michigan. He is a member of Phi Beta Kappa and Sigma Xi, the American Psychological Association, and the Human Factors Society.

Electro-optic three dimensional displays

by H. JOHN CAULFIELD
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Dallas, Texas

ABSTRACT

Man, accustomed to viewing a three-dimensional world, has always been dissatisfied with two-dimensional displays. Unfortunately no fully satisfactory real-time, three-dimensional display technique has been developed. A new method for converting 2-D displays to 3-D is discussed. Uniaxial crystals are used to vary the optical path length between the 2-D display and the viewer. The variation is subject to digital control with electro-optic polarization switches. Thus there are no moving parts and no severe limitations on switching times. The primary limitations of this new method are limited angular field of view, high brightness requirements, and size limitations. The possible applications include computer graphics and 3-D movies or television.

INTRODUCTION

Our ordinary environment is a three-dimensional world. Two-dimensional displays inevitably strike us as less interesting. "Flat" is often used as a derogatory adjective. Conversely a good three-dimensional display is very appealing. Much of the enthusiasm for holography can be understood in this way. Unfortunately holography is not immediately useful as a real-time display mechanism.

Classically 3-D displays are grouped into two categories — illusory and volumetric.[1,2] Illusory displays use some trick to create the illusion of the third dimension while using two-dimensional displays. Volumetric displays present information actually present in three dimensions. Hybrid type displays use a two-dimensional screen sweeping out a volume in space during the viewer's integration time. Alternately the actual length of the light path between the viewer and the screen can be changed by moving a mirror by which the 2-D display is viewed.

The illusory displays all suffer in some way or other from inherent limitations of the illusory technique. For example, the stereo-pair technique is completely ineffective for a significant fraction of population and can lead to characteristic distortions for those who can fuse the images.

The volumetric displays are ideal in principle but no fully satisfactory mechanism exists. For instance, two ionized gas displays have been suggested. One causes breakdown at the intersection of two electron beams and the other simply provides a 3-D matrix of gas cells. Alternately it has been proposed to write in a transparent gelatin. These techniques are characterized by complex addressing, brightness which is a function of depth, and very limited resolution.

Typical of the hybrid display is the CRT with a rotating screen. The hybrid displays offer many advantages over both pure types, but they are characterized by the presence of moving parts.

So far few of the 3-D display techniques provide for such bandwidth savers as random access or memory.

A NEW 3-D PRINCIPLE

It is possible to construct a hybrid 3-D display which involves relatively simple addressing, no moving parts, high resolution, random access, and memory. The principle involved is often discussed in high school physics texts. Consider a coin at the bottom of a glass. As the glass is filled with liquid, the apparent depth of the coin changes. The apparent depth depends on the index of refraction of the liquid and the depth to which the glass is filled. For a glass filled with a liquid, the apparent depth would change as we changed the reference index of the liquid. Instead of a liquid, an optically uniaxial crystal viewed along its optic axis seems most practical. The crystal has a fixed length L, but its index of refraction is either n or $n + \Delta n$ depending on the polarization state of the light. We will show that the apparent depth of an object viewed through this crystal can be changed by an amount ΔL by switching polarization states. Here $\Delta L = L(\Delta n/n^2)$. A stack of N polarization switches and N birefringent crystals can be used to produce 2^N equally spaced steps in apparent depth.

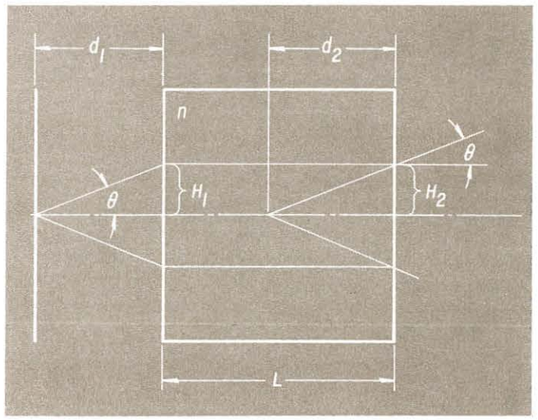

FIGURE 1: Passage of diverging light through a dielectric slab.

DERIVATION OF ΔL FORMULAS

Consider first a single optically isotropic crystal such as shown in Fig. 1. Applying Snell's law, we write that the sine of the internal angle, ϕ, of the extreme ray is given by

$$\sin\phi = \left(\frac{1}{n}\right)\sin\theta \tag{1}$$

Also we have

$$H_2 - H_1 = L\tan\phi = L\sin\theta/(n^2 - \sin^2\theta)^{1/2} \tag{2}$$

Therefore the apparent depth d_2 is given by

$$d_2 = H_1\cot\theta + L\cos\theta(n^2 - \sin^2\theta)^{-1/2} \tag{3}$$

If the index of refraction had been $n + \Delta n^*$ instead of n, the apparent depth would have been

$$d_2 + \Delta L = d_2 + L\cos\theta[(n+\Delta n)^2 - \sin^2\theta]^{-1/2} - L\cos\theta[n^2 - \sin^2\theta]^{-1/2} \tag{4}$$

Therefore if $\Delta n \ll n$ and $\sin^2\theta \ll n^2$,

$$\Delta L = -L\cos\theta\,\Delta n/n^2; \tag{5}$$

and if also $\sin^2\theta \ll 1$,

$$\Delta L = -L\Delta n/n^2 \tag{6}$$

The minus sign means that ΔL is negative when Δn is positive. In what follows it is the magnitude of ΔL which will be of primary interest.

A set of N electro-optic switches each followed by a uniaxial crystal can produce as many as 2^N steps in apparent depth. If the length of the m^{th} crystal is given by

$$L_m = 2^{m-1}\epsilon_1 \tag{7}$$

then the steps in apparent depth are of the form

$$\Delta L_p = p\epsilon\,(\Delta n/n^2), \tag{8}$$

where p is an integer

$$0 \leq p \leq 2^N - 1. \tag{9}$$

Actually Δn should be written $\Delta n(\theta)$. To first order in $\Delta n/n$, $\Delta n(\theta) = \Delta n\,(1 - \sin^2\theta)$. We will later apply the approximation $\sin^2\theta \ll 1$, so for convenience we assume $\Delta n(\theta) = \Delta n$ from the beginning.

DESIGN CONSIDERATIONS

The design of a 2-D to 3-D display converter can be described with reference to Fig. 2. The light emitted from the 2-D display screen, S, must be filtered by a broad band filter, F, to achieve monochromaticity and passed through a polarizing sheet, P. There follows a set of N (3 in this case) pairs of electro-optic polarization switches and birefringent slabs.

Of the uniaxial crystals of high optical quality, calcite ($\Delta n/n^2 \approx 0.10$) and $NaNO_3$ ($\Delta n/n^2 \approx 0.15$) appears to be most promising. A crystal with a 1.5 cm x 1.5 cm face normal to the optic axis would be considered large. The length, of course, is limited only by cost considerations, since it is evident that our derivation for Eq. 6 would apply equally well too to a set of crystals the sum of whose lengths is L. For example, if $\Delta n/n^2 = 0.10$, N = 10, and the maximum shift in apparent depth $\Delta L_{31} \cong 1$ cm; then $\epsilon_1 = 0.32$ cm, $\epsilon_2 = 0.64$ cm, $\epsilon_3 = 1.28$ cm, $\epsilon_4 = 2.56$ cm, and $\epsilon_5 = 5.12$ cm. Thus a total length of almost 10 cm of the uniaxial crystal is required to produce 32 steps of 0.032 cm in apparent depth.

The primary drawbacks of single crystals are their cost and their limited size. A number of plastics appear to offer high values of $\Delta n/n^2$. Unfortunately the birefringence arises as a result of the process, whereby the material is formed into thin sheets. That is, there appears to be significant strain birefringence in most thin plastic materials. What is required is either a way to make a composite slab from numerous thin films or a way to produce strain birefringence during the formation of thick slabs of material.

For those cases in which larger area displays are required, there are two approaches which individually or in combination seem to offer promise. First, a matrix of single crystals can be constructed. This solution involves considerable cost in materials. Second, lenses could be used to present a reduced 2-D display to the device and to expand the resulting 3-D display. Difficulties here arise from resolution and magnification considerations. Not only is the resolving power of the lenses limited, but the spot size of the magnified 2-D image is a function of the magnified depth.[3]

It is possible to control the apparent depth for each x-y element independently by setting up transparent, conducting matrix connections to the modulator crystal.

The high capacitance of the electro-optic switch provides a simple mechanism for memory. That is, RC times in the hours are easily obtainable.

3-D CAMERA

We note that the apparent depth change is a result of physical, not psychological changes; that is, it does not require a human observer for its verification. In particular, the depth to which a camera is focused can be varied by changing the voltage on a 2-D to 3-D converter mounted between the scene and the film plane. If the converter is adjacent the display can provide, through synchronously scanned voltage, apparent depth corresponding to the real depth in the original scene. The magnification-distortion problems are automatically compensated if the viewing optics are essentially identical to the camera optics. Thus moving 3-D pictures of real objects can be presented. Three-dimensional television by this method would be very limited in available depth levels in order to maintain reasonable band widths.

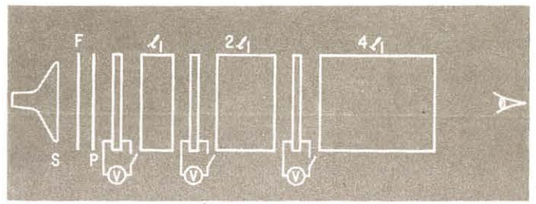

FIGURE 2: Diagrammatic representation of a 3-D display.

HUMAN FACTORS

The unavailability of useful 3-D displays has hindered research in the area of human factors aspects of volumetric and hybrid displays. Apparent movement in a plane picture can be produced by successive displaying of a number of "still" shots per second. Similarly it seems likely that displaying a roughly equal number of still depth cross-sections per second would produce a similar "smoothing" effect, thus creating a 3-D view of the solid object. Studies of this effect will decide the feasibility of 3-D television by this or similar methods. Similarly the postulated effect would utilize the human viewer as a computer to smoothly connect cross-sections at various depths, and thus would save considerable computer time in many applications of the 3-D display to computer readout.

CONCLUSIONS

A new method for producing 3-D displays is available. The new method has no moving parts, speed limited by the time to switch the voltages to the order of a microsecond, high resolution, random accessibility, and built-in memory potential. Materials limitations require either a small display or a complicated lens system to produce a large display. The angular field of view is limited by $\sin^2\theta \ll 1$ or $\theta <$ about 15°. The uses of this method include graphical display and 3-D television or movies.

REFERENCES

1. H. H. Poole, *Fundamentals of Display Systems* (Spartan Books, Washington, 1966).
2. Anonymous, Space/Aeronautics, pp. 60-64 (September 1962).
3. H. J. Caulfield, Appl. Optics (to be published).

THE AUTHOR

H. JOHN CAULFIELD received his BA/Physics from Rice University in 1958 and his PhD/Physics from Iowa State in 1962. He worked in infrared optics design at Texas Instruments (summers, '57 and '58), and was a graduate assistant doing mass spectrometer work at Ames Laboratory, Atomic Energy Commission ('59 - '62). From 1962-64 he was assigned to the Energy Research Lab, engaged in investigation of collector materials for thermionic diodes. Now a member of the Advanced Components Research Laboratory, Dr. Caulfield is performing research in new visual display techniques. He has published papers on thermodynamics, mass spectrometry, thermionic work functions, electron temperature, photoemission, near field diffraction, laser transmission, the uncertainty principle, viewing of laser light, display evaluation, and electro-optical devices. He has eight patents pending in the field of lasers, holography and electro-optics.

A high-precision display system for command and control

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ABSTRACT

This paper describes the technical considerations which are causing a shift in CRT display design from random beam positioning with analog symbol and vector generation to raster beam positioning with digital symbol and vector generation. Precision raster beam positioning, together with computer-generated synthetic digital video is now able to produce CRT displays technically much superior to analog deflection CRT displays

DIGITAL VIDEO, PRECISION RASTER vs ANALOG DEFLECTION CRT DISPLAYS

Basic differences between an analog beam deflection technique such as used in older Philco designs and the digital video, precision raster scan technique used in newer designs can be understood by referring to Figure 1.

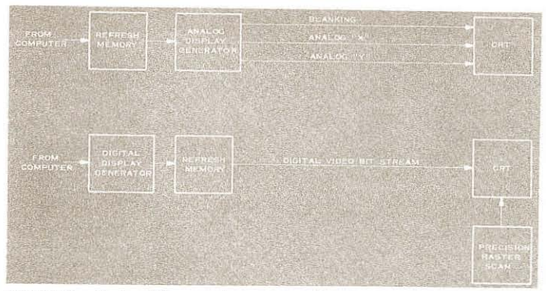


FIGURE 1: Basic difference between analog and digital CRT displays.

The most important difference is that the digital refresh memory which cycles to refresh the CRT precede the display generator in the analog system, whereas the digital refresh memory succeeds the display generator in the precision raster system. This means that the symbol and vector generators of the analog deflection system must recreate the entire display every refresh cycle, whereas in the digital precision raster system the display generator can stand idle during CRT display refreshing. The digital display generator operates only during updates, and then only on the portions of the display which change. Because of this, performance of symbol and vector generators is unaffected by the amount of information displayed, whereas analog display generators produce degraded displays under the strain of recreating any but the simplest display every refresh cycle. These degradations of the analog display take the following form:

1. Refresh rates often fall below the flicker-free display level when displaying more than a modest number of analog vectors or symbols.
2. Symbol and vector position registration is degraded and is in no way commensurate with display resolution. For example, resolution may be one part in 1024, but registration error of a situation display to a background map may be 1% or worse.

Other major differences which cannot be seen from Figure 1, but which result in significant performance advantages for digital video display systems are:

1. Because of the simple electronics required to generate a fixed raster, digital video display consoles are much simpler, lighter, and more easily maintained than analog deflection consoles.
2. Addition of repeater (slave) displays can be done at very low cost.
3. Displays of manual or dynamic status boards, teletype copy, scenes, slides, etc., viewed by high resolution TV cameras or flying spot scanners can be shown on console CRT's by simple mixing of camera video with digital synthetic video.
4. The use of digital rather than analog techniques eliminates the need for frequent adjustments.
5. Signal distribution is much less costly than for analog systems and can be done over long distances without introducing symbol jitter.
6. Registration of computer-generated dynamic data to reference background maps, grids, tables, etc., is perfect element-for-element and is commensurate with display resolution.
7. Video polarity may be inverted to allow viewing black-on-white for high data content displays or white-on-black for low data content displays. This feature is especially important for high resolution map displays. The presence of a large number of white symbols on a black background causes the eyes to be almost unable to look at the display. This "dazzle" effect can be observed by trying to read a negative print of a typewritten page. For black lines on white, significantly more data can be usefully displayed. Conversely, if only a few symbols and vectors are displayed simultaneously, white on black is often preferred. Philco Display/Control systems usually provide a switch to allow operator choice of either polarity.
8. Light pen operation is greatly simplified. First, when viewing black symbols on a white background, there is always a phosphor flash which can be detected, even in the "empty space" between symbols. Thus, the need for a "tracking cross' is eliminated. Second, since the raster is created in a precisely timed fixed pattern, time delays in the light pen circuits can be exactly compensated.
9. Certain promising group displays, not suited to analog deflection, such as Ediphor, discrete element flat panel displays, and mixed color displays, are well-suited to digital video raster scanning.

PRECISION REGISTRATION TEN TIMES BETTER THAN ANALOG SYSTEMS

Perhaps the largest technical advantage exhibited by digital video systems is the order of magnitude decrease in relative registration error between computer generated dynamic data and digitally stored background data. Since all elements of the display, whether they be map elements, symbol or vector elements, are generated by the same high precision digital circuits, the registration of pre-planned data elements to digitally stored background elements is perfect, while registration of random elements is within the digital quantization error which can be made arbitrarily small. As a practical example, quantization error in a 1024 x 1024 element picture is, in the worst case, half an element. Half an element is only 0.05% of display width.

TV Lines Per Frame = L	VERTICAL RESOLUTION ELEMENTS			HORIZONTAL RESOLUTION ELEMENTS			QUALITY (TOTAL PICTURE ELEMENTS)		
	Interlace Field Philco Display V = 0.93L	Optional TV Camera Source V' = 0.7V	Repeat Field Philco Display V'' = 0.5V	Video Bandwidth To Get 1024 Elements Per TV Line (H = 1024) BW = 18.75 HL	Video Bandwidth To Get 512 Elements Per TV Line (H' = 512) BW = 18.75 H'L	Video Bandwidth To Get 256 Elements Per TV Line (H'' = 256) BW = 18.75 H''L	Interlace Field Philco Display Q = HV	Optional TV Camera Source Q' = HV'	Repeat Field Philco Display Q'' = H'V''
525	488	342	244	10.1 Mc	5.0 Mc	2.5 Mc	499 K	350 K	125 K
567	527	369	263	10.9 Mc	5.4 Mc	2.7 Mc	540 K	378 K	135 K
625	581	407	290	12.0 Mc	6.0 Mc	3.0 Mc	595 K	417 K	149 K
675	627	439	313	12.9 Mc	6.5 Mc	3.2 Mc	642 K	450 K	161 K
729	677	474	338	14.0 Mc	7.0 Mc	3.5 Mc	693 K	485 K	173 K
735	683	478	341	14.1 Mc	7.1 Mc	3.5 Mc	699 K	490 K	175 K
875	814	569	407	16.8 Mc	8.4 Mc	4.2 Mc	834 K	583 K	209 K
945	879	614	439	18.2 Mc	9.1 Mc	4.5 Mc	900 K	629 K	225 K
1,029	954	667	477	19.7 Mc	9.8 Mc	4.9 Mc	976 K	683 K	245 K
1,125	1,045	731	522	21.6 Mc	10.8 Mc	5.4 Mc	1,072 K	749 K	268 K
1,215	1,130	791	565	23.3 Mc	11.7 Mc	5.8 Mc	1,158 K	811 K	289 K
1,225	1,140	798	570	23.4 Mc	11.8 Mc	5.9 Mc	1,168 K	818 K	292 K

TABLE 1: Digital television simplified selection guide—graphics.

Why does a military user want such good registration? There are four good reasons:

1. Precision registration greatly adds to the usefulness of situation displays, minimizing the "troops shown on the wrong side of the bridge" problem.
2. Precision symbol placement allows adding much more detail in crowded areas of the display without confusing data overlaps.
3. Precise element positioning allows inexpensive color generation through color mixing rather than requiring a separate source for each color.
4. Overall system precision allows inexpensive console TV monitors to be as accurate as very expensive X-Y plotters for real-time control applications.

DIGITAL VIDEO
RASTER DEFLECTION vs TELEVISION

Digital video can be synthesized to be suitable for driving either special precision raster displays or conventional television monitors. Normally, it is recommended that "television type" rasters be used only if the system already has a large investment in TV equipment which is to be used unchanged. I am defining "television raster" as having each TV "frame" formed by two interlaced "field" rasters. The TV frame refresh rate is 25 frames per second in Europe and 30 frames per second in the USA. Such TV rasters have two typical problems:

1. The interlace circuits can drift causing unequal gaps to appear between scan lines. The larger of the unequal gaps represent unwanted discontinuities in the picture. If interlace is very poor, line-pairing can cut the vertical resolution in half.
2. The twenty-five or thirty frames per second refresh rates are inadequate to prevent white phosphor flicker for high resolution isolated horizontal lines or patterns of horizontal lines. The problem is especially serious at high brightness levels.

In most precision raster systems currently contemplated by Philco, all elements of the display are refreshed on one single raster scan. This feature, together with the 48 rasters or more per second refresh rate, prevents completely the poor interlace and flicker problems of "television type" rasters.

It is also important to notice that vertical resolution in the digital video system is not degraded by the "Kell Factor". That is, since the digital synthetic video is precisely synchronized to appear on the correct scanning line, there is no misalignment as is bound to occur when a television camera or flying spot scanner sweep fails to register on narrow horizontal lines. Thus, a digital video system has 50% more vertical resolution than a television or facsimile system with the same number of active scan lines.

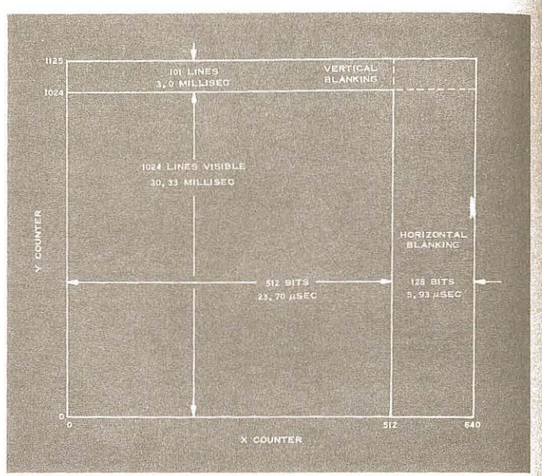


FIGURE 2: Raster layout — 1125-line scan.

TV Lines Per Frame = L	ROWS OF TEXT: Interlace Field Philco Display R = V/10	ROWS OF TEXT: Optional TV Camera Source R' = V'/10	ROWS OF TEXT: Repeat Field Philco Display R'' = V''/10	COLUMNS OF TEXT: Video Bandwidth To Get 128 Columns (C = 128) Megacycles	COLUMNS OF TEXT: Video Bandwidth To Get 64 Columns (C' = 64) Megacycles	COLUMNS OF TEXT: Video Bandwidth To Get 32 Columns (C'' = 32) Megacycles	TOTAL SYMBOLS: Interlace Field Philco Display T = CR	TOTAL SYMBOLS: Optional TV Camera Source T' = CR'	TOTAL SYMBOLS: Repeat Field Philco Display T' = C'R''
525	48	34	24	10.1	5.0	2.5	6,144	4,352	1,536
567	52	36	26	10.9	5.4	2.7	6,656	4,608	1,664
625	58	40	29	12.0	6.0	3.0	7,424	5,120	1,856
675	62	43	31	12.9	6.5	3.2	7,936	5,504	1,984
729	67	47	33	14.0	7.0	3.5	8,576	6,016	2,112
735	68	47	34	14.1	7.1	3.5	8,704	6,016	2,176
875	81	56	40	16.8	8.4	4.2	10,368	7,168	2,560
945	87	61	43	18.2	9.1	4.5	11,136	7,808	2,752
1,029	95	66	47	19.7	9.8	4.9	12,160	8,448	3,008
1,125	104	73	52	21.6	10.8	5.4	13,312	9,344	3,328
1,215	113	79	56	23.3	11.7	5.8	14,464	10,112	3,584
1,225	114	79	57	23.4	11.8	5.9	14,592	10,112	3,648

TABLE 2: Digital television simplified selection guide—text.

SELECTION OF DISPLAY PARAMETERS

To allow easy comparisons with current experience of those receiving this paper, the discussion of selection of digital video parameters will be limited to existing USA television rasters. Extrapolation to other rasters is straightforward. Figure 2 shows graphically the percentage of active time and retrace time normally used to create a 1024 x 1024 element picture. The retrace time has the effect of proportionally raising the required bandwidth. Table 1 shows a matrix which relates display quality in total picture elements to scanning lines per display frame, video bandwidth at 30 frames per second, and video source. "Interlace Field" operation is defined as digitally storing different picture elements for the two fields of one frame. "Repeat Field" operation is defined as digitally storing picture elements for one field and putting these elements out twice to make one frame. The TV camera source vertical resolution has been shown to include a "Kell Factor" of 0.7 for easy comparison. Table I is provided as a reference which can be studied. However, at this time it is shown to point out that picture quality of a low line standard display with a given bandwidth can be as good as a high line standard display with the same bandwidth. For example, the table shows that a 567 line system (527 active) with 1024 visible elements per line requires 10.9 megacycle bandwidth. It also shows that an 1125 line system (1045 active) with 512 visible elements per line requires 10.8 megacycles bandwidth. The two display systems would appear of equal quality to the viewer, because approximately the same number of picture elements are provided in each case.

Table II is provided to translate the data of Table I for the special case of alphanumerics. The trade-offs of rows and columns of maximum readable density 5 x 7 symbols is apparent. That is, if a matrix of 10,000 symbols are to be simultaneously displayed, it can be done by 875 line system driven from a repeat field source with a system bandwidth of 16.8 megacycles. Our experiments have verified the implied ability of one video cycle to display two picture elements.

COMPLETE SYSTEMS

Figure 3 shows a complete system of the type constructed by Philco for the National Aeronautics and Space Administration. This, too, is a diagram meant to be studied. Key points of the system are:

(1) The maps and other reference backgrounds to which computer-generated dynamic data are to be registered are stored in two forms. If reference backgrounds are simple, they are stored as sets of digital control words which use the display system's symbol and vector generator to create the background. Above a certain background complexity, it is more efficient to digitally store the actual picture elements rather than the set of instructions which will cause them to be created.

(2) If data is to be displayed on several independent channels, it is often a good trade-off to update each display in turn in a core memory, taking advantage of core memory random access, then to transfer the picture to delay lines, drum, or disc for display refresh.

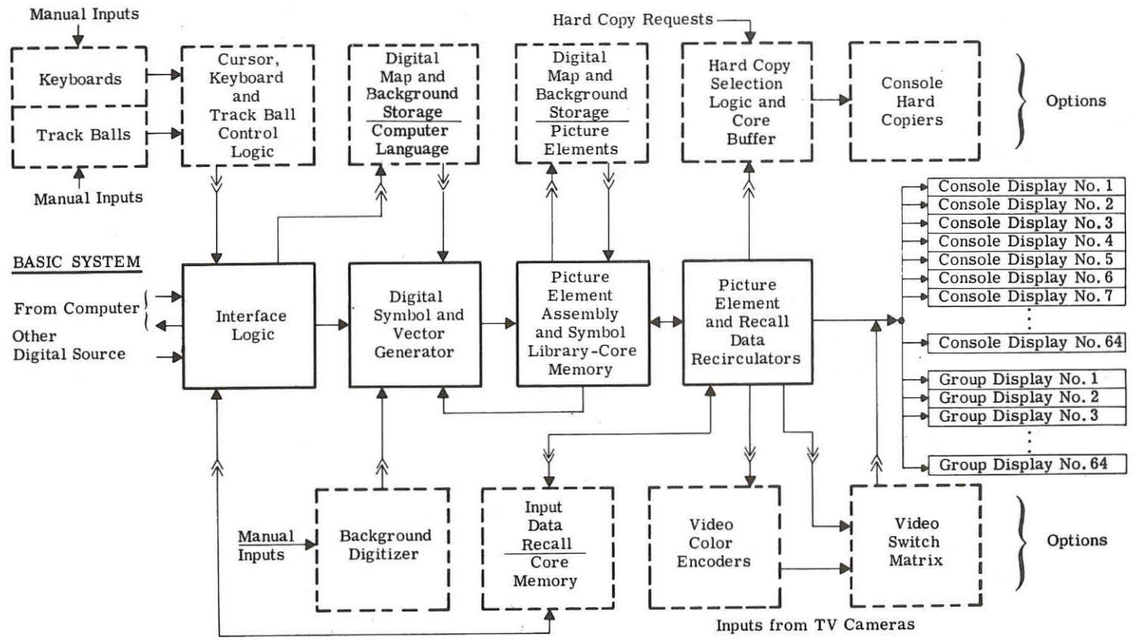


FIGURE 3: Precision digital television display systems.

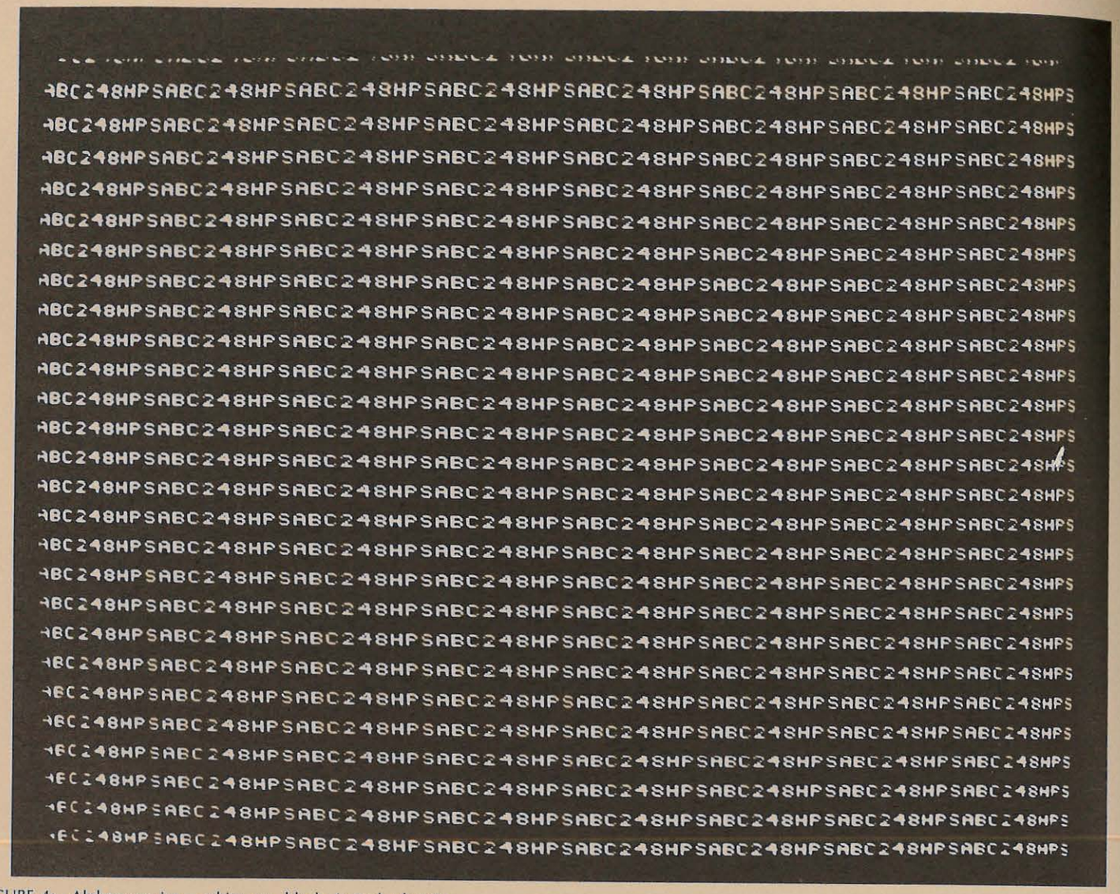


FIGURE 4: Alphanumerics — white on black (actual photo).

(3) If delay lines, drum, or disc are used for refresh, storage must be provided corresponding to horizontal and vertical retrace times. This storage, which is often quite large, can be made available as on line mass storage for the associated computer. In the system built for the NASA, this storage is called "recall data" storage.

ACTUAL EXAMPLES:

The final figure is a photograph taken of a standard 525 line television monitor driven by a digital video system connected to a Philco 210 computer. Figure 4 shows the white on black mode and demonstrates that even 525 line television is adequate to display over 1800 symbols simultaneously.

CONCLUSION:

Precision raster systems employing all digital techniques for video synthesis are already capable of technically outperforming analog deflection displays. The rapidly diminishing size and cost of digital logic elements and memories should serve to accelerate the change from analog to digital video displays for future command and control systems.

THE AUTHOR

HERBERT C. HENDRICKSON is Manager, Display/Control Systems Engineering, Philco Western Development Laboratories, Palo Alto, California. He holds BS and MS degrees in EE from the University of Colorado and the University of Southern California, respectively. Prior to this assignment, he directed design and implementation of the complete NASA Gemini and Apollo Mission Control Center/Houston display/control system. This work extended from the preliminary study phase through proposal preparation, contract award, system design, fabrication, checkout, and technical support during the first missions actually controlled from MCC/H (GT-4 and GT-5). Earlier, as a senior member of the technical staff at Philco Aeronutronic, he designed command and control systems and digital data processing and display equipment. Simultaneously, he taught graduate courses in digital computer logic design at USC, and later at UCLA. Earlier he was responsible for system analysis and logic design for advanced digital track systems, computer consoles, and advanced digital arithmetic units at Hughes Ground Systems, Fullerton, Calif. He is an honorary member of Sigma Tau and Eta Kappa Nu.

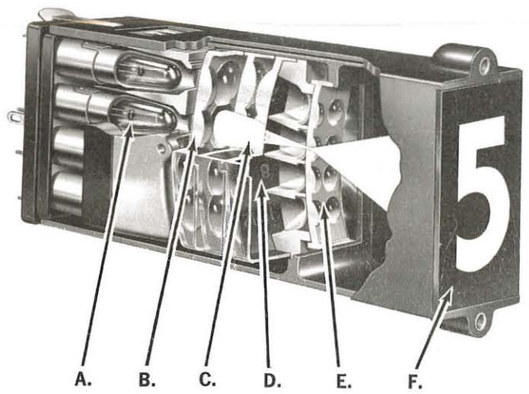
IEE single-plane, rear projection readout devices are unmatched for display readability and versatility. With them, you can display words, numbers, symbols and colors in any combination. Success of these readouts has been spectacular, and they are now used by thousands of leading firms all over the world.

Today, the IEE line includes not only the finest in-line, rear-projection readouts, Status Indicators and Indicator Switches, but a variety of sophisticated electronic components, including Driver/Decoders, and combination Decoder/Readouts. IEE also has the capability for designing and manufacturing entire display systems.

If you can't find the best way to meet your readout and display requirements in the following pages, please contact us. We'll gladly build it. We've been building the best for years.

IEE INDEX

IEE PRINCIPLES OF OPERATION



IEE REAR-PROJECTION READOUTS ARE UNMATCHED FOR THEIR VERSATILITY & LEGIBILITY

IEE patented rear-projection readouts are passive, nonmechanical devices that display with unmatched legibility any image or color that is photographically reproducible, including numbers, letters, words, symbols, designs. When one of the 12 lamps at the rear of the readout is lighted, it illuminates the corresponding film message, focuses it through a lens system, and projects it onto the non-glare viewing screen at the front. This "one lamp per message" design eliminates character misreadings caused by partial failures. Because the message thus displayed is on a single plane, there is no obstruction or confusion caused by unlighted filaments. Since IEE readouts can display type styles that human-factors tests through the years have proved to be most legible, the readout message appears natural to the eye.

ADVANTAGES

READABILITY. Single-plane presentation ensures visual crispness and easy readability. Only the message that's "on" is visible; there is no visual "hash" from unlighted, stacked filaments. **VERSATILITY.** Anything that can be put on film can be displayed on an IEE readout: colors, symbols, numbers, letters and words in any combination! There is literally no limit to the display versatility of IEE readouts. **VERSATILITY OF SIZE:** Five sizes with maximum character heights of 3/8", 5/8", 15/16", 2", 3-3/8". **RELIABILITY:** All IEE readouts are passive, nonmechanical devices with an unlimited life. Long-life replacement lamps which provide up to 40,000 hours of life per lamp are inexpensive and readily available anywhere, making IEE readouts the most reliable of all readout devices. **EASE OF OPERATION:** IEE readouts operate either from straight decimal input or conventional binary codes with IEE low-current driver/decoders.

CUT-AWAY SHOWS THE PATENTED IEE REAR-PROJECTION PRINCIPLE AND HOW THE NEW SERIES 10 READOUT OPERATES:

A. Standard MS or commercial lamp

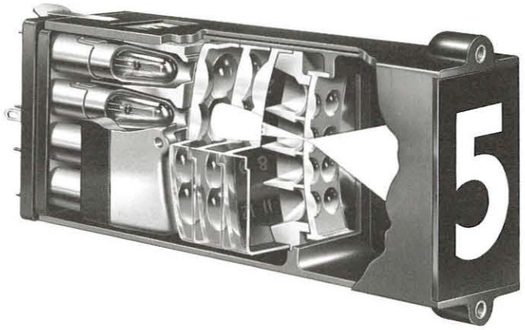
B. Light-collecting lens

C. Dual square-lens condensers provide greater coverage at lower magnification

D. Film containing display symbol (numbers, letters, words, symbols, colors)

E. Projection lens

F. Non-glare viewing screen



SPECIAL LENS SYSTEM MAKES SERIES 10 READOUTS 4 TIMES BRIGHTER

By squaring and enlarging the formerly circular lenses, IEE has increased the character brightness of Series 10 readouts by a magnitude of four over that of previous models. Series 10 readouts now average more than 75 foot-lamberts of character brightness with 6.3-v lamps at rated voltage. This increased brightness means greater visual clarity at wider angles and longer distances with excellent readability under high ambient light conditions.

SERIES 16 MIL-SPEC, VERSION OF SERIES 10 READOUTS

Series 16 MIL-Spec readouts are equipped with standard quick-disconnect lamp assemblies and are available in separate common or split-ground configurations in single units or assemblies. All finishes and materials have been selected to pass the following environmental conditions:

The Series 16 readout has been tested and evaluated by an independent testing laboratory, with tests conducted per MIL-STD-202C.

METHOD 102A, TEMPERATURE CYCLING: Test condition D, temperature range of –55°C to 85°C.

METHOD 106B, MOISTURE RESISTANCE: 90% relative humidity and temperature cycling range of –25°C to 65°C.

METHOD 201A, VIBRATION: 0.06 in. double amplitude of 10 to 55 CPS.

METHOD 202B, SHOCK: 30 G.

METHOD 301, DIELECTRIC-WITHSTANDING VOLTAGE: 1,000 Volts RMS AC.

METHOD 302, INSULATION RESISTANCE: Test condition C, 1K meghoms minimum.

For complete information and specifications on this unit, contact IEE.

IEE Industrial Electronic Engineers, Inc.
7720 Lemona Avenue, Van Nuys, California 91405

SERIES 10

STANDARD
REAR-PROJECTION READOUT

ACTUAL SIZE
OF VIEWING SCREEN AND
MAXIMUM CHARACTER HEIGHT

SPECIFICATIONS

Size (max): 2.624" H x 1.56" W x 5.50" D.

Weight: 12 oz. per unit.

Projected Colors Available: white (standard), amber, yellow, blue, red, green.

Lamp Return: common for all 12 terminals (separate or split grounds optional).

Case: die-cast aluminum, isolated from electrical circuit.

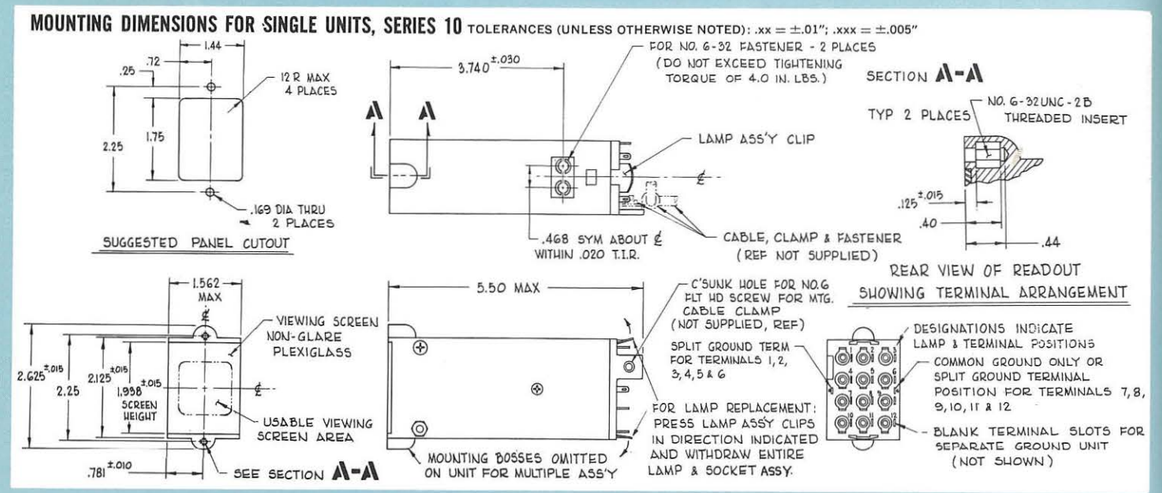
Input: straight decimal or binary coded decimal with an IEE Decoder Module for binary-coded input (see Decoder/Display Section).

Standard Viewing Angle: vertical and horizontal, 160° included angle.

Usable Viewing-Screen Area: any message or character within a .937" square. 1.19" square background may be colored or illuminated.

Voltage: determined by lamps.

Connection: quick-disconnect lamp assembly standard (Amp "Faston" receptacle #42067-1 may be used on wiring to provide snap-on terminal connections). Unit also available with Amphenol connector and mating plug as a standard option at extra cost.



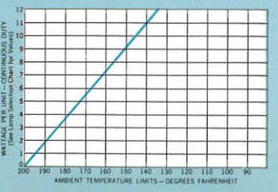
QUICK-DISCONNECT LAMP ASSEMBLIES

All standard Series 10 rear-projection readouts come with a quick-disconnect lamp assembly. The entire lamp and socket assembly is held in position by a spring clip on the top and bottom of the case. Lifting these spring clips permits quick and easy withdrawal of the lamp assembly. Lamps can be changed on the spot or a completely new readout snapped into position on the present lamps. A bracket is provided as part of the lamp assembly for mounting a cable clamp to relieve strain on the lamp terminal wires.

AMBIENT TEMPERATURE CHART

Ambient temperature limits should be considered in the selection of the proper lamp to be used. Curve gives maximum ambient temperature to which a unit may be subjected at a given input wattage. Operating below the ambient temperature is safe and no critical internal temperatures will be exceeded.

To determine the ambient temperature limits, multiply the wattage per lamp by the number of lamps required to be on simultaneously per unit. Then refer to the chart for temperature limits per unit.



LAMP SPECIFICATIONS AND CHARACTER BRIGHTNESS

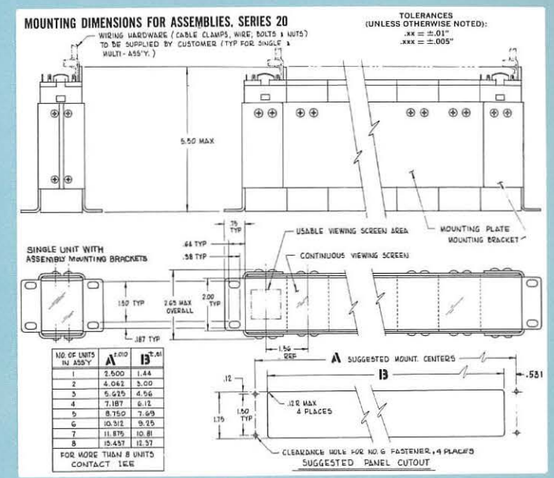
(For general facts to guide lamp selection, see lamp selection section)

Lamps Available for Series 10 by Lamp Number	Rated Voltage	Current at Rated voltage (Milli-Amps.)	†Watts per Lamp at Rated Voltage	Life per Lamp at Rated Voltage (Hours)	Character** Brightness at Rated Voltage	Operating At Reduced Voltage			Lamp Replacement Price, Each
						Reduced Voltage	Life per Lamp at Reduced Voltage (Hours)	Character** Brightness at Reduced Voltage	
44*	6.3	250	1.6	3,000	75	5.3	30,000	38.0	$ .10
47	6.3	150	0.9	3,000	42	5.3	30,000	21.0	.10
755	6.3	150	0.9	50,000	20	5.3	500,000	11.0	.33
1847	6.3	150	0.9	10,000	30	5.3	100,000	15.0	.13
756	14.0	80	1.1	50,000	7	11.5	500,000	3.5	.16
1909***	14.0	100	1.4	1,500	25	11.5	15,000	12.0	.16
1815	*14.0	200	2.8	3,000	60	11.5	30,000	30.0	.13
757	28.0	80	2.2	50,000	14	23.0	500,000	7.0	.21
1820	28.0	100	2.8	1,000	32	23.0	10,000	16.0	.26
1829	28.0	70	2.0	1,000	20	23.0	10,000	10.0	.23

†Please consult ambient temperature chart when selecting lamps.
*Recommended for optimum performance.
**Measurements averaged for all 12 terminal positions with values in foot lamberts as measured with a spot-light meter.
***Replaces lamp No. 1813.

ASSEMBLIES, SERIES 20

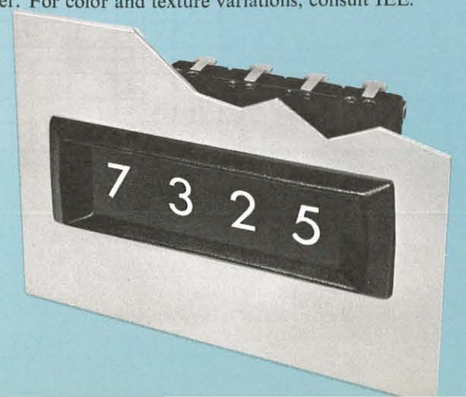
An assembly of Series 10 units is designated Series 20. Assemblies are supplied with a continuous viewing screen for fast, accurate reading. Specification of the individual readouts in an assembly should be made by model number or by written statement of what messages the display units should contain. The proper sequence of individual display units should be listed from left to right, as seen facing the viewing screen. Once an "assembly number" has been assigned for a particular grouping of readouts, that number can be used for future orders.

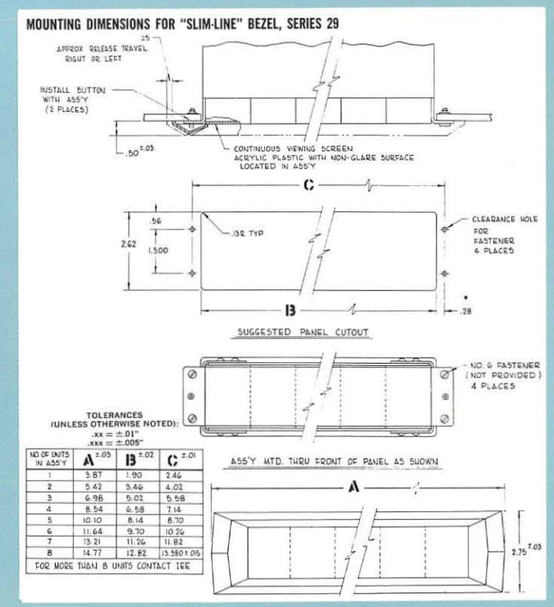


SERIES 29 SLIM-LINE BEZELS

IEE bezels permit easier, more economical mounting of readout assemblies and better-looking display panels. By eliminating the need for costly, precise panel cutouts, the bezels often pay for themselves. Also, when slim-line bezels are employed, Series 10 readouts require front mounting in display panel, greatly facilitating accessibility.

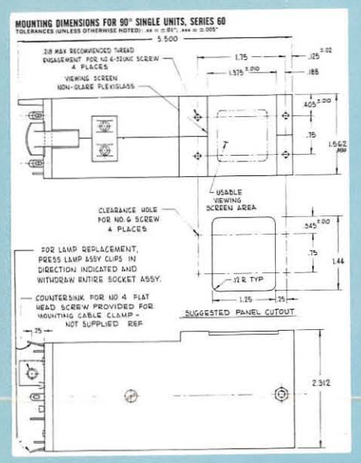
Bezels are attached entirely from the front of the panel and are easily installed or removed by sliding the bezel to the left or to the right. IEE Slim-line bezels come in black, pebble-finished (cycolac) plastic, which is easily cleaned with soap and water. For color and texture variations, consult IEE.





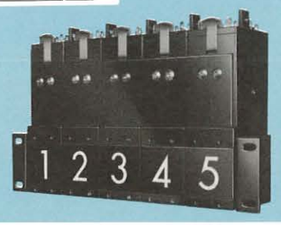
90° ADAPTATION, SERIES 60

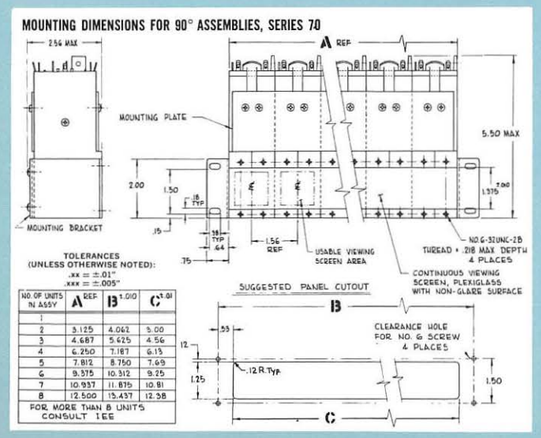
In applications where depth behind panel is limited, special 90° adaptations of the standard Series 10 are available and are designated Series 60.



ASSEMBLIES, SERIES 70

Series 60, 90°—adaptation units, in assemblies are designated Series 70.





NO. OF UNITS IN ASSY	A REF	B ±.010	C ±.01
1			
2	3.125	4.062	3.00
3	4.687	5.625	4.56
4	6.250	7.187	6.13
5	7.812	8.750	7.69
6	9.375	10.312	9.25
7	10.937	11.875	10.81
8	12.500	13.437	12.38

FOR MORE THAN 8 UNITS CONSULT IEE

ANYTHING THAT CAN BE PUT ON FILM CAN BE DISPLAYED ON IEE READOUTS!

Since IEE rear-projection messages are on film, readouts can display anything that is photographically reproducible, including numbers, letters, words, symbols, special characters, and colors. Standard sets of displays are listed in the chart below. Any other messages can be set to order.

STANDARD SETS OF DISPLAYS

FILM NUMBER	TERMINAL 1	2	3	4	5	6	7	8	9	10	11	12	Type Style
4000	1	2	3	4	5	6	7	8	9	0			
0000	1	2	3	4	5	6	7	8	9	0	•	•	1
0003					+			−					
0004	1	2	3	4	5	6	7	8	9	0	Red	F	3
0005		Green			+			−			Red		
0006	A	C	F	M	P	Q	R	T	0	1	+	•	3
0007	1	2	3	4	5	6	7	8	9	0	Red	0	1
0009	0	⅛	¼	⅜	½	⅝	¾	⅞					3
0010	0	1	2	3	4	5	6	7	8	9	10	11	1
0011	1	2	3	4	5	6	7	8	9	0	+	−	1
0013	A	B	C	E	F	L	M	N	P	S	T	X	2
0014	2	1	0		4	3	7	6	5	•	9	8	1
0019	1	2	3	4	5	6	7	8	9	0	Red	•	1
0052	1	2	3	4	5	6	7	8	9	0	Red	Green	1
0056	0	S	L	C	Red	R	E	Green	F	X	Y	Z	2
0057	1	2	3	4	5	6	7	8	9	0	A	B	3
0069	1	2	3	4	5	6	7	8	9	0	Red	Blue	1
0070	A	B	C	D	E	F	G	H	I	J	K	L	2
0079	B	C	E	F	H	L	O	P	S	T	V	Z	2
0085	1	2	3	4	5	6	7	8	9	10	11	12	1
0086	A	B	C	D	E	F	G	H	K	L	M	N	2
0087	O	P	Q	R	S	T	U	V	W	X	Y	Z	2
0099	A	B	C	E	F	L	M	N	P	S	Red	U	2
0100	ALPHA-NUMERIC BAR MATRIX												
0200	2	1	2	3	4	5	6	7	8	1	9	0	2
0221	1	2	3	4	5	6	7	8	9	0	Amber	Green	1
0330	1	2	3	4	5	6	7	8	9	0	:	•	1
0684	N	S	E	W	Red	Green							2
0696	1	2	3	4	5	6	7	8	9	0	+	−	1
*4164	1	2	3	4	5	6	7	8	9	0		: .	1
*061T	1	2	3	4	5	6	7	8	9	0	Red	.	1

*Decimal points for these two models *only* have decimal points positioned at the base of the numbers offset left or right as indicated above.

COLORS REPRESENT PROJECTED BACKGROUND OF COLOR INDICATED.

TYPE STYLES:
(Numbers refer to "Type Style" column in chart.)

1. Futura Medium: 1234567890
2. Futura Medium Condensed: ABCDEFGHIJKLMNOPQRSTUVWXYZ
3. Digits: Futura Medium; Letters: Futura Medium Condensed

READOUT MESSAGE DESIGN GUIDE FOR NON-STANDARD SETS OF DISPLAYS

Studies indicate that Alternate Gothic #3 type face is the most readable for multiple character messages; therefore, this type face is furnished as standard.

Exceptions: Futura Medium style type is supplied for single maximum height (.937") numbers only.

Futura Medium Condensed style type is supplied for single maximum height (.937") letters only.

Other type faces, sizes, and symbols are available on special order. For deviations from character sizes listed in chart to the right, consult IEE.

Alternate Gothic #3:
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

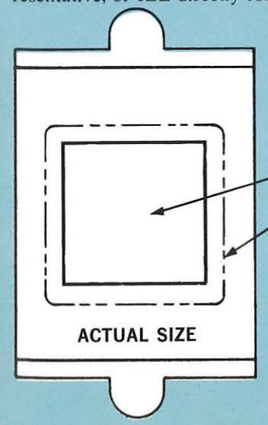
Futura Medium: 1234567890

Futura Medium Condensed: ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

INSTRUCTIONS:

1. From the chart to the right, determine the character size of your message by selecting the character height that will give you a sufficient number of characters per line in a sufficient number of lines to adequately contain your readout message. (All letters and numbers except 1, I, M, and W are approximately the same width; therefore, this chart is based on the normal use of these characters in any one line. Count each space between words as a character.)

2. Now record your readout message with the other information requested on the Design Guide Order Sheet at the back of this catalog. You may write your message information on a duplicate copy of this form or contact your local IEE Sales Representative, or IEE directly for an extra supply of these sheets.



For optimum performance 6 volt lamps are recommended.

Usable message area is .937" sq.

Standard illuminated or color background area is a 1.19" sq.

NOTE: With the exception of the maximum single character height of .937", projected character size and color or illuminated background area will be slightly larger on 90° units, Series 60 and 70.

MESSAGE HEIGHT GUIDE

For Both Horizontal and Vertical Units

ALPHABET SET IN ALTERNATE GOTHIC #3 SHOWN ACTUAL SIZE	STANDARD CHARACTER HEIGHT (Nominal dimension only; standard tolerance for characters less than .500" is ±.015" and for characters .500" or over it is ±.025")	MAXIMUM NUMBER OF CHARACTERS PER LINE (LETTERS AND NUMERALS) 1 Line and All Central Lines for 3 thru 6 Line Messages	Two Lines	TOP AND BOTTOM LINES ONLY — NUMBER OF MESSAGE LINES 3	4	5	6
ABCDEFGHIJK	.090"	13	13	12	11	10	9
NOPQRSTU	.125"	10	10	9	8	7	
WXYZAB	.155"	8	8	6	4		
DEFGHIJ	.185"	7	7	6			
KLMN	.220"	6	6	4			
PQRS	.250"	5	4	3			
TUV	.325"	4	3				
WX	.390"	3	2				
YZ	.468"	2					
AB	.538"	2					
CD	.645"	2					
E	.750"	1					

.10" spacing between lines is the recommended minimum.

MESSAGE AND ILLUMINATED BACKGROUND COLOR COMBINATIONS OBTAINABLE WITH ONE LAMP:

1. A white message on a black background.
2. A black message projected onto either a 1" circular white or colored background.
3. A colored message on a black background.
4. For combinations using more than one lamp, consult IEE.

PRICE SCHEDULE AND ORDERING INFORMATION

DESIGNATION OF MODEL NUMBERS

Complete model numbers should be designated on all orders. An analysis of information included in a typical model number for both single units and assemblies is shown below.

TYPICAL SINGLE-UNIT MODEL NUMBER

10 - 0007 - 44 - L

(A) (B) (C) (D)

TYPICAL ASSEMBLY MODEL NUMBER

20 - 0495 - 44 - K

(A) (E) (C) (D)

TYPICAL MODEL NUMBER FOR ASSEMBLY WITH BEZEL

29 - 0495 - 44 - K

(A) (E) (C) (D)

NOTE: Because panel cut-out dimensions and installation procedures are different for Series 20 assemblies to be used with bezels, bezels should be ordered as an integral part of the assembly.

TYPICAL MODEL NUMBER FOR SERIES 60 READOUTS

60 - 0007 - V - 44

(A) (B) (F) (C)

TYPICAL MODEL NUMBER FOR SERIES 70 READOUTS

70 - 0495 - INV - 44

(A) (B) (F) (C)

A. Series number used to identify unit. 29 designates an assembly of Series 10 readouts with a slim-line bezel.

B. Designates film number for character displays used in readout. Numbers for standard sets of displays are listed in this catalog; numbers for special sets of displays obtained from IEE.

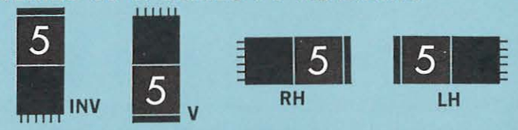
C. Number of lamp selected for use in readout.

D. Case style. Style "L" has front mounting lugs for individual mounting of each unit. Style "K" is without front mounting lugs and is used in Series 20 assemblies for end-bracket mounting.

E. Identifying number assigned by IEE for a particular grouping of individual readouts within an assembly (see text on Assemblies, Series 20).

F. Position in which Series 60 or 70 units will be used (INV, V, RH, or LH).

POSITION DESCRIPTION FOR SERIES 60 & SERIES 70 READOUTS



PRICE SCHEDULE

Series No.	COMBINED QUANTITY 1 to 9	10 to 24	25 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000-over
10	20.00	18.50	17.50	16.50	15.75	15.00	14.50	14.00
10C[1]	21.50	20.00	19.00	18.00	17.25	16.50	16.00	15.50
10S[2]	23.00	21.50	20.50	19.50	18.75	17.50	16.75	16.00
16 (mil-spec.)	25.00	23.00	21.75	20.75	19.75	18.75	18.00	17.50
60 (90° model)	29.00	26.75	25.25	23.75	22.50	21.50	20.75	20.00
60C[1] (90° model)	30.50	28.25	26.75	25.25	23.50	22.50	21.75	21.50
60S[2] (90° model)	34.50	32.25	30.25	28.25	26.25	24.50	23.00	22.00

1. C-Split ground return.
2. S-Separate ground terminal for each lamp.

ASSEMBLIES

Series 20 (Assembly of Series 10 Units)	Assemblies of 2-8 units may be provided with mounting hardware and continuous viewing screen. For assemblies larger than 8 units, please consult IEE.	Extra for assembly mounting hardware 1.50 Per Unit
Series 70 (Assembly of Series 60 Units)		

SERIES 29 "SLIM-LINE" BEZEL

(1-8 Unit Assemblies)

For Bezels accommodating more than 8 units consult IEE. Bezel prices are to be added to price of units listed above.

QUANTITY	UNIT PRICE
1-49	$5.00
50-99	4.25
100-249	4.00
250-499	3.75
500-over	3.50

SET UP CHARGE: Standard models or sets of displays in this catalog are available at the listed prices. An additional charge of $40 is required for other models to cover the cost of master film which is kept on file for 12 months from its last use. Reorders within this period will not incur the $40 initial set-up charge.

QUANTITY DISCOUNTS ON EXTENDED SHIPMENTS

1. To break an order down into more than one shipment, the order must total 100 or more display units.
2. Each shipment must equal at least 10% of total order or 25 units (whichever is larger).
3. Shipments on a particular order must be completed within 12 months from receipt of order.
4. Quantity orders cancelled before completion will be billed at prices based on the Price Schedule for the number of displays actually shipped.

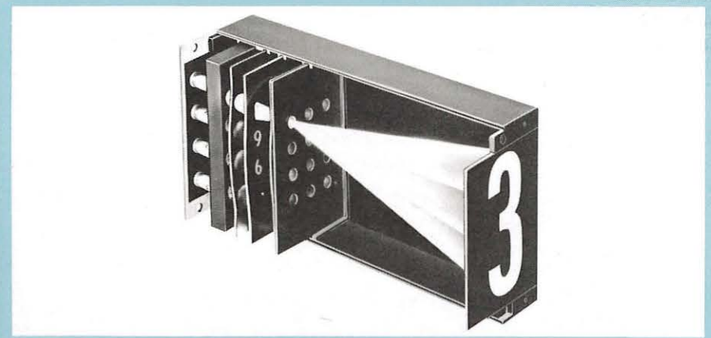
TERMS AND CONDITIONS

1. Minimum billing — $5.00.
2. F. O. B. — All prices F. O. B. our plant Van Nuys, California.
3. TERMS — ½ of 1% 10 days; net 30 days.
4. DELIVERY — For standard displays: 30 days depending upon quantity. For special displays, 30 to 45 days after receipt of order.
5. Return of goods — Positively no products may be returned without factory authorization. All claims must be made within 10 days after receipt of goods.
6. All prices subject to change without notice.

These units are covered by one or more of the following patents: 3,041,600; 3,244,071; other patents pending. Design details subject to change without notice.

SERIES 80

LARGE-SCREEN REAR-PROJECTION READOUT



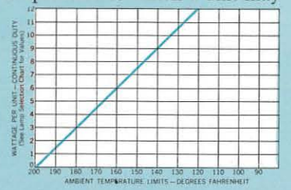
The Series 80 large screen unit is suited to a wide variety of annunciator applications. These displays are particularly useful in connection with factory call systems or equipment and production control boards.

Of particular note is the fact that the 3-3/8" message or character can be easily read at a distance of 100'.

AMBIENT TEMPERATURE CHART

Ambient temperature limits should be considered in the selection of the proper lamp to be used. Curve gives maximum ambient temperature to which a unit may be subjected at a given input wattage. Operating below the ambient temperature is safe and no critical internal temperatures will be exceeded.

To determine the ambient temperature limits, multiply the wattage per lamp by the number of lamps required to be on simultaneously per unit. Then refer to above chart for temperature limits per unit.



LAMP SPECIFICATIONS AND CHARACTER BRIGHTNESS

(FOR GENERAL FACTS TO GUIDE LAMP SELECTION, SEE INSIDE BACK COVER)

Lamp No.	Rated Voltage	Current at Rated Voltage (Amps.)	Watts† per Lamp at Rated Voltage	Life per Lamp at Rated Voltage	Character* Brightness at Rated Voltage	Operating at Reduced Voltage: Reduced Voltage	Life per Lamp at Reduced Voltage (Hours)	Character* Brightness at Reduced Voltage	Lamp Replacement Price Each
1855	6.3	.80	5	3000 hrs.	26	5.3	30,000	13	$ .20
**1886	6.3	.91	5.7	3000 hrs.	45	5.3	30,000	22.5	.20
1414	14	.46	6.4	500 hrs.	35	11.5	5,000	17.5	.25
1495	28	.30	8.4	500 hrs.	19	23	5,000	9.5	.26

†Please consult ambient temperature chart when selecting lamps.

*Measurements averaged for all 12 terminal positions with values in foot lamberts as measured with a spot-light meter.

**Recommended for optimum performance.

Note: For high ambient-light conditions and television applications we recommend the use of lamp #209 which produces approx. 75 foot lamberts average brightness at 6.5V, 1.78 amps. The unit must be modified to accept this lamp and a price additive of $15.00 per unit is required in small quantity purchases. CAUTION: Because of the heat produced by the #209 lamp, only one lamp at a time should be operated in each unit.

IEE Industrial Electronic Engineers, Inc.
7720 Lemona Avenue, Van Nuys, California 91405

VIEWING SCREEN AND MAXIMUM CHARACTER HEIGHT

SPECIFICATIONS

Size (max): 5.30" H x 3.29" W x 12.00" D

Weight: 3 pounds, 12 ounces

Projected Colors Available: white (standard), amber, yellow, blue, red, green

Lamp Return: common for all 12 terminals (separate returns optional)

Case: die-cast aluminum, isolated from electrical circuit

Input: straight decimal system

Standard Viewing Angles: vertical and horizontal, 160°

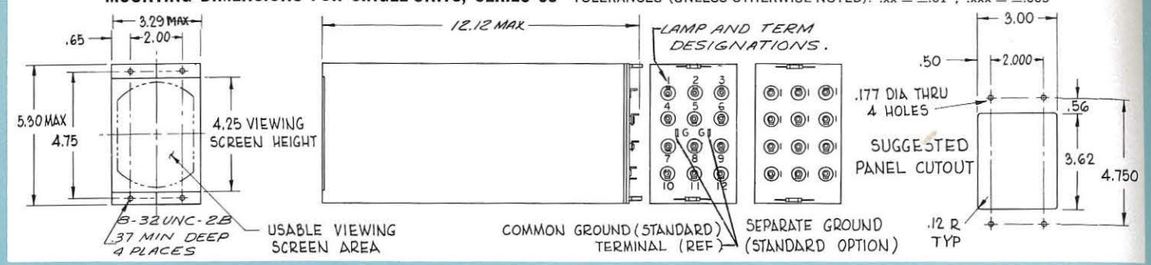
Usable Viewing-Screen Area: Any character or message within a 3.375" high by 2.75" wide area with 1.75" radius top and bottom within an illuminated or color background area of 4" high by 3" wide

Voltage: determined by lamps

Note: Unit available with Amphenol connector and mating plug as a standard option at extra cost

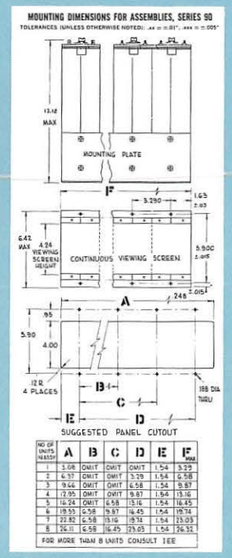
MOUNTING DIMENSIONS FOR SINGLE UNITS, SERIES 80

TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01", .xxx = ±.005"



ASSEMBLIES, SERIES 90

An assembly of Series 80 units is designated Series 90. Assemblies are supplied with a continuous viewing screen for fast, accurate reading. Specification of the individual readouts in an assembly should be made by model number or by written statement of what messages the display units should contain. The proper sequence of individual display units should be listed from left to right, as seen facing the viewing screen. Once an "assembly number" has been assigned for a particular grouping of readouts, that number can be used for future orders.



90° ADAPTATION, SERIES 100

In applications where depth behind panel is limited, special 90° adaptations of the standard series 80 are available and are designated Series 100.

ASSEMBLIES, SERIES 110

Series 100, 90°-adaptation units, in assemblies are designated Series 110.

ANYTHING THAT CAN BE PUT ON FILM CAN BE DISPLAYED ON IEE READOUTS!

Since IEE rear-projection messages are on film, readouts can display anything that is photographically reproducible, including numbers, letters, words, symbols, special characters, and colors. Standard sets of displays are listed in the chart below. Any other messages can be set to order.

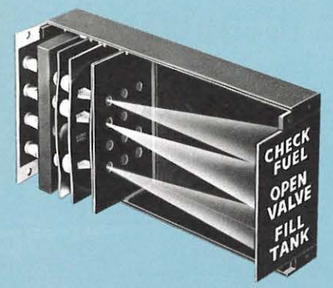
STANDARD SETS OF DISPLAYS

Film Number	TERMINAL											
	1	2	3	4	5	6	7	8	9	10	11	12
4000	1	2	3	4	5	6	7	8	9	0		
0000	1	2	3	4	5	6	7	8	9	0	.	.
0005		Green			+			—			Red	
0009	0	⅛	¼	⅜	½	⅝	¾	⅞				
0010	0	1	2	3	4	5	6	7	8	9	10	11
0011	1	2	3	4	5	6	7	8	9	0	+	—
0019	1	2	3	4	5	6	7	8	9	0	Red	.
0052	1	2	3	4	5	6	7	8	9	0	Red	Green
0056	0	S	L	C	Red	R	E	Green	F	X	Y	Z
0085	1	2	3	4	5	6	7	8	9	10	11	12
0086	A	B	C	D	E	F	G	H	K	L	M	N
0087	O	P	Q	R	S	T	U	V	W	X	Y	Z
0099	A	B	C	E	F	L	M	N	P	S	Red	U
0100	ALPHA-NUMERIC BAR MATRIX											
0200	2	1	2	3	4	5	6	7	8	1	9	0
0221	1	2	3	4	5	6	7	8	9	0	Amber	Green

COLORS REPRESENT PROJECTED BACKGROUND OF COLOR INDICATED

Standard displays are set in Futura Medium Condensed type style, ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

EXCEPTION: Film number 0200 is set in Alternate Gothic #3 type style, 1234567890



SERIES 80 READOUT MESSAGE DESIGN GUIDE FOR NON-STANDARD SETS OF DISPLAYS

Studies indicate that Alternate Gothic #3 type face is the most readable for multiple letter readouts; therefore, this type face is furnished as standard.

Exception: Futura Medium Condensed style type is supplied for single maximum height (3.375") numbers and letters.

Other type faces, sizes, and symbols are available on special order. For deviations from character sizes listed in chart to the right, consult IEE.

Alternate Gothic #3
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

Futura Medium Condensed
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

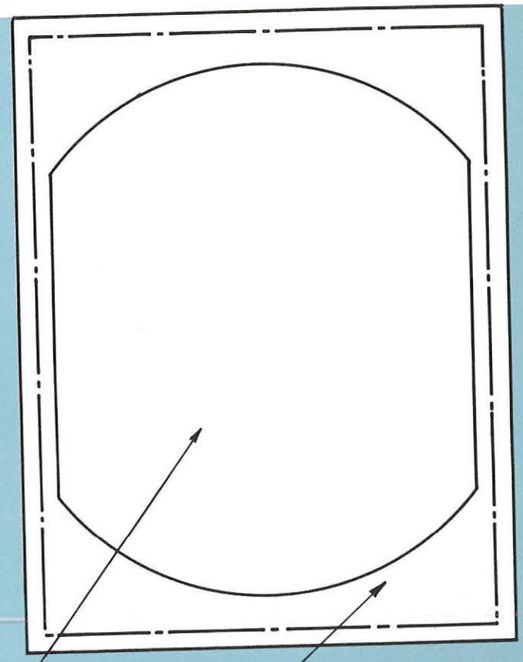
INSTRUCTIONS:

1. From the chart to the right, determine the character size of your message by selecting the character height that will give you a sufficient number of characters per line in a sufficient number of lines to adequately contain your readout message. (All letters and numbers except 1, I, M, and W are approximately the same width; therefore, this chart is based on the normal use of these characters in any one line. Count each space between words as a character.)

2. Now record your readout message with the other information requested on the Design Guide Order Sheet printed at the back of this catalog. You may write your message information on a duplicate copy of this form or contact your local IEE Sales Representative, or IEE directly for an extra supply of these sheets.

MESSAGE AND ILLUMINATED BACKGROUND COLOR COMBINATIONS OBTAINABLE WITH ONE LAMP:

1. A white message on a black background.
2. A black message projected onto either a white or colored background.
3. A colored message on a black background.
4. For combinations using more than one lamp, consult IEE.



MESSAGE HEIGHT GUIDE

For Vertical Units Only

STANDARD CHARACTER HEIGHT (Nominal dimension only; standard tolerance for characters less than .500" is ±.015" and for characters .500" or over it is ±.025").	MAXIMUM NUMBER OF CHARACTERS PER LINE (letters and numerals)										
	1 Line and All Central Lines for 3 thru 11 Line Messages	2 Lines	TOP & BOTTOM LINES ONLY								
			NUMBER OF MESSAGE LINES								
			3	4	5	6	7	8	9	10	11
.170	20	20	19	18	17	17	17	17	15	13	11
.230	15	15	14	13	12	12	12	12	10	8	
.285	12	12	11	10	9	9	9	9	8		
.340	11	11	10	9	8	8	8	7			
.405	9	9	9	8	7	7	7				
.468	8	8	6	6	5	4					
.597	6	6	6	5							
.723	5	5	4								
.860	4	4	4								
.985	3	3									
1.185	3	3									
1.380	2	2									

.10° spacing between lines is the recommended minimum.

PRICE SCHEDULE AND ORDERING INFORMATION

DESIGNATION OF MODEL NUMBERS

Complete model numbers should be designated on all orders. An analysis of information included in a typical model number for both single units and assemblies is shown below.

TYPICAL SINGLE UNIT MODEL NUMBER:

80 – 0069 – S – 1886
(A) (B) (C) (D)

TYPICAL ASSEMBLY MODEL NUMBER:

90 – 0211 – C – 1886
(A) (E) (C) (D)

A. Series number used to identify unit.

B. Designates film number for character displays used in unit. Numbers for standard sets of displays are listed in this catalog; numbers for special sets of displays obtained from IEE.

C. Designates type of lamp socket assembly. S = separate ground terminal for each lamp; C = split ground with common ground provided for terminals 1 to 6 and another common ground provided for terminals 7 to 12. If no callout is indicated, unit will be furnished with common ground for all 12 terminals.

D. Number of lamp selected for use in readout.

E. Identifying number assigned by IEE for a particular grouping of individual units within an assembly (see text on assemblies, Series 90).

PRICE SCHEDULE
COMBINED QUANTITY

Series No.	1 to 9	10 to 24	25 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000-over
80	43.00	39.50	37.50	35.50	34.00	32.50	31.00	30.00
80S[1]	46.00	42.50	40.50	38.50	37.00	35.00	33.25	32.00
80C[2]	44.50	41.00	39.00	37.00	35.00	33.50	32.00	31.00
100 (90° model)	58.00	53.00	50.00	47.50	45.50	43.50	41.50	40.00
100S[1] (90° model)	63.50	57.75	54.25	51.50	49.25	47.00	44.75	43.00

1. S= Separate ground terminal for each lamp.
2. C= Split ground return.

ASSEMBLIES

Series 90 (Assembly of Series 80 Units)	Assemblies of 2-8 units may be provided with mounting hardware and continuous viewing screen. For assemblies larger than 8 units, please consult IEE.	Extra for assembly mounting hardware **$1.50 Per Unit**
Series 110 Assembly of Series 100 Units)		

SET-UP CHARGE:
Standard models or sets of displays in this catalog are available at the listed prices. An additional charge of $40 is required for other models to cover the cost of master film which is kept on file for 12 months from its last use. Reorders within this period will not incur the $40 initial set-up charge.

QUANTITY DISCOUNTS ON EXTENDED SHIPMENTS

1. To break an order down into more than one shipment, the order must total 100 or more display units.
2. Each shipment must equal at least 10% of total order or 25 units (whichever is larger).
3. Shipments on a particular order must be completed within 12 months from receipt of order.
4. Quantity orders cancelled before completion will be billed at prices based on the Price Schedule for the number of displays actually shipped.

TERMS AND CONDITIONS

1. **MINIMUM BILLING** – $5.00
2. **F.O.B.** – All prices F.O.B. our plant Van Nuys, California.
3. **TERMS** – ½ of 1% 10 days; net 30 days.
4. **DELIVERY** – For standard displays, 30 days depending upon quantity. For special displays, 30 to 45 days after receipt of order.
5. **RETURN OF GOODS** – Positively no products may be returned without factory authorization. All claims must be made within 10 days after receipt of goods.
6. All prices subject to change without notice.

NEW LENS SYSTEM INCREASES CHARACTER BRIGHTNESS 50%

Designed for use where size, space and weight are critical, the Series 120H gives you unmistakable clarity from wide viewing angles and long distances and provides greater readability even under high ambient light conditions. The lamp chart on page 17 illustrates how a slight reduction in lamp voltage produces excellent character brightness while providing up to 10 times longer lamp life.

QUICK-DISCONNECT LAMP ASSEMBLIES

All Series 120H rear-projection readouts come equipped with a quick-disconnect lamp assembly. The entire lamp and socket assembly is held in position by a spring clip on the top and bottom of the terminal cap. Depressing these spring clips permits quick and easy withdrawal of the lamp assembly. Lamps can be changed on the spot or a completely new readout snapped into position on the existing lamps.

IEE Industrial Electronic Engineers, Inc.
7720 Lemona Avenue, Van Nuys, California 91405

SERIES 120H HI-BRITE

MINIATURE REAR-PROJECTION READOUT

ACTUAL SIZE OF VIEWING SCREEN AND MAXIMUM CHARACTER HEIGHT

SPECIFICATIONS

Size (max): 1.00" W x 1.56" H x 4.16" D (standard terminal clips) 4.70" D (non-standard extension terminal clips).

Weight: 4 ounces max.

PROJECTED COLORS AVAILABLE: white (standard), amber, yellow, blue, red, green.

Lamp Return: Common for all 12 terminals standard (other split-ground configurations optional on special order with up to 6 ground terminals available).

Case: Die-cast aluminum, isolated from electrical circuit.

Input: straight decimal or binary coded decimal with an IEE Decoder Module for binary-coded input (see Decoder/Display section).

Viewing Angle: Vertical and horizontal, 160°.

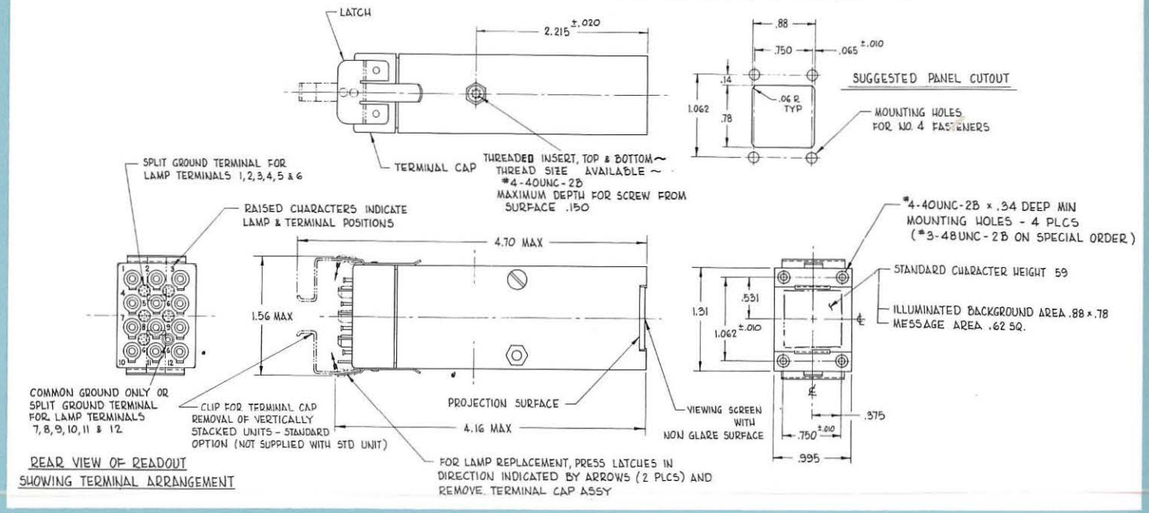
Usable Viewing-Screen Area: Standard character height, 0.59"; Standard illuminated or color background area, 0.88" x 0.78"; usable message area, 0.62" square.

Voltage: Determined by lamps.

Connection: Quick-disconnect lamp assembly standard.

For lamp selection and character brightness chart, ambient temperature chart, standard sets of displays, and Readout Message Design Guide for non-standard sets of displays, see page 17.

MOUNTING DIMENSIONS FOR SINGLE UNITS, SERIES 120H TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01"; .xxx = ±.005"

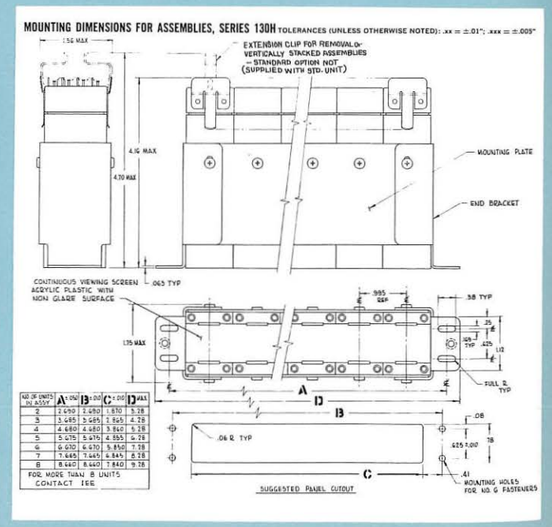


REAR VIEW OF READOUT
SHOWING TERMINAL ARRANGEMENT

ASSEMBLIES, SERIES 130H

An assembly of series 120H units is designated Series 130H. Assemblies are supplied with a continuous viewing screen for fast, accurate reading. Specifications of the individual readouts in an assembly should be made by model number or by written statement of what messages the display units should contain. The proper sequence of individual display units should be listed from left to right, as seen facing the viewing screen. Once an "assembly number" has been assigned for a particular grouping of readouts, that number may be used for future orders.

MOUNTING DIMENSIONS FOR ASSEMBLIES, SERIES 130H TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01"; .xxx = ±.005"



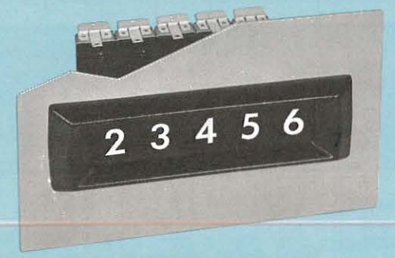
NO. OF UNITS IN ASSY	A ±.010	B ±.010	C ±.010	D MAX
2	2.690	2.690	1.870	5.28
3	3.685	3.685	2.865	6.28
4	4.680	4.680	3.860	6.28
5	5.675	5.675	4.855	6.28
6	6.670	6.670	5.850	7.28
7	7.665	7.665	6.845	8.28
8	8.660	8.660	7.840	9.28

FOR MORE THAN 8 UNITS CONTACT IEE

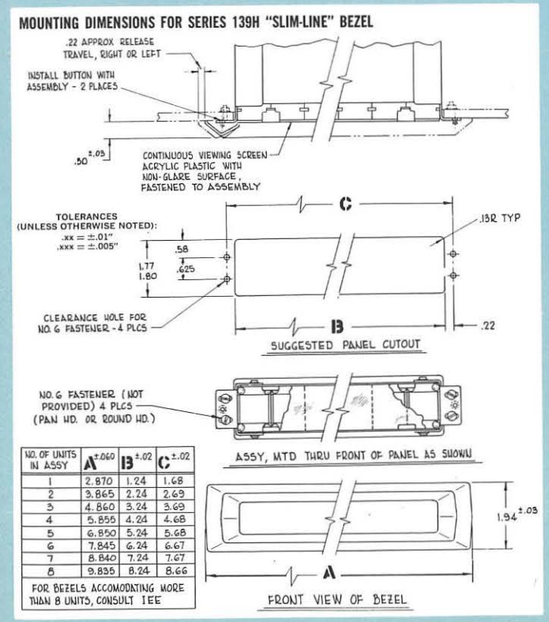
SERIES 139H SLIM-LINE BEZELS

IEE bezels permit easier, more economical mounting of readout assemblies and better-looking display panels. By eliminating the need for costly precise panel cutouts, the bezels often pay for themselves. Also, when Slim-line bezels are employed, Series 120H readouts require front mounting in display panel, greatly facilitating accessibility.

Bezels are attached entirely from the front of the panel and are easily installed or removed by sliding the bezel to the left or to the right. IEE Slim-line bezels come in black, pebble-finished (cycolac) plastic, which is easily cleaned with soap and water. For color and texture variations, consult IEE.



MOUNTING DIMENSIONS FOR SERIES 139H "SLIM-LINE" BEZEL



NO. OF UNITS IN ASSY	A ±.060	B ±.02	C ±.02
1	2.870	1.24	1.68
2	3.865	2.24	2.69
3	4.860	3.24	3.69
4	5.855	4.24	4.68
5	6.850	5.24	5.68
6	7.845	6.24	6.67
7	8.840	7.24	7.67
8	9.835	8.24	8.66

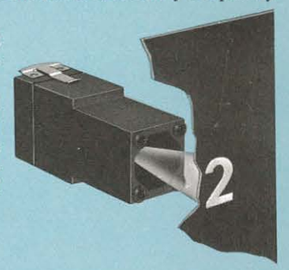
FOR BEZELS ACCOMODATING MORE THAN 8 UNITS, CONSULT IEE

SERIES 120H SP, PROJECTS MESSAGE ONTO SCREEN

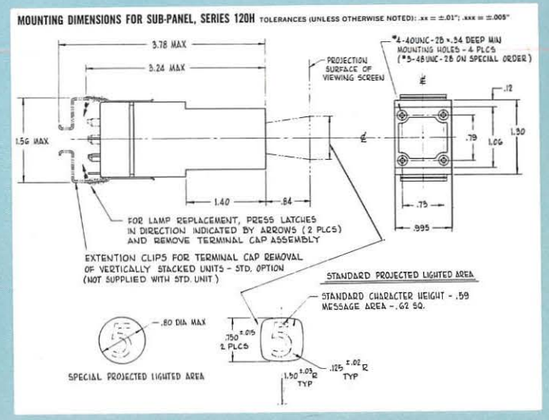
The Miniature Readout Series 120H SP is positioned 0.840" behind a panel-mounted translucent viewing screen and projects the message onto the screen. Readout units are easily accessible for replacement or maintenance, since the viewing screen is not an integral part of the readout and may be quickly moved out of position.

These Sub-panel Readouts may be random-positioned behind the panel screen.

Extremely compact and lightweight, the Series 120H SP Miniature Readout is ideally suited for those applications where space and weight are at a premium.



MOUNTING DIMENSIONS FOR SUB-PANEL, SERIES 120H TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01", .xxx = ±.005"



SPECIAL 90° ADAPTATIONS

For special applications where depth behind the panel is a problem, special 90° adaptations of the standard Series 120H are available for vertical mounting. Series 140H, a single unit is shown; in assembly, the unit is designated the 150H.

PRICE SCHEDULE AND ORDERING INFORMATION

DESIGNATION OF MODEL NUMBERS

Complete model numbers should be designated on all orders. An analysis of information included in a typical model number for single units, assemblies, and assemblies with bezels is shown below.

TYPICAL SINGLE UNIT MODEL NUMBER

120H - 0052 - SP - 328

(A) (B) (C) (D)

TYPICAL ASSEMBLY MODEL NUMBER

130H - 0186 - 328

(A) (E) (D)

TYPICAL MODEL NUMBER FOR ASSEMBLY WITH BEZEL

139H - 0186 - 328

(A) (E) (D)

NOTE: Because panel cut-out dimensions and installation procedures are different for Series 130H assemblies to be used with bezels, bezels should be ordered as an integral part of the assembly.

A. SERIES number used to identify unit. 120HC and 130HC indicate split ground with common ground provided for terminals 2 to 6 and another common ground provided for terminals 7 to 12. If letter C is omitted from callouts, unit will be furnished with common ground for all 12 terminals. Other split-ground combinations available on special order – max. of six ground terminals available. 139H designates an assembly of Series 120H readouts with a slim-line bezel.

B. Designates film number for character display used in readout. Numbers for standard sets of displays are listed in this Catalog; numbers for special sets of displays obtained from IEE.

C. Designates sub-panel mounting.

D. Number of lamp selected for use in readout.

E. Identifying number assigned by IEE for a particular grouping of individual readouts within an assembly (see text on assemblies, Series 130H).

QUANTITY DISCOUNTS ON EXTENDED SHIPMENTS

1. To break an order down into more than one shipment, the order must total 100 or more display units.
2. Each shipment must equal at least 10% of total order or 25 units (whichever is larger).
3. Shipments on a particular order must be completed within 12 months from receipt of order.
4. Quantity orders cancelled before completion will be billed at prices based on the Price schedule for the number of displays actually shipped.

TERMS AND CONDITIONS

1. MINIMUM BILLING – $5.00.
2. F.O.B. – All prices F.O.B. our plant, Van Nuys, California
3. TERMS: ½ of 1% 10 days; net 30 days.
4. DELIVERY – For standard displays, 30 days depending upon quantity. For special displays, 30 to 45 days after receipt of order.
5. RETURN OF GOODS – Positively no products may be returned without factory authorization. All claims must be made within 10 days after receipt of goods.
6. All prices subject to change without notice.

These units are covered by one or more of the following patents: 3,041,600; 3,244,071; other patents pending. Design details subject to change without notice.

COMBINED QUANTITY

Series No.	1 to 9	10 to 24	25 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000-over
120H	35.00	33.00	32.00	31.00	30.00	29.00	28.00	27.00
120H-SP (sub-panel)	35.00	33.00	32.00	31.00	30.00	29.00	28.00	27.00
140H (90° model)	50.00	47.00	45.00	43.00	41.50	40.00	38.50	37.00

For both standard and non-standard split-ground options, apply $1.50 per unit

ASSEMBLY

SERIES 130H (Assembly of Series 120H Units)	Assembly of 2-8 units may be provided with mounting hardware and continuous viewing screen. For assemblies larger than 8 units, please consult IEE.	Extra for assembly mounting hardware
SERIES 150H (Assembly of Series 140H Units)		$1.50 Per Unit

SERIES 139H "SLIM-LINE" BEZEL

(1-8 Unit Assemblies)

For Bezels Accommodating More Than 8 Units Consult IEE

QUANTITY	UNIT PRICE
1 - 49	$5.00
50 - 99	4.25
100 - 249	4.00
250 - 499	3.75
500 - over	3.50

SET-UP CHARGE: Standard models or sets of displays in this catalog are available at the listed prices. An additional charge of $40 is required for other models to cover the cost of master film which is kept on file for 12 months from its last use. Reorders within this period will not incur the $40 initial set-up charge.

ANYTHING THAT CAN BE PUT ON FILM CAN BE DISPLAYED ON IEE READOUT!

Since IEE rear-projection messages are on film, readouts can display anything that is photographically reproducible, including numbers, letters, words, symbols, special characters, and colors. Standard sets of displays are listed in the chart below. Any messages of a special nature can be set to order.

STANDARD SETS OF DISPLAYS

Film Number	TERMINAL NO. AND RELATED CHARACTER											
	1	2	3	4	5	6	7	8	9	10	11	12
4000	1	2	3	4	5	6	7	8	9	0		
0000	1	2	3	4	5	6	7	8	9	0	.	.
0005		Green			+			—			Red	
0009	0	⅛	¼	⅜	½	⅝	¾	⅞				
*0010	0	1	2	3	4	5	6	7	8	9	10	11
0011	1	2	3	4	5	6	7	8	9	0	+	—
0019	1	2	3	4	5	6	7	8	9	0	Red	.
0052	1	2	3	4	5	6	7	8	9	0	Red	Green
0056	0	S	L	C	Red	R	E	Green	F	X	Y	Z
*0085	1	2	3	4	5	6	7	8	9	10	11	12
0086	A	B	C	D	E	F	G	H	K	L	M	N
0087	O	P	Q	R	S	T	U	V	W	X	Y	Z
0100				ALPHA-NUMERIC BAR MATRIX								
*0200	2	1	2	3	4	5	6	7	8	1	9	0
0221	1	2	3	4	5	6	7	8	9	0	Amber	Green
0696	1	2	3	4	5	6	7	8	9	0	+	—

COLORS REPRESENT PROJECTED BACKGROUND OF COLOR INDICATED

Standard displays are set in Futura Demibold type style:

ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

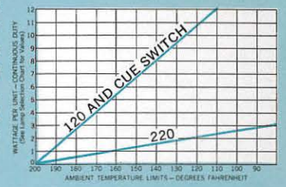
*EXCEPTIONS: All of film number 0200; the numerals 10, 11 and 12 in film number 0085; and the numerals 10 and 11 in film number 0010 are set in Futura Medium Condensed type style: 1234567890

In 0200 the characters on terminals 1 and 10 are set to the left. All others set to the right, so that by proper selection of simultaneous characters the unit may display from 0 to 29.

AMBIENT TEMPERATURE CHART

Ambient temperature limits should be considered in the selection of the proper lamp to be used. Curve gives maximum ambient temperature to which a unit may be subjected at a given input wattage. Operating below the ambient temperature is safe and no critical internal temperatures will be exceeded.

To determine the ambient temperature limits, multiply the wattage per lamp by the number of lamps required to be on simultaneously per unit. Then refer to the chart to the left for temperature limits per unit.



LAMP SPECIFICATIONS AND CHARACTER BRIGHTNESS

(FOR GENERAL FACTS TO GUIDE LAMP SELECTION, SEE INSIDE BACK COVER)

LAMP NO.	RATED VOLTAGE	CURRENT AT RATED VOLTAGE	WATTS† PER LAMP AT RATED VOLTAGE	LIFE PER LAMP AT RATED VOLTAGE (hours)	CHARACTER** BRIGHTNESS AT RATED VOLTAGE	Operating at reduced voltage: REDUCED VOLTAGE	Operating at reduced voltage: LIFE PER LAMP AT REDUCED VOLTAGE (hours)	Operating at reduced voltage: CHARACTER** BRIGHTNESS AT REDUCED VOLTAGE	LAMP REPLACEMENT PRICE EACH
*328	6.	200 ma.	1.20	3,000	100	5	30,000	53	$.228
349	6.	190 ma.	1.14	5,000	70	5	50,000	37	.228
330	14.	80 ma.	1.12	2,500	35	12	17,500	20	.254
327	28.	40 ma.	1.12	5,000	25	24	35,000	15	.254
387	28.	40 ma.	1.12	25,000	20	24	175,000	12	.280

†Be sure to consult ambient temperature chart when selecting lamps.

*Recommended for optimum performance.

**Measurements averaged for all 12 terminal positions with values in foot lamberts as measured with a spot-light meter.

READOUT MESSAGE DESIGN GUIDE FOR NON-STANDARD SETS OF DISPLAYS

Studies indicate that Alternate Gothic #3 type face is the most readable for multiple letter readouts; therefore, this type face is furnished as standard.

Exception: Futura Demibold style type is supplied for single maximum height (0.59") numbers and letters.

Other type faces, sizes, and symbols are available on special order. For deviations from character sizes listed in the chart on the following page, consult IEE.

Alternate Gothic #3,

ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

Futura Demibold

ABCDEFGHIJKLMNOPQRSTUVW 1234567890

INSTRUCTIONS:

1. From the chart below, determine the character size of your message by selecting the character height that will give you a sufficient number of characters per line in a sufficient number of lines to adequately contain your readout message. (All letters and numbers except 1, I, M, and W are approximately the same width; therefore, this chart is based on the normal use of these letters in any one line. Use adjacent letters as a guide for spacing. Count each space between words as a character.)

2. Now record your readout message with the other information requested on the Design Guide Order Sheet printed at the back of this catalog. You may write your message information on a duplicate copy of this form or contact your local IEE Sales Representative, or IEE directly for an extra supply of these sheets.

MESSAGE HEIGHT GUIDE

For Both Horizontal and Vertical Units

BLUE NUMBER FOR CUE-SWITCH® ONLY

ALPHABET SET IN ALTERNATE GOTHIC #3 SHOWN ACTUAL SIZE	STANDARD CHARACTER HEIGHT (Nominal dimension only; standard tolerance for characters less than .500″ is ±.015″	MAXIMUM NUMBER OF CHARACTERS PER LINE (LETTERS AND NUMERALS)				
		1 Line and All Central Lines for 3 thru 5 Line Messages	Two Lines	TOP AND BOTTOM LINES ONLY		
				NUMBER OF MESSAGE LINES		
				3	4	5
ABCDEFGHIJK	.090″	11 9	11 9	10 9	10 8	8 7
LMNOPQRSTU	.107″	10 8	10 8	10 7	8 6	6
VWXYZABC	.125″	8 7	8 7	8 7	7 5	
DEFGHIJ	.160″	7 5	7 5	5 4	5	
KLMNO	.193″	5 4	5 4	4		
PQRS	.230″	4 3	4 3			
TUVW	.263″	4 3	4 2			
XYZ	.317″	3 2	2			
AB	.370″	2 2				

.05″ spacing between lines is the recommended minimum.

MESSAGE AND ILLUMINATED BACKGROUND COLOR COMBINATIONS OBTAINABLE WITH ONE LAMP:

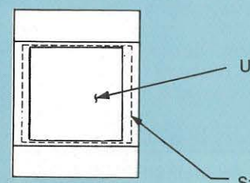
1. A white message on a black background.

2. A black message projected onto either a white or colored background.

3. A colored message on a black background.

4. For combinations using more than one lamp, or color film for complex, multicolor displays, consult IEE.

ACTUAL SIZE SERIES 120H

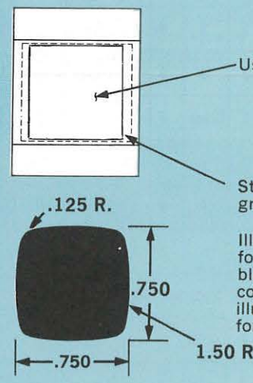


Usable message area is .62″ square.

Standard illuminated or color background area is .88″ x .78″.

Illuminated or color background area for standard units when projecting a black message onto either a white or colored background, and the standard illuminated or color background area for all sub-panel units.

ACTUAL SIZE SERIES 220H

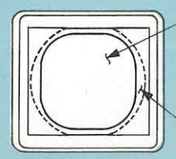


Usable message area is .62″ square.

Standard illuminated or color background area is .94″ x .77″.

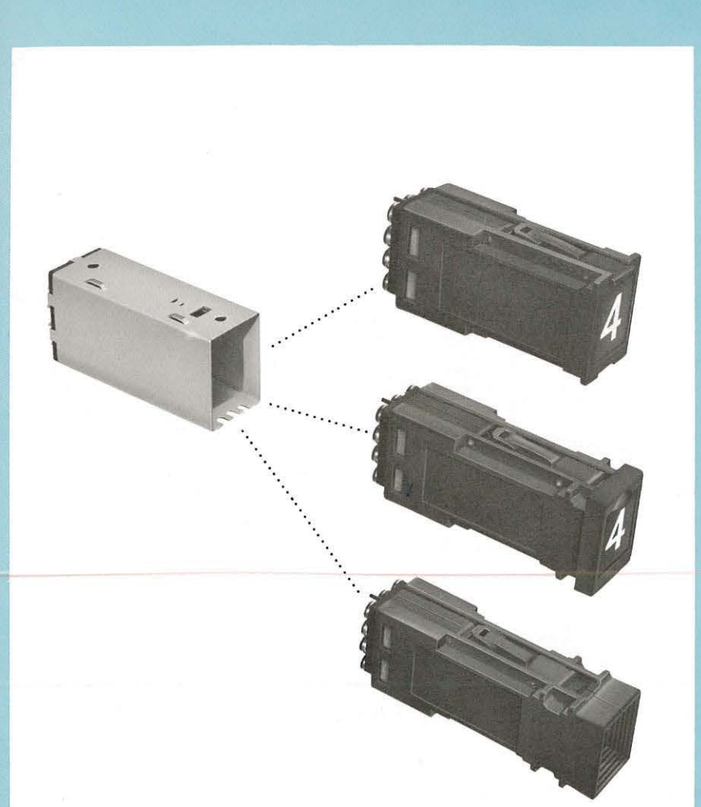
Illuminated or color background area for standard units when projecting a black message onto either a white or colored background, and the standard illuminated or color background area for all sub-panel (A insert) units.

ACTUAL SIZE CUE-SWITCH



Usable viewing screen area; .62″ square with .16″ radius corners.

Illuminated or color background area .75″ dia. max. (as clipped by screen frame to .68″ top to bottom).



NEW LENS SYSTEM INCREASES CHARACTER BRIGHTNESS 50%

The new lens system of the Series 220H gives you unmistakable clarity from wide viewing angles and long distances and provides greater readability even under high ambient light conditions. The lamp chart on page 7 illustrates how a slight reduction in lamp voltage produces excellent character brightness while providing up to 10-times longer lamp life.

Series 220H readouts also provide a front plug-in capability. Readout inserts can be removed simply by pressing on the viewing screen until the insert clicks. The unit is then withdrawn from its case through the front panel for convenient lamp replacement or for changing inserts to show different displays.

IEE Industrial Electronic Engineers, Inc.
7720 Lemona Avenue, Van Nuys, California 91405

SERIES 220H HI-BRITE

FRONT PLUG-IN READOUT DESIGNED TO MEET MIL-R-39027

C

ACTUAL SIZE OF VIEWING SCREEN AND MAXIMUM CHARACTER HEIGHT

SPECIFICATIONS

Size (max): 1.07″ W x 1.610″ H x 3.96″-4.42″ D (depending upon insert used).

Weight: 4.5 ounces max.

PROJECTED COLORS AVAILABLE: white (standard), amber, yellow, blue, red, green.

Lamp Return: common for all 12 terminals standard (other split-ground configurations optional on special order with up to 6 ground terminals available).

Case: stainless steel, isolated from electrical circuit.

Insert Body: glass-filled diallyl phthalate.

Input: straight decimal or binary coded decimal with an IEE Decoder Module for binary-coded input (see Decoder/Display section).

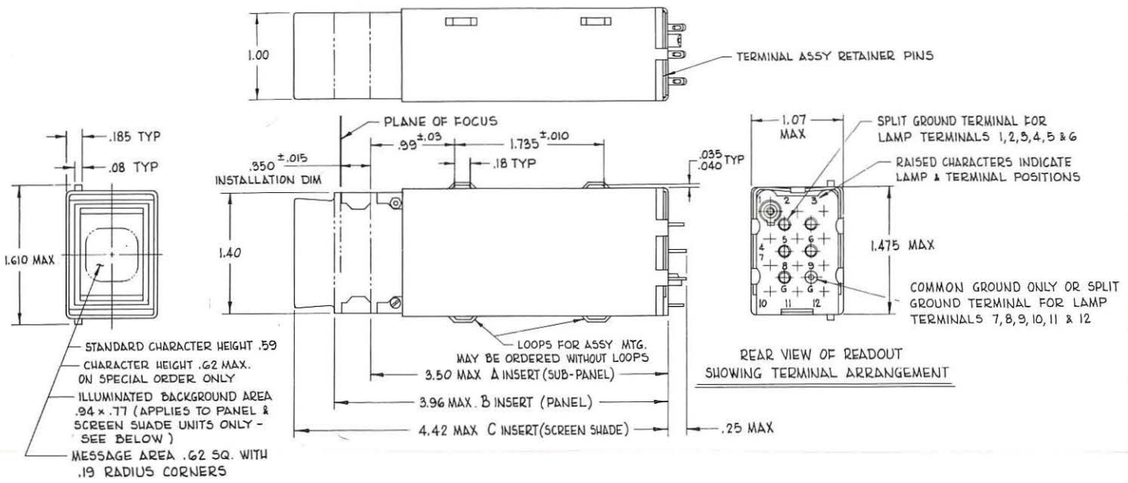
Viewing Angle: both vertical and horizontal, 160°.

Usable Viewing-Screen Area: standard character height, 0.59″; illuminated or color background area, 0.94″ x 0.77″; usable message area.

Voltage: determined by lamps.

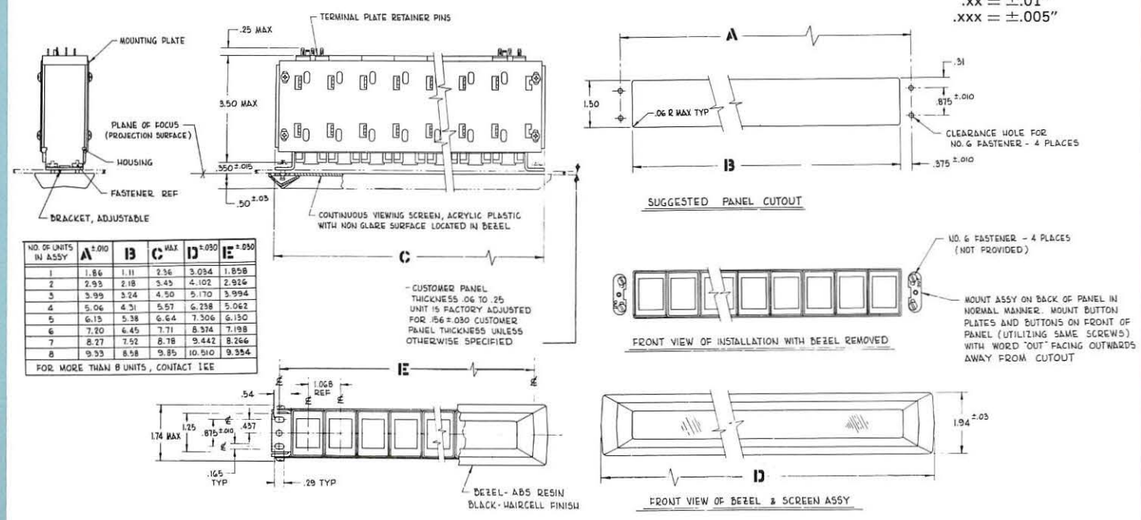
For lamp selection and character brightness chart, ambient temperature chart, standard sets of displays, and Readout Message Design Guide for non-standard sets of displays, see page 17.

MOUNTING DIMENSIONS FOR SINGLE UNITS, SERIES 220H TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01"; .xxx = ±.005"



MOUNTING DIMENSIONS FOR ASSEMBLIES, SERIES 230H, SUB-PANEL MOUNTED (A-INSERTS)

TOLERANCES (UNLESS OTHERWISE NOTED):
.xx = ±.01"
.xxx = ±.005"



NO. OF UNITS IN ASSY	A ±.010	B	C MAX	D ±.030	E ±.050
1	1.86	1.11	2.36	3.054	1.858
2	2.93	2.18	3.43	4.102	2.926
3	3.99	3.24	4.50	5.170	3.994
4	5.06	4.31	5.57	6.238	5.062
5	6.15	5.38	6.64	7.306	6.130
6	7.20	6.45	7.71	8.374	7.198
7	8.27	7.52	8.78	9.442	8.266
8	9.33	8.58	9.85	10.510	9.334

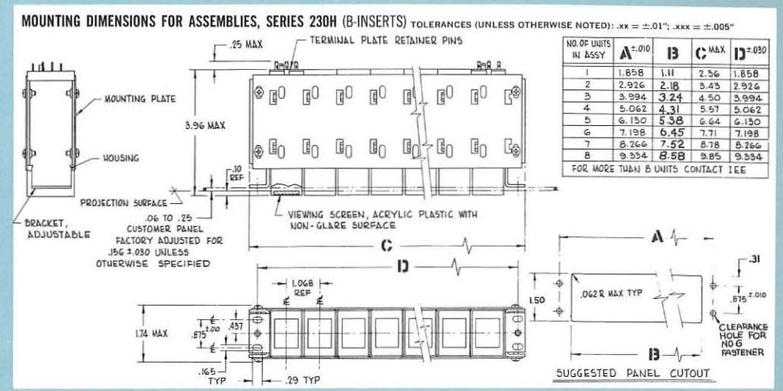
FOR MORE THAN 8 UNITS, CONTACT IEE

ASSEMBLIES, SERIES 230H

An assembly of Series 220H units is designated Series 230H. Several viewing screen arrangements are available, including sub-panel mounting with a common viewing screen which is mounted inside an IEE Slim-Line Bezel, Series 230H-A; panel mounting with individual viewing screens, Series 230H-B; and panel mounting with individual screen shade bezels and viewing screens, Series 230H-C. Series 230H assemblies can be wired permanently in place. Front-panel accessibility for lamp replacement or for changing inserts eliminates the need for access doors and special cabling. Individual units behind the 230H-A (common viewing screen with bezel) are easily accessible by simply removing the bezel.

Specifications of the individual readouts in an assembly should be made by model number or by written statement of what messages the display units should contain. The proper sequence of individual display units should be listed from left to right, as seen facing the viewing screen. Once an "assembly number" has been assigned for a particular grouping of readouts, that number may be used for future orders.

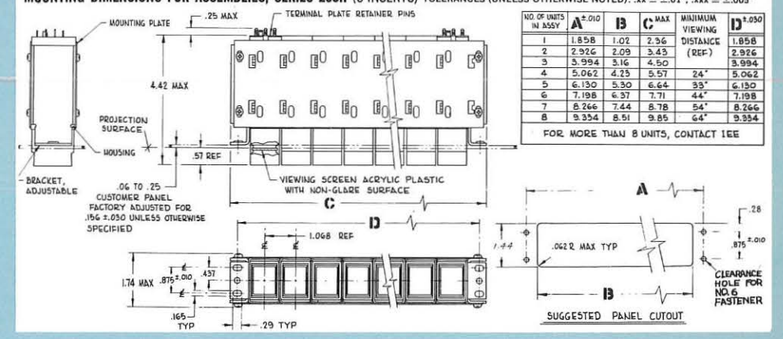
MOUNTING DIMENSIONS FOR ASSEMBLIES, SERIES 230H (B-INSERTS) TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01"; .xxx = ±.005"



NO. OF UNITS IN ASSY	A ±.010	B	C MAX	D ±.030
1	1.858	1.11	2.36	1.858
2	2.926	2.09	3.43	2.926
3	3.994	3.16	4.50	3.994
4	5.062	4.23	5.57	5.062
5	6.130	5.30	6.64	6.130
6	7.198	6.37	7.71	7.198
7	8.266	7.44	8.78	8.266
8	9.334	8.51	9.85	9.334

FOR MORE THAN 8 UNITS, CONTACT IEE

MOUNTING DIMENSIONS FOR ASSEMBLIES, SERIES 230H (C-INSERTS) TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01"; .xxx = ±.005"



NO. OF UNITS IN ASSY	A ±.010	B	C MAX	MINIMUM VIEWING DISTANCE (REF.)	D ±.030
1	1.858	1.02	2.36	24"	1.858
2	2.926	2.09	3.43	24"	2.926
3	3.994	3.16	4.50	33"	3.994
4	5.062	4.23	5.57	44"	5.062
5	6.130	5.30	6.64	54"	6.130
6	7.198	6.37	7.71	64"	7.198
7	8.266	7.44	8.78	64"	8.266
8	9.334	8.51	9.85	64"	9.334

FOR MORE THAN 8 UNITS, CONTACT IEE

PRICE SCHEDULE AND ORDERING INFORMATION

DESIGNATION OF MODEL NUMBERS

Complete model numbers should be designated on all orders. An analysis of information included in a typical model number for single units and assemblies is shown below.

TYPICAL SINGLE UNIT MODEL NUMBER

220H - 0139 - B - 328 - 2
(A) (B) (C) (D) (F)

TYPICAL ASSEMBLY MODEL NUMBER

230H - 0447 - A - 328 - 1
(A) (E) (C) (D) (F)

A. SERIES number used to identify unit. 220HC and 230HC indicate split ground with common ground provided for terminals 1 to 6 and another common ground provided for terminals 7 to 12. If letter C is omitted from callouts, unit will be furnished with common ground for all 12 terminals. Other split ground combinations available on special order. Maximum of six ground terminals available.

B. Designates film number for character displays used in unit. Numbers for standard sets of displays are listed in this catalog; numbers for special sets of displays see page 17.

C. Designates type of insert (A, sub-panel for use with separate bezel/viewing screen combination; B, panel; C, shade screen).

D. Number of lamp selected for use in the readout.

E. Identifying number assigned by factory for a particular grouping of individual units within an assembly (see text on assemblies, Series 230H).

F. -2 designates a can with assembly mounting loops for customers who are going to use standard IEE mounting hardware. -1 designates a can without mounting loops for customers who wish to provide their own mounting hardware or spot weld the units together into an assembly.

COMBINED QUANTITY

Series No.	1 to 9	10 to 24	25 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000-over
220H	36.00	34.00	33.00	32.00	31.00	30.00	29.00	28.50

For both standard and non-standard split-ground options, apply $1.50 per unit. Above Units Available with Type A, "Sub-Panel" Insert; Type B, "Panel" Insert; or Type C, "Shade Screen" Insert

SET-UP CHARGE: Standard models or sets of displays in this catalog are available at the listed prices. An additional charge of $40 is required for other models to cover the cost of art and master film which is kept on file for 12 months from its last use. Reorders within this period will not incur the $40 initial set-up charge.

ASSEMBLIES (SERIES 230)

Assembly of 2-8 units may be provided with mounting hardware. A combination bezel/viewing screen is required with sub-panel A inserts only. For assemblies larger than 8 units, please consult IEE.

	Amount extra for mounting hardware per unit	Amount extra for bezel viewing screen combination per assembly
230-A	$1.50	$6.00*
230-B	$1.50	None
230-C	$1.50	None

*See Below for Quantity Prices of Bezel/Screen Combination

SERIES 230H SUB-PANEL (A INSERT) BEZEL/VIEWING SCREEN COMBINATION PRICE SCHEDULE

(1-8 Unit Assemblies)

For Bezels Accommodating More Than 8 Units Consult IEE

QUANTITY	UNIT PRICE
1-49	$6.00
50-99	5.00
100-249	4.75
250-499	4.50
500-over	4.25

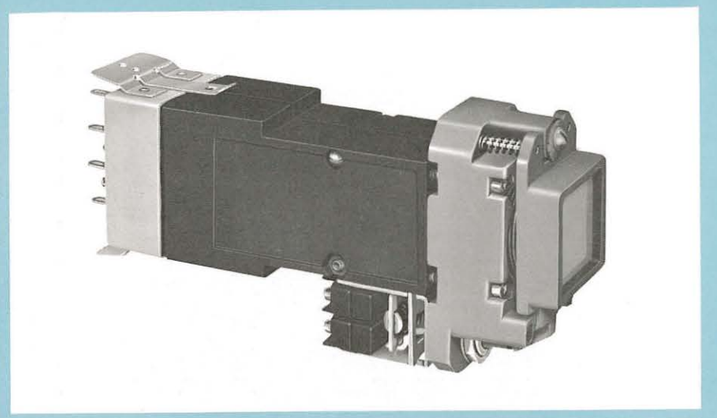
QUANTITY DISCOUNTS ON EXTENDED SHIPMENTS

1. To break an order down into more than one shipment, the order must total 100 or more display units.
2. Each shipment must equal at least 10% of total order or 25 units (whichever is larger).
3. Shipments on a particular order must be completed within 12 months from receipt of order.
4. Quantity orders cancelled before completion will be billed at prices based on the price schedule for the number of displays actually shipped.

TERMS AND CONDITIONS

1. MINIMUM BILLING—$5.00.
2. F.O.B.—All prices F.O.B. our plant, Van Nuys, California
3. TERMS: ½ of 1% 10 days; net 30 days.
4. DELIVERY—For standard displays, 30 days depending upon quantity. For special displays, 30 to 45 days after receipt of order.
5. RETURN OF GOODS—Positively no products may be returned without factory authorization. All claims must be made within 10 days after receipt of goods.
6. All prices subject to change without notice.

These units are covered by one or more of the following patents: 3,041,600; 3,244,071; other patents pending. Design details subject to change without notice.

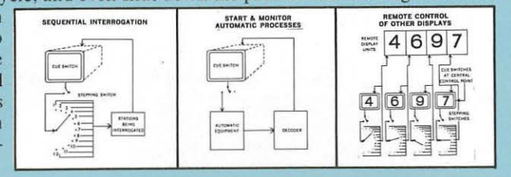


By combining a pushbutton 2PDT switch with a rear-projection readout, IEE's Cue-Switch® indicator provides simultaneous circuit control and message display. Pushing on the viewing screen closes the switch contacts to control external circuits making it ideal for data entry applications. The Cue-Switch display is available in both momentary-contact and alternate-action types.

Though the 1"-square pushbutton face requires only the same amount of space as many back-lighted indicator switches, 10 Cue-Switch readouts can replace up to 120 conventional control-panel switches. By replacing so many switches, IEE's Cue-Switch readout greatly simplifies the panel operator's work and reduces the possibility of error. This is especially advantageous in sequential action, because displayed instructions on the readout virtually eliminate search time as well as the possibility of pushing the wrong button. Operator training time is also considerably reduced.

CONTROL AND MONITOR MULTIPLE OPERATIONS

The versatile Cue-Switch readout can be used to interrogate and read out existing conditions at remote stations. Cue-Switch readouts are also used to start automatic processes, monitor the cycle, and even shut down the process if a warning condition is indicated. Cue-Switch displays can be used to control other remote readout indicators and provide a simultaneous display of what has been set up on these indicators.



QUICK-DISCONNECT LAMP ASSEMBLIES

All Cue-Switch indicators come equipped with a quick-disconnect lamp assembly. The entire lamp and socket assembly is held in position by a spring clip on the top and bottom of the terminal cap. Depressing these spring clips permits quick and easy withdrawal of the lamp assembly. Lamps can be changed on the spot or a completely new Cue-Switch readout snapped into position on the existing lamps.

IEE Industrial Electronic Engineers, Inc.
7720 Lemona Avenue, Van Nuys, California 91405

HI-BRITE CUE-SWITCH® INDICATOR DISPLAY

COMBINATION SWITCH AND REAR-PROJECTION READOUT

B

ACTUAL SIZE OF VIEWING SCREEN AND MAXIMUM CHARACTER HEIGHT

SPECIFICATIONS

Size (max): 2.031" H x 1" W x 3.97" D (Standard terminal clips); 4.51" D (Non-standard extension terminal clips)

Weight: 6 oz.

PROJECTED COLORS AVAILABLE: white (standard), amber, yellow, red, blue, green

Panel Thickness: 0.06" to 0.19"

Usable Viewing Screen Area: standard character height 0.59"; illuminated or color background area 0.75" diameter. Usable message area, 0.62" square with 0.16" radius corners. Variations with identical front panel appearance: switch-display, switch only, display only, and switch-pilot light

Lamp Return: common for all 12 terminals, standard (other split-ground configurations optional on special order with up to 6 ground terminals available)

Case: die-cast aluminum, isolated from electrical circuit

Input: straight decimal or binary coded decimal with an IEE Decoder Module for binary-coded input (see Decoder/Display section)

Viewing Angle: vertical and horizontal, 160°

Voltage: determined by lamps

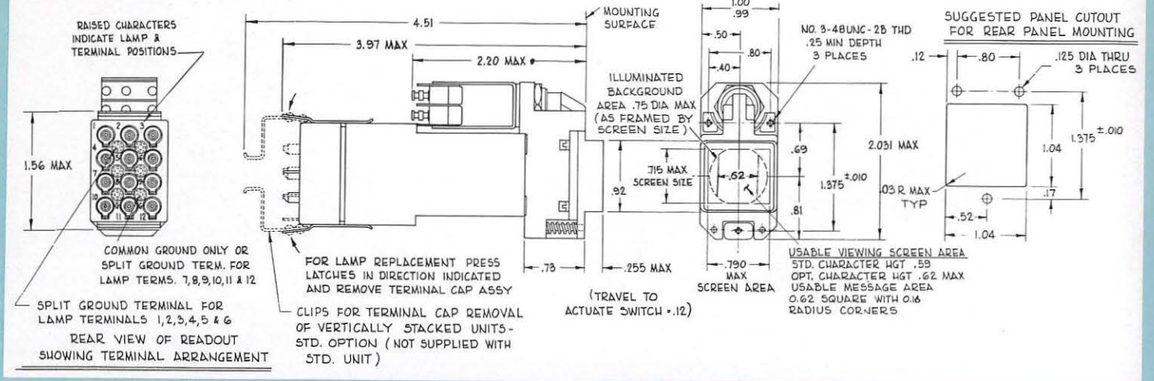
Connection: quick-disconnect lamp assembly standard

SWITCHES	OPERATING FORCE	ELECTRICAL RATINGS
2PDT mom. contact	4.5 lbs.	5 amps. @ 250 VAC
2PDT alt. contact	5 lbs.	3 amps @ 30 VDC

For lamp selection and character brightness chart, ambient temperature chart, standard sets of displays, and Readout Message Design Guide for non-standard sets of displays, see page 17.

IEE HI-BRITE CUE-SWITCH®

MOUNTING DIMENSIONS FOR HIGH-BRITE CUE-SWITCH® TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01"; .xxx = ±.005"



PRICE SCHEDULE AND ORDERING INFORMATION

DESIGNATION OF MODEL NUMBERS

Complete model numbers should be designated on all orders. An analysis of information included in a typical model number is shown below.

TYPICAL MODEL NUMBER

CSDH - 0000 - 2MC - 327 - T
(A) (B) (C) (D) (E)

A. Ordering designation for standard Hi-Brite Cue-Switch indicator display.
B. Model number assigned by IEE to the film message in each unit.
C. Switch type ordering designation.

SWITCH TYPES:

ORDERING DESIGNATION	DESCRIPTION (See specifications section for electrical ratings)
2 MC	Double-Pole. Double-throw (2 PDT) momentary contact
2 AC	Double-Pole. Double-Throw (2-PDT) alternate contact

D. Lamp number.
E. "T" Designates Top-mounted switch.
"B" Designates Bottom-mounted switch.

SET-UP CHARGE: Standard models or sets of displays, as listed in this catalog are available at the above prices. An additional charge of $40 is required for other models to cover the cost of art and master film which is kept on file for 12 months from its last use. Reorders within this period will not incur the $40 initial set-up charge.

PRICES — STANDARD UNIT

QUANTITY	2MC	2AC
1-9	$55.00	$61.00
10-24	51.50	57.00
25-49	49.50	54.50
50-99	47.50	52.50
100-249	45.50	50.50
250-499	44.00	48.50
500-999	42.50	46.75
1000 & Over	41.00	45.25

For both standard and non-standard split ground options apply $1.50 per unit.

QUANTITY DISCOUNTS ON EXTENDED SHIPMENTS

1. To break an order down into more than one shipment, the order must total 100 or more display units.
2. Each shipment must equal at least 10% of total order or 25 units (whichever is larger).
3. Shipments on a particular order must be completed within 12 months from receipt of order.
4. Quantity orders cancelled before completion will be billed at prices based on the price schedule for the number of displays actually shipped.

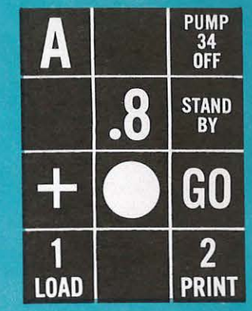
TERMS AND CONDITIONS

1. MINIMUM BILLING — $5.00.
2. F.O.B. — All prices F.O.B. our plant, Van Nuys, California
3. TERMS: ½ of 1% 10 days; net 30 days.
4. DELIVERY — For standard displays, 30 days depending upon quantity. For special displays, 30 to 45 days after receipt of order.
5. RETURN OF GOODS — Positively no products may be returned without factory authorization. All claims must be made within 10 days after receipt of goods.
6. All prices subject to change without notice.

These units are covered by one or more of the following patents: 3,041,600; 3,244,071 and 3,201,784; other patents pending. Design details subject to change without notice.

SERIES 280

STATUS INDICATOR DISPLAY



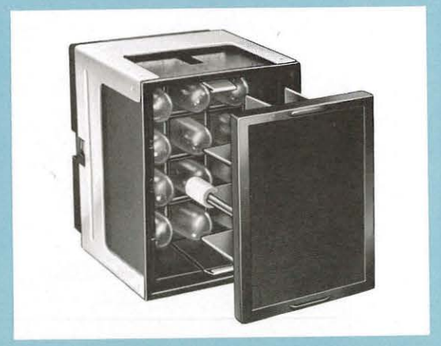
ACTUAL SIZE OF VIEWING SCREEN AND 12 INDIVIDUAL MESSAGE AREAS

The IEE Series 280 Status Indicator display is a back-lighted, simultaneous message indicator with a 12-lamp assembly in the rear of the unit to illuminate each of 12 possible message displays. The low-cost, compact 280 displays all messages on a single plane. Messages can be illuminated individually, in any combination, or all at one time by lighting the corresponding lamp or lamps. This unit is ideal for indicating more than one condition in a system at a time, the status of a process at various stages, a check list of operating procedures, sequential instructions for a machine operator, or with call boards, signal alarm systems, etc.

VIEWING SCREEN IS REMOVABLE FROM FRONT PANEL

Replacing lamp or message is simplified with removable viewing screen. No external hardware is required on the self mounting status indicator.

Unit can be installed vertically or horizontally, through a cutout in the panel. Two screws inside the Status Indicator display draw a retainer frame tight against the front panel and secure the unit.



SPECIFICATIONS

Size (Max): 2.415" H x 1.935" W x 2.62" D
Weight: 12 oz.
Message Displays: numbers, letters, words, symbols, and colors
Message Areas: Maximum of 12 message areas, each .437" sq., per unit. On special order, adjacent areas can be combined to form larger displays.
Viewing Angle: 160° included angle, both vertical and horizontal
Input: straight decimal system
Voltage: determined by lamp
Lamp Return: common for all 12 terminals (separate ground optional)
Case: die-cast zinc, isolated from electrical circuit
NOTE: Amp "Faston" receptacle #42067-1 may be used on wiring to provide snap-on terminal connections.

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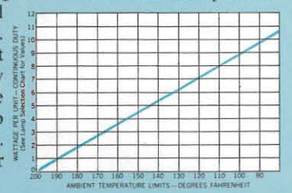
7720 Lemona Avenue, Van Nuys, California 91405

AMBIENT TEMPERATURE CHART

Ambient temperature limits should be considered in the selection of the proper lamp to be used. Curve gives maximum ambient temperature to which a unit may be subjected at a given input wattage. Operating below the ambient temperature is safe and no critical internal temperatures will be exceeded.

To determine the ambient temperature limits, multiply the wattage per lamp by the number of lamps required to be on simultaneously per unit. Then refer to the chart for temperature limits per unit.



LAMP SELECTION AND CHARACTER BRIGHTNESS

(FOR GENERAL FACTS TO GUIDE LAMP SELECTION, SEE INSIDE BACK COVER)

Lamp No.	Rated Voltage	Current At Rated Voltage (ma.)	Watts Per Lamp at Rated Voltage†	Life Per Lamp At Rated Voltage (hrs.)	Average* Character Brightness at Rated Voltage	Operating At Reduced Voltage: Reduced Voltage	Operating At Reduced Voltage: Life Per Lamp At Reduced Voltage (hrs.)	Operating At Reduced Voltage: Average* Character Brightness At Reduced Voltage	Lamp Replacement Price Each
44	6.3	250	1.6	3,000	350	5.3	30,000	175	$.10
47*	6.3	150	0.9	3,000	200	5.3	30,000	100	.10
1909	14.0	100	1.4	1,500	150	11.5	15,000	75	.16
1815†	14.0	200	2.8	3,000	220	11.5	30,000	110	.13
1819*	28.0	40	1.1	1,000	40	23.0	10,000	20	.30
1820†	28.0	100	2.8	1,000	140	23.0	10,000	70	.26
1829†	28.0	70	2.0	1,000	80	23.0	10,000	40	.23
1847*	6.3	150	0.9	10,000	120	5.3	100,000	60	.13
755*	6.3	150	0.9	50,000	120	5.3	500,000	60	.334
756*	14.0	80	1.1	50,000	35	11.5	500,000	17.5	.16
757†	28.0	80	2.2	50,000	60	23.0	500,000	30	.21
1835†	55.0	50	2.75	5,000	100	46.8	50,000	50	.37
1813	14.0	100	1.4	1,500	150	11.5	15,000	75	.16
NE-51H	115 VAC	1.2	1/7	25,000	12				.36
NE-51H	150 VDC	1.9	3/10	12,000	20				.36

*Recommended for optimum performance.
*Values in foot lamberts as measured with a spot-light meter.
†Be sure to consult Ambient Temperature chart when selecting lamps.
NOTE: Neon lamp requires resistor

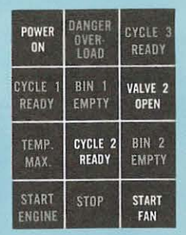


FIG. 1

FIG. 2

FIG. 3

FIG. 4

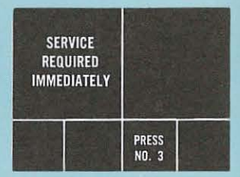


FIG. 5

VERSATILITY OF DISPLAYS

Displays may be illuminated to provide white or colored messages on black backgrounds or black messages on white or colored backgrounds.

PHOTOGRAPHIC FILM DISPLAYS: Messages can be photographed and the film mounted behind the viewing screen. Only illuminated messages will be visible, as in Fig. 2, when using frosted viewing screen. Film displays can also have white or colored backgrounds and black or colored characters, as in Fig. 4. Clear viewing screen can be provided so that all messages will be visible, but only those with lamps turned on will be brightly illuminated, as in Fig. 1.

TYPED OR HAND-LETTERED DISPLAYS: Messages can be typed or hand-lettered on translucent film and mounted behind the viewing screen, as in Fig. 3. Message background can be white or colored with black characters. When not illuminated, messages will be either visible or hidden depending on whether clear or frosted viewing screens are used.

ENGRAVED VIEWING SCREEN: Messages or dividing lines between message areas can be engraved on the viewing screen. All messages will be visible at all times, but only those with lamps turned on would be brightly illuminated, as in Fig. 1.

COMBINATION DISPLAYS: Fig. 5 shows dividing lines engraved on viewing screen, but messages have been photographed on film and mounted behind viewing screen so that only illuminated displays are visible.

LARGER DISPLAY AREAS: Standard message areas are .437" square. On special order, adjacent areas can be combined to provide larger displays, as in Fig. 3, 4, and 5.

ANYTHING THAT CAN BE PUT ON FILM CAN NOW BE SHOWN ON THE IEE STATUS INDICATOR!

Since the messages are on film, the Status-Indicator display can show anything that is photographically reproducible, including numbers, letters, words, symbols, special characters, and colors. Standard sets of displays are listed in the chart below. Any other messages can be set to order.

STANDARD SETS OF DISPLAYS

Film Number	TERMINAL NUMBER 1	2	3	4	5	6	7	8	9	10	11	12
0010	0	1	2	3	4	5	6	7	8	9	10	11
0085	1	2	3	4	5	6	7	8	9	10	11	12
0086	A	B	C	D	E	F	G	H	K	L	M	N

Standard displays indicated above are set in Alternate Gothic #3.
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

SERIES 280 STATUS INDICATOR MESSAGE DESIGN GUIDE FOR NON-STANDARD SETS OF DISPLAYS

Studies indicate that Alternate Gothic #3 type face is the most readable for multiple character messages; therefore, this type face is furnished as standard.

Other type faces, sizes, and symbols are available on special order. For deviations from character sizes listed in chart below to the right, consult IEE.

INSTRUCTIONS:

1. From the chart to the right, determine the character size of your message by selecting the character height that will give you a sufficient number of characters per line in a sufficient number of lines per display area to adequately contain your indicator message. (All letters and numbers except 1, I, M and W are approximately the same width; therefore, this chart is based on the normal use of these characters in any one line. Count each space between words as a character.)

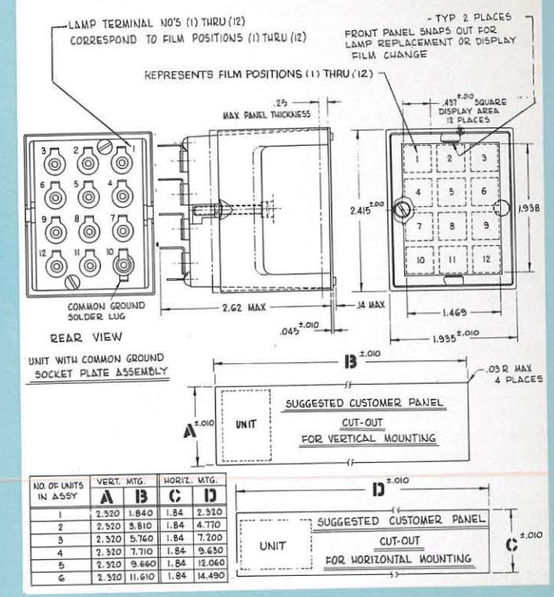
2. Now record your indicator message with the other information requested on the Design Guide Order Sheet printed at the back of this catalog. You may write your message information in a duplicate copy of this form or contact your local IEE Sales Representative, or IEE directly for an extra supply of these sheets.

MESSAGE AND ILLUMINATED BACKGROUND COLOR COMBINATIONS OBTAINABLE WITH ONE LAMP

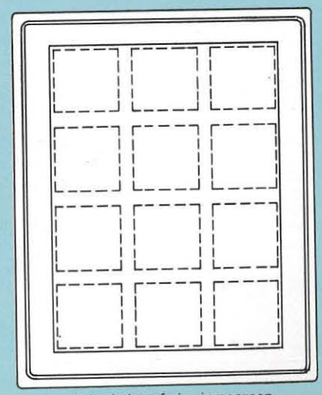
1. A white message on a black background.
2. A black message projected onto a white or colored background.
3. A colored message on a black background.
4. Color film is also available for complex, multi-color displays. Contact IEE for cost and specifications.

MOUNTING DIMENSIONS FOR SINGLE UNITS AND ASSEMBLIES, SERIES 280

TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01"; .xxx = ±.005"



NO. OF UNITS IN ASSY	VERT. MTG. A	B	HORIZ. MTG. C	D
1	2.320	1.840	1.84	2.320
2	2.320	3.810	1.84	4.770
3	2.320	5.760	1.84	7.200
4	2.320	7.710	1.84	9.630
5	2.320	9.660	1.84	12.060
6	2.320	11.610	1.84	14.490



Actual size of viewing screen with its 12 individual message areas

Standard message areas are .437" square. Overall maximum message area (with lamp separator removed) is 1.45" x 1.94". Adjacent standard message areas may be combined to provide special grid patterns as indicated in figs. 3, 4, and 5, on page 26.

For specifications on engraved viewing screens, contact IEE.

STANDARD CHARACTER HEIGHT (Nominal dimension only; standard tolerance for characters less than .375" is ±.015"	Maximum number of characters per line (letters and numerals).
.062	9 (4 lines max)
.081	7 (3 lines max)
.098	6 (3 lines max)
.117	5 (2 lines max)
.133	4 (2 lines max)
.161	3 (2 lines max)
.187	3 (1 line max)
.375	1 (1 line max)

.03" spacing between lines is the recommended minimum.

PRICE SCHEDULE AND ORDERING INFORMATION

DESIGNATION OF MODEL NUMBERS

TYPICAL MODEL NUMBERS:

280 – 0000 – S – 47 – 2

(A) (B) (C) (D) (E)

A. Series number used to identify unit.

B. Designates film number for character displays used in unit. Numbers for standard sets of displays are listed in this catalog; numbers for special sets of displays obtained from IEE. When film number 0000 is specified, a blank piece of Cronaflex film is supplied which allows the customer to type or print his own message directly onto the film.

C. Indicates separate ground for each lamp. Common ground is automatically furnished unless the S is designated.

D. Number of lamp selected for use in display.

E. Lamp separator configuration. 2 is the number assigned for the standard 12 message areas (see examples below). For any other configuration, a different dash number will be assigned by the factory. When ordering, please include a sample diagram of the separator desired along with the message to be displayed. (See the Design Guide Order Sheet printed at the back of this catalog.)

EXAMPLES

1	2	3
4	5	6
7	8	9
10	11	12

SEPARATOR #2

RUNWAY CLEAR		
1	2	3
4	5	6
7	8	9

SEPARATOR #21

IMMEDIATELY			
ON		DOWN	
1	2	3	4

SEPARATOR #44

PRICE SCHEDULE

Quantity of Units	PRICE OF STANDARD 12 POSITION UNIT WITH VARIOUS LAMPS			
	Lamp Nos. 44, 47 1847	Lamp Nos. 1813, 1815 1909	Lamp Nos. 1819, 1820 1829	Lamp Nos. NE-51H
1-9	$17.50	$18.50	$19.50	$20.00
10-24	16.00	17.00	18.00	18.25
25-49	15.25	16.00	17.00	17.50
50-99	14.50	15.25	16.00	16.50
100-249	13.75	14.50	15.25	15.75
250-499	13.00	13.75	14.50	15.00
500-999	12.50	13.25	14.00	14.50
1000 & Over	12.25	13.00	13.75	14.00

	QUANTITY	PRICE ADDED TO UNIT PRICE
PRICING FOR SPECIAL LAMP SEPARATORS. The standard 12 position separator will not incur this charge. See explanation "E" under Model Number Designation.	1-9	$2.00
	10-24	1.85
	25-49	1.75
	50-99	1.65
	100-249	1.55
	250-499	1.50
	500-999	1.45
	1000 & Over	1.40

SET-UP CHARGE: Standard models or sets of displays in this catalog are available at the listed prices. An additional charge of $1.00 per message area (with a minimum of $5.00 per set-up) is required for non-standard displays to cover the cost of art and master film. This is kept on file for 12 months from its last use, and reorders within this period will not incur the initial set-up charge.

QUANTITY DISCOUNTS ON EXTENDED SHIPMENTS

1. To break an order down into more than one shipment, the order must total 100 or more display units.
2. Each shipment must equal at least 10% of total order or 25 units (whichever is larger).
3. Shipments on a particular order must be complete within 12 months from receipt of order.
4. Quantity orders cancelled before completion will be billed at prices based on the Price Schedule for the number of displays actually shipped.

TERMS AND CONDITIONS

1. MINIMUM BILLING—$5.00 per order.
2. F.O.B.—All prices F.O.B. our plant Van Nuys, California.
3. TERMS—½ of 1% 10 days; net 30 days.
4. DELIVERY—For standard displays, 30 days depending upon quantity. For special displays, 30 to 45 days after receipt of order.
5. RETURN OF GOODS—Positively no products may be returned without factory authorization. All claims must be made within 10 days after receipt of goods.
6. All prices and/or design details subject to change without notice.

SERIES 340

MICROMINIATURE REAR-PROJECTION READOUT

E

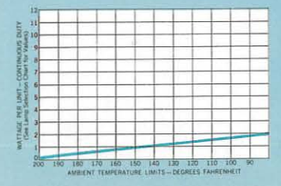
ACTUAL SIZE OF VIEWING SCREEN AND MAXIMUM CHARACTER HEIGHT

Series 340 is the smallest rear-projection readout with based lamps ever made. Front plug-in feature permits easy front-panel accessibility. Each readout is insertable into a permanently wired housing containing a positive latch. The readout insert can be removed from its housing by simply pressing to release and then withdrawing it. This system permits insertion of new readouts with different message displays or easy lamp replacement.

AMBIENT TEMPERATURE CHART

Ambient temperature limits should be considered in the selection of the proper lamp to be used. Curve gives maximum ambient temperature to which a unit may be subjected at a given input wattage. Operating below the ambient temperature is safe and no critical internal temperatures will be exceeded.

To determine the ambient temperature limits, multiply the wattage per lamp by the number of lamps required to be on simultaneously per unit. Then refer to chart below for temperature limits per unit.



LAMP SPECIFICATION CHART

(FOR GENERAL FACTS TO GUIDE LAMP SELECTION, SEE INSIDE BACK COVER)

Lamp No.	Rated Voltage	Current At Rated Voltage (ma)	**Watts Per Lamp At Rated Voltage	Life Per Lamp At Rated Voltage	Character Brightness***	Lamp Replacement Price Each
*A1	5	115	.575	40,000	30	.63
*A1	6	125	.750	4,000	60	.63
A3	14	40	.500	1,000	23	.84

*Recommended for optimum performance.
**Please consult ambient temperature chart when selecting lamps.
***Brightness is in foot lamberts as measured by a spot-light meter and averaged for all 11 terminal positions.

SPECIFICATIONS

Size (max): .760" H x .505" W. Depth depends upon insert used.

Weight: ¾ oz.

Projected Colors Available: white (standard), amber, yellow, blue, red, green.

Lamp Return: common for all 11 terminals.

Housing, Assembly Brackets, and Plates: stainless steel.

Insert Body: glass-filled nylon.

Input: straight decimal or binary coded decimal with an IEE Decoder Module for binary-coded input (see Decoder/Display Section).

Viewing Angle: vertical and horizontal, 160°.

Usable Viewing-Screen Area: any character or message within an area of .37" H x .34" W with an illuminated or color background area of .562" H x .375" W.

Voltage: determine by lamps.

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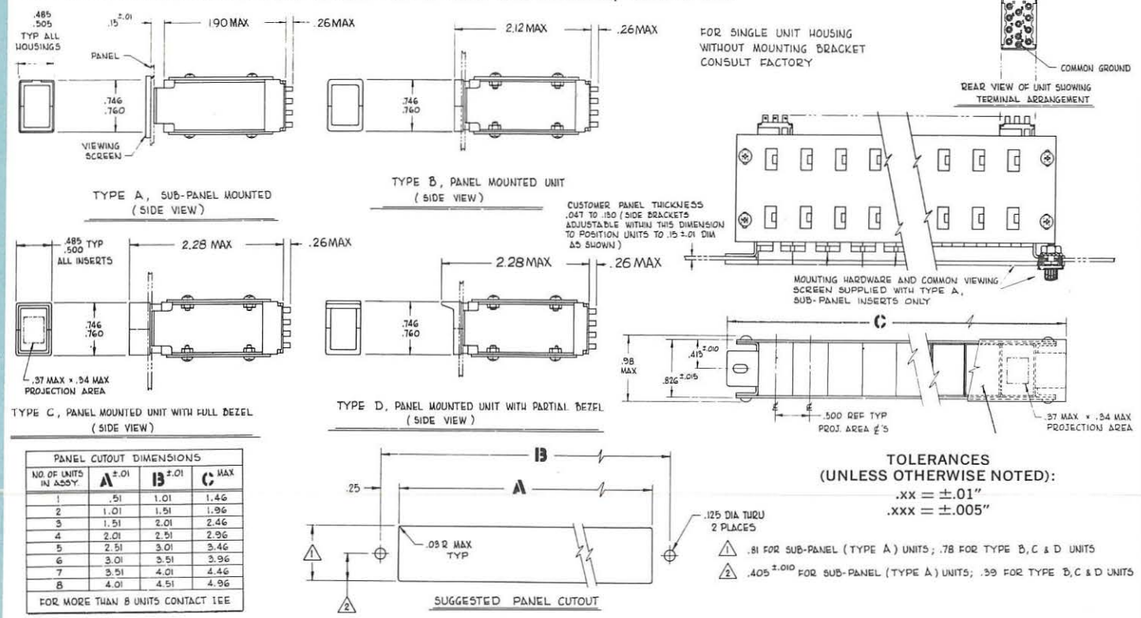
7720 Lemona Avenue, Van Nuys, California 91405

MOUNTING DIMENSIONS FOR SINGLE UNITS AND ASSEMBLIES, SERIES 340



PANEL CUTOUT DIMENSIONS

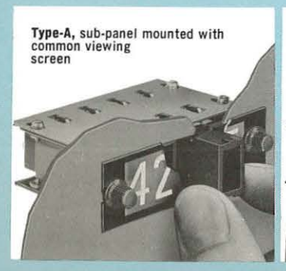
NO. OF UNITS IN ASSY	A ±.01	B ±.01	C MAX
1	.51	1.01	1.46
2	1.01	1.51	1.96
3	1.51	2.01	2.46
4	2.01	2.51	2.96
5	2.51	3.01	3.46
6	3.01	3.51	3.96
7	3.51	4.01	4.46
8	4.01	4.51	4.96

FOR MORE THAN 8 UNITS CONTACT IEE

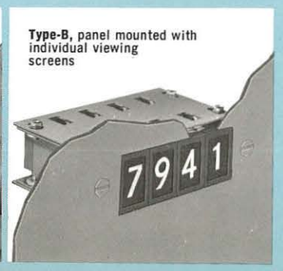
ASSEMBLIES, SERIES 350

An assembly of Series 340 units is designated Series 350. These assemblies are available with Type-A inserts, sub-panel mounted with common viewing screen; Type-B inserts, flush-panel mounted with individual viewing screens; Type-C inserts, flush-panel mounted with full bezels and individual viewing screens; and Type-D inserts, flush-panel mounted with partial bezels and individual viewing screens.

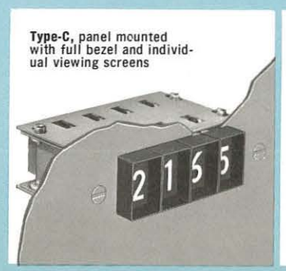
Series 350 assemblies can be permanently wired in place. Front plug-in eliminates the need for rear-access doors and special cabling because lamp replacement is accomplished by removing the individual readout insert from the front of the panel. Access to the individual units behind the common viewing screen of Type-A, sub-panel mounted assemblies, is through simple removal of two nuts that hold the common viewing screen in place.



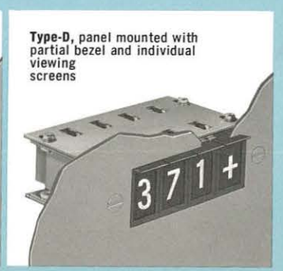
Type-A, sub-panel mounted with common viewing screen



Type-B, panel mounted with individual viewing screens



Type-C, panel mounted with full bezel and individual viewing screens



Type-D, panel mounted with partial bezel and individual viewing screens

ANYTHING THAT CAN BE PUT ON FILM CAN BE DISPLAYED ON IEE READOUTS!

Since IEE rear-projection messages are on film, readouts can display anything that is photographically reproducible, including numbers, letters, words, symbols, special characters, and colors. Standard sets of displays are listed on the chart below. Any other messages can be set to order.

STANDARD SETS OF DISPLAYS

FILM NO.	TERMINAL POSITIONS 1	2	3	4	5	6	7	8	9	10	11	TYPE STYLE
0000	1	2	3	4	5	6	7	8	9	0		1
3785	1	2	3	4	5	6	7	8	9	0	.	1
0005		Green			+			—			Red	
082X	1	2	3	4	5	6	7	8	9	0	Red	1
084X	1	2	3	4	5	6	7	8	9	0	Green	1
086X	A	B	C	D	E	F	G	H	I	J	K	2
087X	L	M	N	O	P	Q	R	S	T	U	V	2
088X	P	Q	R	S	T	U	V	W	X	Y	Z	2
089X	0	1	2	3	4	5	6	7	8	9	10	1
090X	1	2	3	4	5	6	7	8	9	10	11	1

COLORS REPRESENT PROJECTED BACKGROUND OF COLOR INDICATED

TYPE STYLES

(Numbers refer to "Type Style" column of chart)

1. Futura Demibold, **1234567890**
2. Futura Medium Condensed,
   ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

NOTE: Numerals 10 and 11 in film number 090X and numeral 10 in film number 089X are futura medium condensed type style.

SERIES 340 READOUT MESSAGE DESIGN GUIDE FOR NON-STANDARD SETS OF DISPLAYS

Studies indicate that Alternate Gothic #3 type face is the most readable for multiple character messages; therefore, this type face is furnished as standard.

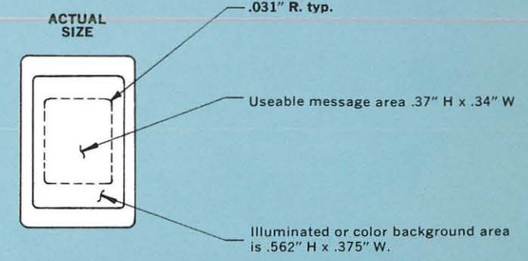
Exceptions: Futura Demibold style type is supplied for single maximum height (.375") numbers.

Other type faces, sizes, and symbols are available on special order. For deviations from character sizes listed in chart below, consult IEE.

Alternate Gothic #3,
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890
Futura Demibold, **123456890**
Futura Medium Condensed,
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

INSTRUCTIONS:

1. From the chart below, determine the character size of your message by selecting the chacter height that will give you a sufficient number of characters per line in a sufficient number of lines to adequately contain your readout message. (All letters and numbers except 1, I, M and W are approximately the same width; therefore, this chart is based on the normal use of these characters in a line. Count each space between words as a character.)
2. Now record your readout message with the other information requested on the Design Guide Order Sheet printed at the back of this catalog. You may write your message information on a duplicate copy of this form or contact your local IEE Sales Representative, or IEE directly for an extra supply of these sheets.



MESSAGE HEIGHT GUIDE

For Vertical Units Only

STANDARD CHARACTER HEIGHT (Nominal dimensions only; tolerance is ± .015)	MAXIMUM NUMBER OF CHARACTERS PER LINE (letters and numerals) 1 Line and Central Line of 3 Line Message	2 Lines	Top and Bottom Line Only of 3 Line Message
.076	6	6	5
.091	5	5	4
.109	4	4	3
.125	4	4	
.150	3	3	
.176	2		

.04" spacing between lines is the recommended minimum.

MESSAGE AND ILLUMINATED BACKGROUND COLOR COMBINATIONS OBTAINABLE WITH ONE LAMP:

1. A white message on a black background.
2. A black message projected onto either a .37" H x .37" W white or colored background area.
3. A colored message on a black background.

PRICE SCHEDULE AND ORDERING INFORMATION

DESIGNATION OF MODEL NUMBERS

Complete model numbers should be designated on all orders. An analysis of information included in a typical model number for both single units and assemblies is shown below.

TYPICAL SINGLE UNIT MODEL NUMBER:

340 – 0000 – B – A1 – 2

(A) (B) (C) (D) (E)

TYPICAL ASSEMBLY MODEL NUMBER:

350 – 2212 – A – A1 – 2

(A) (F) (C) (D) (E)

A. Series number (340 for single units; 350 for assemblies.)

B. Designates film for character displays used in readouts. Numbers for standard sets of displays are listed in this catalog; numbers for special displays obtained from IEE.

C. Type of insert A, B, C or D (see section on assemblies).

D. Lamp number.

E. Housing style. Dash-2 housing has stirrups on the top and bottom to retain standard IEE assemblies plates.

F. Identifying number assigned by IEE for a particular grouping of models within an assembly. Specifications of the individual readouts in an assembly should be made by model number or by written statement of what messages the display units should contain. The proper sequence of individual display units should be listed from left to right, as seen facing the viewing screen. Once an "assembly number" has been assigned for a particular grouping of readouts, that number can be used for future orders.

2 Actual size viewing screen and maximum character height with standard width number, also adaptable with decimal point.

PRICE SCHEDULE

SINGLE UNITS				EXTRA PER UNIT FOR ASSEMBLIES		
NO. OF UNITS	PRICE PER UNIT	NO. OF UNITS	PRICE PER UNIT	TYPE OF INSERT	MTG. HDW.	EXTRA FOR COMMON VIEWING SCREEN
1-9	$39.50	100-249	$32.50	A	$1.50	$7.50
10-24	$36.50	250-499	$31.50	B	$1.50	NONE
25-49	$34.50	500-999	$30.50	C	$1.50	NONE
50-99	$33.50	1000 & Over	$29.50	D	$1.50	NONE

SET-UP CHARGE: Standard models or sets of displays in this catalog are available at the listed prices. An additional charge of $40 is required for other models to cover the cost of art and master film which is kept on file for 12 months from its last use. Reorders within this period will not incur the $40 initial set-up charge.

QUANTITY DISCOUNTS ON EXTENDED SHIPMENTS

1. To break an order down into more than one shipment, the order must total 100 or more display units.
2. Each shipment must equal at least 10% of total order or 25 units (whichever is larger).
3. Shipments on a particular order must be complete within 12 months from receipt of order.
4. Quantity orders cancelled before completion will be billed at prices based on the price schedule for the number of displays actually shipped.

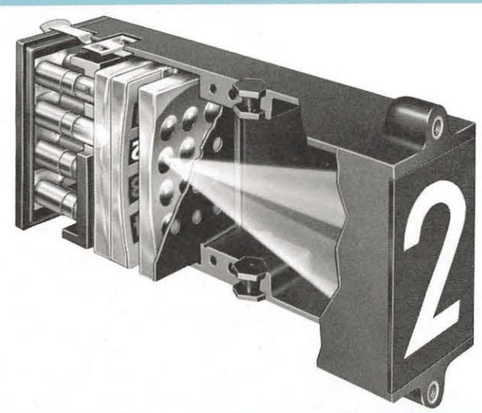
TERMS AND CONDITIONS

1. MINIMUM BILLING—$5.00.
2. F.O.B.—All prices F.O.B. our plant Van Nuys, California.
3. TERMS—½ of 1% 10 days; net 30 days.
4. DELIVERY—For standard displays, 30 days depending upon quantity. For special displays, 30 to 45 days after receipt of order.
5. RETURN OF GOODS—Positively no products may be returned without factory authorization. All claims must be made within 10 days after receipt of goods.
6. All prices subject to change without notice.

These units are covered by one or more of the following patents: 3,041,600; 3,244,071; other patents pending. Design details subject to change without notice.

SERIES 360

DISTANT-VIEWING REAR-PROJECTION READOUT



2

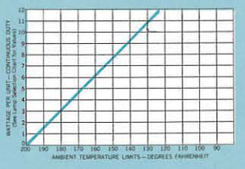
ACTUAL SIZE OF VIEWING SCREEN AND MAXIMUM CHARACTER HEIGHT

DISPLAYS 2″-HIGH CHARACTERS, READABLE FROM OVER 50 FEET · MOUNTS ON 2″ CENTERS FOR MINIMUM PANEL SPACE · The Series 360 meets human engineering requirements for distance viewing by providing characters up to 2″ in height which are clearly visible from over 50 feet. Despite the Jumbo-sized characters, this unit is only 3″ high, 2″ wide, 7.75″ deep.

AMBIENT TEMPERATURE CHART

Ambient temperature limits should be considered in the selection of the proper lamp to be used. Curve gives maximum ambient temperature to which a unit may be subjected at a given input wattage. Operating below the ambient temperature is safe and no critical internal temperatures will be exceeded.

To determine the ambient temperature limits, multiply the wattage per lamp by the number of lamps required to be on simultaneously per unit. Then refer to the chart at right for temperature limits per unit.



LAMP SELECTION AND CHARACTER BRIGHTNESS

(FOR GENERAL FACTS TO GUIDE LAMP SELECTION, SEE INSIDE BACK COVER)

LAMP NUMBER	RATED VOLTAGE	CURRENT AT RATED VOLTAGE (amps)	*WATTS PER LAMP AT RATED VOLTAGE	LIFE PER LAMP AT RATED VOLTAGE (hours)	CHARACTER** BRIGHTNESS AT RATED VOLTAGE	OPERATING AT REDUCED VOLTAGE			LAMP REPLACEMENT PRICE EACH
						REDUCED VOLTAGE	LIFE PER LAMP AT REDUCED VOLTAGE (hours)	CHARACTER** BRIGHTNESS AT REDUCED VOLTAGE	
44	6.3	.250	1.6	3,000	18	5.3	30,000	9.0	$.10
***238	6.3	.500	3.2	2,000	40	5.3	20,000	20.0	.195
1815	14.0	.200	2.8	3,000	13	11.5	30,000	6.5	.13
313	28.0	.170	4.8	500	17	23	5,000	8.5	.30

*Be sure to consult Ambient Temperature chart when selecting lamps.
**Measurements averaged for all 12 terminal positions with values in foot lamberts as measured with a spot-light meter.
***Recommended for optimum performance

SPECIFICATIONS

Size (max): 3″ H x 2″ W x 7.80″ D.

Weight: 1 lb. 7 oz. per unit.

Projected Colors Available: white (standard), amber, yellow, blue, red, green.

Lamp Return: common ground for all 12 terminals (separate return for each lamp optional).

Case: die-cast aluminum, isolated from electrical circuit.

Input: straight decimal or binary coded decimal with an IEE Decoder Module for binary-coded input (see Decoder/Display Section).

Standard Viewing Angle: vertical and horizontal, 160°.

Usable Viewing Screen Area: any character or message within an area of 2″ high x 1.625″ wide with .375″ radius corners and a maximum illuminated or color background area of 2.300″ high by 1.800″ wide.

Voltage: determined by lamps.

Connection: quick-disconnect lamp assembly standard (Amp "Faston" receptacle #42067-1 may be used on wiring to provide snap-on terminal connections). Unit also available with Amphenol connector and mating plug as a standard option at extra cost.

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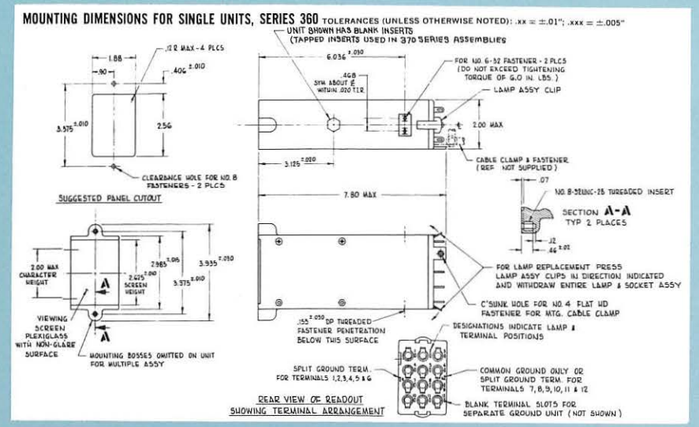
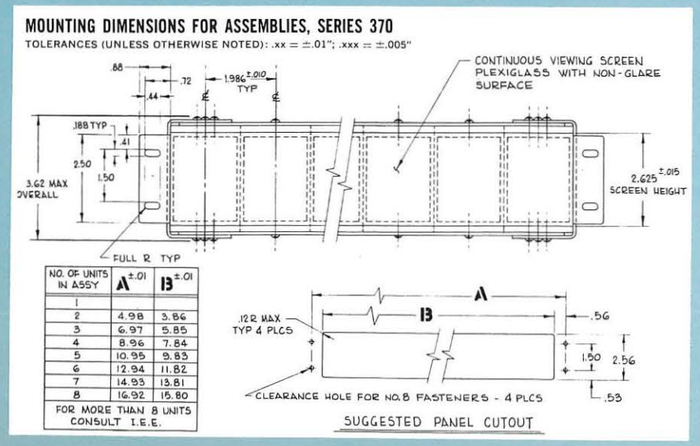


QUICK-DISCONNECT LAMP ASSEMBLIES

All standard Series 360 rear-projection readouts come with a quick-disconnect lamp assembly. The entire lamp and socket assembly is held in position by a spring clip on the top and bottom of the case. Lifting these spring clips permits quick and easy withdrawal of the lamp assembly. Lamps can be changed on the spot or a completely new readout snapped into position on the present lamps. A bracket is provided as part of the lamp assembly for mounting a cable clamp to relieve strain on the lamp terminal wires.

ASSEMBLIES, SERIES 370

An assembly of Series 360 units is designated Series 370. Assemblies are supplied with a continuous viewing screen for fast, accurate reading. Specification of the individual readouts in an assembly should be made by model number or by written statement of what messages the display unit should contain. The proper sequence of individual display units should be listed from left to right, as seen facing the viewing screen. Once an "assembly number" has been assigned for a particular grouping of readouts, that number can be used for future orders.



NO. OF UNITS IN ASSY	A ±.01	B ±.01
2	4.98	3.86
3	6.97	5.85
4	8.96	7.84
5	10.95	9.83
6	12.94	11.82
7	14.93	13.81
8	16.92	15.80

FOR MORE THAN 8 UNITS CONSULT I.E.E.

ANYTHING THAT CAN BE PUT ON FILM CAN BE DISPLAYED ON IEE READOUTS!

Since IEE rear-projection messages are on film, readouts can display anything that is photographically reproducible, including numbers, letters, words, symbols, special characters, and colors. Standard sets of displays are listed in the chart below. Any other messages can be set to order.

STANDARD SETS OF DISPLAYS

FILM NOS.	TERMINALS 1	2	3	4	5	6	7	8	9	10	11	12	TYPE STYLE
0000	1	2	3	4	5	6	7	8	9	0			1
051U	1	2	3	4	5	6	7	8	9	0	.	.	2
0005		Gr.			+			—			Red		
054U		Gr.			+			—			Red		
0009	0	⅛	¼	⅜	½	⅝	¾	⅞					3
0010	0	1	2	3	4	5	6	7	8	9	10	11	1
055U	1	2	3	4	5	6	7	8	9	0	+	—	2
0011	1	2	3	4	5	6	7	8	9	0	+	—	1
078U	1	2	3	4	5	6	7	8	9	0	+	—	2
0019	1	2	3	4	5	6	7	8	9	0	Red		1
052U	1	2	3	4	5	6	7	8	9	0	Red	.	2
0052	1	2	3	4	5	6	7	8	9	0	Red	Gr.	1
079U	1	2	3	4	5	6	7	8	9	0	Red	Gr.	2
0056	0	S	L	C	Red	R	E	Gr.	F	X	Y	Z	2
0085	1	2	3	4	5	6	7	8	9	10	11	12	1
0086	A	B	C	D	E	F	G	H	K	L	M	N	2
0087	O	P	Q	R	S	T	U	V	W	X	Y	Z	2
0099	A	B	C	E	F	L	M	N	P	S	Red	U	2
0100	ALPHA-NUMERIC BAR MATRIX												
0200	2	1	2	3	4	5	6	7	8	1	9	0	2
0221	1	2	3	4	5	6	7	8	9	0	Amb.	Gr.	1

COLORS REPRESENT PROJECTED BACKGROUND OF COLOR INDICATED

TYPE STYLES

(Numbers refer to "Type Style" column of chart)

1. Futura Medium: 1234567890
2. Futura Medium Condensed: ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890
3. Alternate Gothic #3: 1234567890

NOTE: Numerals 10 and 11 in Film Number 0010; and numerals 10, 11, and 12 in Film Number 0085 are Futura Medium Condensed type style.

SERIES 360 READOUT MESSAGE DESIGN GUIDE FOR NON-STANDARD SETS OF DISPLAYS

• Studies indicate that Alternate Gothic #3 type face is the most readable for multiple character messages; therefore, this type face is furnished as standard.

Exceptions: Futura Medium style type is supplied for single maximum height (2.00") numbers only.

Futura Medium Condensed style type is supplied for single maximum height (2.00") letters and for maximum height numbers to be displayed with a polarity sign or a decimal.

Other type faces, sizes, and symbols are available on special order. For deviations from character sizes listed in chart to the right, consult IEE.

Alternate Gothic #3,
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890
Futura Medium: 1234567890
Futura Medium Condensed:
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

INSTRUCTIONS:

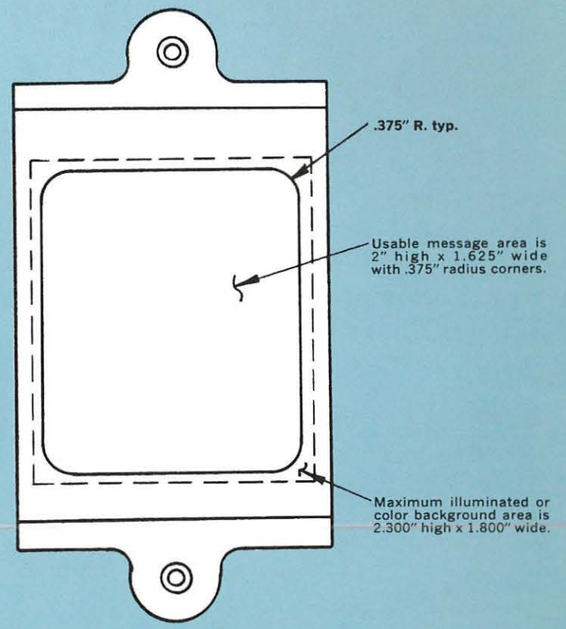
1. From the chart to the right, determine the character size of your message by selecting the character height that will give you a sufficient number of characters per line in a sufficient number of lines to adequately contain your readout message. (All letters and numbers except l, I, M, and W are approximately the same width; therefore, this chart is based on the normal use of these characters in any one line. Count each space between words as a character.)

2. Now record your readout message with the other information requested on the Design Guide Order Sheet printed at the back of this catalog. You may write your message information on a duplicate copy of this form or contact your local IEE Sales Representative, or IEE direct for an extra supply of these sheets.

MESSAGE AND ILLUMINATED BACKGROUND COLOR COMBINATIONS OBTAINABLE WITH ONE LAMP:

1. A white message on a black background.
2. A black message projected onto a 2.300" × 1.800" rectangular white or colored background.
3. A colored message on a black background.
4. For combinations using more than one lamp, consult IEE.

SERIES 370



ACTUAL SIZE

MESSAGE HEIGHT GUIDE

For Vertical Units Only

STANDARD CHARACTER HEIGHT (Nominal dimension only; standard tolerance for characters less than .500 is ± .015" and for characters .500 or over it is ± .025")	MAXIMUM NUMBER OF CHARACTERS PER LINE (letters and numerals)					
	1 Line and All Central Lines for 3 thru 6 Line Messages	Two Lines	TOP AND BOTTOM LINES ONLY			
			NUMBER OF MESSAGE LINES			
			3	4	5	6
.162	13	13	13	12	11	10
.220	10	10	10	9	8	7
.273	8	8	8	7	6	
.326	7	7	7	6		
.387	6	6	6	5		
.450	5	5	5			
.570	4	4	4			
.690	3	3				
.827	2	2				
.940	2	2				
1.130	2					
1.320	2					

.10" spacing between lines is the recommended minimum

PRICE SCHEDULE AND ORDERING INFORMATION

DESIGNATION OF MODEL NUMBERS

Complete model numbers should be designated on all orders. An analysis of information included in a typical model number for both units and assemblies is shown below.

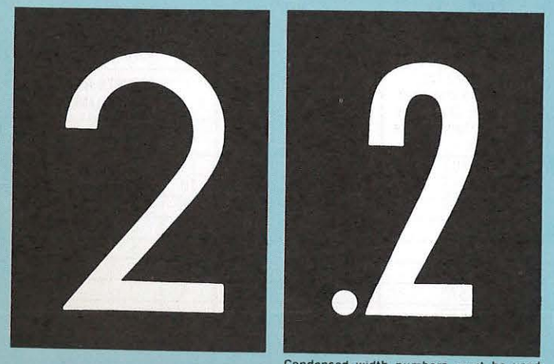
TYPICAL SINGLE UNIT MODEL NUMBER

360 – 0011 – S – 44 – L
(A) (B) (C) (D) (F)

TYPICAL ASSEMBLY MODEL NUMBER

370 – 0725 – C – 44 – K
(A) (E) (C) (D) (F)

A. Series number used to identify units.
B. Designates film number for character displays used in unit. Numbers for standard sets of displays are listed in this catalog; numbers for special displays obtained from IEE.
C. S= Separate ground terminal for each lamp; C= Split ground with common ground provided for terminals 1 to 6 and another common ground provided for terminals 7 to 12; if no callout is indicated, unit will be furnished with common ground for all 12 terminals.
D. Number of lamp selected for use in readout.
E. Identifying number assigned by factory for a particular grouping of individual readouts within an assembly (see text on assemblies, Series 370).
F. Case style. (Style "L" has front mounting lugs for individual mounting; style "K" is without front mounting lugs and is used in Series 370 assemblies for end-bracket mounting.



Condensed width numbers must be used when a decimal point or polarity symbol is required for simultaneous projection with numbers.

PRICE SCHEDULE

360 SERIES—COMBINED QUANTITY

Series No.	1 to 9	10 to 24	25 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000—over
360	33.00	30.50	28.75	27.25	26.00	24.75	23.75	23.00
360C[1]	34.50	32.00	30.25	29.00	27.50	26.00	25.00	24.00
360S[2]	36.00	33.50	31.75	30.25	29.00	27.25	26.00	25.00

1. C = Split ground return.
2. S = Separate ground terminal for each lamp.

ASSEMBLIES

Series 370 (Assembly of Series 360 Units)	Assemblies of 2-8 units may be provided with mounting hardware and continuous viewing screen. For assemblies larger than 8 units, please consult IEE.	Extra for assembly mounting hardware **$1.50 Per Unit**

SET-UP CHARGE: Standard models or sets of displays in this catalog are available at the listed prices. An additional charge of $40 is required for other models to cover the cost of art and master film which is kept on file for 12 months from its last use. Reorders within this period will not incur the $40 initial set-up charge.

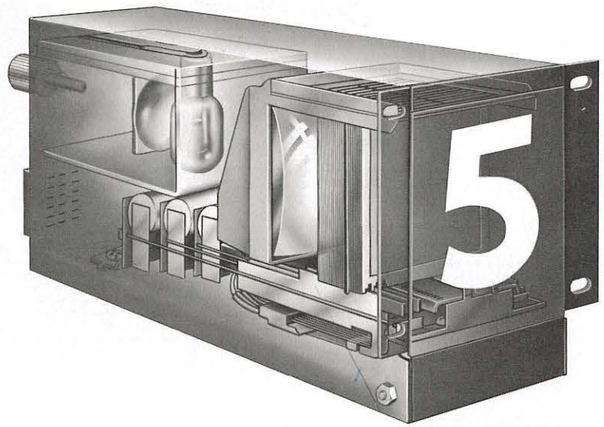
QUANTITY DISCOUNTS ON EXTENDED SHIPMENTS

1. To break an order down into more than one shipment, the order must total 100 or more display units.
2. Each shipment must equal at least 10% of total order or 25 units (whichever is larger).
3. Shipments on a particular order must be complete within 12 months from receipt of order.
4. Quantity orders cancelled before completion will be billed at prices based on the price schedule for the number of displays actually shipped.

TERMS AND CONDITIONS

1. MINIMUM BILLING—$5.00.
2. F.O.B.—All prices F.O.B. our plant Van Nuys, California.
3. TERMS—½ of 1% 10 days; net 30 days.
4. DELIVERY—For standard displays, 30 days depending upon quantity. For special displays, 30 to 45 days after receipt of order.
5. RETURN OF GOODS—Positively no products may be returned without factory authorization. All claims must be made within 10 days after receipt of goods.
6. All prices subject to change without notice.

These units are covered by one or more of the following patents: 3,041,600; 3,244,071; other patents pending. Design details subject to change without notice.



The Bina-View Readout accepts any binary or teletype code up to six bits, does its own decoding, and displays the proper character. No auxiliary translators, relays, diodes are required.

Low Power: The Bina-View Readout may be operated with as little as 128 milliwatts per bit, four watts per set pulse. It may be driven directly from computers and other electronic equipment.

Memory: The Bina-View will continue to display the last character entered after all signal-pulse and set-pulse power has been removed. In addition, should all power be removed for any reason, such as power failure, the character information will be retained and then redisplayed when power is restored.

Optional Check Back: When required, contact closures can be provided to verify input signals. These contact closures can also be used to transmit the input signals back into the source or other related equipment.

Color Displays: Various colors in addition to white can be displayed on command. To provide any color and white, one of the bit coils is used. This provides one color and white or two colors and no white. Use of a second bit coil provides three colors and white or four colors. Each color, except for white, requires a color plate.

Optional Floating Decimal Point: A separate decimal point, which will display with any character on command, can be added to the Bina-View. It is illuminated by a separate lamp circuit and does not require a bit coil or character plate. Lamp operates at 6.3 volts, 0.3 watts, and has a 60,000-hour life.

Optional Quick-Disconnect: A quick-disconnect connector is available to permit the Bina-View to be easily unplugged and removed from equipment without disturbing wiring connections. It also permits less expensive assembly line wiring of the connector, eliminating the need for a technician to wire directly to the Bina-View.

IEE Industrial Electronic Engineers, Inc.
7720 Lemona Avenue, Van Nuys, California 91405

BINA-VIEW®

BINARY-INPUT SELF-DECODING READOUT

ACTUAL SIZE OF VIEWING SCREEN AND MAXIMUM CHARACTER HEIGHT

SPECIFICATIONS

1. Signal Input Coil

Voltage (DC)	Current (Milliamps)	Power (Watts)	Resistance (Ohms)
6 ± 10%	19 min., 28 max.	.144 nominal	250 nominal
12 ± 10%	10 min., 14 max.	.148 nominal	980 nominal
24 ± 10%	5 min., 7 max.	.128 nominal	4500 nominal

2. Set Pulse Coil

	For units with up to 12 character plates and without optional check back.			For units with up to 12 character plates and with optional check back, or 13 to 26 character plates without check back.		
Voltage (DC)	Current (Amps)	Power (Watts)	Resistance (Ohms)	Current (Amps)	Power (Watts)	Resistance (Ohms)
6	0.67	4	9	1.33	8	4.5
12	0.33	4	36	0.67	8	18.0
24	0.17	4	144	0.33	8	72.0
48	0.08	4	576	0.17	8	288.0
		*90%			*50%	

	For units with 27 to 38 character plates without optional check back, or 13 to 26 character plates with check back. For ratings up to 64 plates, consult IEE.			For units with 27 to 38 character plates with optional check back. For ratings up to 64 plates, consult IEE.		
Voltage (DC)	Current (Amps)	Power (Watts)	Resistance (Ohms)	Current (Amps)	Power (Watts)	Resistance (Ohms)
6	2.0	12	3	4.0	24	1.5
12	1.0	12	12	2.0	24	6.0
24	0.5	12	48	1.0	24	24.0
48	0.25	12	192	0.5	24	96.0
		*25%			*15%	

*Duty Cycle—Maximum Time Energized Over One-Minute Period

3. Lamps available for light source:

Lamp No.	Volts	Amps.	Watts	Hrs.	Brightness	Lamp Replacement Price Each
1855	6.3	.80	5.0	3000*	70**	.20
1886***	6.3	.90	5.9	3000*	85**	.20
1495	28.0	.30	8.4	500*	40**	.26
1414	14.0	.46	6.44	500*	80**	.25

*@ Rated Voltage
**Average character brightness for a 12 plate unit; measured in foot lamberts, using a spot-light meter.
***Recommended for optimum performance

4. Minimum Operating Time: 50 milliseconds.
5. Usable Message Area:
   Any characer or message not to exceed 1.38" H by 1.25" W. Minimum character size, .375". Maximum illuminated background area, 1.50" H by 1.30" W.
6. Number of character plates available per unit: up to 38, standard. 39 through 64 available on special order only.
7. Dimensions: $3\frac{11}{32}$" H x $1\frac{27}{32}$" W x $6\frac{27}{32}$" D.
8. Weight: $2\frac{1}{3}$ lbs. approx.
9. Life: 20 million operations of set pulse. With Check Back switch, 10 million operations.
10. Ambient temp: 160°F maximum.
11. Case: Die-cast zinc, isolated from electrical circuit.
12. Check Back switch electrical rating: 2 watts AC or 1 watt DC.

HOW THE BINA-VIEW READOUT WORKS

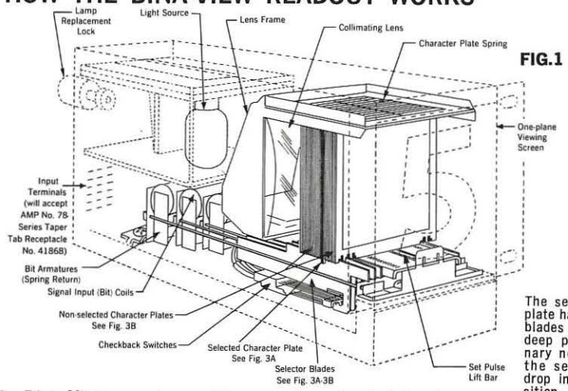
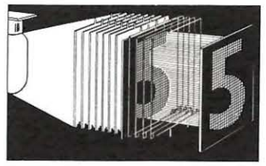


FIG.1

The **Bina-View** accepts any binary code up to six bits, does its own translating, and displays the proper character. No auxiliary translators, relays or diodes required.

FIG. 2



The Bina-View employs a light interference technique as illustrated.

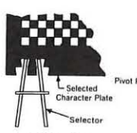


FIG. 3A

The selected character plate has all the selector blades aligned with the deep portion of the binary notching allowing the selected plate to drop into "display" position.

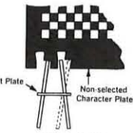
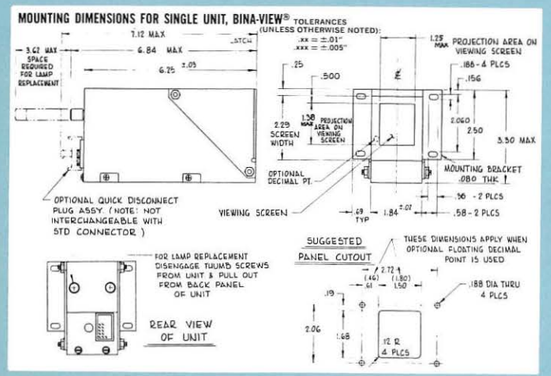
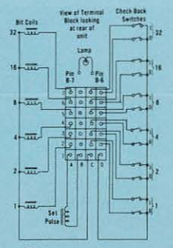


FIG. 3B

The non-selected character plates have at least one selector blade aligned with the shallow portion of the binary notching, maintaining all non-selected character plates in a lifted "non-display" position.

MOUNTING DIMENSIONS FOR SINGLE UNIT, BINA-VIEW® TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01" .xxx = ±.005"





CIRCUIT OPERATION

The Bina-View has approximately 130 to 150 milliwatt signal input coils, one per bit, and one medium-power set-pulse coil. The signal input coils decode the proper character from the binary data upon command from the set-pulse coil. The character is displayed by energizing the set-pulse coil for a minimum period of 30 milliseconds. Additional signal inputs can now be applied to the unit without disturbing the character on display. 30 ms. is the minimum duration for the set pulse, but 50 ms. is the minimum signal input time. Furthermore, at least 30 ms. of the bit pulse must be coincident with the set pulse, plus an additional 20 ms. (minimum) extending beyond the set pulse.

The Bina-View is a noncomplementary input device requiring that the coil of each bit be energized for "1." The absence of a signal allows the bit to be spring returned to the "0" state.

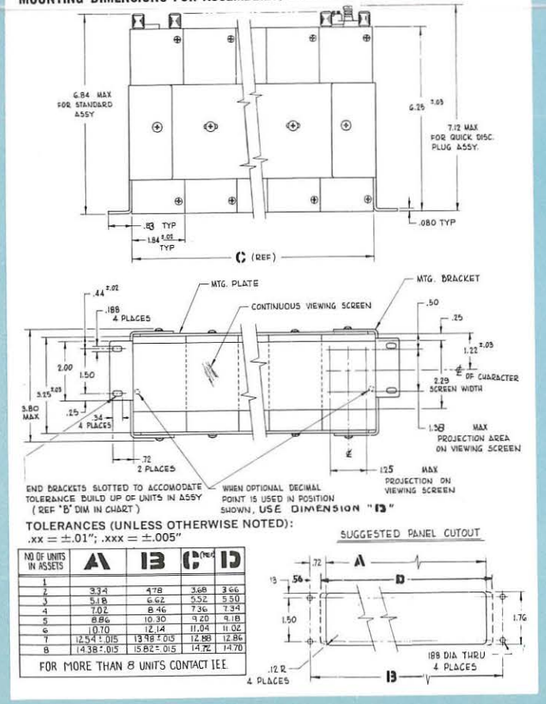
The optional Check Back switches consist of two isolated reeds per bit, making alternate contact with a common return. In operation one reed is prevented from making contact with the common, and allows the other of the pair to make contact. When the bit is selected, this situation is reversed, so that either condition of a bit may be checked both as an open and a closed circuit. During operation of the set pulse, however, all reeds make contact to the common.

NOTE: For 5 Bit Codes, coil (32) and check-back switches (32) are omitted. For 4 Bit Codes, coils (32) and (16) and Check Back switches (32) and (16) are omitted. If unit is ordered without Check Back switches, all switches are omitted.

BINA-VIEW ASSEMBLIES

Bina-View Readouts can be grouped to form in-line assemblies. A continuous viewing screen extends the full width of the assembly for ease of reading. The individual Bina-View Readouts desired should be specified by written information of what each unit should contain. The proper sequence of individual Bina-View Readouts within the assembly should be listed from left to right as seen from the viewing screen. Once IEE assigns an "assembly number" for a particular grouping of units, this number may be used for all re-orders.

MOUNTING DIMENSIONS FOR ASSEMBLIES, BINA-VIEW®



TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01"; .xxx = ±.005"

NO. OF UNITS IN ASSEMBLY	A	B	C (REF)	D
1				
2	3.34	4.78	3.68	3.46
3	5.18	6.62	5.52	5.30
4	7.02	8.46	7.36	7.14
5	8.86	10.30	9.20	8.98
6	10.70	12.14	11.04	11.02
7	12.54 ± .015	13.98 ± .015	12.88	12.86
8	14.38 ± .015	15.82 ± .015	14.72	14.70

FOR MORE THAN 8 UNITS CONTACT IEE.

SUGGESTED PANEL CUTOUT

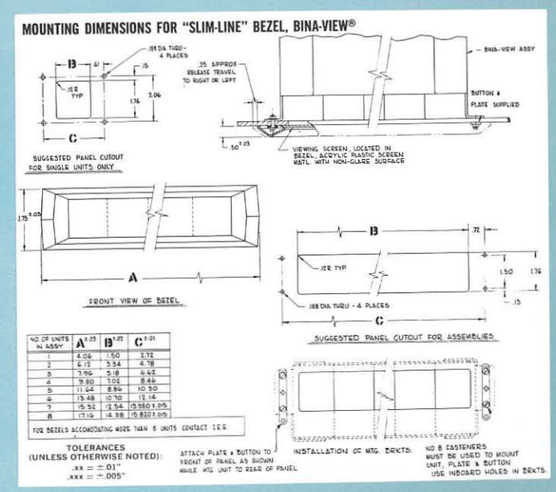
BINA-VIEW SLIM-LINE BEZELS

IEE Slim-Line Bezels permit easier, more economical mounting of readout assemblies and better-looking display panels. By eliminating the need for costly, precise panel cutouts, the bezels often pay for themselves.

Bezels are attached entirely from the front of the panel and are easily installed or removed by sliding the bezel to the left or to the right.

IEE Slim-Line Bezels come in black, pebble-finished (cycolac) plastic, which is easily cleaned with soap and water. For color and texture variations, consult the factory. Bezels are available in eight sizes to accommodate the number of readouts in the assembly.

MOUNTING DIMENSIONS FOR "SLIM-LINE" BEZEL, BINA-VIEW®



NO. OF UNITS IN ASSY	A ±.05	B ±.01	C ±.01
1	4.06	1.50	2.72
2	6.12	3.34	4.78
3	7.96	5.18	6.62
4	9.80	7.02	8.46
5	11.64	8.86	10.30
6	13.48	10.70	12.14
7	15.32	12.54 (5.980 ±.015	
8	17.16	14.38 (5.822 ±.015	

FOR BEZELS ACCOMODATING MORE THAN 8 UNITS CONTACT IEE

TOLERANCES (UNLESS OTHERWISE NOTED): .xx = ±.01" .xxx = ±.005"

ATTACH PLATE & BUTTON TO FRONT OF PANEL AS SHOWN WHILE MTG. UNIT TO REAR OF PANEL

INSTALLATION OF MTG. BRKTS.

NO SCREWS MUST BE USED TO MOUNT UNIT, PLATE & BUTTON. USE INBOARD HOLES IN BRKTS.

BINA-VIEW READOUT MESSAGE DESIGN GUIDE FOR STANDARD AND NON-STANDARD SETS OF DISPLAYS

You may select your Bina-View display message from the standard sets of displays listed on the Design Guide Order Sheet on page 44 or specify your own message to be displayed.

PRICE SCHEDULE AND ORDERING INFORMATION

DESIGNATION OF MODEL NUMBERS

Complete model numbers should be designated on all orders. An analysis of information included in a typical model number for both single units and assemblies is shown below.
When ordering, specify code and characters; signal input coil voltages; set pulse coil voltage; and lamp desired.

TYPICAL SINGLE UNIT MODEL NUMBER

KA - 6 / 12 - 001 E - 1855 - C

(A) (B) (C) (D) (H) (E) (F)

TYPICAL ASSEMBLY MODEL NUMBER

KA - 0007 - 1885 - C

(G) (E) (F)

TYPICAL MODEL NUMBER FOR ASSEMBLY WITH BEZEL

KA9-0007 - 1855 - C

(G) (E) (F)

NOTE: Because panel cut-out dimensions, installation procedures and the mounting of the common viewing screen are different for Bina-View assemblies to be used with bezels, bezels should be ordered as an integral part of the assembly.

A. Series Number used to identify unit.

B. Signal Input Coil Voltage.

C. Set-Pulse Coil Voltage.

D. Model Number for character displays used in unit (see ordering reference chart for standard Bina-View display units) page 44.

E. Lamp Number.

F. Optional Check Back Feature.

G. Number assigned by factory for a particular grouping of models. The number 9 immediately following the KA designation signifies the inclusion of a bezel with the assembly.

H. Designates Quick Disconnect Connector.

INSTRUCTIONS FOR PRICING: To determine the cost of each Bina-View display unit, start with the basic cost of the unit, which depends upon the number of bits required. Next add the cost of the total character plates in the unit, plus the cost of any optional features you desire, such as Check Back floating decimal point operated by separate lamp circuit, color, or quick disconnect mating connector.

AS AN EXAMPLE: Model 001 (0-9, + and −) would require 12 character plates. This is a 4-bit unit and the basic cost of $92.50 plus $2.00 times 12 or $116.50. For the unit to have the Check Back feature, floating decimal and the quick disconnect connector, add $27.50, $5.00, and $6.00 for a total of $155.00. To be able to display either white or a color on command, you must add a 5th bit to the unit, making the basic price $102.50 plus $24.00 for the 12 character plates and $5.50 for the color plate or a total of $132.00. Prices of other optional features must be added to this price.

PRICE SCHEDULE

QUANTITY	BASIC COST OF UNIT, LESS CHARACTER & COLOR PLATES, CHECK-BACK, FLOATING DECIMAL POINT & Q.D.						CHARACTER PLATE PRICE EACH	OPTIONAL CHECK-BACK FEATURE	ADDITION* FOR EACH COLOR PLATE	ADDITION FOR FLOATING DECIMAL POINT	ADDITION FOR QUICK DISCONNECT
	1 BIT 2 PLATES MAX.	2 BIT 4 PLATES MAX.	3 BIT 8 PLATES MAX.	4 BIT 16 PLATES MAX.	5 BIT 32 PLATES MAX.	6 BIT 38 PLATES MAX.					
1-9	$70.00	$77.50	$85.00	$92.50	$102.50	$112.50	$2.00	$27.50	$5.50	$5.00	$6.00
10-24	64.50	71.50	78.25	85.00	94.25	103.50	1.85	25.25	5.35	5.00	5.75
25-49	61.00	67.50	74.00	80.50	89.00	98.00	1.75	24.00	5.25	5.00	5.50
50-99	58.00	64.50	70.50	76.75	85.00	93.50	1.65	23.00	5.15	5.00	5.25
100-249	55.50	61.50	67.00	73.00	81.00	89.00	1.55	22.00	5.05	5.00	5.00
250-499	53.00	58.50	63.50	69.25	77.00	84.50	1.50	21.00	5.00	5.00	4.75
500-999	50.50	56.00	61.00	66.50	74.00	81.00	1.45	20.25	4.95	5.00	4.50
1,000-OVER	49.00	54.25	59.50	65.00	71.75	78.75	1.40	19.50	4.90	5.00	4.25

**To be able to display either white or a color on command, an extra bit coil is used, which can provide either 1 color and white, or 2 colors and no white. By using a second extra bit coil you can have either 3 colors and white, or 4 colors. Maximum number of bit coils is 6 and bit coils used for colors must be subtracted from those available for character selection. Each color, except for white, requires a separate color plate.

SPECIAL NOTE: The above prices apply only to the standard Bina-View models and standard characters shown on the readout message design guide reference chart for standard Bina-View display units. For special codes and/or characters not listed on the chart nor previously purchased (within the preceding 12 months), an artwork charge is necessary for each character plate: For single, full height standard style characters, $7.50; for single standard style characters less than full height, $12.50; for 2 standard style characters per plate, $12.50; for three (3) or more characters per plate, $17.50. For information on special artwork charges, consult your local representative or contact IEE directly.

QUANTITY DISCOUNTS ON EXTENDED SHIPMENTS
Quantity discounts may be applied to orders on an extended shipment basis where the following conditions are met.
1. To break an order down into more than one shipment, the order must total 100 or more display units.
2. Each shipment must equal at least 10% of the total order or 25 units (whichever is larger).
3. Shipments on a particular order must be completed within 12 months from receipt of order.
4. Quantity orders cancelled before completion will be billed at prices based on the price schedule for the number of displays actually shipped. All prices subject to change without notice.

NOTES:
1. MINIMUM BILLING—$5.00 per order.
2. F.O.B. POINT—All prices are F.O.B. our plant, Van Nuys, California.
3. TERMS: ½ of 1% 10 days; net 30 days.
4. DELIVERY—For standard display units, 6 weeks. For special display units, 8 weeks.
5. STANDARD TERMS AND CONDITIONS—"Positively no products may be returned without factory authorization. All claims must be made within 10 days after receipt of goods."

Design details subject to change without notice. These units are covered by Patent No. 3,103,007.

IEE INDICATOR ASSEMBLIES are available with up to eleven rear-projection readouts for indicating seconds, minutes, hours, days, etc. Each assembly is packaged in an attractive housing with a common viewing screen for the readouts. By using the adjustable mounting bracket, these Indicator Assemblies can be mounted in almost any location: desk, wall, ceiling, or shelf. All readouts in these assemblies are prewired to a connector on the rear of the unit and are ready for installation in the customer's system. However, counting and control equipment are not supplied with the unit.

Available with either decimal or binary input, these Indicator Assemblies can be operated remotely from a central control system. Typical applications would be to indicate time-of-day, or count down, at missile launch centers, tracking stations, etc.

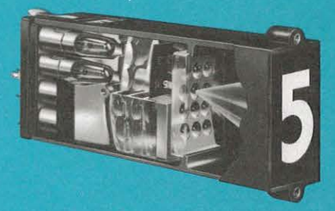
IEE Industrial Electronic Engineers, Inc.
7720 Lemona Avenue, Van Nuys, California 91405

SERIES 500

Indicator assembly for installation in customer's relay rack or cabinet.

SERIES 510

Comes complete with case and mounting brackets. Brackets are designed for either wall or ceiling mounting and will accommodate either one or two INDICATOR ASSEMBLIES.



INDICATOR ASSEMBLIES are available with any of the following IEE READOUTS: Series 10 rear-projection readouts, which have a maximum character height of 1"; Series 120 rear-projection readouts, which have a maximum character height of .59"; Series 220 rear-projection readouts, which have a maximum character height of .59" and provide a front-plug-in capability for front panel accessibility; and Series 360 rear-projection readouts, which have a maximum character height of 2". For specifications on any of the above listed IEE rear-projection readouts refer to the catalog pages on each individual unit.

FOR PRICE SCHEDULE, ORDERING INFORMATION AND SPECIFICATIONS ON INDIVIDUAL APPLICATIONS, CONSULT IEE.

READOUT MESSAGE DESIGN GUIDE ORDER SHEET FOR BINA-VIEW DISPLAY UNITS ONLY

From the chart to the right, you can order the standard Bina-View displays indicated or you can specify your own display by following the instructions listed below.

You may print your readout message information on a duplicate copy of this page or contact your local IEE Sales Representative, or IEE directly for extra sheets.

NOTE: Unless it is absolutely essential for you to specify the exact size of the message characters to be used, IEE will assist you by selecting the best possible size for your individual readout message application.

INSTRUCTIONS FOR USE:

1. Indicate the Bit Coil, Set Coil, Character Height, and the Lamp Number to be used with this unit.
2. Determine the character or message to be used with each code.
3. Now write in the character or message desired for each code in the space provided in the chart to the right.
4. Indicate any remarks or special instructions.

Character Height____; Bit Coil____Volts

Set Coil____Volts; Lamp #____

Special Instructions:____

Date:____

By:____
Signature

Title

Company Name and Address:____

Refer to P.O. #____

IEE Industrial Electronic Engineers, Inc.
7720 Lemona Avenue, Van Nuys, California 91405

ORDERING REFERENCE CHART FOR STANDARD BINA-VIEW DISPLAY UNITS

	CUSTOMER MESSAGE DESIGNATION	WEIGHTED VALUE	MODEL NUMBER, CODE NAME, AND CHARACTER ASSIGNMENT																				
			001	002	003	004	005	006	007	015	017	117	118	089	090	091	093	101	119	083	105	111	126
		32-16-8-4-2-1	Pure Binary	2421	Excess Three	Cyclic Grey	7421	5421	Pure Binary		Baudot												Tele-Type
1-4 BIT INPUT		000000	0	0		0	0		0	+			0		0	0	0			0	ACV	0	
		000001	1	1		1	1	1	1	–	3	A	1		1	1	1			1	DCV	1	E
		000010	2	2		3	2	2	2			B	2		2	2	2	E		2	VOLTS	2	
		000011	3	3	0	2	3	3	3			C	3		3	3	3			3	SEC	3	A
		000100	4	4	1	7	4	4	4			D	4		4	4	4			4	OHMS	4	
		000101	5		2	6	5	0	5			E	5		5	5	5			5	CPS	5	S
		000110	6		3	4	6		6		8	F	6		6	6	6	A		6		6	I
		000111	7		4	5			7		7	G	7		7	7	7	0	½	7		7	U
		001000	8		5		7	5	8			H	8		8	8	8			8		8	
		001001	9	+	6		8	6	9			I	9		9	9	9			9		9	D
		001010		–	7		9	7			4	J	10					S		A		10	R
		001011		5	8			8				K	11						¾	B		11	J
		001100		6	9	8		9				L	12					I		C		12	N
		001101		7		9						M	13						¾	D		13	F
		001110	+	8	+	+	+	+				N	14					U		E		14	C
		001111	–	9	–	–	–	–				O	15					I		F		15	K
5 BIT INPUT MINIMUM		010000									5	P	16										T
		010001										Q	17										Z
		010010										R	18			S		D	¼				L
		010011									2	S	19	0		T			¼				W
		010100										T	20	1	A	U		R	¼				H
		010101									6	U	21	2	B	V			¾				Y
		010110									0	V	22	3	C	W		J					P
		010111									1	W	23	4	D	X		2					Q
		011000									9	X	24	5	E	Y		N	¼				O
		011001										Y	25	6	F	Z							B
		011010										Z	26	7	G			F					
		011011											27	8	H								
		011100											28	9	I			C					M
		011101											29										X
		011110											30					K					V
		011111											31					3					
6 BIT INPUT MINIMUM		100000												A			A	T					
		100001												B		J	B						3
		100010												C		K	C	Z	¼				
		100011												D		L	D						
		100100												E	J	M	E	L	½				
		100101												F	K	N	F						
		100110												G	L	O	G	W					8
		100111												H	M	P	H	4					7
		101000												I	N	Q	I	H	½				
		101001												J	O	R	J						
		101010												K	P		K	Y					4
		101011												L	Q		L						
		101100												M	R		M	P					
		101101												N			N						
		101110												O			O	Q					
		101111												P			P	5					
		110000												Q			Q	O					5
		110001												R		A	R		½				
		110010												S		B	S	B					
		110011												T		C	T						2
		110100												U		D	U	G					
		110101												V	S	E	V						6
		110110												W	T	F	W						0
		110111												X	U	G	X	6					1
		111000												Y	V	H	Y	M					9
		111001												Z	W	I	Z						
		111010													X			X					
		111011													Y								
		111100													Z			V					
		111101																					
		111110																					
		111111																7					

GUIDE TO PROPER LAMP SELECTION

1. The choice of the lamp should always be based on the environmental conditions before

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...actors being the same.

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...conditions. However, if a situation
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...not produce sufficient light at an
...wing screen, it would be possible
...e-load, and as a result reduce the
...n a voltage of two volts per lamp
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...PLAY UNITS. The unit has been
... picture photography, and for use
... that the unit cannot be subjected
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reduced by the camera, the picture is still legible. In general most applications have been quite successful. The television cameras as well as most films are red sensitive and as such pick up the image quite well as the primary color of the lamp filament is red.

- ☐ Please send an additional copy of your Readout catalog to:
- ☐ Please send a copy of your Decoder Display manual to:
- ☐ Please send a copy of your Lamp catalog to:
- ☐ Please have your Sales Representative call:

Name ____

Company ____

Title ____ Dep't. ____

Address ____

City, Zone, State ____

I would like more information about ____

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Address ____

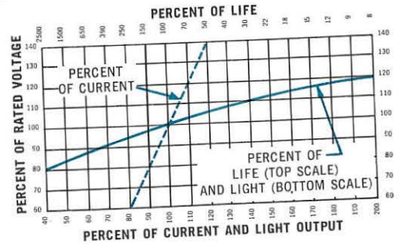
City, Zone, State ____

I would like more information about ____

6,3 volt lamp which consists of a short length of coiled wire suspended between two support wires. Of the lamps available, this is the closest to the point source, and for the power required results in the brightest projected image, and with a minimum of distortion

MINIATURE INCANDESCENT LAMP CHARACTERISTICS

LAMP CHARACTERISTICS. The following chart may be used to determine the effect on life, light output, and current when the voltage is varied above or below the rated voltage of the lamp. As the relationship of life to light output is generally the most important aspect so far as the display unit is concered, one line is used to represent both of these values, with the scale at the top representing percentage of life as compared to percentage of light output, which is represented by the scale at the bottom. As an example, if you want to see what happens when operating the lamps at 90% of rated voltage, draw a horizontal line from 90% until it intersects the "Life/Light" curve. Then draw a vertical line from this point down to the bottom scale, and you can see that you would have 70% of the light output; continuing this vertical line up to the top scale, it shows that lamp life is increased 400%. To see how reduced voltage affects current continue the horizontal line on across until it intersects the dotted line representing current. Draw a vertical line from this point down to the bottom scale, and you see that you still use 95% of the current.



READOUT MESSAGE DESIGN GUIDE ORDER SHEET FOR BINA-VIEW DISPLAY UNITS O

From the chart to the rig
order the standard Bina
plays indicated or you
your own display by fo
instructions listed below

You may print your read
information on a duplic
this page or contact you
Sales Representative, or
for extra sheets.

NOTE: Unless it is absol
tial for you to specify th
of the message character
IEE will assist you by s
best possible size for you
readout message applica

INSTRUCTIONS FOR U

1. Indicate the Bit Co
Character Height, and
Number to be used wi

2. Determine the chara
sage to be used with eac

3. Now write in the c
message desired for each
space provided in the
right.

4. Indicate any remark
instructions.

Character Height____; Bit C

Set Coil_____Volts; Lamp

Special Instructions:____

Date:_____

By:_____
Signature

_____
Title

Company Name and Address: _____

Refer to P.O. # _____

IEE Industrial Electronic Engineers, Inc.
7720 Lemona Avenue, Van Nuys, California 91405

Postage Will be Paid by Addressee

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 376, VAN NUYS, CALIF.

No Postage Stamp Necessary If Mailed in the United States

IEE Industrial Electronic Engineers, Inc.
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Van Nuys, California 91405

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ORDERING REFERENCE CHART FOR STANDARD BINA-VIEW DISPLAY UNITS

CUSTOMER MESSAGE	WEIGHTED VALUE	MODEL NUMBER, CODE NAME, AND CHARACTER ASSIGNMENT																		
		001	002	003	004	005	006	007	015	017	117	118	089	090	091	093	101	119	083	105	111	126
																						Tele-
	110100												U		D	U	G					
	110101												V	S	E	V						6
	110110												W	T	F	W						0
	110111												X	U	G	X	6					1
	111000												Y	V	H	Y	M					9
	111001												Z	W	I	Z						
	111010													X			X					
	111011													Y								
	111100													Z			V					
	111101																					
	111110																					
	111111																7					

GUIDE TO PROPER LAMP SELECTION

1. The choice of the lamp should always be based on the environmental conditions before active service as well as after.

2. Lamps designed for 6 or 6.3 volts are inherently stronger than those designed for 14 or 28 volts because the filaments are shorter and heavier, thus more resistant to shock and vibration.

3. You will get a brighter, more distinct character with less power input by using a 6 or 6.3 volt lamp, because it provides the best point source of light.

4. If noise is a problem, the 6 or 6.3 volt lamps are less likely to exaggerate the condition than the 14 or 28 volt lamps.

5. The lamps having a long life rating (5,000 hrs. or more) have a better chance to survive shock than those of the normal life rating; all other factors being the same.

6. Lamps may be operated at less than their rated voltage which will considerably extend their operating life. Although this also will decrease the character brightness, in many cases the brightness is still sufficient to warrant operating at reduced voltage to increase lamp life.

LAMP INFORMATION

LAMP SELECTION. The lamps used in the digital display unit are mass-produced items, and as such have certain manufacturing tolerances. As a result, a certain amount of lamp selection is required during our manufacturing process, and should also be expected by the customer when changing lamps in the field. This only pertains to projection type readouts, rather than a back lighted readout, such as the Status Indicator.

The procedure to follow in selecting lamps is to first examine the projected image for even illumination and for sharpness of character lines. If the quality of any of the characters is less than desired, it may in most cases be corrected by rotating the associated lamp 180° in the socket. If after re-examination no improvement is noted, then a new lamp should be installed and the process repeated. In general there are relatively few cases that cannot be corrected by simply rotating the lamp.

It should be noted that occasionally a lamp will have to be reselected in a unit that has just been received by the customer to achieve maximum sharpness of the character. This has been an infrequent occurrence, and is probably due to a slight shift in the position of a marginal lamp during shipping or installation of the unit. In any event, when a unit is received and the quality of the image is less than anticipated, it is generally wise to check the lamp selection first before making a final decision as to rejecting the unit.

INTERMITTENT OPERATION OF LAMPS. The life figures shown for each lamp are of course average values, and may vary slightly, up or down for individual lamps. The hours of life listed are for actual hours of use, and do not vary to any appreciable extent between continuous and intermittent use provided that the power source is well regulated to prevent a temporary overvoltage being applied to the lamp during the time the filament is reaching operating temperature and the correct filament resistance is attained. A poorly regulated power supply may result in a 10 or 20 percent voltage fluctuation at the time the lamp is energized and even though this will only be for a very short period of time the effect is extremely detrimental. This is substantiated by noting the curves on the chart below showing lamp characteristics.

As with vacuum tubes, the incandescent lamps tend to fail after only a very short period of operation, if they are going to fail at all prior to their rated life. Normally a very small percentage (about 1%) will fail during the first 50 to 100 hours of operation. If only a small number of display units are involved in a given installation the effect of this is negligible. However, in a large installation involving perhaps several hundred display units, there will be a short initial period where several lamps per day may fail. This is to be expected and should not be cause for alarm. Once the minimum break-in period is past, the display units should operate for extended periods with little or no failure due to lamp burn-out. In cases where the various lamps within the display are used evenly and with random distribution the unit may operate for years without additional failures.

LAMP FILAMENT DESIGN. Since the lamp filament is an important part of the projection system of the display unit, it is worthwhile to consider the filament design of the lamp in relation to the optical design of the display unit. (This does not apply to a back-lighted readout, such as the Status Indicator, which does not use a projection system.)

Basically the optical system is designed to utilize a point source of light. From a practical viewpoint a true point source is not available in the miniature lamps, and therefore the resultant efficiency of the system depends to a large extent upon how close the lamp filaments approach the desired point source of light. In the type of lamps used in the display unit, two different filament designs predominate. First is the type used in the 6.3 volt lamp which consists of a short length of coiled wire suspended between two support wires. Of the lamps available, this is the closest to the point source, and for the power required results in the brightest projected image, and with a minimum of distortion and lack of sharpness. The other type filament, used in the 28 volt lamps, consists of a much longer coiled wire that runs from a point near the glass bead out to the end of the lamp, then across the end, and finally back down the side of the lamp to a point near the bead. As a result the light available is spread out along the full length of this filament and even though there is considerably more wattage available, the optical system is focused only on a point at the top part of the filament and as such utilizes only a small portion of the light available.

An additional drawback to this type of filament is that the optical system will have a tendency to pick up light from a second point, and some sharpness of line will be lost. This can be corrected in most cases by additional lamp selection, but it is a factor to be recognized when selecting or replacing lamps in 28 volt units. The 14 volt filaments are somewhere in between the 6.3 and 28 volt filaments, and efficiency and sharpness are in the same category.

PREMATURE BLACKENING OF GLASS BULB OF LAMP. During the life of the lamp the tungsten of the filament is gradually discharged until such time as the strength is reduced to a point when the filament breaks and the lamp is said to be "burned-out". Under normal conditions there is no great decrease in the light output as the lamp ages. However, if a severe over-voltage is applied for any length of time the tungsten is actually deposited to a considerable degree on the end of the glass bulb and as such will materially reduce the transmission of light through the optical system. The projected image on the screen of the display may appear to be 20 to 30 percent dimmer under this condition, and for all practical purposes the lamps should not be used with the display. It is possible that other causes such as improper evacuation of all air during manufacture will cause discoloration of the glass bulb, but in general if any number of lamps in a display are observed to be blackened, it would be well to check the circuitry involved, as well as the history of the use of the units.

OPERATING SPEED. The maximum operating speed, that is, the fastest time that the display may change from one character to another without interference, is approximately 100 ms. This is essentially based upon the length of time required for the filament of the lamp to reach operating temperature and the length of time for the filament to cool when de-energized. Both of these times are about 50 ms. of duration. As such, the maximum number of discrete characters that may be displayed per second is ten. This is faster than the eye can follow and is certainly adequate for most conditions. However, if a situation does arise where it is necessary to record data at a higher rate, (for example, to record data with a camera) it is possible to increase this to some extent by letting the heating time of one lamp overlap the cooling time of another and thus approach the rate of 20 readings per second. In addition, since the lamp will not produce sufficient light at an applied voltage of one or two volts to show on the viewing screen, it would be possible to apply this voltage to all the lamps as a constant pre-load, and as a result reduce the heating time. This should be done with caution as even a voltage of two volts per lamp will create a reasonable quantity of heat when applied to all 12 lamps, and adequate ventilation should be provided.

PHOTOGRAPHIC AND TELEVISION USES OF DISPLAY UNITS. The unit has been successfully used both for purposes of still or motion picture photography, and for use with television cameras. There are certain limitations in that the unit cannot be subjected to the full glare of spotlights and the size of the character must be considered so that when reduced by the camera, the picture is still legible. In general most applications have been quite successful. The television cameras as well as most films are red sensitive and as such pick up the image quite well as the primary color of the lamp filament is red.

MINIATURE INCANDESCENT LAMP CHARACTERISTICS

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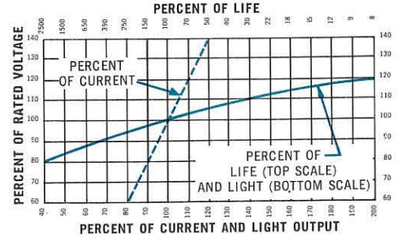

The Rand Tablet: A Man-Machine Graphical Communication Device

by M. R. DAVIS and T. O. ELLIS
The RAND Corporation
Santa Monica, California

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FIGURE 1: Complete System in Operation.

Present-day user-computer interface mechanisms provide far from optimum communication, considerably reducing the probability that full advantage is being taken of the capabilities of either the machine or of the user. A number of separate research projects are underway, aimed at investigating ways of improving the languages by which man communicates with the computer, and at developing more useful and more versatile communication channels. Several of these projects are concerned with the design of "two-dimensional or "graphical" man-computer links.

Early in the development of man-machine studies at RAND, it was felt that exploration of man's existent dexterity with a free, penlike instrument on a horizontal surface, like a pad of paper, would be fruitful. The concept of generating hand-directed, two-dimensional information on a surface not coincident with the display device (versus a "light pen") is not new and has been examined by others in the field. It is felt, however, that the stylus-tablet device developed at RAND (see Fig. 1) is a highly practical instrument, allowing further investigation of new freedoms of expression in direct communications with computers.

The RAND tablet device generates 10-bit x and 10-bit y stylus position information. It is connected to an input channel of a general-purpose computer and also to an oscilloscope display. The display control multiplexes the stylus

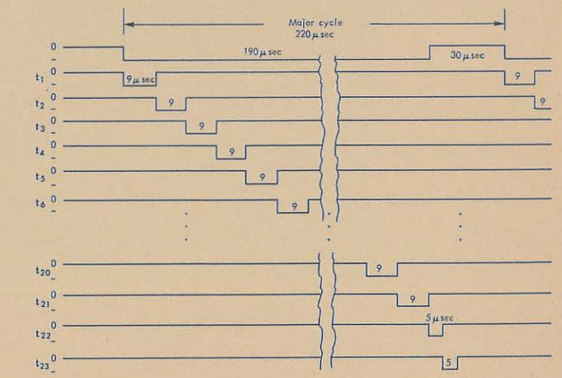


FIGURE 2: Timing Waveforms (μsec)

position information with computer-generated information in such a way that the oscilloscope display contains a composite of the current pen position (represented as a dot) and the computer output. In addition, the computer may regenerate meaningful track history on the CRT, so that while the user is writing, it appears that the pen has "ink." The displayed "ink" is visualized from the oscilloscope display while hand-directing the stylus position on the tablet, as in Fig. 1. Users normally adjust within a few minutes to the conceptual super-position of the displayed ink and the actual off-screen pen movement. There is no apparent loss of ease or speed in writing, printing, constructing arbitrary figures, or even in penning one's signature.

To maintain the "naturalness" of the pen device, a pressure-sensitive switch in the tip of the stylus indicates "stroke" or intended input information to the computer. This switch is actuated by approximately the same pressure normally used in writing with a pencil, so that strokes within described symbols are defined in a natural manner.

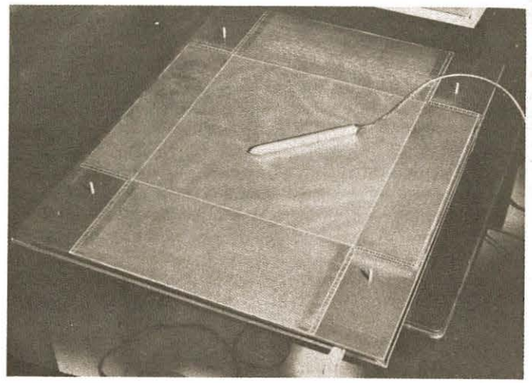


FIGURE 4: Unmounted Printed Circuit

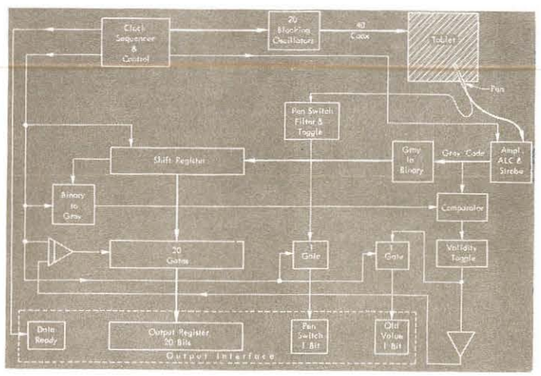


FIGURE 3: Graphic Input System Block Diagram

In addition to the many advantages of a "live pad of paper" for control and interpretive purposes, the user soon finds it very convenient to have no part of the "working" surface (the CRT) covered by the physical pen or the hand.

The gross functioning of the RAND tablet system is best illustrated through a general description of the events that occur during a major cycle (220 μsec; see timing diagram, Fig. 2). Figure 3 is the system block diagram with the information flow paths indicated by the heavier lines. The clock sequencer furnishes a time sequence of 20 pulses to the blocking oscillators. During each of the 20 timing periods, a blocking oscillator gives a coincident positive and negative pulse on two lines attached to the tablet.

The pulses are encoded by the tablet as serial (x,y) Gray-code position information which is sensed by the high-input-impedance, pen-like stylus from the epoxy-coated tablet surface. The pen is of roughly the same size, weight, and appearance as a normal fountain pen. The pen information is strobed, converted from Gray to binary code, assembled in a shift register, and gated in parallel to an interface register.

The printed-circuit, all digital tablet, complete with printed-circuit encoding, is a relatively new concept made possible economically by advances in the art of fine-line photoetching. The tablet is the hub of the graphic input system, and its physical construction and the equivalent circuit of the tablet itself will be considered before proceeding to the system detail.

The basic building material for the tablet is 0.5-mil-thick Mylar sheet clad on both sides with ½-ounce copper (approximately 0.6 mils thick). Both sides of the copper-clad

This research was supported by the Advanced Research Projects Agency under contract No. SD-79. Any views or conclusions should not be interpreted as representing the official opinion or policy of ARPA or of the RAND Corporation.

Mylar sheets are coated with photo resist, exposed to artwork patterns, and etched using standard fine-line etching techniques. The result is a printed circuit on each side of the Mylar, each side in proper registration with the other. (Accurate registration is important only in the encoder sections, as will be seen later.) Figure 4 is a photo of the printed circuit before it has been packaged. The double-sided, printed screen is cemented to a smooth, rigid substrate and sprayed with a thin coat of epoxy to provide a good wear surface and to prevent electrical contact between the stylus and the printed circuit. The writing area on the tablet is 10.24 x 10.24 in. with resolution of 100 lines per inch. The entire tablet is mounted in a metal case with only the writing area exposed, as can be seen in Fig. 1.

Although it would be very difficult to fully illustrate a 1024 x 1024-line system, it does seem necessary, for clarity, to present all the details of the system. Thus an 8 x 8-line system will be used for the system description and expansion of the concept to larger systems will be left to the reader.

Figure 5 shows the detailed, printed circuit on each side of the 0.5-mil Mylar for an 8 x 8-line system. The top circuit contains the x position lines and the two y encoder sections, while the bottom circuit has the y position lines and the two x encoder sections. It should be noted that the position lines are connected at the ends to wide, code-coupling buses. These buses are made as wide as possible in order to obtain the maximum area, since the encoding scheme depends on capacitive coupling from the encoder sections through the Mylar to these wide buses. It should be further noted that the position lines are alternately connected to wide buses on opposite ends. This gives symmetry to the tablet and minimizes the effect of registration errors.

With reference to Fig. 5, at time t_1 encoder pads p_1+ are pulsed with a positive pulse and pads p_1- are pulsed with a negative pulse. Pads p_1+ are capacitively coupled through the Mylar to y position lines y_5, y_6, y_7, and y_8, thus coupling a positive pulse to these lines. Pads p_1- are capacitively coupled to y position lines y_1, y_2, y_3, and y_4, putting a negative pulse on these lines. At time t_2, encoder pads p_2+ and p_2- are pulsed plus and minus, respectively, putting positive pulses on y position lines y_3, y_4, y_5, and y_6, and negative pulses on y position lines y_1, y_2, y_7, and y_8. At the end of time t_3, each y position line has been energized with a unique serial sequence of pulses. If positive pulses are considered as ones and negative pulses are zeroes, the Gray-pulse code appearing on the y position wires is as follows:

y_1	000
y_2	001
y_3	011
y_4	010
y_5	110
y_6	111
y_7	101
y_8	100

The x encoder pads are now sequentially pulsed at times t_1, t_5, and t_6, giving unique definitions to each x position line.

If a pen-like stylus with high input impedance is placed anywhere on the tablet, it will pick up a time sequence of six pulses, indicating the (x,y) position of the stylus. It should be pointed out again that the stylus is electrostatically coupled to the (x,y) position lines through the thin, epoxy wearcoat.

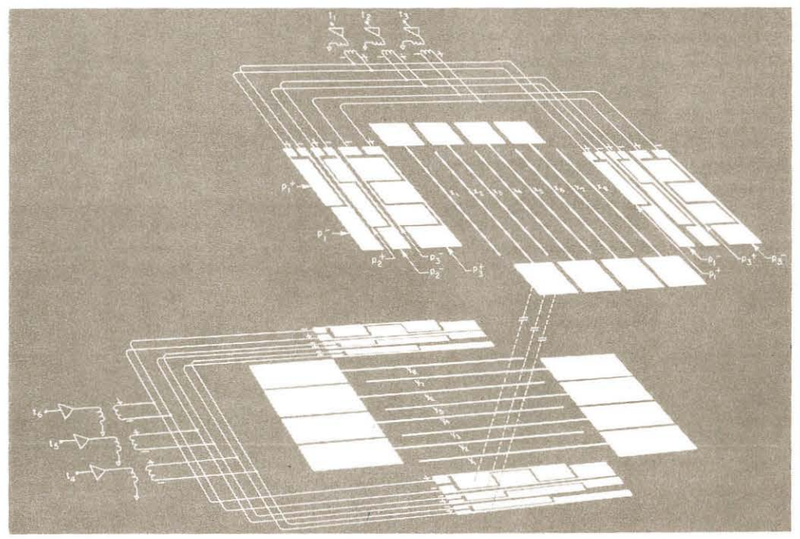


FIGURE 5: Double-sided Printed-circuit Layout for 8 x 8 System

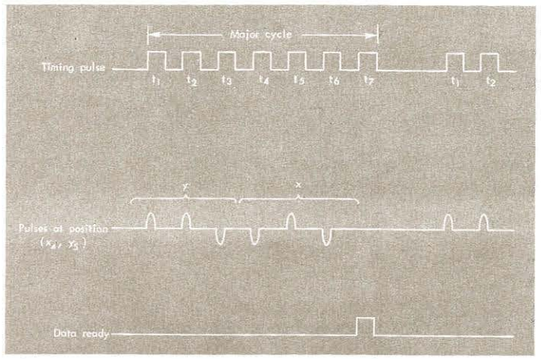
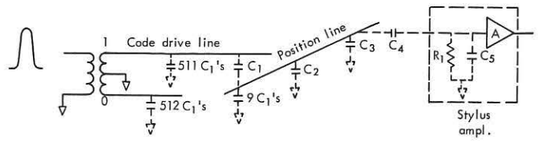


FIGURE 6: Timing Diagram and Pen Signals for the Example 8 x 8 System

If the stylus is placed on the tablet surface at a point (x_1,y_5), the pulse stream appearing at the pen tip would be as indicated in Fig. 6. This detected pulse pattern will repeat itself every major cycle as long as the stylus is held in this position. If the stylus is moved, a different pulse pattern is sensed, indicating a new (x,y) position.

Since there are 1024 x position lines and 1024 y position lines, 20 bits are required to define an (x,y) position. The actual timing used in the RAND system was shown in Fig. 2. Timing pulses t_{21}, t_{22}, and 2_{23} are additional pulses used for bookkeeping and data manipulation at the end of each major cycle.

The position lines on the full-size tablet are 3 mils wide with a 7-mil separation. The code-coupling pads are 16 to 17 mils wide with a 3- to 4-mil separation. Figure 4 shows that the encoding pads which couple to the lower set of position lines (y position lines) are enlarged. This greater coupling area increases the signal on the lower lines to compensate for the loss caused by the shielding effect on the upper lines (since they lie between the lower lines and the stylus pick-up). The encoding pad for the two least-significant bits in both x and y was also enlarged to offset the effect of neighboring-line cancellations. With these compensations, all pulses received at the stylus tip are of approximately the same amplitude.



C_1 = Encoder pad coupling capacity ~ 5 pf
C_2 = Capacity to adjacent parallel wires in tablet ~ 10 pf
C_3 = Capacity to crossing lines in screen ~ 100 pf
C_4 = Stylus-to-tablet coupling capacity ~ .5 pf
C_5 = Stylus input shunt capacity ~ 5 pf
R = Stylus input resistance ~ 200 KΩ

FIGURE 7: Equivalent Circuit of Encoder-Tablet-Stylus Coupling and Attenuating Elements.

Figure 7 is an illustration of the approximate equivalent circuit of the encoder-tablet-stylus system, along with typical system parameter values. It is clear that the values of C_1 vary with encoder-pad size, and the value C_4 varies according to whether top or bottom lines are being considered. The value of C_4 is also dependent on the stylus-tip geometry and wear-coat thickness of the tablet. The signals arriving at the input to the stylus amplifier are approximately 1/300 of the drive-line signals. The character of the signals at the stylus input is greatly dependent on the drive-pulse rise time.

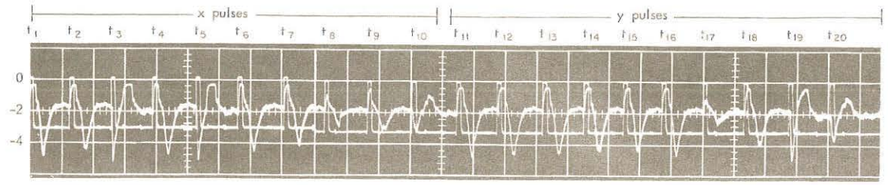


FIGURE 8: Oscillogram of Pen Signal and Strobe

Figure 8 is an oscilloscope pattern of the amplified signals at the stylus output.† These signals are amplified again and strobed into a Gray-code toggle. An x bit at t_8 and a y bit at t_{17} are smaller than the rest. This indicates that the stylus tip is somewhere between lines and these are the bits that are changing.

Since the final stages of the amplification and the strobing circuit are dc-coupled, the system is vulnerable to shift in the dc signal level. For this reason, an automatic level control (ALC) circuit has been provided to insure maximum recognizability of signals. During the first 180 μsec of a major cycle, the stylus is picking up bits from the tablet. During the last 40 μsec, the tablet is quiet — i.e., the stylus is at its quiescent level. During this 40-μsec interval, the quiescent level of the pen is strobed into the ALC toggle. If the quiescent level is recognized as a zero, the ALC condenser changes slowly into the proper direction to change the recognition (via a bias circuit) to a one, and vice versa. For a perfectly balanced system, the ALC toggle would alternate between 1 and 0 with each major cycle.

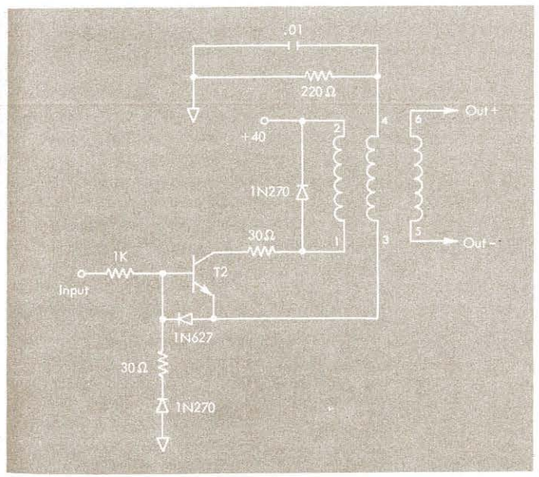


FIGURE 9: Blocking Oscillator

†It will be noted in the oscilloscope pattern of Fig. 8 that the pulsing sequence is x first and y last. This is mentioned only because it is the opposite order of that shown in the 8 x 8-line example system discussed above; otherwise, it is unimportant.

A Gray code was selected so that only one bit would change value with each wire position, giving a complete and unambiguous determination of the stylus position. Furthermore, a reflected Gray code facilitates serial conversion to binary. The conversion logic for an N-bit number, when N is the most significant bit, is:

$$\text{Binary}_N = \text{Gray}_N$$
$$B_j = (\overline{B_{j+1}} \wedge G_j) \vee (B_{j+1} \wedge \overline{G_j}) \quad . \; j < N$$

Time-wise, the bits are received from the stylus in the order $N, \ldots, j+1, j, \ldots, 1$. When all 20 bits have been assembled in the shift register, they are gated to the output register.

As a new (x,y) value is being converted to binary and shifted into one end of the shift register, the old binary value is being shifted out the other end. This old binary information is serially reconverted to Gray and compared to the new, incoming Gray value, one bit at a time. If the old Gray number and incoming Gray number differ in more than one bit in either x or y, a "validity" toggle is set to indicate an error. If the two Gray-code series differ in more than one bit, this indicates that the pen has moved more than one line during the 220-μsec interval. As this is not probable during normal usage, it is assumed that an error has occurred. If a set of data are determined as not valid, the output register is left with its previous value, and an "old-value" toggle is flagged.

The binary-to-Gray conversion logic is:

$$G_N = B_N$$
$$G_j = (\overline{B_{j+1}} \wedge B_j) \vee (B_{j+1} \wedge \overline{B_j}) \quad . \; j < N$$

In practice, the validity check rarely detects errors while the pen is in contact with the tablet. The pen validity check is used to suppress the display of the pen position as the pen is lifted off the tablet.

The logic and clock systems are made up principally with state-of-the-art NOR circuits and univibrators. The blocking-oscillator circuit shown in Fig. 9 was designed to drive the encoder pads. This use of transformer coupling was found to be important since well-matched positive and negative pulses were required to obtain proper cancellation at the tablet surface. The stylus amplifier has a gain of approximate-

ly 30 db with an additional 30-db gain in the principal electronic package.

The total electronic system is assembled in a 5" X 5" X 19" printed-circuit card cage and contains some 400 transistors and about 220 diodes; however, little attempt has been made to minimize the number of components. Also, the electronics could be shared with a number of tablets in a multiple-tablet system.

Figure 10 is a block diagram showing the graphic input-output system as used at RAND for the evaluation of hardware, human engineering studies, and investigation of programming implications. The computer used was the JOHNNIAC, a tube machine of the Princeton class.

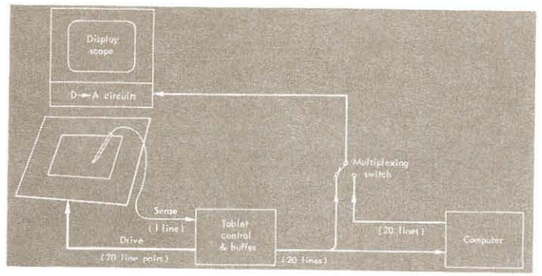


FIGURE 10: Information Paths in Graphic I/O System

Preliminary studies indicate that with a great amount of care in construction, a 200-line-per-inch tablet could be achieved. The resolution of this line density would not present a major problem; on the other hand, 100 lines per inch is adequate for all current intended applications.

It is certainly within the state of the art to decrease the major cycle time; however, in usage at RAND, the 4.5-kc rate has been adequate. When the stylus is swept rapidly across the surface of the tablet, it has been found that an average of two or three complete sets of position data are obtained for each line. Setting the multiplexing switch (Fig. 10) to display the stylus position on the scope every 10 msec has proved adequate, and since only 50 μsec are required to display the point, 99.5 per cent of the display scope time is left for the computer.

The tablet currently is in regular use at RAND in studies toward the development of on-line graphical programming languages and on-line interaction with problem parameters. In addition to its use at RAND, several copies of the tablet have been supplied to other researchers in the field.

The tablet has been found to be particularly valuable in applications where excellent linearity and accuracy are important. Normal-thickness C.G.S. maps have been placed over the tablet to digitize contours by manual tracing with the pen.

Development of the stylus-tablet device has been carried to the point where, we feel, it represents a practical and economical tool for use in many applications. Additional application areas might be served by more development effort in directions such as providing for rear-projection of images onto the (translucent) tablet panel, provision for use of more than one sensing element, extension of the surface dimensions, etc.

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THE AUTHOR

THOMAS O. ELLIS received the M.S. degree from the University of California at Los Angeles in 1953. He joined the Computer Sciences Department at The RAND Corporation in 1953, where has has since been active in the research and design of computers and on-line systems. These have included such projects as JOHNNIAC, JOSS, the RAND Tablet, several display systems, and GRAIL — an experiment in graphical man-machine communication techniques. Mr. Ellis is a member of Tau Beta Pi, Sigma Xi, and IEEE.

THE AUTHOR

MALCOLM R. DAVIS received his B.S. degree in Engineering from the University of California at Los Angeles in 1954. He attended graduate school at U.C.L.A. for one year prior to joining The RAND Corporation where he supervised the Analog Computer laboratory. Since 1958, he has been active in the digital field, doing design of digital systems for research in man-machine interaction. He is currently head of the Hardware Group of the Computer Sciences Department at RAND. Mr. Davis is a member of Sigma Xi, IEEE, and is a past chairman of the Los Angeles chapter of the IEEE Computer Group.

New security alarm telephone system provides total prison communications

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

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

INTRODUCTION

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

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

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

Installation Operation

Let's examine the installation at the Maryland Correctional Institution, a modern maximum security prison which houses a daily average of 1,353 male inmates between 16-25 years of age. The institution's Security Alarm System is designed to provide special communications for routine operation of the prison, as well as for coping with possible emergency situations, such as fire or inmate disturbances.

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

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

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

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

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

Safeguard Systems

The Security Alarm System is under a continuous line test. Each station is continuously tested and any abnormal condition gives a visual and audio alarm at the console. For example, if a telephone is torn loose or a component

removed, the trouble station is immediately identified by the appearance of red and amber behind the corresponding status segment. Although these visual indicators remain lighted until the trouble is corrected, the audio alarm can be turned off until repairs are completed. This built-in safeguard makes the system virtually tamper-proof.

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

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

In addition, a command conference arrangement enables key administrators to call a group of pre-determined stations simultaneously. If a station is in use at the time a conference call is established, a distinctive ringing notifies the prison official that a command conference call is waiting. By hanging up and picking up the phone again, he is automatically connected to the conference call.

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

CONCLUSION

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

We have spent a tremendous amount of time studying communications, knowing that a better system can save money in personnel and enable officers to perform their duties more efficiently. Before the Security Alarm System was installed, there was some discussion that we might be better off with two separate systems — the reasoning being that one might break down and the other still be in operation. But with the communications arrangement supplied by the telephone company, we actually have a number of different systems in one, so that continuous operation is assured. For instance, one inoperative phone or system does not jeopardize the institution. We have fire and guard reporting, signals that indicate when the telephone is knocked off the hook, communications procedures which assure reaching the various staff members, a command conference as well as conventional telephone communications. Together they provide a number of ways to keep information flowing. We also found that two different types of installations can create confusion among employees at certain times. In other words, we would have to train everyone in the uses and procedures of two communications systems.

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

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

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

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

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

THE AUTHOR

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

Eighth National SID Symposium

San Francisco Meeting called "Great Success"

View of the Banquet

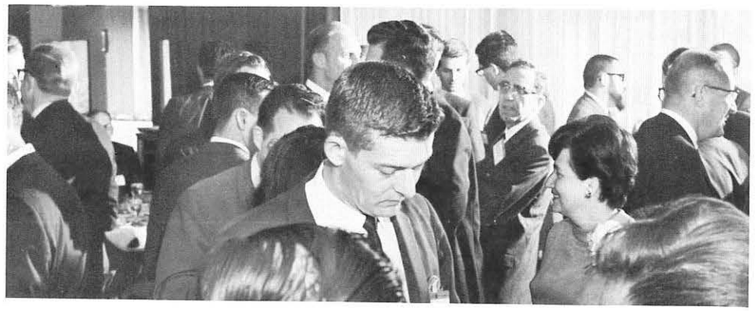
Before the Banquet members gather for a no-host cocktail hour.

Attendance ran high at the recent *SID* Eighth National Symposium, held May 24-26, 1967 at the Jack Tar Hotel in San Francisco. Chairman Donald R. Cone *(Stanford Research Institute)*, reported many favorable comments from attendees both as to overall operation of the meeting and organization of the excellent technical program.

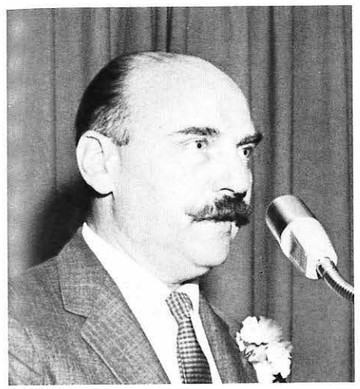
Basic theme of the Symposium was *"Modern Technology in Information Display,"* chosen in recognition of the ever-increasing impact of technology and the significant extent to which information display affects all aspects of our complex society.

Thirty papers were presented at six sessions, which were under the direction of Technical Program Chairman Jan Engel *(IBM Corp.)*. The sessions covered Display Devices, Display Materials, Display Systems and Applications (two sessions) Display Techniques, and Display Evaluation. Some twenty industrial organizations took the opportunity to exhibit and demonstrate their newest developments.

Keynote speaker Dr. Arthur L. Aden, vice president and director of R&D, Electro Optical Systems Inc., summarized the future potential, challenges and opportunities in the display field. LCDR Carl D. Drenkard, USN, Naval Systems Command, presented the Luncheon Address "The Display in Navy System Development."



William Bethke, National *SID* President



Professor Charles Susskind, University of California

Donald R. Cone, Symposium Chairman

John F. White, president of the National Educational Television association.

Banquet speaker was John F. White, president of the National Educational Television Association. Professor Charles Susskind, of the University of California, served as master of ceremonies.

An interesting addition to the program was a special evening session on "Unusual Color Techniques for Displays," at which Professor Arthur Karp *(Stanford Research Institute)* demonstrated some original Wood-Ives diffraction color photographs taken around the turn of the century. The Wood-Ives photographs are transparent collodion images which project in full color when a properly designed "spatial filter" is added to the projection system. The technique is based on a set of three interlaced diffracting gradings of different spacings, each of which has been amplitude modulated by one of three primary color separation negatives.

Byron R. Brown, *(IBM)* followed with a demonstration of modern counterparts of the Wood-Ives slides and a discussion of potential display applications of the technique.

Host chapter to the symposium was the Bay Area Chapter, whose officers are: Dr. Joseph Stafford, president; John Dusterberry, vice president; and Jim Wurtz, secretary/treasurer. The chapter consists of those members of the Society who reside in the general vicinity of San Francisco, extending from Salinas to Santa Rosa and east to Modesto. The first oragnizational meeting of the chapter was held in October of 1965, and the chapter now has some 120 members and associates.

The Banquet

INFO '68

CALL FOR PAPERS

Ninth National Symposium of the Society For Information Display

Papers are solicited for five Symposium Sessions covering the Explosion of Display Technology now occurring. Emphasis should be on Display Systems and their applications to the problems of modern society. It is desired to have five areas covered:

CIVIL
MEDICAL
MILITARY
EDUCATION
ENTERTAINMENT

This Symposium, which is sponsored by the Los Angeles Chapter of SID, will be held May 22, 23, and 24, 1968 at the Ambassador Hotel. Please send Definitive Abstracts by November 3, 1968 to:

ERWIN A. ULBRICH, JR., Papers Chairman
INFORMATION SYSTEMS SUBDIVISIONS
Douglas Space Center
5301 Bolsa Avenue
Huntington Beach, California 92646
Telephone: 714 - 897-0311, Ext. 4525

Inquiries regarding Exhibits should be directed to:

THOMAS V. CURRAN, Arrangements Chairman
Radio Corporation of America
West Coast Division
8500 Balboa Blvd.
Van Nuys, Calif.
Telephone: (213) - 894--8111, Ext. 3075

SID Activities

CHAPTER NEWS

The June meeting of the *Los Angeles Chapter* of the Society for Information Display was held at the Hughes Aircraft Company Fullerton plant following a dinner hour at the nearby Mill Restaurant. Seventy-five members and guests were hosted by our own *SID* member, Mr. Robert Knepper of Hughes.

A summary of display consoles now utilized in current Military Command and Control applications was presented by Mr. L. H. Robinson. Following this, Mr. Peter Baron reviewed three generations of Hughes TColor Data Large Screen Displays. The evening was concluded with a tour and live demonstration of various console and projection display units by Mr. W. W. Capdevielle.
— Fred Smith, *Publicity*, L. A. Chapter.

Seen in the Hughes Conference facility prior to the tour are, left to right, R. C. Knepper, P. C. Baron, both of Hughes; T. V. Curran, RCA, *SID* Chapter Program Chairman; E. Ulbrich, McDonnell Douglas, *SID* Chapter Chairman; D. Haratz, U.S. Army Electronics Command and L. H. Robinson, Hughes Marketing Manager.

The *Bay Area Chapter* successfully put on the 8th National Symposium of the Society. Judging from comments heard by the writer, everyone seemed pleased with the show. The Symposium Committee held their final meeting on June 22.

An election of officers was held for the coming year. The new officers are: John Dusterberry, NASA Ames Research Center, Chairman; Jim E. Wurtz, Litton Industries, Vice-Chairman; Don Cone, Stanford Research Institute, Secretary-Treasurer. — Jim E. Wurtz, *Publicity*, Bay Area Chapter.

NATIONAL DISPLAY APPLICATIONS SEMINAR TO BE SPONSORED BY THE WASHINGTON, D.C. CHAPTER DURING NOVEMBER 1967

1967-1977 display applications areas will be examined during the seminar to identify and characterize the relationship of man and his environment as mediated by the display interface for;

- Aerospace and Terrestrial Traffic Control
- Medicine
- Education and Library facilities
- Public Information to include real time reporting
- Communications

Information display technology appears to be at an impasse; i.e., there have been few, if any, significant hardware breakthroughs in the past five years. There are still no standards. If there is to be any meaningful activity in the field of Information Display, it is important to identify the actual and probable areas of application. Once it is well understood where and how displays can and should be used, the desired technological advances must occur.

In order to gather and publicize information pertinent to this end, the seminar will cover the present and extrapolate over the coming decade to determine where we are headed and to assess the probable impact of display technology on the public.

Program and registration information requests should be addressed to: Lewis R. Blair, Chairman, Washington, D.C. Chapter, *SID*, P.O. Box 187, Kensington, Md. 20795.

The Society wishes to welcome the following New Members:

Arthur L. Aden—*Electro-Optical Systems;* Raymond A. Airton—*General Precision Link;* Ladd J. Allen—*Hughes Aircraft FS&S;* Charles M. Alsabrook—*Texas Instruments Inc;* W. G. Ansley—*Hewlett-Packard;* James B. Armstrong—*Sperry Phoenix Co.;* David I. Binder—*Oceanside, New York;* Ray Aylsworth—*IBM Corporation;* I. Gary Bard—*Monitor Systems;* Dr. G. Octo Barnett—*Massachusetts General Hospital;* Carl G. Beatty—*IBM Corporation;* Cleveland L. Bell—*Mitre Corporation;* Eugene P. Binnall—*Lawrence Radiation Lab.;* Donald L. Blanchard—*Hughes Aircraft Company;* William S. Block—*Chicago Aerial Industries;* Betty D. Bogar—*Alameda, California;* Rodney L. Boothrayd—*Lockheed Missiles & Space Co.;* Stephen J. Bostwick—*Aerojet General;* Dean W. Boyer—*Philco-Ford;* Edward R. Brady—*Industrial Electronic Engineers;* Eric G. Breeze—*Kaiser A & E;* W. Brooks—*Brooks Optronics;* Norman H. Bryant—*U.S. Army;* John Buhr—*General Electric;* Ronald J. Burr—*Pratt & Whitney Aircraft;* David J. P. Byrd—*Philco-Ford;* Robert G. Cameron—*USAF;* Gerald Carp—*General Learning Corporation;* Ronald G. Chappel—*RCA Instructional Systems;* Robert S. Coates—*North American Aviation.*

Carter Compton Collins—*Institute of Medical Science;* Don E. Collins—*Autonetics;* John P. Coulter—*Cossor Electronics Ltd.—England;* Ann G. Cropper—*English Electric Computers Ltd.—England;* David L. Cox—*Librascope;* Leo O. Craft—*Fairchild Semiconductors;* Charles R. Craven—*General Motors;* Robert J. Creasy—*IBM Corporation;* Dan Crockett—*McDonnell-Douglas Aircraft Co.;* Allen B. J. Cuccio—*General Electric;* Dr. T. J. deBoer—*Philips Research Labs.;* Dominick DeSimone — *Hewlett-Packard;* Henry S. Donaldson—*UNIVAC;* Richard F. Dubbe—*3-M Company;* George K. Durfey—*Stanford Research Institute;* Thomas A. Enger—*Logistics Research (G.W. Univ.);* Barry M. Epstein—*Bell Telephone Labs.;* John V. Erck—*Butler Publications;* Paul J. Erdle—*Sylvania Elec. Prod;* Carl W. Ericson, Jr.—*Hughes Aircraft Co. GSG;* Paul F. Evans—*Xerox Corp.;* J. Garrett Forsythe—*E. I. duPont;* Richard S. Frary—*UNIVAC;* Donald L. Fresh—*GPI—Librascope;* Harold G. Gaidsick—*NASA Flight Res. Cntr.;* Henry E. Gazin—*Goodyear Aerospace Corp.;* Richard K. Gerlach—*Datanetics;* P. M. Giles—*Opto-Electronics—England;* Frank N. Gillette—*General Precision.*

Paul H. Gleichauf—*Stromberg-Carlson;* Theodore Gold—*Sperry Gyroscope;* W. J. Gorman—*Varrelman-Gorman Co.;* Herman Graft—*General Precision;* Stanley Graham—*Fairchild Semiconductors;* Joseph D. Grandine II—*Adage, Inc.;* Ellis Greene—*Dialight Corporation;* Richard P. Griot—*Griot Associates;* A. G. Hanlon—*NCR-ED Research;* Dr. Donald R. Haring—*MIT;* Dr. Ronald W. Harris—*Shell Development Co.;* Ralph M. Heintz—*Stanford Research Institute;* Herbert

C. Hendrickson—*Philco-Ford WDL;* Charles M. Hill—*Hewlett-Packard F&T;* Roger L. Hill—*National Bureau of Standards;* William C. Hoffman—*Hughes Aircraft Company;* James A. Horton—*Goodyear Aerospace;* Russell J. Houldin—*IBM Systems Development;* Gordon Hughes — *ICT—England;* John Hughes—*British Navy Staff;* R. O. Hungkun—*RCA Instructional Systems;* Byron G. Hunter—*ITT Federal Labs.;* Alfred G. James—*Bunker-Ramo Corporation;* Donald N. James—*Ball Bros. Res. Corp.;* Edward W. James—*E. I. duPont;* William S. Jarnagin—*Wolf Research & Development;* Edward T. Johnson—*IBM Corporation;* Floyd E. Johnson—*Honeywell Inc.;* Earl L. Jones—*U.S. Post Office, Bureau Res. & Engr.;* Warren J. Kelleher—*Zenith Radio Corp.;* Raymond G. Kenyon—*Lawrence Radiation Lab.*

Bernard Kibort—*United Airlines;* Gheen A. Kimball—*GD/Convair;* John J. Klein—*RCA—ASD;* John L. Knupp, Jr.—*Jackson Laboratory;* Gerard D. Koeijmans—*Mobil Oil Corporation;* John Lake—*Winters & Co.;* Wendell J. Lehr—*Varian Associates;* E. Lepetit—*Societe D'Etudes Des Systems D'Automation;* Guenther Leue—*GERMANY;* Wayne B. Lyon—*Illinois Tool Works Inc.;* John B. MacLeod—*NASA—FSD;* Lyle W. Mader—*Control Data Corporation;* Bruce B. Mahoney—*USNEL;* Anteo A. Marchetti—*IBM;* Vito V. Marchi—*Metra Instruments, Inc.;* Frederick John Marshall—*Litton Industries;* Jon A. Meads—*Wolf Research & Development;* Gene S. Micheli—*Naval Training Device Center;* Edward R. Millen—*Boeing Company;* John C. Mitchell—*Crocker-Citizens Bank;* F. V. Moore—*IBM Corp.;* Phillip O. Morgan—*The Rauland Corp.;* John E. Morse—*Eastman Kodak Co.;* Jon C. Mutton—*Tektronix Inc.;* Harry L. McGehee—*Xerox Corp.;* Raymond McTague—*Litton Industries;* Irvin M. McVey—*Litton Systems—DSD;* David A. Naurath—*U.S. Navy—Naval Missile Center;* James L. Nevins—*MIT Instrumentation Lab.*

Charles E. Newcomb—*IBM;* John L. Nichols—*Fairchild Semiconductors;* Lowell A. Noble—*Ii Shear;* John Opel—*General Electric;* Robert H. Norwait—*RCA—WCD;* Richard F. Overmyer—*Computer Sciences Corp.;* Everett Palmer—*Ames Research Center;* Norman W. Patrick—*RCA;* Robert A. Payne—*Stewart Warner Electronics;* Albert A. Pedicini—*Tektronix, Inc.;* David W. Phillips—*IBM Corp.;* James H. Pinkoski—*Jet Propulsion Lab;* Walter R. Prasifka—*General Dynamics;* Joseph J. Pucilowski, Jr.—*Army Electronics Command;* Robert G. Quick, Jr.—*Litton Industries;* John A. Rado—*Hughes Aircraft Co.;* Leonard G. Rich—*Gerber Scientific Inst. Co.;* Robert Rinder—*Auerbach Corp.;* Stephen P. Robinson—*D. B. Milliken Co.;* H. C. Rock—*Loral Elec. Sys.;* Meier Sadowsky—*Video Color Corp.;* Michel N. Sauvage—*CFTH-HB—FRANCE;* Allen H. Schmidt—*Harvard University;* Elmer A. Schmidt—*Pacific Missile Range;* Marvin E. Schulhof—*Tasker Industries;* Robert W. Schutz—*Honeywell, Inc.;* Richard C. Sinnott—*Sinnott Co.;* Edward S. Smierciak—*ITT;* Irwin Sobel—*(STUDENT) Stanford University;* Charles F. Spitzer—*Ampex.*

Joseph E. Stalder—*Magnavox Res. Labs.;* Harold G. Stanley—*Autonetics;* Harold H. Stern—*Philco-Ford;* John E. Stewart—*Motorola Inc.;* Samuel M. Stone—*New York;* Alfred Strohlein—*Univ. of California;* Norman F. Sullivan—*Autonetics;* Robert C. Swanson—*Teledyne Corp.;* Frank V. Thiemann—*Honeywell, Inc.;* Robert J. Towns—*Kaiser Aerospace;* Gerald L. Toyen—*GD/Convair;* Lester Turner—*Ampex;* Gilbert A. Van Dine—*Bell Telephone Labs.;* S. Snider Vick—*Ocean Technology Inc.;* Robert G. Wallstrom—*Tasker Industries;* Robert W. Waller—*Information International Inc.;* John W. Walters—*General Electric—IS;* Rolf D. Weglein—*Hughes Aircraft;* Stanley R. Weingart—*Douglas Aircraft, Missile & Space Systems;* Andrew E. Wessel—*Rand Corporation;* LaVar E. Whittle—*UTI;* Jack R. Williams—*Interstate Electronics Corp.;* Peter Wolff—*General Precision, Inc.;* E. Albert Woodin—*Massachusetts Institute of Technology;* Kenneth Zeidman—*TRW Systems.*

ID Readout

DISPLAY SYSTEMS ENGINEERING COURSE

A five-day short course will be presented August 28-September 1, 1967 at UCLA, Los Angeles, by the Engineering and Physical Sciences Extension. Two main aspects of display systems are covered: theoretical supporting disciplines and system concepts, and technological reduction to practice. The purpose of the course is to present pertinent technologies, concepts, theoretical foundations and practical applications of contributing disciplines to information display systems for engineers and scientists who are concerned with aspects of the specification, evaluation, or design of complex display systems. Instructors include R. L. Kuehn, Manager, Command Control Systems, Douglas Aircraft Co., and H. R. Luxenberg, Consultant in Information Systems, Lux Associates, and Executive Secretary, *Society for Information Display*. The fee of $225 includes textbook, "Display Systems Engineering." For information concerning the program, write or call: Engineering and Physical Sciences Extension, Room 6532, Boelter Hall, University of California, Los Angeles, Calif. 90024. (213) 478-9711, Ext. 7277 or 7178.

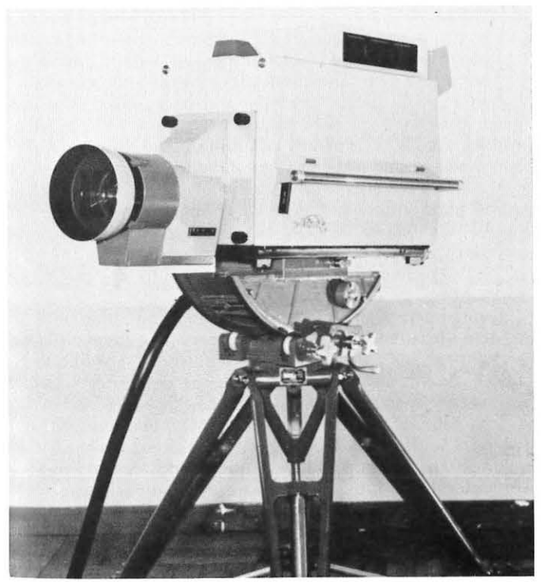
SMALL COLOR TELEVISION CAMERA

A new color TV camera, one-fourth the size and half the weight of conventional models, will go into use this summer on Japanese television, according to its developer, Tokyo Shibaura Electric Co., Ltd. (Toshiba).

The IK-37, world's lightest and smallest color TV camera, was shown at the Chicago convention of the National Association of Broadcasters in April. Toshiba is building several units to be delivered this summer to NTV, a leading Tokyo Network station.

The compact camera weighs only 109 lb. and overall dimensions are 22 in. in length, including view finder, 11 in. in width and 18½ in. in height.

Toshiba's IK-37 incorporates features never before used in the design of color TV cameras. It is a separate luminance color camera using three vidicon-type "Sensicon" tubes, newly developed by Toshiba for red, blue, and green. An image orthicon tube is used for black-and-white.



NEW TYPE RECORDER

A new type of graphic recorder, believed to be the first of its kind, has been announced by Texas Instruments, Houston, Texas. Called the "contour/riter" recorder, the instrument combines the functions of X-Y and multi-point recorders into a single unit. This permits three-input "X-Y-Z" recording on a single chart. TI uses null-balancing potentiometric drives for the "X" and "Y" axes, and a twenty-four position multipoint head for recording the "Z" axis inputs.

Initial application of the new recorder will be for material flatness plotting. Other applications currently being explored include automatic map plotting, on-line and off-line recordings of such production information as sheet thickness and moisture content in paper manufacturing, temperature hardness and thickness in metal production, radiographic plots, and other data which currently require coordination of two or more separate recordings for interpretation and use. The recording of medical information is another area where the "contour/riter" recorder can offer great advantages; plotting the path of radioactive tracers, or of RF probes, is possible with the instrument, since the X and Y axes can synchronize easily to random scan patterns, and the X axis can be used to record measured intensity of the radiation. Contour electrocardiograms, skin temperature plots, circulatory records, or any other data which may be reduced to electrical outputs, can also be plotted on the instrument.

The new recorder utilizes many engineering advancements which were originally developed for other TI display instruments. Some elements of the instrument have been field-proven for two years or more. Since these elements are used in current production model instruments, they are off-the-shelf items.

Span step response time of the X and Y axes is 5, 10 and 24 seconds standard, with accuracy ± 0.5% of full scale, and linearity ± 0.25% of full scale (maximum deviation), while deadband is ± 0.25% of full scale, maximum. Chart frame size is nominally 9.75" by 9.75" with other sizes optional. Print rate of the Z axis is once per second with digit change rate of one per second. Printing mode can be numbers only, points with numbers, or points only. Since the points are color coded, visual differentiation is convenient.

'3-D' ALTITUDE-REPORTING SYSTEM DESCRIBED

An altitude-reporting system that automatically provides an air traffic controller with a three-dimensional look at aircraft on a radar screen was described in a paper presented at the Society of Automotive Engineers business aircraft conference. Robert R. Hansen, of Bendix Instruments and Life Support Division, Davenport, Ia., said "a major advantage of the new automatic altitude-reporting system, a part of the new Beacon air traffic control system, will be the automatic appearance of aircraft altitude information on the controller's radar screen, with no voice communication necessary."

Bendix supplies major elements of the altitude-reporting equipment for the Beacon system.

Many of the commercial airlines are installing various types of altitude-reporting equipment, Hansen told the group. In new aircraft equipped with a Central Air Data System, altitude reporting is an integral function of the system; other aircraft in the commercial and business aircraft field may be equipped with an altitude computer or an altitude-reporting altimeter.

A signal from one of these instruments is also commonly used to drive a servo-pneumatic indicator with various dial

presentations. This same system may also be used to drive an all-digital, 5-digit indicator directly from the encoder signal in 100-foot increments, or segments, in order to determine directly the encoded altitude.

"To equip an aircraft for altitude reporting," the Bendix engineer said, "several pieces of airborne equipment are required. These are: a transponder equipped for receiving and transmitting altitude signals upon interrogation from the ground; and an altitude device for reporting altitude information to the transponder."

At present, installation and use of Beacon transponders and altitude reporting equipment is not required by the FAA. However, certain airline and military aircraft are now being equipped, and ground equipment is in operation at Atlanta and New York. The equipment formerly installed at Indianapolis is being moved to New York. The next installation is scheduled at Jacksonville, Fla. "Business aircraft," the Bendix engineer told the group, "for the most part have not been equipped with altitude-reporting devices, although many of them have the 4096 code Beacon transponders with altitude-reporting capability.

FLAT SOLID-STATE LIGHT DISPLAYS POSSIBLE

The field effect gallium arsenide transistor perfected at RCA may prove possible integrated, solid-state electronic circuits combining light emission and control functions to form a flat illuminate display composed of a single chip of semiconducting material. The transistor was made possible when RCA scientists used silicon nitride insulation in conjunction with that of gallium arsenide grown by a hydride-vapor-synthesis technique. Development of the gallium arsenide, metal-insulator-semiconductor field-effect transistor (MISFET) was sponsored by the Advanced Devices Div., Avionics Lab, Wright-Patterson AFB.

SMITHSONIAN INSTITUTION PREPARING SPECIAL COMPUTER EXHIBIT

The Smithsonian Institution will unveil a greatly enlarged computer exhibit in connection with the 20th anniversary conference in Washington of the Association for Computing Machinery August 29-31.

The Institution's present permanent exhibit will be augmented considerably, both in display items and space allocation, according to Dr. Uta C. Merzbach, curator of mathematical instruments. Manufacturers and individuals in the computing field are already displaying excellent cooperation in helping with exhibit material and background, she said.

Working with Dr. Merzbach are Dr. Jack Minker, chairman of the ACM program committee, and Herbert Koller, ACM advisor and program committee member.

An exhibit catalog is also being prepared, including historical notes and descriptions of computing machinery dating from antiquity to the 1950s. Both computer hardware and software will be shown.

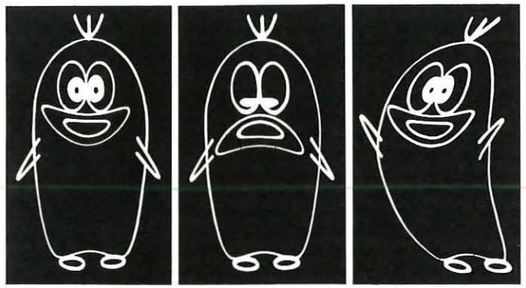
The special exhibit will remain open to the public for six months.

Approximately 5000 specialists in the computer field are expected to attend the ACM conference; the theme of "Past is Prologue" is reflected in the Smithsonian exhibit and a special ACM session wherein pioneer computer scientists will review their personal experiences in earlier years.

The Association for Computing Machinery is the professional society for 20,000 scientists and engineers who are involved in the application, design, and development of computer hardware and software. The annual conference provides the nation's professionals in computer science and technology with opportunities to communicate on significant new developments, applications, and long-range trends and affects.

CARTOONS BY COMPUTER

Oba-Q, a comic hero currently enjoying great popularity in Japan, may one day take his place alongside Mickey Mouse in the World of Fantasy as the pioneer of a whole new generation of cartoons drawn by electronic computer. The gnomelike character was used by Mr. Takeo Miura of the Hitachi Central Research Laboratory, Tokyo, Japan, to illustrate two methods of generating cartoon animation by computer. Using conventional methods, an animated cartoon only 15 minutes long is an elaborate, expensive production requiring many man-hours of effort. Thousands of pictures must be drawn by hand, each incorporating slight changes in the positions of the figures so that when photographed in sequence they will appear to move. According to Mr. Miura, the computer promises to do away with traditional film animation techniques and produce cartoons in a fraction of the time at much lower cost. One method employs an analog computer. A picture consisting of a series of closed curves is represented by mathematical equations which are programmed into the computer. Movement is created for any or all of the curves by changing the constants of their corresponding equations and displaying the results on a cathode ray tube, similar to a TV screen. When the equations are changed rapidly by the computer according to a pre-programmed format the picture appears to move. The curve representing a mouth, for example, may be turned up for a smile or down for a frown. Another curve forming a body may be twisted and turned, and smaller curves for eyes, nose, hands and feet may be wiggled or otherwise distorted to obtain a desired effect.



FALL JOINT COMPUTER CONFERENCE

The 1967 FJCC will be held in Anaheim November 14-16. Harry T. Larson, chairman of the Technical Program Committee, reports the committee has arranged for Mr. Robert Perry, of Hughes Aircraft Co., to work with FJCC authors to provide newly developed information to enable them to "design uniquely effective presentations which sustain audience interest, speed introduction of stimulating concepts, and build speaker stature." A second innovation relates to increased two-way communication between speakers and audiences, in order to explore subjects in depth. A special conference will be held for panel and discussion leaders, where tested methods will be presented by a profssional staff experienced in discussion planning and leadership.

MICROSCOPE

Memorex Corp., Santa Clara, Calif., has announced installation of the first 125-kilovolt Siemens Electron Microscope on the West Coast. The microscope, capable of magnification up to 1,600,000 times actual size, can make the head of a pin appear one mile wide. The microscope will be used by the firm in basic research, examination of incoming ingredients, in chemistry, formulation, coating, slitting, certification, packaging and in the study and development of new products. The microscope, manufactured in West Berlin, affords a most advanced means of examing microscopic detail, and is said to offer the only accurate direct measurement of small particles.

GE ADDS REMOTE PLOTTING TO TIME-SHARING SERVICE

The General Electric Co. has expanded the "conversational" features of its nationwide computer time-sharing service to accommodate remote digital plotting equipment manufactured by California Computer Products Inc., Anaheim, Calif.

The first remote plotting to be available through commercial time-sharing computer centers, it enables engineers, scientists, businessmen, and students to obtain immediate solutions to computational problems in both graphic and typewritten form without having to leave their offices.

GE and CalComp demonstrated remote plotting at the recent International Data Processing Management Association convention in Boston. According to E. L. McCleary, manager/marketing for GE's Information Service Department, the combined time-sharing service with plotting is locally available in most metropolitan areas across the country.

The CalComp system consists of a Model 210 Remote Plotter Controller and a standard CalComp 500-series plotter. The software needed to operate remote plotters was developed by CalComp and is now available from all GE Time-Sharing computer centers. The leased or purchased equipment operates with the same leased teletypewriter terminal used by subscribers of GE's time-sharing service to "talk" with a distant computer.

Problems to be solved are sent from the teletypewriter over a conventional telephone line to the computer. Output from the computer is monitored by the controller and fed to either the teletypewriter or plotter. Data intended for the plotter is first decoded in the CalComp controller and these signals drive the plotter at speeds up to 280 increments per second. If tabular output is desired, it is printed on the teletypewriter.

The remote time-sharing plotting service, McCleary said, is expected to have vast potential in scientific, engineering, financial, and business applications where graphic presentations are more meaningful than tabular arrays. In many cases, he pointed out, tabular data must be plotted manually for meaningful interpretation, as with circuit board designs, graphic test results, curve fitting, trend studies, and financial analyses.

With time-sharing plotting, data can be presented directly in graphic form with substantial savings in time and manpower, since a problem solution can be generated in minutes without long and complicated manual efforts.

PATTERN-RECOGNITION SYSTEM

Scope Inc., Falls Church, Va., has announced the first commercially available pattern-recognition system for laboratory use. "Socrates," a system designed to meet the requirements of research facilities and computer service centers, is said to be capable of separating, identifying, classifying, analyzing, rejecting or selecting at a high rate of speed in distinguishing among patterns that can be presented in graphic form. The system can be programmed to have between 2 and 504 classes or sub-classes. For the training process, samples of the desired information are presented to the system in graphic form. The system is then placed in the "recognize" mode. New patterns can be submitted as "unknowns" and the system will identify the class or grouping to which the new pattern belongs, indicating the "level of confidence" of the class assignment. Normal operations are stored internally and selected by control-panel switches. According to Scope, the entire system can be operated by a technician without specialized skills after less than a day's training.

Single-plane vacuum tube readout with ten guns, shaped beam and decimal input

by DONALD GUMPERTZ
President,
Industrial Electronics Engineers Inc.,
Van Nuys, Calif.

[This is a continuation of a feature series utilizing specially-prepared product-oriented technical articles. Such articles will be published as made available, after the Publications Chairman and Editorial Advisory Board have assessed the material and found it to have sufficient technical merit for presentation to Information Display *readers.]*

Five years of R&D has resulted in a single-plane, Vacuum Tube Readout, produced by Industrial Electronics Engineers Inc., Van Nuys, Calif., a manufacturer of rear projection readouts since 1945.

Basically, the tube is a ten-gun, shaped beam, having decimal input (10 grids — of the 10 grids, 9 must be held in the cutoff pos. and only 1 grid is turned on to project the image). The 10 guns are basically flood guns, with the tube working on the shadow-graph principle, requiring no external or internal focusing.

A single gun with a character mask and just a flood gun operates in the following manner:

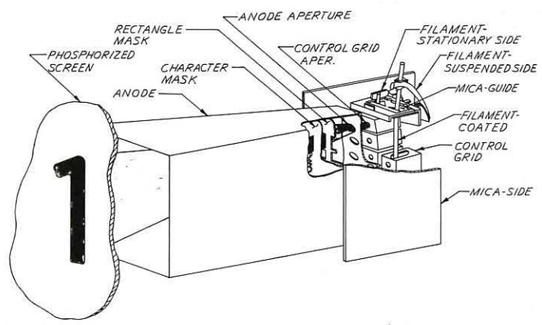
The coated filament passes through a grid cup which is brought out through a pin on the stem. It has an aperture looking out towards the screen. There is an anode in line with it having an aperture. At the far end of the tube there is a screen deposited with phosphor. Inside the grid cup is a cloud of electrons forming a virtual cathode. If the anode operates at 2.5 voltage (by means of a button on the side of the envelope) the electronic lines of force between the anode and the grid determine the direction of the cone of electrons sprayed through the aperture. If the grid is neg. with respect to filament, the grid aperture will not allow the high voltage field to dip down and pull the electrons out; it effectively "pinches" off.

If the grid is at zero volts or slightly pos. with respect to filament, it allows these electronic lines to dip down into the virtual cathode and accelerate electrons toward the screen and, due to the shape of the electron field, it makes a flood gun which floods the screen; without a character mask it would illumine the entire screen.

Since there is no change of potential inside the anode, once the electron passes the aperture in the anode, it flies in a straight line, thus giving an apparent point source about 1/64 in. behind; i.e., toward the filament from the grid aperture. In this one-gun structure a solid metal plate is interposed across the anode. It intercepts all the electrons and prevents them from reaching the screen, but if a stencil type character is cut or etched out of that metal plate, then all the electrons are intercepted except those that fly through the etched-out opening. Therefore, on the screen side of the character plate the beam is shaped and the shaped beam strikes the phosphor, causing it to fluoresce appropriately.

Although the 10 guns of the IEE product are arranged in two rows of five, it can be explained as a 2-gun structure. The 2-gun structure contains a single anode but with two apertures. Electronic lines running between the anode and each grid box are perpendicular to a line from the center axis of the grid box to the center of the screen, so that the gun is mechanically aimed toward the center of the screen.

The two cones of electrons which cover the screen overlap each other. If the character mask is put forward of the point where the cones cross they would then interfere with each other; but by positioning the character mask at a



Cut-Away diagram of the IEE Vacuum Tube Readout.

place before the crossover point, two characters can be etched so that when the gun is turned on, the electrons fly through this character mask making a "2." If gun #2 is turned off, made neg. with respect to filament, and gun #3 is turned on, then the electrons come out of this gun through the opening forming a "3."

A reason for not choosing a circular mask structure is that it will not lend itself to making a rectangular tube. However, the two rows of five characters are so designed that, in addition to fitting into a round envelope about 1⅛ in. O.D., it will also fit into a small, slightly more expensive rectangular envelope of ¾ in. max. width. A circular arrangement would also have certain cathode disadvantages.

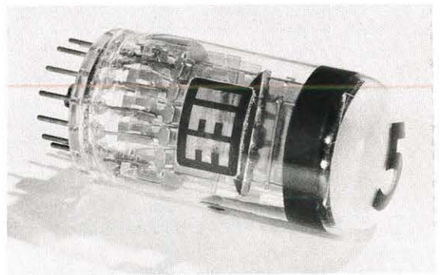
The tube is a triode and, therefore, has a fixed μ or amplification factor, so that the total control swing required on the grid is directly related to anode voltage. The greater the anode voltage the greater the neg. bias required to cut off the grids not desired to be projecting.

The filament of this tube operates at 1.1V at approximately 185mA, so that the total filament power required is 200 mw. The anode at 2500 V DC and 35 microamps, adds 90 mw making the total power dissipation of the entire tube less than 300 mw.

In the 2 rows of 5 guns, each gun points toward the center of the screen. Because a 10-volt swing is sufficient to drive a gun, the beams can be selected and driven directly from digital IC's. Current drain is under 1 nanoamp per gun.

The company supplies a high voltage supply, with the high voltage button up the side of the envelope, well removed from the logic circuitry, allowing the circuit designer to concern himself only with the logic voltages of the base. To mitigate chances of injury, there is a ½ megohm resistor in series with the high voltage, limiting the max. current that can be drawn to less than 5 milliamps.

In the standard power supply, the voltage is variable (by means of adding external resistor) and the brightness of the tube varies directly with the anode voltage. Size and focus remain uniform with variations in voltage. At 2KV anode voltage, 7 volts swing is actually adequate to operate the tube and that is 7 volts at 0 microamps, i.e., the grids take only electrostatic voltage for control and do not require any current other than leakage current, which is extremely low in value.



One of 10 flood guns operating on 10 V swing.

There are three possible methods of filament return to ground. If the filament is returned directly to ground then the grids will be cut off at —5½ volts with respect to ground, and fully turned on at +1½ volts, if the grids are then returned to ground they are biased off (being 5½ volts negative with respect to the positive filament). When the filament is returned to —1½ volts which, when it is grounded, causes it to be positive 1½ volts with respect to filament, and therefore ON, the off grids must be connected to —7 volts.

The unit features powerless control grid switching, low power consumption (approx. 300 milliwatts), small grid control swing and a wide viewing angle. Total power dissipation is 300 mW.

Brightness can be varied up to a high of 350 FL by means of a changing resistance in the anode circuit. Normal operation brightness however, is approx. 100 FL. Colors can be selected by choosing the phosphor.

Preliminary testing has revealed that the product meets shock up to 100g., vibration 10-50-10 cps at .06 DA, and MIL-I-26600 for RFI.

New Products

Photorepeaters

David W. Mann Co., Burlington, Mass., division of GCA Corp. has introduced a new, improved line of photorepeaters, the 1480 series. Designed to provide integrated circuit manufacturers with photomask production instruments having larger formats, higher resolution and greater image positional precision, the series includes a single-barrel, four-barrel and six-barrel instrument to fit a variety of production requirements. Each instrument is said to provide a new degree of positional precision of 0.00001" over an exposable area up to 2 x 2 in., as well as a larger 10X format with an image field of 120 mils sq.

Circle Reader Service Card No. 24

Digitizing System

Auto-trol Corp., Arvada, Colo., offers a new X-Y Coordinate Digitizing System. Utilizing a precisely ruled glass scale, X & Y measurements are taken from maps, engineering drawings, printed circuit layouts, and projected images. The measured coordinates are recorded, in computer compatible formats, onto punch cards, paper tape, magnetic tape, typewriter, or IBM document writing systems. Special features are offered including grid recognition for printed circuit layout, and a third coordinate for X, Y, & Z measurements in photogrammetry.

Circle Reader Service Card No. 40

Universal Graphics Processor

Concord Control Inc., Boston, announces the introduction of the Universal Graphics Processor. Designated the Mark 8, this system consists of an Automated Plotting Table joined to a modern, high-speed general purpose digital computer and may be operated in any one of the following three modes: (1) as an input tracing digitizer; (2) as an output digital plotter; (3) as both an input and output system simultaneously. The company claims the Mark 8 has numerous applications in all fields of high accuracy automatic drafting, including map making, surveying, engineering design, graphic compilation and the analysis of graphic data. The computer has a memory storage capacity of 4096 words of 12 bits each and functions as the controlling element for the system.

Circle Reader Service Card No. 41

New Indicator Lights

A new series of indicator lights is available from Dialight Corp., Brooklyn, N.Y. The series is designed for mounting in 11/16 in. clearance hole, accommodate T-2 bulb with telephone slide base (PSB type) and have a minimum lamp life of 5000 hrs. Features include a choice of five lens styles, seven lens colors and hot stamped legend markings for in color/legend identification.

Circle Reader Service Card No. 42

Bar Graph Generator

Colorado Video Inc., Boulder, Colorado, offers model 120 Bar Graph Generator to be used with standard closed circuit TV systems to provide a graphic display of 30 separate input signals in the form of a series of horizontal bars, the length of each being proportional to the associated input voltage. Features include selection of black or white bars for display, individual bar identification, expansion of individual decades to fill the entire TV screen, zero suppression, and individual input level controls.

Circle Reader Service Card No. 43

Miniature Indicator

Allard Instrument Corp., Westbury, N.Y., announces the development of miniature indicator Type 124, "the same as Type 104 but smaller." The new version is just ⅜" dia. x 1.250" long + approx 1.50" for a split hub flag mounting device. The unit is designed for use with a detachable flag or disc, fabricated to user requirements, to provide on-off signaling of circuit condition. According to the company, Type 124 is not a meter movement but a rugged electro-mechanical device using a balanced magnetic cylinder as the only moving part. It may be operated in any position and used with all types of mounting devices or brackets.

Circle Reader Service Card No. 44

Transistorized Indicator Lights

Dialight Corp. announces the introduction of a series of transistorized indicator lights for use with integrated circuits. The design has two features: (1) operates directly from standard TTL, DTL and RTL micrologic modules. (2) signal level requirements as well as the power supply voltage are completely compatible with integrated circuits, eliminating the need for special power supplies and interface circuitry.

Circle Reader Service Card No. 45

Display Storage Tube

Westinghouse Electronic Tube Division, Elmira, N.Y. announces the availability of a new high-contrast display storage tube. Designated WX-31016, the tube uses a Westinghouse-patented design that permits high-contrast operation — essentially this means that background brightness is made independent of erase duty cycle and persistence. Two electro-static focused writing guns in the WX-31016 reportedly afford the systems designer a wide range of operating modes while offering an alternate TV display.

Circle Reader Service Card No. 46

Low Evaporation Cathode

Semicon Associates Inc., Lexington, Ky., offers a new cathode, Semicon type SRLV211, which provides the emission density of the Semicon "S" cathode with 1/6 the evaporation products. According to the firm, this cathode has been proven in both laboratory and field tests; has been used succesfully in devices which exhibit frequency drift due to evaporation products collecting on the anode and in some devices which display grid emission due to excessive barium evaporation; and has also proven beneficial on cathode structures which have non-emitting end shields, center buttons or focusing rings.

Circle Reader Service Card No. 47

Display System

Data-Line Display System, an in-line modular display and control assembly, is offered by

Circle Reader Service Card No. 49

Transistor Electronics Corp., Minneapolis, Minn. The firm claims display and control functions can be intermixed in any sequence — separated by colored barriers — in an extruded aluminum frame up to four ft. long. The frame forms its own bezel and mounts in a single rectangular hole. Incandescent and neon lamps are T-1-¾ type and replaceable. Switch options offered include: 1 or 2 SPDT N.O. or N.C. switching circuits mounted behind single length button lenses and up to 4 SPDT switching circuits mounted behind double length button lenses. Contact rating is: ½ amp inductive, 1 amp resistive at 30 VAC with gold contacts; 3 amps non-inductive at 30 VAC, 5 amps at 125-250 VAC with silver contacts.

Circle Reader Service Card No. 50

Image Intensifier

Westinghouse New Products Div., Westinghouse Electric Corp., Pittsburgh, offers a two-stage image intensifier which reportedly intensifies low light level images with low distortion, high resolution, and high signal-to-noise ratio at high gains. Applications include observation of transient events and viewing under very low light level conditions. The two-stage magnetically focused image converter is designed to eliminate stray light and prevent corona. According to the firm, the intensifier can be used as a directly viewed light amplifier, or as an image amplifier when coupled to a video camera tube. The 1.5 in. dia. viewing screen is of Phosphor P-11 for optimum energy transfer to a photographic film or succeeding image tubes. Magnification is unity, and typical center resolution is 36 lines per millimeter.

Circle Reader Service Card No. 51

Communications Station

A modular remote terminal, called the CC-30 Communications Station, has been announced by Computer Communications Inc., Inglewood, Calif. The terminal is applicable both as a single remote user display and data entry station communicating over phone lines or other common carriers and as a directly computer-coupled input-output device at computer rates. The heart of the station is the CC-301 Display Controller which drives a standard television receiver or TV monitor; this makes possible the use of any TV set as a readily available computer CRT readout. It contains a high-speed buffer memory and allows interface to a computer either directly or over serial or parallel common carrier transmission paths. The manufacturer reports that optional input-output devices for either on-line or off-line data entry or printout can be attached through the controller.

Circle Reader Service Card No. 52

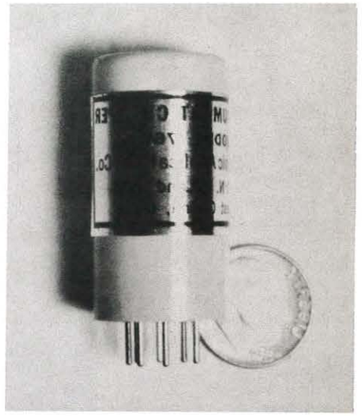
Indicator Lights

Penn Keystone Corp., Derby, Conn., offers the Peaklite Indicator Light Assembly, a simple one-piece component designed for operation in ambient temperatures from —65F to +150F. The firm claims it is sufficiently rugged to withstand the hazards of severe shock and vibration encountered in handling or the operating environment, because resilient encapsulation material cushions the lamp, removes the heat, and thermal conduction of the encapsulant lowers the bulb temperature and extends life. An insulated case provides 1000 volts rms min. isolation from the mounting and between lamp circuits of dual aperture units. Power requirements — approximately 2.5 watts total for 2 lamps (2 lamps per Indicator Light Assembly).

Circle Reader Service Card No. 53

Low Noise Level Chopper

A low noise level chopper which reportedly eliminates thermal noise is available from Electronic Applications Co., El Monte, Calif. The noise elimination is effected by using copper cored header pins and gold contacts mounted



to these pins. Magnetic coupling noise is less than one microvolt, which is achieved by shielding the drive coil from the contacts. Model 600, with a standard 7 pin plug-in header, is a direct replacement for many units now in the field. It has a standard drive voltage of 6.3 volts, 160 ohm coil with an impedance of 200 ohms and exceeds the requirements of MIL-E-5400. All units have various mounting options, terminations and top drive is available.

Circle Reader Service Card No. 54

Decoding Readout

Numex Corp., Waltham, Mass., has announced Numex Series SR-100 decoding readout assemblies. The unit provides a 1½ in. high, 250 ft.-Lamberts numerical readout. The device uses one four-element lens and a single powerful bulb to project distortion-free in-plane numerals on a wide-angle, high-contrast screen, the firm reports. Although the unit is designed to take BCD 8-4-2-1 input, any other four-bit code can be included to order. Only a standard 6.3 volt transformer is required as a power source. Optional messages of up to four lines, five characters per line, are available on special order.

Circle Reader Service Card No. 55

High Speed Printer

Shepard Laboratories Inc., Summit, N.J., offers the Model 824 Minityper High Speed Printer which is activated by a computer. After data is supplied through the information stream, the printer will, upon command, go "on-line" or "off-line," provide horizontal or vertical formatting and perform other programmed detail functions. The product is a 24 column unit, capable of printing alpha-numerics at a rate of 1200 lines per minute with a 64 character

font, full line of buffering, solid-state power supply and enclosed in a compact rack mounted pack 12½ x 19 x 22 in. The units are designed for 10,000 hours of operation.

Circle Reader Service Card No. 56

Tape Buffer

Houston Omnigraphic Corp., Bellaire, Texas, offers Model 6830, a buffer for use in selecting and presenting data read from tape readers to a Houston Omnigraphic Model 6710 Digital Plotting System. It accepts ASC II tape code. The word length on the tape may be any length between 3 and 10 digits. Reading speed is 120 characters per second maximum. The output is a controlled transfer of any three adjacent digits from a 10 digit word on the tape to the 6710 system. The reader may be stopped automatically with a null code on the tape. The 6830 uses end of tape contact closure from tape reader to sense end of tape.

Circle Reader Service Card No. 57

Operational Demonstrator

A portable, fully operative demonstrator that includes several types of lighted pushbutton switches, word indicator lights, and unlighted pushbutton and toggle switches is available from Master Specialties Co., Costa Mesa, Calif. It was designed to provide a means of quick comparison of various units under actual operating conditions, and to assist in determining proper light levels for optimum visibility under known ambient light conditions. Each series is displayed to show the key functional features, mounting methods, and wiring requirements. A master dimming switch controls light intensity, making it possible to determine the proper color filter value and intensity required

Circle Reader Service Card No. 58

Oscilloscope

Tektronix Inc., Beaverton, Ore., offers the Type 454 portable oscilloscope with 2.4-ns risetime and DC-to-150 MHz bandwidth at the probe tip. It features a 5 mV/div-dual-trace vertical, 150 MHz triggering, 5-ns/div delayed sweep and solid state design in a 31-lb instrument. 1 mV/div single-trace measurements and 5 mV/div X-Y measurements can also be made. Featured is a new CRT with distributed vertical deflection plates and a 14-kV accelerating potential. It has a 6 x 10 div viewing area, a P-31 phosphor and an illuminated, n-parallax, internal graticule. The Type C-30 and Type C-40 camera mount directly on the oscilloscope.

Circle Reader Service Card No. 59

Electronic Magnifiers

Fairchild-Du Mont Electron Tubes, N.J., has introduced electronic magnifiers and minifiers, a new development in tube technology. The tubes perform as image intensifiers and image converters as well as enlargers and reducers. Large area flat photocathodes are featured; 4 in. useful diameter for the minifier, 2 in. for the magnifier as well as flat anodes and short length to useful and overall diameter ratios. The magnifier has a magnification capability of continuously variable electrostatic magnifications from 1:1 to 1:4 with a single control; the minifier has a minification capability of 4:1.

Circle Reader Service Card No. 60

Page Printer

The Datalog div. of Litton Industries, Santa Monica, Calif., offers a high-speed alpha-numeric page printer which records over a half-million characters per minute on photosensitive paper. The MC 8800 Datalog is a CRT printer designed for compatibility with existing computers and communications equipment. It accepts data serially at a rate, consistent or varying from zero to 8800 characters per second. Although the printer uses a photosensitive paper, the printed record as it emerges is a permanent copy. The MC 8800 is said to have an MTBF of over 8000 hours, chiefly through the extensive use of integrated circuits.

Circle Reader Service Card No. 61

Incremental Plotters

Benson-Lehner, Van Nuys, Calif., offers the 8000 Series of incremental plotters, operating at the rate of 800 steps per second. The series features a resolution up to 0.0025 in. All models make use of Delta Control Logic, an exclusive engineering concept introduced by the firm to generate multiple plotting commands from a minimum of digital input. Over an average run of plotting applications, Delta Logic is said to save from 50% to 90% of computer write-time. The 8000 Series is designed to operate on-line with computer, multiplexed to a time-sharing system, or off-line with magnetic tape input. Used off-line, the plotters accept either 7-track or 9-track mag tape.

Circle Reader Service Card No. 62

Decade Counters

Veeder-Root, Hartford, Conn., offers the Veeder Decade electrical counter family of single-wheel counter modules, featuring electric reset, readout and transfer. The basic 1969 unit with decimal readout is available with or without a preset/reset function, and a subtractive version is also offered. New models consist of a binary coded decimal counter and a unit equipped with an acknowledgement switching function. The binary coded decimal model features four-line 1, 2, 4, 8 - readout. The "acknowledgement" decade utilizes a switching function to verify the account registration at a remote location. The model is also available as a subtractive version.

Circle Reader Service Card No. 63

Servo Amplifier

Westamp Inc., Santa Monica, Calif., announces Model A466 high power DC servo amplifier, designed to drive DC servo motors up to ¾ hp. Unique feature is said to be the self-contained RFI filter. The amplifier is designed to fulfull requirements for a power servo amplifier suitable for operation in adverse conditions of shock, vibration and moisture and when RFI suppression is required.

Circle Reader Service Card No. 64

CRT

A new cathode ray tube, especially designed for high frequency operations, has been developed by Electron Tube Division of General Atronics, Philadelphia, Pa. Designated the ETC Model M1252, the all-electrostatic tube has a rectangular helix and a mesh deflection system to insure superior performance in HF applications. It is flat faced with a 4 x 5 in. viewing area and features high light output at good resolution; the tube has been designed with an aluminized screen for maximum light output and minimum charging effects.

Circle Reader Service Card No. 65

Circle Reader Service Card No. 66

New Literature

Circuit Application for Photocells

"Integrated Circuit Applications for Photocells" are described in Sensor Technology's, Van Nuys, Calif., new 6-page brochure. Featured are the advantages of Silicon Photocells, the degree of performance of photovoltaic devices, illustrations, definitions of modes of operation and outlines of all other Sensor Tech products.

Circle Reader Service Card No. 67

Two New Catalogs

Two catalogs are offered by Moore Associates Inc., San Carlos, Calif. The first covers an analog voltage to pulse duration converter; the second deals with a pulse duration to digital converter. Catalog 6501B details the Marc AN/PD II; the Marc 4825 pulse duration to digital converter is covered in Catalog 5611A.

Circle Reader Service Card No. 68

Electronic Scenography

Optical Electronics Inc., Tucson, Arizona, offers Electronic Scenography Application Note 10037, "Mapping a TV image onto a Hemisphere in the Scenoscope." Described is the process whereby the plane projection of the terrestrial or lunar globe can be electronically displayed in the form of a hemisphere, containing all the features present on the original flat map or plotting board. Two such systems can be used to display the entire globe in the form of a sphere.

Circle Reader Service Card No. 69

Replaceable Cartridge Lite

Data Sheet 545 is offered by Transistor Electronics Corp., Minneapolis, Minn. Described is a compact, low cost indicator lite that plugs into a panel mounted socket for fast replacement without tools. Outline drawings are given of the Replaceable Cartridge Lite, RCL Series, which is 0.33 in. in diameter. Four styles are offered: long flat top, short flat top, flush flat top and spherical; each is available in 10 lens colors.

Circle Reader Service Card No. 70

CRT Quick Reference Guide

Westinghouse Electric Corp., Elmira, N.Y., offers a quick reference guide listing a complete line of military and industrial cathode-ray tubes for radar display, computer readout, and oscilloscope applications. The 12-page guide gives physical and electrical characteristics, including dimensions, typical operating conditions, and resolution capabilities.

Circle Reader Service Card No. 71

Computer Brochure

University Computing Co., Dallas, Texas, offers a 12-page color brochure describing the range of services and facilities available from the company. UCC operates 10 computer centers in six major cities across the nation; covered in the brochure are computing equipment, programming services, and subsidiary operations.

Circle Reader Service Card No. 72

Word Indicator Lights

A 12-page catalog detailing the Master Specialties Co. (Costa Mesa, Calif.) line of series 6000 and 7000 Roto-Tellite miniature word indicator lights is available. The small sized, 2-lamp, flush mounting lights are designed for aircraft cockpit applications as well as industrial, commercial and military requirements, the co. says.

Circle Reader Service Card No. 73

Picture Tube Data

A picture tube characteristics brochure which includes both black and white and color picture tubes has been published by Sylvania Electric Products Inc., Seneca Falls, N.Y. According to the co., extensive cross-referencing has been included to permit maximum flexibility and ease of use. "How to" handle and install TV picture tubes has been added for mechanical and electrical circuit handling.

Circle Reader Service Card No. 74

Display Plotting Brochure

A 12-page brochure from Milgo Electronic Corp., Miami, describes the DPS-6 Digital Plotting System, a total data display system which includes an X-Y plotter, an input source and supporting software. The folder illustrates typical plots for such varied applications as production scheduling graphs, highway roadbed diagrams, building component designs and schematic engineering drawings.

Circle Reader Service Card No. 75

Engineering/Procurement Catalog

A line of 243 Netic Co-Netic magnetic shields, which covers over 90% of currently manufactured photomultier tubes, is listed and described in a 12-page catalog published by Magnetic Shield Div., Chicago. The part numbering system is clearly explained and the PM tube part number and PM tube manufacturer are given with each shield part number. Engineering data includes a chart of test results at several values of magnetic field strength, design considerations, the advantages of the product, shield dimensions and a page of dimensional drawings, the firm reports.

Circle Reader Service Card No. 76

Magnetic-Memory Systems Bulletin

Ferroxcube Corp. of America, Saugerties, N.Y., has announced the publication of an 8-page brochure on its new FX-18 family of 0.5 million-bit, full control, true random access memories, with an access time of less than 4 microsec. According to the co. the bulletin demonstrates how this compact "mass memory" avoids the speed limitations and control problems usually associated with mass memories, and makes possible a practical, commercial system at a basic cost of less than 4 cents per bit. The logical organization, operating modes and control functions are described in detail and illustrated with block diagrams.

Circle Reader Service Card No. 77

Keyboard Display Data Sheet

Scientific Data Systems Inc., Los Angeles, announces a data sheet describing the model 7550/7555 multipurpose keyboard display, a self-contained input/output device that provides keyboard input and cathode-ray-tube (CRT) display for SDS Sigma computers. Included in the sheet are a physical and functional description of the unit, a user-oriented summary of operational characteristics and detailed specifications.

Circle Reader Service Card No. 78

Readout Catalog

Dialight Corp., Broklyn, N.Y., has published a catalog which offers 9 data sheets plus a portfolio cover with descriptive information on segmented readout modules. Incandescent modules for 14-16V and 24-28V AC-DC operation and Neon modules for 150-160V DC and 110-125V AC circuits are described. Specifications and a discussion of lamp performance characteristics are provided.

Circle Reader Service Card No. 79

Computer Graphics System Brochure

A specification sheet on the model 80-816A series computer graphics system is offered by Systems Engineering Laboratories, Ft. Lauderdale, Fla. The product is described in general as well as specific terms. Diagrams are included to show product with and without optional input/output processor.

Circle Reader Service Card No. 80

Indicator and Readout Lit

A complete line of transistor controlled indicators and readouts designed to operated from typical integrated circuit logic levels is available from Transistor Electronics Corp., Minneapolis, Minn. Also included is information on digital readout devices for integrated circuits, designed to operate from decimal input or from 4-wire 1,2,4,8 binary coded decimal input. In addition, small dia. subminiature indicators that offer high density packaging for use in miniaturized integrated circuit systems.

Circle Reader Service Card No. 81

Data Acquisition Systems

A 24-page brochure detailing 5 new Digital Data Acquisition Systems is offered by Vidar Corp., Mountain View, Calif. The systems described are: 5201 tabular printed tape readout, 5202 punched tape readout, 5203 magnetic tape readout, 5204 printed page with punched tape readout and 5205 punched card readout. The folder covers each system in regard to application, operations, specifications and the standard and optional components.

Circle Reader Service Card No. 82

Brochure Describes Co.

University Computing Co., Dallas, Tex., has made available a brochure describing the range of professional services and facilities at the co. The 12-page color brochure covers computing equipment, programming services and subsidiary operations. The firm's commercial and scientific applications, proprietary programming, direct access time sharing and educational seminars are described. Also noted are activities of the Academy of Computer Sciences; the Computer Leasing Co.; Technical Services Div.; and the Mortgage Systems Co.

Circle Reader Service Card No. 83

Data Processing Lit

Spatial Data Systems Inc., Goleta, Calif., announces a technical brochure which describes automatic data-processing equipment used with a plotter to make permanent "hard-copy" records, charts, graphs in 3-D. The system is described as a self-contained console, desk high, capable of automatically producing a variety of multipurposed 3-D models visible from any angle, the co states. Cover of the 4 pages devotes to photographic treatment of 3-D models under preparation and completed. The publication lists a diversity of users within such categories as aerospace, electronics, scientific research, relief mapping, civil engineering, mathematical analysis, meteorology and business economics.

Circle Reader Service Card No. 84

Pushbutton Control Catalog

Entry of Unimax Switch, Wallingford, Conn., into the field of lighted pushbutton controls has been highlighted by the publication of a 12-page brochure demonstrating the range and serviceability provided by the LPB series 9. The co. reports that the products are 4-lamp lighted pushbutton panel controls designed to meet the requirements of MIL-S-22885/9-12. They can be used either as lighted pushbutton switches or as indicator lights — with conversion accomplished by the addition or removal of a limit plate at the rear of the basic unit.

Circle Reader Service Card No. 85

Alloy Folder

Primec Corp., Los Angeles, announces a special brochure covering their new Magnetic Shielding Alloys. This technical information gives the engineer and designer a balanced choice over a wide range of coercive forces, the firm claims. The brochure further includes magnetization as well as attenuation curves, which gives the systems designer the ability to optimize and economically choose foils and sheet materials as described.

Circle Reader Service Card No. 86

Thumbwheel Switch Bulletin

The Digitran Co., Pasadena, Calif., has issued a 4-page bulletin describing the newest units in their line of thumbwheel switches. Included are the new series of sealed Digiswitches for both industrial and military applications; the miniature line of Miniswitches which are used where panel space presents a problem; and the miniature pushbutton rotary switch which permits complete panel sealing and meets MIL-S-22710A.

Circle Reader Service Card No. 87

Communications Brochure

Canoga Electronics Corp., Chatsworth, Calif., offers a brochure describing a variety of Voice/Data Communications and Switching Systems. The folder also contains information on voice communication systems including administrative telephone systems, operational voice comm systems and voice paging systems as well as miscellaneous signal, terminating and patching equipment.

Circle Reader Service Card No. 88

on the move

R. KLONFAS, Ferroxcube Corp.'s director of marketing has announced a reorganization of the firm's marketing dept. The realignment involves the sales, advertising, and linear ferrite products groups. JAN VAN DER POEL is now product manager, Linear Ferrite Products. JOHN TURNBULL, formerly manager/advertising and sales promotion, and EDWARD HELLENSCHMIDT, formerly manager, customer service have been named to new posts. Turnbull has been named manager, marketing services, a new post, while Hellenschmidt is now assistant field sales manager.

Control Data Corp.'s Computer Mfg. Operations will install ROBERT C. HALL as vp. Hall will continue his general management responsibilities for standard computer system mfg.

RICHARD GOTTARDI is the new western regional sales manager for commercial television systems at Fairchild Space & Defense Systems, Div. of Fairchild Camera & Instrument Corp. The corp.'s Du Mont Electron Tubes Div. announces the appointment of HERBERT W. COLE as marketing manager. Cole is the author of several technical articles on complex power and microwave tubes, and holds several patents.

Sensor Technology, a designer and producer of light sensitive devices, names LAWRENCE K. DUDLEY to the new position of technical business manager and A. J. FILOMENO to the post of mfg. manager.

Two senior scientists join the staff of Granger Assocs., Palo Alto, Calif. Both DR. ROBERT L. TANNER & DR. EDWARD M. T. JONES come to G/A from TRG-West, where the former was general manager and the latter was director of engineering.

Named as department manager for Wolf Research and Development Corp.'s new Computer Graphics Dept. in Boston is RICHARD P. GAGAN, formerly director of the Computer Systems Dept. in the firm's Washington Division. Mr. Gagan is currently principal investigator of an interactive display research project for NASA Goddard Space Flight Center.

JOHN L. TURNBULL

ROBERT L. TANNER

RCA's newly-formed Solid-State Receiving Tube Div., Harrison, N.J., announces six new appointments in their marketing department. Appointees include THOMAS R. HAYS, manager/sales, BENJAMIN A. JACOBY, manager/market planning — solid-state signal devices, GEORGE J. JANOFF, manager/marketing policies & administration and JOHN P. McCARTHY, manager/market planning — solid-state power devices. Also appointed are DANIEL R. OZVATH, manager/market planning — receiving tubes and PAUL P. ROUDAKOFF, manager/market planning — special electronic components.

Electro Development Corp., Seattle, Wash., announces the appointment of OTHMAR W. SAILER as vp/marketing. In this capacity Sailer will plan and supervise the corp.'s sales of instrumentation and power conversion equipment to the aerospace industry.

ROBERT FRIEDMAN is now vp/General Manager of the Dalto Electronics Corp., Norwood, N.J. A. R. TUCKER, president, made the recent announcement. Mr. Friedman was formerly assistant to the president of the Corp. and had held key engineering and management positions with the Link Group of General Precision Inc. and the Kollsman Instrument Corp.

ROBERT C. TURNER is joining Pek Inc., Sunnyvale, Calif., as field engineer. An electrical engineering graduate of No. Carolina State College, Turner will be responsible for customer technical service and applications engineering.

DR. VICTOR MAYPER, JR. is the newly appointed chief engineer of the Automatic Control & Test Dept. of Jacobi Systems Corp., Sherman Oaks, Calif. Mayper, who earned his Ph.D. in Physics at M.I.T. in 1947, was manager of Automatic Test Advanced Projects at Hughes Aircraft, and most recently was president of Mayper Associates.

Burroughs Corp. announces that E. GARY CLARK will serve as manager/systems planning for large data processing systems. Clark joined Burroughs in 1955 as a development engineer. HARRY B. ROTTIERS will assume Clark's former position as director of contracts & sales for the Defense, Space and Special Systems Group.

PAUL H. HODGE is serving as manager/information services for Memorex Corp., Santa Clara, Calif. Just prior to joining Memorex, Mr. Hodge was director/information services for Calif. Canners & Growers in San Francisco.

JOHN R. EASTLING wil assume offices in London as European general manager for Memorex Corp., Santa Clara, Calif. Eastling replaces D. JAMES GUZY, who will return to a Memorex subsidiary in a senior management position.

JOHN MESSERSCHMITT, associated with Amperex Electronic Corp. since 1957, has been promoted to executive vp and chief operating officer. In addition, he has been elected a director of the Co. Prior to his current appointment Mr. Meserschmitt served as vp and general manager of the Hicksville, N.Y. div.

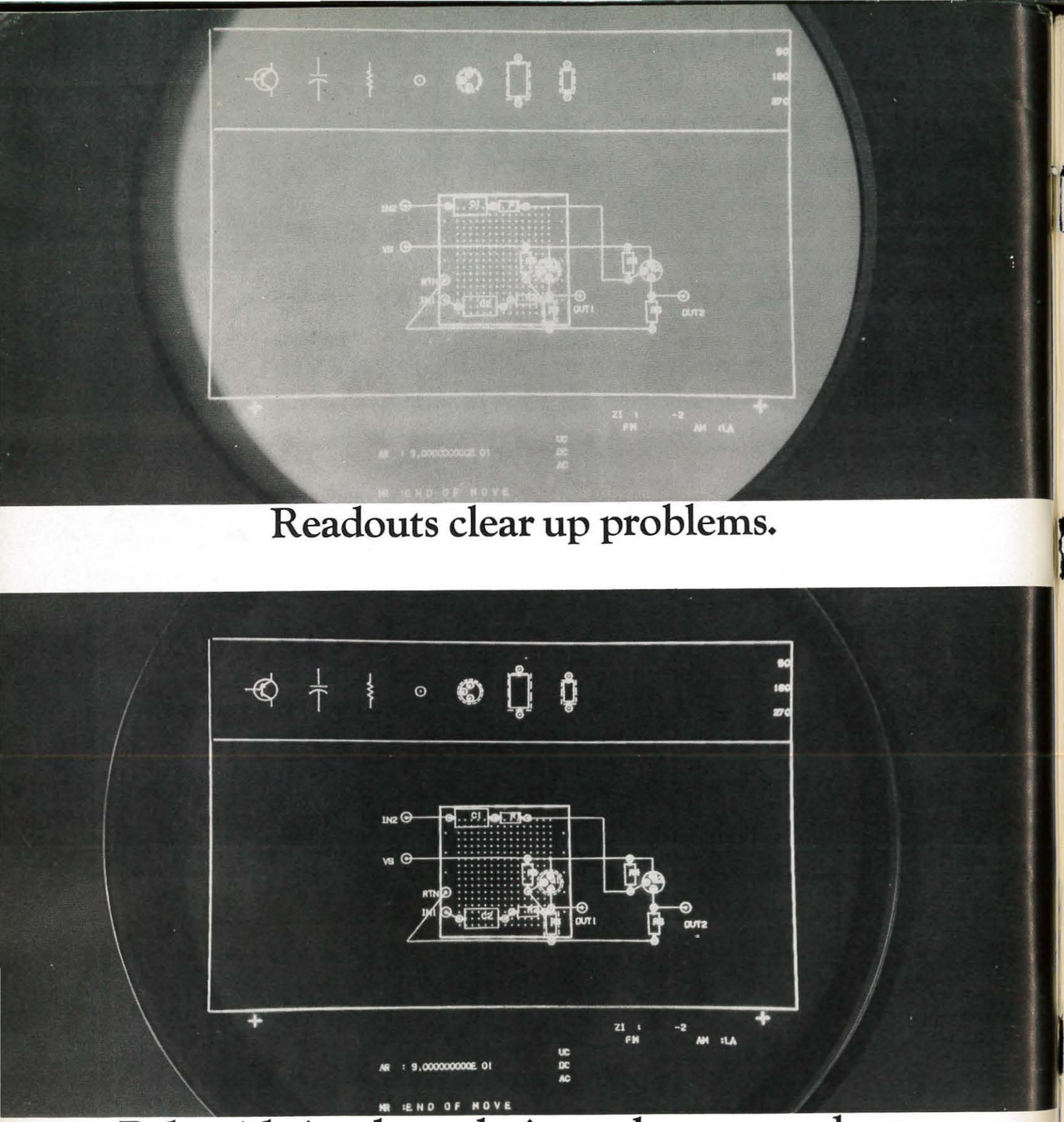
Information Displays Inc., Mt. Vernon, N.Y. is adding DAVID L. PELTZ to their staff. As product manager Peltz will have major responsibility for the Co.'s line of computer controlled display equipment and systems.

WILLIAM L. SLOVER, former eastern area marketing manager for Ampex Corp., is now marketing manager/computer products div. with headquarters in Culver City, Calif.

EUGENE D. WARREN is the newly elected vp of TNT Communications Inc., Woodside, N.Y. Prior to joining TNT in 1961, Warren was manager/effects services at CBS.

Calif. Computer Prods. Inc., Anaheim, Calif. announces the appointment of JAMES HARTSHORN as systems analyst and FRANK FLEMING as western regional manager.

C. H. LANE will serve as manager/marketing dept. of the newly-formed RCA Solid-State & Receiving Tube Div. Mr. Lane studied Chemical Engineering at Pratt Institute and is the holder of several patents relating to cathode-ray tube design. RCA's Distributor Products welcomes MORRIS S. LEWIS as manager/receiving & picture tube merchandising. In his new post, Mr. Lewis succeeds JOSEPH J. KEARNEY, now manager/distributor sales for RCA electronic components & devices.



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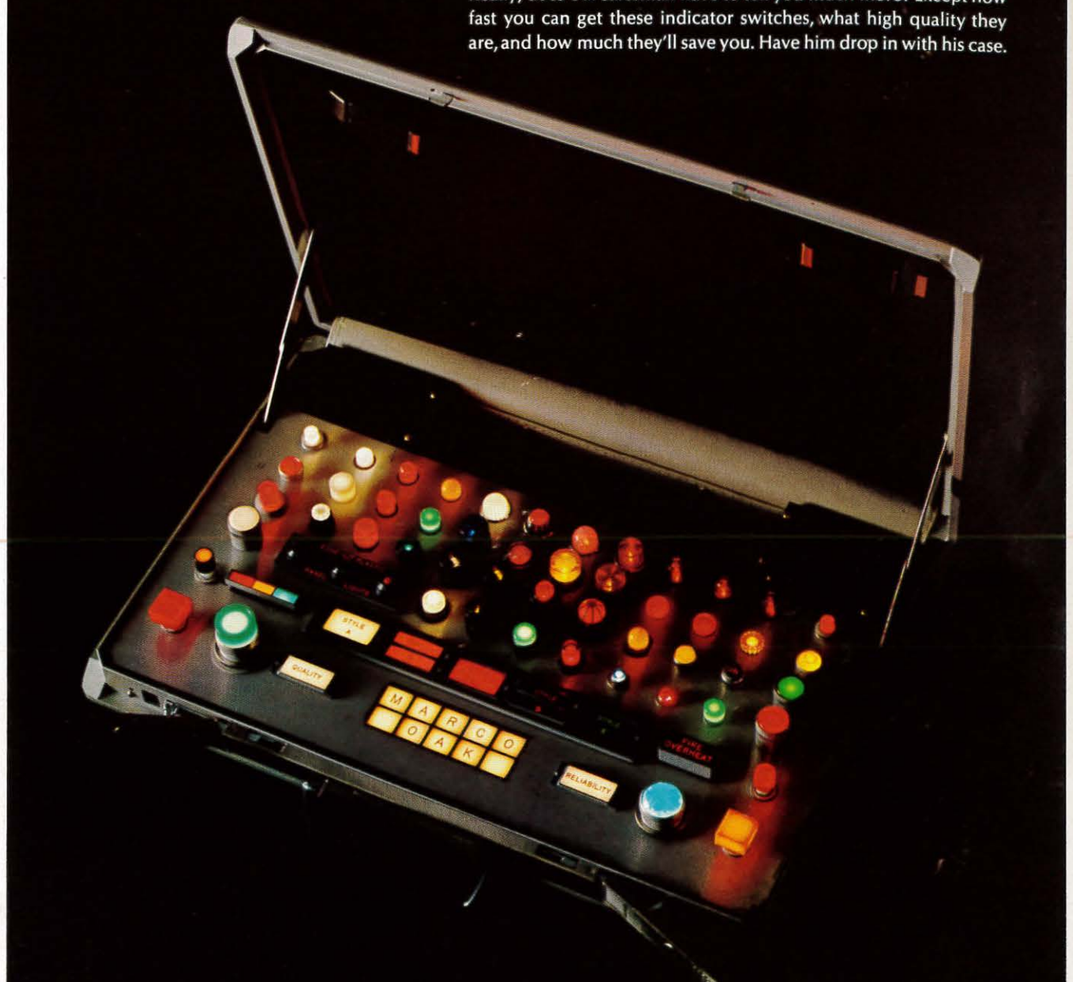

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