SID JOURNAL

The Official Journal of the Society For Information Display
Formerly INFORMATION DISPLAY JOURNAL

Driving Beam Penetration Color CRT's
By A. J. Mayle

600 Attend SID Symposium in NYC

Imagery Storage Techniques
By Robert D. Vernot

IMAGERY

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DEPARTMENTS

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ENT'S MESSAGE PRESIDENT'S ME

My attendance at the 1973 SID International Symposium served to confirm the technical excellence which was forecast by the advance program. In every way, the symposium was an outstanding success. I was particularly impressed with the very high level of professionalism of the attendees. It may sound odd for one to comment on the attendees, but I am firmly convinced that "paper quality" and "audience quality" bear a "chicken and egg" relationship to each other in that good papers are attracted to high quality audiences and vice-versa. As evidence that the annual SID meeting has arrived, I was particularly pleased to note that virtually every session was well attended, and as a surprise to some, even the last sessions on Thursday afternoon, by virtue of their excellence, continued to attract audiences of several hundred.

An important corollary to my personal attendance was the opportunity it afforded to me as President of the Society to meet with a broad cross-section of the membership on a personal face-to-face basis. In such meetings, one has an opportunity to hear about both the good and the bad. As I expected, there was virtually unanimous satisfaction with our annual symposium. The area of publications revealed both some very legitimate criticism and also some misunderstanding about the Society's publications. Since it is my strong conviction that publications represent our primary contact with the general membership, I should like to report to all of you about this important area.

First, as a general criticism, I must agree with those who are dissatisfied with the regularity of our publication schedule. This is an important and legitimate criticism; while there are many excuses which could be described, I shall say simply that I, and those concerned with publications, put as top Society priority the achievement of regular and periodic publications.

The Proceedings, our archival technical publication, is, I believe, on the verge of achieving regular publication of articles of the highest technical quality. As a result of personal discussions with Jay Brandinger, Proceedings Editor; and Erwin Ulbrich, Publications Chairman, I am able to report that our first 1973 issue should have been received by the time you read this, and that regularity of publication henceforth appears assured. While there has been some delay due to implementing the highest quality technical review cycle, I believe that it has been an important investment in the future quality of the Proceedings. It is this publication, available without cost only to our members in good standing, (for others at a subscription cost of $30/year) that is the primary technical publication of the Society.

The SID Journal, our other periodical, has an entirely different purpose: to provide not only to our membership, but the profession as a whole, articles of broad interest and currency, news items about Society functions, and survey articles of various areas of display technology. The problems of attempting to 'turn around" both of our publications simultaneously has been very difficult, but I believe we are now "around-the corner". I am concerned, however, that some members have apparently confused the different goals of our two publications, failing to recognize that the more specific, highly technical articles are more appropriate to the archival "Proceedings" than the SID Journal. There is an important place for both publications, and I would be less than frank if I did not admit that much yet remains to be done to achieve the highest possible quality in the editorial content of our Journal. The Executive Committee and the SID Editorial Board intend to devote major efforts during the coming year to this objective and I believe that each issue will show steady improvement in this regard. I ask each of you also, who feels that he has editorial material to submit, to submit it so that we may all benefit.

Dr. Carlo P. Crocetti
President

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By A. J. MAYLE
CPS, Inc.
Sunnyvale, California

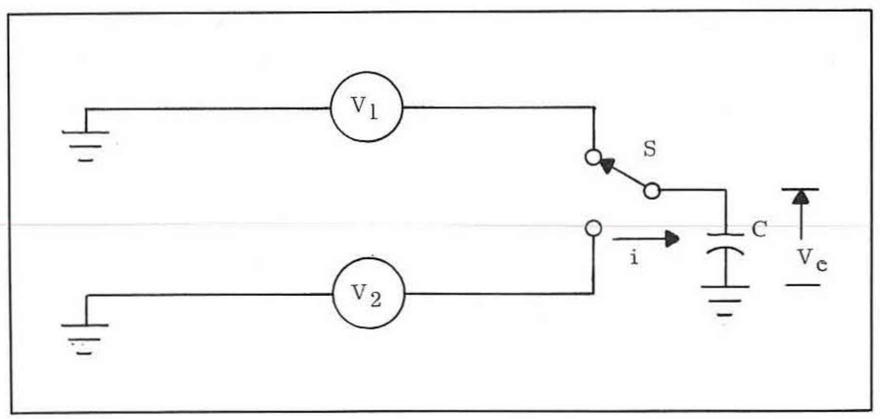
Driving Beam Penetration Color CRTs

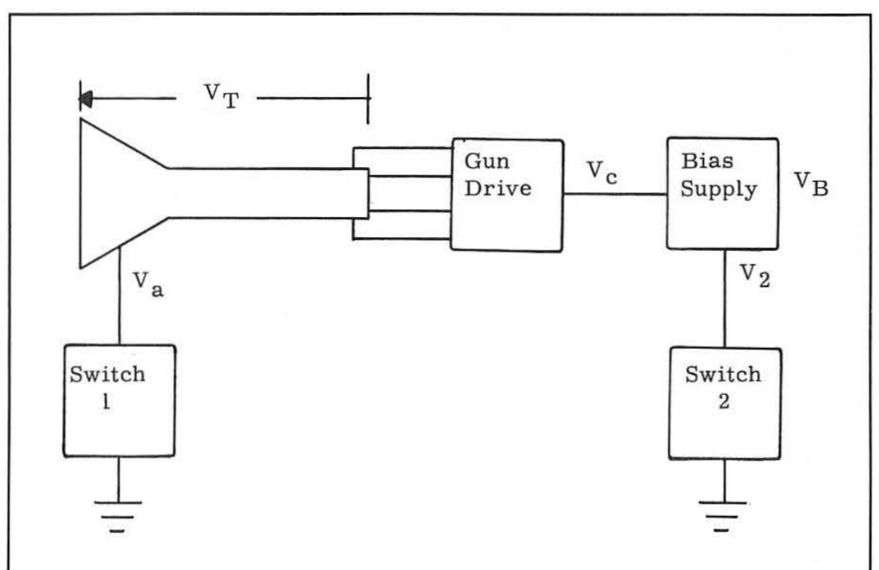
■ Currently there are two basic CRT technologies capable of producing a multicolor display. These are: (1) the mosaic phosphor technology, of which the shadow masked tube used in color TV is the most common example and (2) the beam penetration multilayer phosphor CRT.

The success of the mosaic tube in providing color television is undisputed. However, its application to computer output displays leaves much to be desired. The mosaic pattern which is not perceived when viewing color television pictures at a few meters becomes very obvious at the 30 to 100cm viewing distance typical of a CRT terminal operator.

The resolution of a mosaic display is limited to the size of the color phosphor dot pattern as each element of the image must include at least one dot of each color. For commercial TV tubes this limits line width to something greater than 1.5mm (0.060").

In the beam penetration tube each color phosphor is laid uniformly over the entire area. Basically, each color phosphor has a different energy barrier which the electron beam must penetrate to excite that color. Color is selected by adjusting the anode to cathode





CRTS CRTS CRTS CRTS

voltage to give the electron the energy which excites the desired color. Since this color is uniformly deposited across the screen, a uniform line of one color is drawn. The width of the line is limited only by the electron beam size which for visual display can be less than 0.25mm. (0.010"). Currently available penetration CRTs are capable of providing four clearly defined colors, red, orange, yellow and green.

This article discusses the basic requirements for driving beam penetration multiphosphor CRTs. It is shown how the CPS-7004 multicolor CRT Driver provides the required high voltage switching and video and focus correction. Methods for deflection correction and alternate focus correction are discussed.

Description

The multicolor CRT Driver is the result of several years of research and development. It incorporates two Energy Conservative high voltage switches, a high voltage bias supply and CRT gun supplies and drivers. High voltage is switched through 6kV and settled to ±.05% in 15μsec (500pf load). An 8kV swing at slightly longer settling time is also available. The series switches are capable of repetition rates up to 50,000 transitions per second. The design is completely solid state using standard devices. Only 4 inputs are needed to drive it. They are: (1) 2 bit word to define one of four colors, (2) 1 volt intensity signal, (3) unblank signal and (4) 115V AC at less than 3 Amps.

High Voltage Switching

A penetration CRT Driver must be capable of quickly changing the cathode to anode accelerating voltage. This can be accomplished by changing either the anode voltage, the gun operating level (cathode) or both. The CRT anode can be represented by a current source in parallel with a capacitor to ground. The current source represents the electron beam current, the capacitor the equivalent capacitance of the anode to ground. Since no information is displayed while the anode voltage is changing, the load becomes a pure capacitor during the switching time.

The Power Problem

The most obvious way to quickly change the anode voltage to several discrete levels is to use a separate power supply for each level, or one supply tapped at each level, and a set of switches to connect the anode to the desired level as shown in figure 1.

The anode represented by capacitor C is alternately connected to supplies V_1 or V_2 by switch S. Consider the case where S has been in the V_1 position so that $V_C = V_1$. To change V_C to V_2, S opens the connection to V_1 and connects C to V_2. To change V_C to V_2 a current i must flow through S to change C. During this time the voltage across S will fall from $V_2 - V_1$ to zero. Thus, the switch has a power dissipation of $i(V_2 - V_C)$ at any time during the switching period. If this power is integrated over the switching period we get the total energy dissipated in the switch E_{DS}. It can be shown that for all cases.

$$E_{DS} = \frac{(V_2 - V_1)^2 C}{2}$$

Note that the energy loss is only a

function of voltage change and the load capacitance.

To see what this means, the energy lost in switching 6kV into 500pf is

$$E_{DS} = \frac{(6x10^3)^2 x500x10^{-12}}{2} = 9x10^{-3}\text{joules}$$

If this transition is made 10,000 times a second, the power lost is $P=9x10^{-3}jx10^4/sec=90^j/sec=90$ watts

This means that any design which changes the capacitor voltage by placing a controlled conductor (be this a transistor, vacuum tube, spark gap, relay, SCR, thyratron or what have you) between the capacitor and voltage sources set at the desired output levels it must dissipate at least 90 watts when operating under the above conditions. The reason for this is the capacitor voltage can only change by integrating a current, the controlled conductor must pass this current at the same time there is a substantial voltage across it. The result is the large energy loss.

While the total energy is lost in this type of switch is not a function of the time, T, taken to change the voltage, the rate of dissipation, i.e., power, is. The power dissipated by the controlled conductor during the transition is E_{DS}/T.

For example T is 15μsec, thus

$$\frac{E_{DS}}{T} = \frac{9 \times 10^{-3}j}{15 \times 10^{-6}\text{ sec}} = 600\text{ watts}$$

The controlled conductor must be able to withstand this power surge.

The Energy Conservative Switch

To eliminate the power losses in the switches, they must be opened or closed such that either no current flows through the switch or no voltage appears across the switch when it is operated. The Energy Conservative Switch (ECS) accomplishes this. In our proprietary circuit, the theoretical losses for ideal components are zero. For real components the losses are very small.

The actual losses in the Energy Conservative Switch per transition are given by

$$E_{ECS} = V^2C_L(1\text{-}a)$$

where V is ½ the peak to peak output swing

C_L is the load capacitance

and a is $0 \leq a \leq 1$

a is a measure of the "idealness" of the E_{CS} and equals 1 for ideal components. This expression is a very useful one since "a" is easily determined from the E_{CS} output voltage waveform.

For this circuit a >.85, thus the maximum total energy lost per transition is

$$E_{ECS} = (3 \times 10^3)^2 \times 500 \times 10^{-12} \times (1 - .85) = 6.75 \times 10^{-4}\text{ joules}$$

For 10,000 transitions/sec the power loss in the E_{CS}, P_{ECS}, is

$$P_{ECS} = 6.75 \times 10^{-4}j \times 10^4/sec = 6.75\text{ watts}$$

This is less than one-tenth the power lost in the brute force switch.

Try as we did, even our E_{CS} must do a little brute force switching, because of nonideal components. However, due to the energy conservative nature of our design, it will only have to deal with (1-a)V volts instead of 2V volts. For our example, the energy lost due to this is

$$\frac{[(1\text{-}a)V]^2C}{2} = \frac{[.15(3 \times 10^3)]^2C}{2} = 50.9 \times 10^{-6}\text{ joules}$$

In such a design this typically would occur in 8μsec, thus the peak power in the device is

$$P = \frac{50.9 \times 10^{-6}j}{8 \times 10^{-6}\text{ sec}} = 6.3\text{ watts}$$

This is quite a bit better than the 600 watts of the pure brute force switches.

By A. J. MAYLE

Four Colors

The Energy Conservative Switch is basically a 2 level switch. To get four levels from 2 level switches, two switches are required. To get the proper operating levels, a high voltage bias supply is also needed.

Two switches and the bias supply can be put in series and connected to the anode of the tube. A preferred method, and the one employed is to connect one switch to the anode, and the other switch, in series with the bias supply, to the cathode. The advantages of this method are:

1. By not having the switches in series, they can operate simultaneously, reducing overall switching time.
2. The gun and its associated drive can be packaged to have much less capacitance to ground than the anode, thus the bias supply has a smaller charging current through it, simplifying its design.
3. The anode operates at an average voltage of zero, thus dust is not attracted to the faceplate of the CRT. Nor does an operator using a light pen or similar device feel a charge when touching the faceplate.
4. By dividing the total switching swing between two supplies, the anode is switched through a smaller voltage. Thus, EMI from display operation is reduced compared to all anode switching schemes.
5. By applying this technique to two or three level operations, much greater voltage swings in less time are readily achievable.

The block diagram, figure 2, shows the operating level for the

about the author

A. J. Mayle received his BSEE in 1965 from Rose Hulman Institute of Technology (formerly Rose Polytechnic Institute). He joined Singer Link in 1965 where his activities ranged from radar landmass simulation to high quality graphics computer output microfilm reading. In 1969 he joined CPS, Inc. as a Project Engineer. He is currently responsible for development of switching supplies to drive penetration CRT's and penetration CRT display systems.
Mr. Mayle has one patent pending and is a member of IEEE, Tau Beta Pi and Eta Kappa Nu.

By A. J. Mayle

penetration CRT $V_T = V_a - V_C$, where V_a is the output of switch 1 and V_C is the sum $V_2 + V_B$. V_2 is the output of switch 2 and V_B is the value of the fixed bias supply. V_a and V_2 may be either plus or minus. (See table right.)

Thus there are four operating levels at $2V_2$ volt intervals, and the total swing is $6V_2$. For this unit, $6V_2 = 6kV$, $V_2 = 1kV$ and $V_a = 2kV$. Thus with $V_B = -9kV$, V_T is 6kV, 8kV, 10kV or 12kV.

The switching time of both V_a and V_2 is 15μsec. Since they may operate simultaneously the time from any level is 15μsec.

CRT Gun Drive

The CRT gun requires both power and control. Power is required for the heater, G2, focus element and for operating the circuits which drive the grid and cathode.

Power is transmitted from ground level to the isolated gun through a high frequency transformer. Using high frequencies, above 20kHz, keeps the core size down, permits filtering with small capacitors, and puts any singing of the transformer above the audible range.

Figure 3 shows the block diagram of the gun drive. An unblank signal is transmitted from ground and applied to the CRT cathode. This cathode is driven through 60 volts in less than 50nsec with a uniform delay from ground of less than 200nsec. The intensity signal is transmitted by a 5mHz bandwidth optical coupler and drives the control grid with 50V range. When the CRT operating level is changed, the beam current must be changed to maintain a uniform intensity. This correction is applied to the control grid amplifier. The power supply provides the G2, focus element and filament power. A focus potentiometer adjusts the focus voltage from 0 to 500 with respect to the cathode. CPS's experience with driving low voltage electrostatic focused penetration CRTs indicates no adjustment of the focus is required for either level change or deflection. If some application requires this, it can be

The following table shows the possible values of V_T.

State	V_a	V_2	V_T
1	−	+	$-V_a - V_2 - V_B$
2	−	−	$-V_a + V_2 - V_B$
3	+	+	$V_a - V_2 - V_B$
4	+	−	$V_a + V_2 - V_B$

If $V_a = 2V_2$ and V_B is a negative voltage,

1	−	+	$V_B - 3V_2$
2	−	−	$V_B - V_2$
3	+	+	$V_B + V_2$
4	+	−	$V_B + 3V_2$

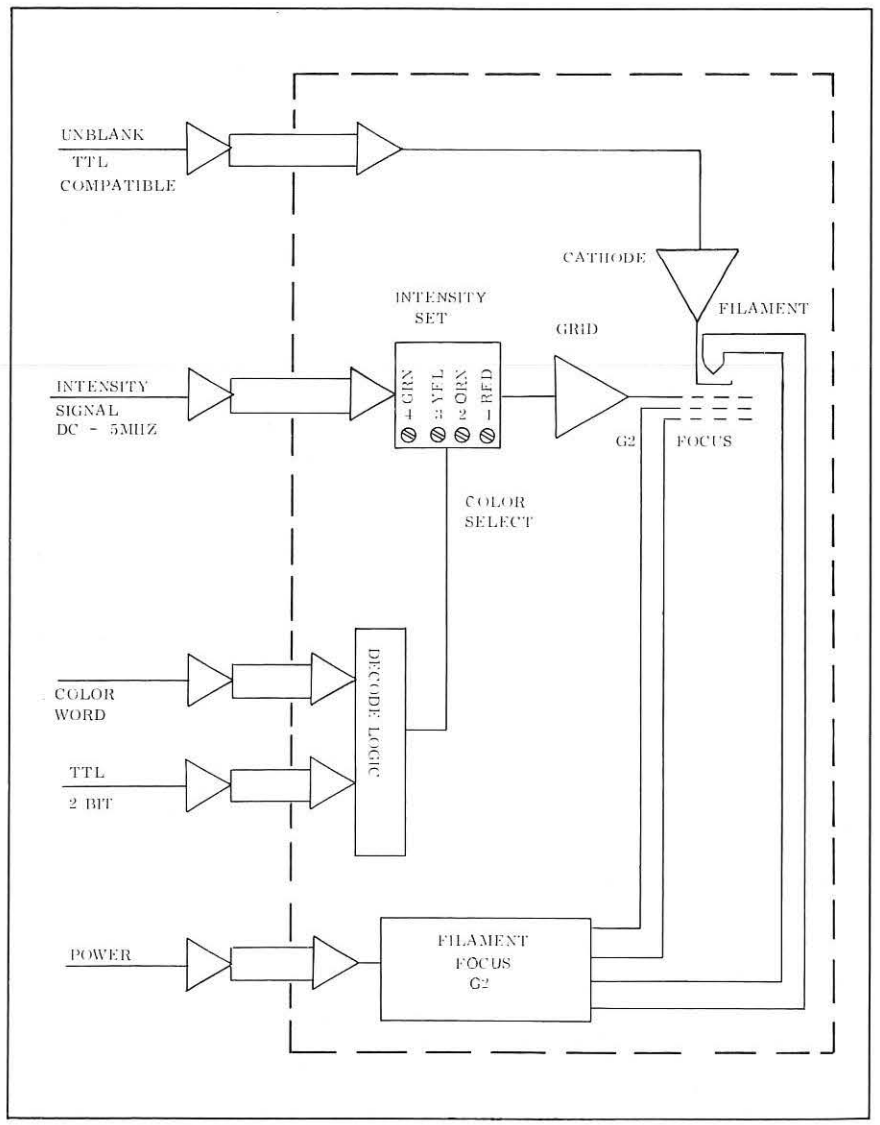


Figure 3. Storage Tube

incorporated in a modified design.

Deflection Correction
(not furnished as part of the unit)

For a magnetically deflected CRT

$$\text{Sin}\theta = \frac{KI}{V_a}$$

Where θ is the angle between an undeflected beam and the deflected beam

K is a constant determined by the coil design

I is the deflection coil current and V_a is the anode to cathode acceleration voltage.

Let I_1 be the deflection current at Va_1 and I_2 be the deflection current at Va_2. If θ is to remain the same at Va_1 and Va_2 then

$$\frac{KI_1}{Va_1} = \frac{KI_2}{Va_2} => \frac{I_2}{I_1} = \frac{Va_2}{Va_1}$$

To keep the same deflection angle at two different acceleration potentials the deflection current must be multiplied by the square root of the ratio of acceleration voltages.

The most practical way to accomplish this is to change the deflection amplifier gain as a function of tube operating level. The change should be accomplished after all centering and offset signals have been added to the deflection signal. This insures that only one convergence adjustment is required per axis.

The gain adjustment could be handled by changing the closed loop gain of the deflection driver. This can be used if the performance of the driver does not change significantly for different gain settings. A method that always works is to put an attenuator at the input of the driver. If centering inputs are summed in the driver, the attenuator may have to incorporate an amplifier.

Electronic switches, such as FETS, are used to select the gain of the attenuator. One of four independent gains is selected by the two color bits. Each gain is adjusted by an independent pot to converge the images.

Figure 4 illustrates the relative

Driving Beam

simplicity of a fully corrected beam penetration color CRT display.

Need More Performance?

To get light output and resolution equivalent to high performance monochromatic CRT displays, high beam current magnetically focused CRT guns are required. The current in the focus coil required to focus the spot is proportional to the square root of the anode to cathode voltage. Thus, the current must be changed for each operating level. This requirement is implemented with the same techniques used to drive and correct the deflection currents.

The potential of the techniques used in Model 7004 and discussed above are best illustrated by two companion products. The 7003 is a two level switch designed for driving dual persistence beam penetration CRTs. The 7003 switches 10kV in 16μsec with this range setable between 5 and 20kV.

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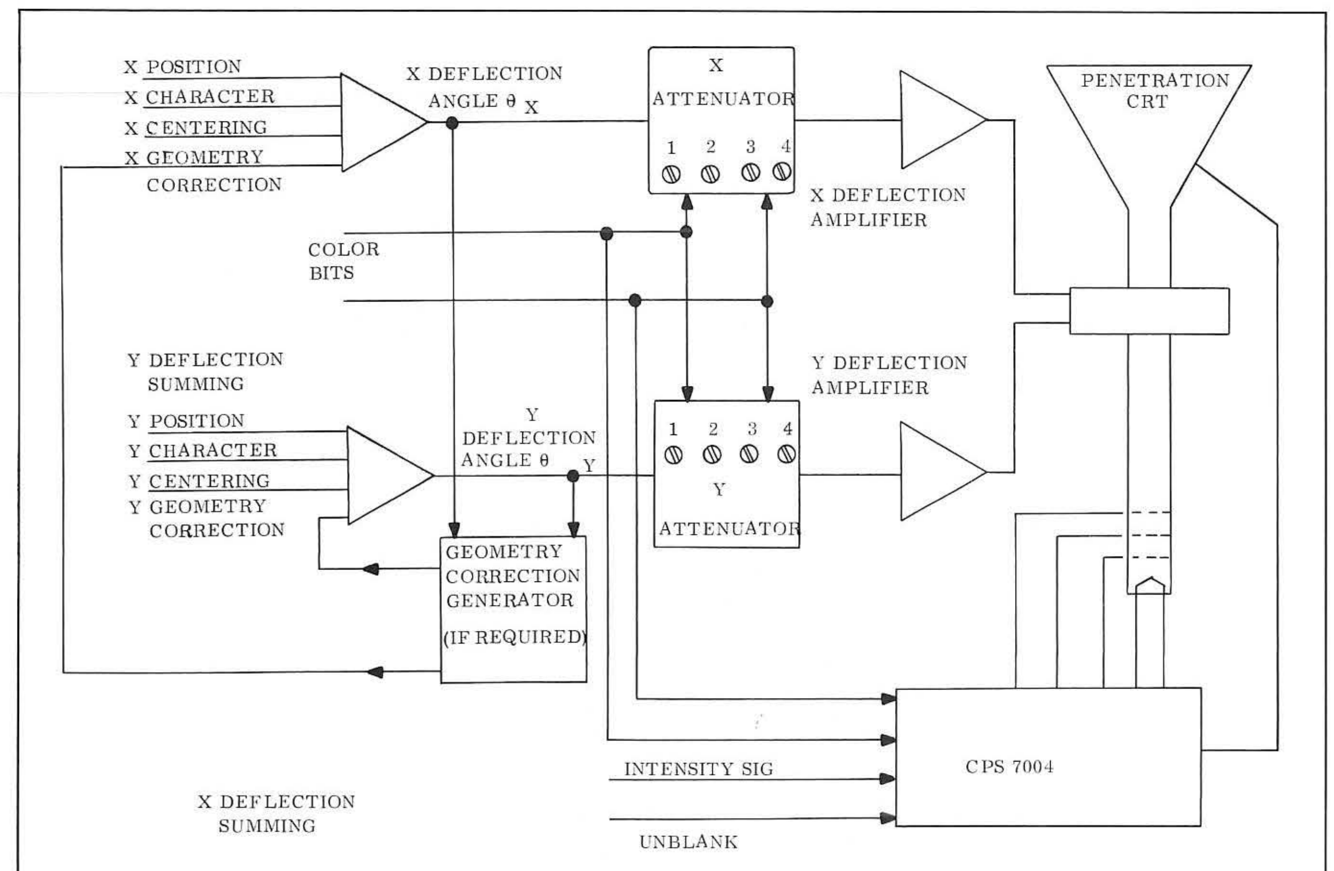
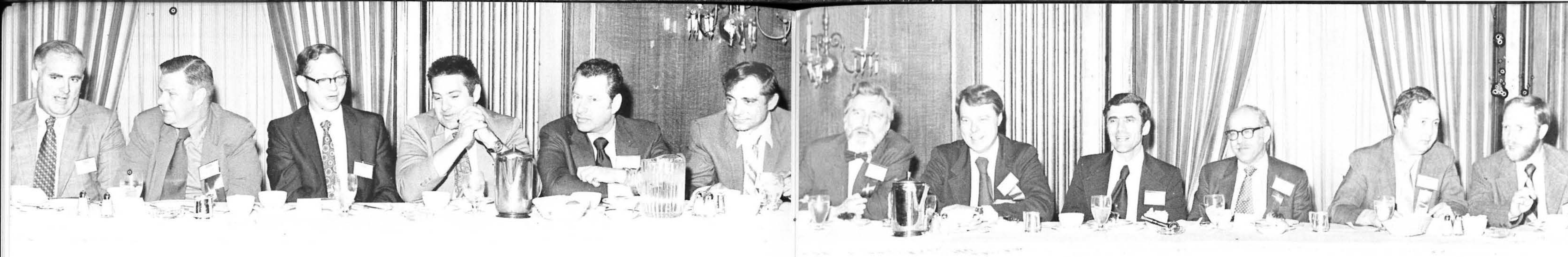


Figure 4. Typical Color Display Using CPS 7004 and Penetration CRT.



THE HEAD TABLE — Reading from left along head table at luncheon during SID Symposium, we have: E.A. Ulbrich, SID Secretary; B.S. Lechner, Treasurer; R.C. Knepper, immediate past Treasurer; (unidentified); H.E. Slottow, Program Chairman; C.P. Crocetti, President, SID; J.H. Becker, General Chairman, 1973 Symposium; L. Harrison, III, President, Computer Image Corp. (speaker); R.C. Klein, Vice President, SID; Sol Sherr, Executive Vice President; Philip Damon immediate past President, SID; J.A. Van Raalte, Treasurer, 1973 Symposium.

600 ATTEND 1973 SID SYMPOSIUM in N.Y.C.

1 

2 

Approximately 600 professionals in the field of information display and allied disciplines registered for the 1973 International Symposium & Exhibition of the Society for Information Display (SID), held at the Statler-Hilton hotel, New York, May 15-17. The meeting was approximately the same size as the previous year's in San Francisco. More than 100 new members were enrolled for SID during the course of the Symposium.

The meeting, reflecting the growing technological status of the event, presented comprehensive global development reports on a wide range of information display subject matter. More than 60 papers by more than 120 authors (there were multiple authors on numerous papers) were presented. In addition to speakers from the U.S., those presenting papers numbered speakers from England, Japan, Norway, Italy and The Netherlands, in 14 daylight sessions, plus 21 panelists in evening discussion forums.

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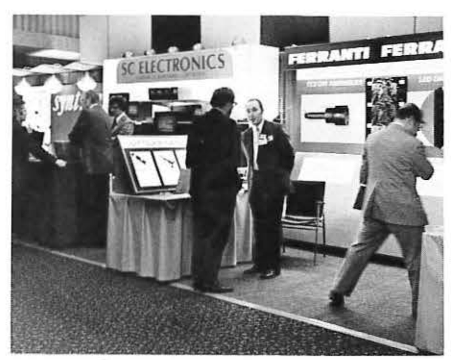
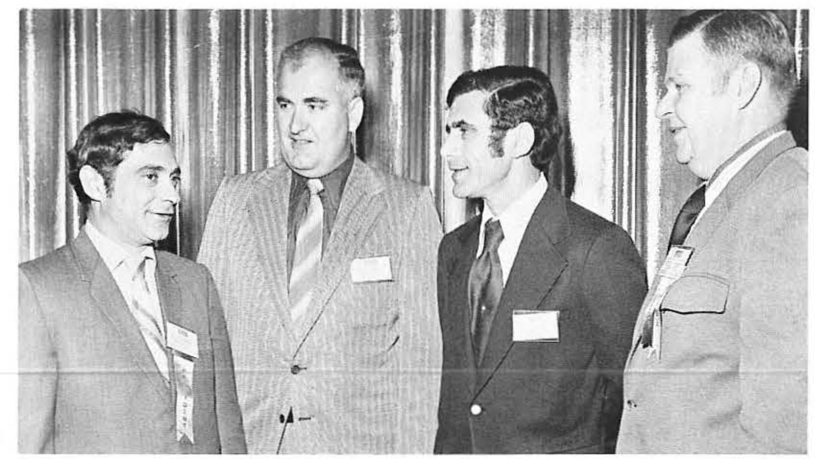
6 

Besides the regular on-going program of papers, the Symposium was highlighted by talks by invited speakers, covering topics such as a long-range forecast on the future of television; on-line dialogues on graphic terminals; perception of displayed information; and integrated character animation display.

7 

Another special feature of the Symposium was the series of face-to-face discussions with authors of papers. In addition to the sessions at the Statler-Hilton, the Symposium continued the custom, inaugurated in 1972, of an additional two-day post-Symposium seminar offering eight lectures by authorities in the field on two main topics: human factors in information display; and on computer graphics. These seminars were held at the Polytechnic Institute of Brooklyn.

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Photo Sequence

1 *The Frances Rice Darne SID Memorial Award for contributions to the field of information display is presented to H. Gene Slottow (at right) during Symposium by C.P. Crocetti, President, SID.*

2 *CONGRATULATED — Irving Reingold (at right) is congratulated on his election as a Fellow of the Society for Information Display, in recognition of outstanding contributions to the advancement of display technology, by C.P. Crocetti, President of SID.*

3 *SIGNING 'EM UP — Exactly 101 new members enrolled in the Society for Information Display at SID membership table in Symposium hotel.*

4 *KEYNOTER — SID Symposium keynote speaker R. Adler (at right), VP/Director of Research, Zenith Radio Corp., who spoke on "The Future of Television" is congratulated on address by J.H. Becker, Symposium General Chairman.*

5 *BEST PAPER — Award for presentation of the outstanding paper at the 1972 SID Symposium in San Francisco was presented to W.F. Goede (at right) for paper on "512 Character Alphanumeric Display Panel," by Chairman J.H. Becker.*

6 *Portion of technical exhibits at SID Symposium*

7 *THE 1973-74 TEAM — Here are the officers of the Society for Information Display for the 1973-74 society year. All were re-elected from the previous year with the exception of the Treasurer. From left: C.P. Crocetti, Rome Air Force Development Center, Griffis AFB, N.Y.; E.A. Ulbrich, McDonnell-Douglas Astro, Huntington Beach, Cal.; R.C. Klein, Vice President, Rollsman Instrument Corp., Syosset, N.Y.; B.J. Lechner, Treasurer, RCA Laboratories, Princeton, N.J.*

LCDs, Plasma Displays Among Symposium Highs

The 1973 SID INTERNATIONAL SYMPOSIUM which closed in New York City, May 17th, covered an unusually wide area of information display technology, and emphasized in particular some major technological developments within the discipline.

The first session, on Display Input-Output Techniques, highlighted advances in plasma display hardware, with a particularly interesting paper by J. A. Turner and G. J. Ritchie of the University of Essex in England, on a finger-operated computer graphic input device. Following an interesting second session on Solid State Display Technology, was the third panel on Liquid Crystal Displays. Here, in particular, changes in the technology were emphasized which indicate that liquid crystal display manufacturers are moving more and more to field-effect technology as opposed to dynamic-scattering techniques, with a resultant improvement in character legibility.

In a paper by R. A. Soref of Sperry-Rand Research Center, the technology of implanted interleaved electrodes for a liquid crystal display mechanism was discussed in some detail. In a report from Japan, from the Institute of Physical and Chemical Research, Mr. Kobayashi and Mr. Takeuchi discussed the development of a multi-color field effect device. A team from Hughes Research Laboratories, Malibu, California, outlined work done on a photo-activated liquid crystal light valve operating in a reflection mode, and driven with AC power.

Image Storage Panel

A team of scientists from Xerox Corporation reported on the development of an image storage panel based on Cholesteric liquid crystals, and a team from Hughes Aircraft Company, Oceanside, California, described the design and operational characteristics of a liquid crystal matrix display, using nematic liquid crystals in a reflective mode.

New Display Terminals

The fifth session, on Raster and Vector Graphic Display Systems, was high-lighted by the rapidly improving controls in Raster Scanning Systems, and the development of new high-performance graphic display terminals. B. Rosen of Carnegie-Mellon University presented a paper describing an intelligent terminal capable of drawing 50,000 vectors from 5,000 software defined stroke characteristics. His associate at the University, Mr. S. Kriz, offered a paper on a graphic display processor which can draw very large numbers of short vectors on a random access CRT.

Other technical sessions emphasized developments in plasma displays, which was dominated by three reports from Japan—Picture Display With Gray Scale in the Plasma Panel, by a team from Fujitsu Laboratories Ltd.; a paper on "Plasma Dislay with Gray Scale", by a team from Mitsubishi Electric Research Laboratory; and another paper on "Surface Discharge Type Plasma Display Panel" by a different team of researchers from Fujitsu Laboratories. The sole American contribution to the panel was a paper on Megabit Display Panel by two researchers from Owens-Illinois, Inc.

Overseas Contributors

There were additional technical panels on Special Display Techniques, Cathode Ray Tube Devices, Light-Emitting Diode Displays, Aerospace Display Applications, Displays and Systems, and Processing and Applications. The international aspects of the meeting were emphasized by the number and quality of contributions from both Japan and England, and the depth of technology was significantly enhanced by the number of University research based papers.

Annual SID Business Meeting Held

On Tuesday, May 15, 1973, the annual SID Business Meeting, presided over by President C. P. Crocetti, was held. It consisted of three main items of business:

1. Introduction of the newly-elected officers (See picture in this issue).
2. Presentation of the Honors and Awards: the Frances Darne Award to H. G. Slottow and the election as Fellow of Irving Reingold (picture in this issue).
3. Presentation of the Best-Paper Award for the 1972 Symposium to W. F. Goede of Northrup Corporation, for his paper "512 Character Alphanumeric Display Panel." (see picture in this issue).

The annual business meeting was followed by the Keynote Address, "The Future of Television", delivered by Robert Adler of the Zenith Corporation. (see picture).

Executive Committee Meeting of SID

On May 13, the Executive Committee of SID, comprised of the elected officers, dealt with an extensive agenda of action items in effect managing the Society. Although many of the actions were routine, the following will be of interest to the general membership:

1. SID normally trades membership mailing lists with other technical societies at cost for things thought to be of interest to our members. It was pointed out that the IEEE added an overhead charge when SID used their lists and it was decided to reciprocate.
2. We have converted from computer-generated mailing labels to addressograph plates on the basis of costs which were steadily increasing and quality concontrol which we found ultimately to be our responsibility.
3. A plan for regularizing publication of the proceedings was made and a publication schedule for 1973 and 1974 was agreed on by all concerned. It was agreed that regular publication of the proceedings was vital to maintaining membership interest.
4. A summary of our relationship with the publisher of SID Journal was prepared and a publication schedule for 1973 and 1974 was suggested. It was agreed in general to widen the interest in the Journal.
5. It was agreed to try to disseminate the material from the Symposium to the members much more rapidly both through SID Journal and the proceedings. This report is part of this effort.

Board of Directors Meeting of SID

On May 14, the Board of Directors of SID met and went through an agenda of action items prepared by the Executive Committee on the day preceding. The following actions are of general interest:

1. The Director from Huntsville, H. K. Johnson, and the Director from the Southwest, D. K. McConnell, voiced the opinion that the general member did not identify with the Society in many cases except through the publications. Thus, when publications stop for a while as happened this Spring, they are in a quandary about SID and its values. The following plan of action was agreed upon by the Board:
    1. Attempt to solicit wider interest material for publications.
    2. Point out values of membership.
    3. Preview proceedings in the SID Journal.
    4. Solicit news of contract awards, front office promotions, legal judgments, etc.
    5. Use full page ad in SID Journal to notify readers about all publications which are available.
2. A resolution was passed approving the Agreement of Settlement and Compromise settling a civil action under Civil File No. C9325 in the Superior Court of the State of California instituted by Technology Publications Corporation, the previous journal publisher, against SID. This settlement has greatly aided our efforts in publishing the SID Journal, and it signals the beginning of a more regular publication schedule.
3. The one day Fall Technical Meetings were discussed. There will not be one this year (1973), and next year a joint one will be held with the Electron Devices group of the IEEE if all details can be worked out. If this goes well, the possibility of alternating this meeting from coast to coast and of holding it jointly with various related societies is the general intention of the Board. Mr. Lechner, as Convention Chairman, is to conduct all negotiations.
4. As a follow-up to an earlier item, the Board resolved to authorize Mr. Ulbrich to move the National Office from Bel Air (California), where it has been for almost 10 years, to Westchester (California), in the hope of achieving lower rent, better parking and a more central location. It is also hoped that the new office, which should be within 1 mile of the Los Angeles International Airport, will be easier to visit for out-of-town members.
5. Herb Hendrickson was appointed by the Board to look at the possible wording of an amendment to the By-Laws allowing wine-tasting parties with non-members as an SID function while avoiding any possible abuse.

If any member of good standing would like a copy of the full Minutes of Board of Directors meeting of SID, they are normally available about a month after the meeting and may be obtained by writing the Secretary at the National office. It may be easier to ask your local Director, who is mailed a copy, at a subsequent chapter meeting. It is prohibitive to mail each member a copy because of cost.

Electro-Optics Papers

Those who wish to submit papers for the Electro-Optical Systems Design Conference (September 18-19-20, New York Coliseum) are advised of the Call for Papers. Persons who are doing innovative work "in any area of electro-optics" are invited to send abstracts to Industrial & Scientific Conference Management, Inc., 222 W. Adams St., Chicago, Ill. 60606.

Special IEEE Issue, On Display Devices

A special issue of "IEEE Transactions on Electron Devices" dealing with display devices will be published in November, 1973. Papers on the following subjects are requested: New devices; improvements in existing devices; manufacturing methods; systems considerations as related to device characteristics, including performance requirements, drive and circuitry requirements, supporting hardware and software, and cost factors and trade-offs; user requirements, such as contrast, color, luminance, and other human factors; and display applications, but only as affected by or relating to device characteristics. A limited number of review and tutorial papers, covering classes of devices or areas of work in display devices, will be accepted. For information contact Alan Sobel, Associate Editor, c/o Zenith Radio Corp., 6001 W. Dickens Ave., Chicago, Ill. 60639.

Unique Measurement Done in Laboratory

For the first time the frequency of an electromagnetic wave emitted in the visible region of the spectrum has been measured experimentally in the laboratory. These results, recently reported[1] by Z. Bay, G. G. Luther, and J. A. White of the NBS Optical Physics Division, have demonstrated the experimental feasibility of making optical frequency measurements in the visible spectrum beyond the accuracy limitations of the ^{86}Kr wavelength standard.

The frequency measured was that of the 633 nm red line of a helium-neon laser. The basic concept of the measurement technique is simple, though the laboratory realization is not. The optical beam of the laser is modulated at a microwave frequency. The modulation generates two sideband frequencies whose ratio can be set equal to two known order numbers in a Fabry-Perot interferometer cavity. Through the use of these order numbers and the known microwave frequency, the optical frequency is determined making reference only to the unit of time. Such measurements relate the optical to the microwave frequency in one step and are applicable to any laser line. Their simplicity allows them to be useful tools for future spectroscopy and for measurements of length in terms of microwave frequencies and the speed of light.[2] Because the frequency and wavelength are measured independently, they can be combined to yield a new measurement of the speed of light. The result is $c = 299{,}792.462 \pm 0.018$ km/sec; the probable error is about one-fifth that of the previous best measurements. The success of the experiment lends further weight to the proposal previously advanced by Z. Bay that the definitions of the units of length and of time might be connected by a definition of the speed of light.

[1] Bay, Z., Luther, G. G., and White, J. A., Measurement of an optical frequency and the speed of light, Phys. Rev. Letters *29*, No. 3, 189 (July 1972).

[2] Measurement of light frequencies, Nat. Bur. Stand. (U.S.), Tech. News Bull. *53*, No. 9, 206 (Sept. 1969).

IMAGERY IMAGERY IMAGERY IMAGERY STORAGE TECHNIQUES

Facsimile has met some of the requirements of the growing need for visual communication in both the industrial and military world. However, facsimile must be supplemented by imagery transmission of non-formatted data.

By ROBERT D. VERNOT
Philco-Ford Corporation
Willow Grove, Pa.

■ Visual communications is a growing requirement within both the industrial and military world. Facsimile has already addressed some of the requirements. However, this must be complemented with imagery transmission of non-formatted data. To accommodate this growing requirement, systems have been developed to communicate TV imagery in digital form. The digital approach has been selected because digital information is easier to store, process, and transmit, thereby affording better picture fidelity.

To offer real-time transmission of digitized standard TV imagery, (1/30 second per frame), communication links must support a 40 megabit per second data rate; this assumes a 4.5 MHz bandwidth and a 4-bit prec. at 10 MSS. Using binary to quaternary conversion, this rate can be reduced to 20 mezabits per second which can then be communicated via a 12 megahertz channel. This has been accomplished as early as 1966, and

Imagery Storage

the system remains operational to this day. However, communication links with this band-width are either not available or are too costly.

If the application can use less than real-time, a frame update scheme can be employed, where, once the image has been communicated, only changes on a frame-to-frame basis will be transmitted. This system can be supported by a 16 megabit per second rate and on the average requires, 1/4 second to transmit a single frame. No motion is accommodated by this scheme, however it offers visual communication to a larger population since more links of this variety are available. (5 MHertz of bandwidth required using the quaternary conversion scheme).

A still larger network of communication links exists at lower frequencies. These links cover the frequency spectrum from 75 baud to 1.5 megabits, with a concentration in the area of voice circuits (the range from 2.4 kilobits to 50 kilobits).

Temporary Storage

For this network, we are limited to visual communications on a single-frame basis. To this end, imagery transmission systems have been developed which temporarily store a single frame of TV to provide the rate conversion required to communicate wideband video data (40 megabits/sec) over narrow band lines. For these systems, an average transmission time for a single frame at 2.4 kilobits is 8 minutes, at 50 kilobits is 25 sec, and at 1.5 megabits is less than 1 sec.

The concept of communicating single frame digital TV is shown in FIGURE 1. A video source supplies standard 525 line TV at a thirty frame per second rate to the encoder/storage unit which selects and stores, upon command, a single frame of video. Once in storage, the video frame can recirculate at a 1/30 second rate to preview the selected image. If the image captured is to be transmitted, the data is presented in a digital format to the rate converter. The read-out rate of the memory is, in general, fixed. So the rate converter functions as an elastic buffer to provide an interface with a variety of data modem/links operating over the aforementioned frequency spectrum. Wireline, HF, and Satellite links are within this range.

Into Bulk Storage

The receiver function is the mirror image of the transmitter. Data from the receiver modem is buffered in the rate converter, and forwarded to the decoder/storage unit. This unit accumulates the data, a line at a time, until the entire frame is recorded in memory. A simultaneous read-write memory permits display of the line-by-line build-up, as viewed on the display monitor.

At this point, the data can be transferred to bulk storage, allowing reception of another image.

Two categories of storage devices permit single frame digital communications; analog and digital devices. The analog device stores the information directly from the TV camera. The data is then accessed a line at a time and converted to a digital format by the A/D converter prior to transmission. For a digital storage device, the A/D converter necessarily precedes the storage medium. The conversion is therefore at real-time, and the binary digits are written in the memory at the sampling rate. The capacity of the digital storage device is dictated by the encoding precision required, and the sample rate needed to meet the specified resolution. Once stored, the single frame can be read-out at a speed consistent with the transmission rate via the rate converter.

Choice of Devices

In general, analog storage devices suffer from finite S/N ratios and limited bandwidth which degrade the image before encoding. This limitation is not inherent in digital storage, and they, therefore, offer higher image quality. Analog storage devices are usually less expensive than digital and therefore the choice must be impacted by the picture fidelity required in a specific application.

Analog storage devices include video disc recorders, silicon storage tubes and storage Vidicons. Digital storage devices include Disc memories, plated wire memories and solid state memories.

A video disc recorder used as a single frame memory is shown in Figure 2. The disc rotated in sync with the input video signal at approximately 1800 RPM (or one video frame per revolution). Sync is via the servo control loop which is phase locked to the horizontal and vertical sync signals stripped from the composite video input. The single frame write command is also synced to ensure that a full

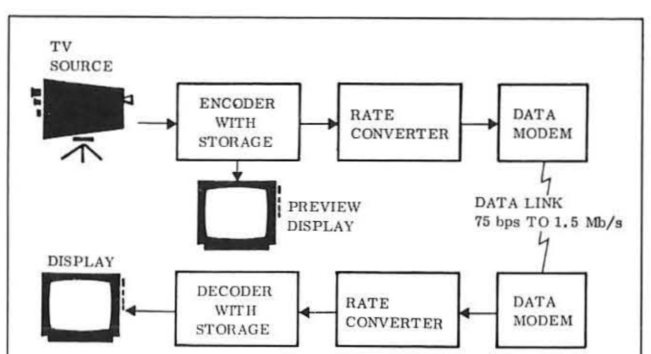

Figure 1. Single-Frame Digital TV System

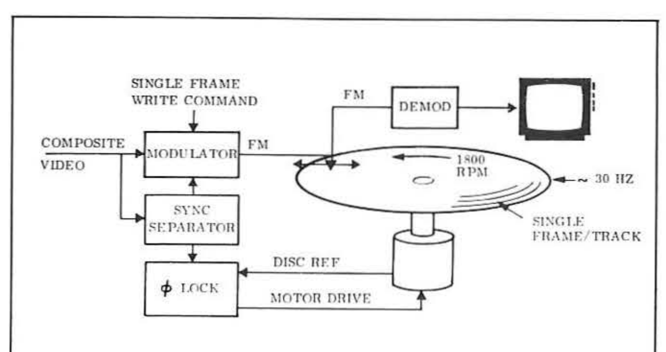

Figure 2. Video Disc Recorder

frame of video is captured.

By way of the modulator, an fm signal (representing the video) is generated and recorded on the magnetic surface of the disc. Once recorded, the data circulates at the frame rate and is displayed on a standard monitor to determine if the correct image has been captured. If so, the image is read from the disc for analog to digital conversion and subsequent transmission. This read operation is not accomplished in 1/30 of a second, but rather a line at a time, at a rate dictated by the transmission rate as reflected through the line buffer or rate converter.

Some of the parameters to be considered with respect to the video disc recorder are:

1. Most units are limited to 4MHz bandwidths.
2. A signal-to-noise ratio of 40db is max. and is a visible limitation.
3. Units are multi-frame and their application should reflect this capacity.
4. Units are not compact.
5. Sparing is costly.

The second analog storage device for consideration is the silicon storage tube (Figure 3). This unit is an electrical-in electrical-out device and can store a single frame of TV imagery.

To write, the video signal is converted to a Z axis modulated electron beam that is scanned across the silicon target in sync with the horizontal and vertical sync signals.

The photo-conductive surface of the target absorbs the energy and can retain it for several days. However, if the tube is constantly scanned in the read mode, the retention time drops to something under 5 minutes. This would be the case if a preview of the capture image were required.

Similar to the disc concept, the data is read, a line at a time. However, there is no need to recycle the entire image; the read command is simply pulsed at a vertical rate synced in to the processing and transmission rate.

The key parameters associated with the silicon storage tube are:

1. Limited retention time.
2. Visible target signature.
3. Non linear gray scale.

The next analog storage device to be discussed is the storage vidicon. In the single frame TV communication system, this unit replaces the standard video camera. (Figure 4.)

'Tailored' Scan Rate

The image is exposed to the storage vidicon through a shutter to capture the information of interest. The image is then read off the photo conductive material by scanning the surface in the x-y direction at the desired horizontal and vertical rates. For preview, these rates would be standard video rates allowing display on a conventional video monitor. In processing, the scan rate can be tailored to the transmission rate, however, the character of the storage material does require periodic refresh for retention of information if the rate drops below a specified minimum.

Characteristics of the storage vidicon are:

1. Required exposure time—1/2 sec. implying no motion.
2. Refresh required.
3. Image focus and sizing only after capture.

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A parallel disc memory unit functioning as a digital single frame memory is shown in Figure 5. The disc spins at 1800 RPM or approximately 1/30 of a second per revolution. The speed is controlled by the servo drive system, which is synced to the incoming video such that each revolution corresponds to a single TV frame time. Note that horizontal and vertical retrace intervals, as well as the video information, are included in this time period. The storage capacity required must be calculated by assuming a 60 μ sec line time or at 10MSS a total of 600 samples per line. With 500 lines per frame, a total of 300 kilosamples per frame are generated. Four bit precision dictates the need for 1.2 megabits of storage.

16-Track Device

A sixteen track device, with a read-in rate of 2.5 mb/s, and a channel capacity of at least 75 kilobits, meets the requirement. The parallel read-in uses 4:1 demultiplexers on each of the four 10 mb/s sample bit lines. The 600 samples of a given line, in groups of four samples, four words high (bit precision) are written onto the disc at a 2.5 megabits rate following each horizontal drive pulse. The read operation is handled in a similar manner with the 4:1 multiplexers generating the original four 10mbs sample bits.

The important points with respect to the digital disc concept are as follows:

1. Required capacity includes

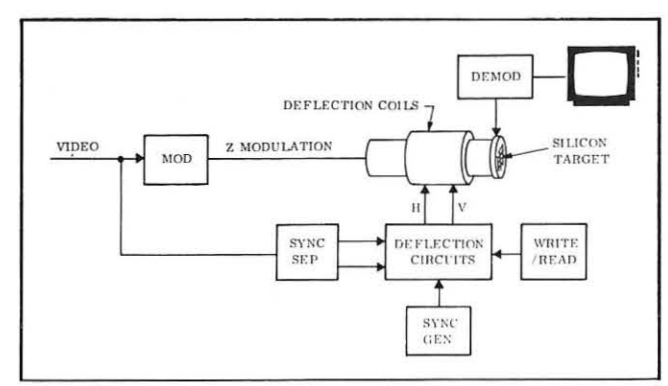

Figure 3. Storage Tube

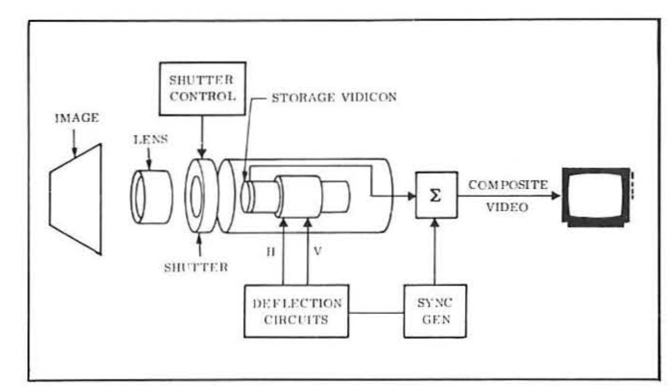

Figure 4. Storage Vidicon

video data and TV retrace times.

2. The servo loop is required to maintain speed and phase synchronism within 50 nanoseconds.
3. Large capacity requires many heads.
4. The scheme does not lend itself to easy expansion.
5. Sparing costs are high.

High Speed Recording

Figure 6 depicts a plated wire memory used as the digital storage device. The memory is organized in a 32K word x 8 bit configuration affording a 250K bit module; four of which are required to provide one megabit of storage. Note that the needed capacity has been reduced, since only the active portion of the line is stored (50 μ sec) in this case.

The input bit rate as shown is 1.25 megabits per second; the demultiplexer provides an 8 to 1 rate reduction of the 10 megabit per second sample bits. In this scheme, each word represents eight samples of the video data in one of the four bits of precision.

The memory "write" operation is accomplished by addressing the "w o r d" current generator coincident with the appearance of the digit line current which is present at the input as a result of a sample bit. The addressing could be in any sequence as long as the order is maintained during read out (true random access).

To read, an interrogation current is passed through the word line, and the output is detected along the digit line. All four 8-bit words would be read out simultaneously.

Some points worth mentioning concerning this particular scheme are:

1. High speed recording is easily accommodated by simultaneously writing since each word line goes over many bit wires.
2. Random access is inherent, offering greater versatility.
3. Non destructive readout.
4. Low operating power (.1 nw bit) even lower in standby (.075 mw/bit).
5. The concept lends itself to easy expansion.
6. Sparing is not economical.

Solid State Memory

A solid state shift register memory is shown in Figure 7. A RAM could of course be used if the added versatility offered, would be required by the application. In either case, the solid state memory for the model under discussion would require a capacity of 1 megabit (video data only). Employing 1024 bit chips, a 10 x 25 matrix would accommodate approximately 250 kilobits of storage or an entire frame of one bit of precision. As indicated, this scheme requires 10:1 demultiplexing which is in concert with the 1 megabit per second input shift rate.

If a dynamic shift register is used in an effort to reduce cost, the data, once in storage, must be circulated at the minimum rate specified by the IC manufacturer. In most cases, this rate is in the area of 10 to 20 kilohertz assuming a fair range of operating temperatures. If processing rates are less than this minimum recirculating rate, buffering will be required to handle the rate conversion.

Of interest concerning the shift register memory is

1. Expansion to accommodate higher bit precision or more samples per line is easily accomplished.
2. Dynamic shift registers can be used in most applications, since recirculation is required for image preview.
3. Power consumption is in the neighborhood of 0.2mw/bit.
4. Economical Sparing.

A few of the more noteworthy applications for single frame digital communication systems are remote surveillance, remote video file, visual conferencing and imagery information systems.

Remote surveillance, as it applies to this discussion, is a concept that employs a number of remotely located TV cameras which are accessed on a regular basis to relay a single frame of video information to a central terminal for display. Using a video store at each remote terminal and assuming a 50 kilobit transmission link, full gray scale imagery could be relayed from each camera, to up date the central terminal displays, every 30 seconds.

Storage Alternative

Candidate storage devices for this application include the analog storage tube, the plated wire digital memory and the solid state shift register memory. All of these devices possess no moving parts and are somewhat compact. The storage tube suffers from limited gray scale, linearity, and resolution. However, it is about half the cost of the other two. Power consumption is also higher for the plated wire and shift register memories. However, maintainability is excellent for the shift register memory which also exhibits the lowest spares cost. Obviously all these need be weighed in selecting a storage device for a specific user requirement.

Like Computer Terminal

The concept of a remote video file system is similar to a time shared computer data terminal where information is disseminated to various subscribers through a dial-up network. In the central video file, data is stored on bulk storage media such as analog discs or video tape units. Digital tape is also appropriate and in fact preserves image fidelity to a greater degree than the analog devices.

When a particular file is addressed, a single frame of video is transmitted to the subscriber via a narrow band digital link. At the subscriber terminal, the data is accumulated on a frame memory device for display. For this application where high quality imagery is required, an analog frame memory should be avoided. The bandwidth restriction and finite S/N ratios are sufficient reason to select a digital storage medium. Any one of the three digital candidates are appropriate, however, ease of maintenance and reliability gives the solid state shift register memory a slight edge.

Visual Conferencing covers a good percentage of the applications for single frame digital TV Communications. Two major business areas or, in the military application, large command centers can be tied together using the single frame video communications concept. Images could be communicated during the conference, or if a large number of images are required for the presentation, they could be sent earlier and stored at both terminals for reference and update during the actual discussions. A video disc is an excellent choice for this application in that it can provide both single and multiframe storage in same unit. High resolution is not a requirement, and the finite S/N and limited bandwidth offered by the analog storage device should not cause image degradation beyond a tolerable level.

Single Frame TV

Paralleling the conferencing application, is the use of single frame TV communication in imagery information networks. These networks offer management, command and control capabilities, weather evaluation, photo interpretation, intelligence and medical data evaluation. In this application, data can be exchanged between various terminals and disseminated for evaluation. The ability to communicate non formatted video data over narrow band lines and distribute it via standard TV monitors to a large interested population, remote from the receive terminal, is the reason why this concept can address a variety of users.

The imagery information networks are characterized by high resolution requirements, high S/N levels and good gray scale reproduction, which indicate that digi-

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tal storage devices should be employed. Reversible simplex terminals would seem very appropriate from a cost point of view and should not severely limit operations. The single frame memory device would be time shared between transmitter and receiver.

We have only touched on a few of the applications for single frame TV communications. The basic concept is flexible enough and the networks required are available in sufficient number, so that one can envision an unending list of communication requirements that can be satisfied. Until wide band link can be offered at reasonable prices, single frame digital TV over narrow band lines has to be the answer to visual communications of non-formatted gray scale imagery. ■

Human Factors Society Meeting

The Consumer Factor is the theme of the Human Factors Society Annual Meeting to be held at the Marriott Twin Bridges Motor Hotel, Washington, D.C., October 16-18, 1973. Host will be the Potomac Chapter of the Society, represented by the General Chairman, Mr. William J. King.

Papers, workshops, and symposia related to consumer factors are encouraged. Possible session titles include: HF Applications to Consumer Areas; HF in Rehabilitation and Health Care, including the Handicapped, the Aged, and Health Services; HF in Government and Politics, Education and School Systems, Manufacturing and Production, Service Industries, Home, City, Transportation, Recreation and Play, Media, and Criminal Justice; Aerospace Research and the Consumer — Technology Fallout; Consumer/User Information Systems; Environment Quality Protection—Noise, Air, and Water Pollution.

Paper abstracts, and workshop and symposium proposals, should be submitted to Dr. Thomas B. Malone, Technical Program Committee, HFS Annual Meeting, 303 Cameron Street, Alexandria, Virginia 22314.

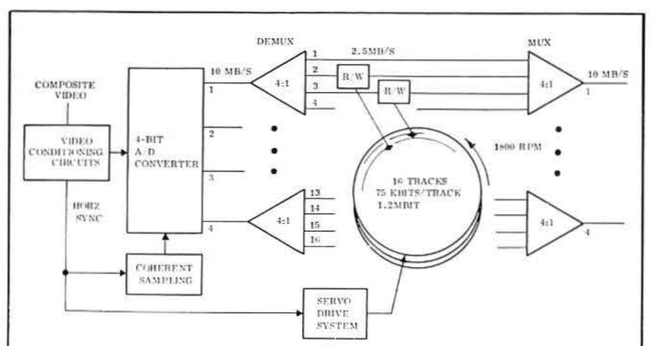


Figure 5. Parallel Disc Memory

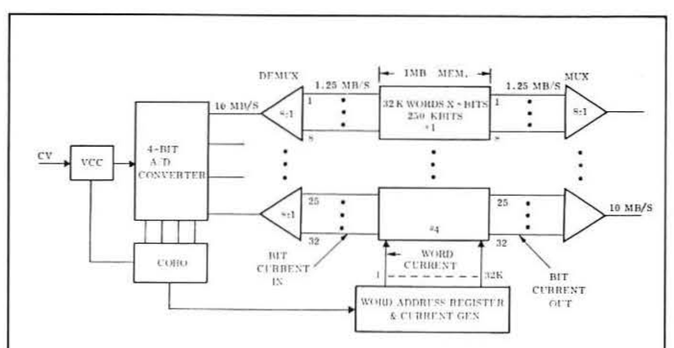


Figure 6. Plated Wire Memory

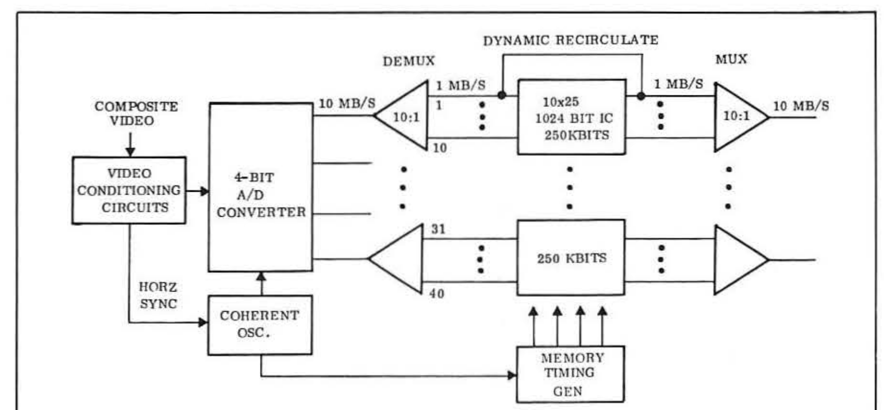


Figure 7. Shift Memory Register

LASER BEAM

Writes on Screen

Words, numbers and drawings can now be written by laser light on a new kind of large screen black and white display demonstrated by Bell Labs scientists. The new display uses a laser beam to write information, which can be transmitted over ordinary telephone lines, on a liquid crystal contained in a small glass slide.

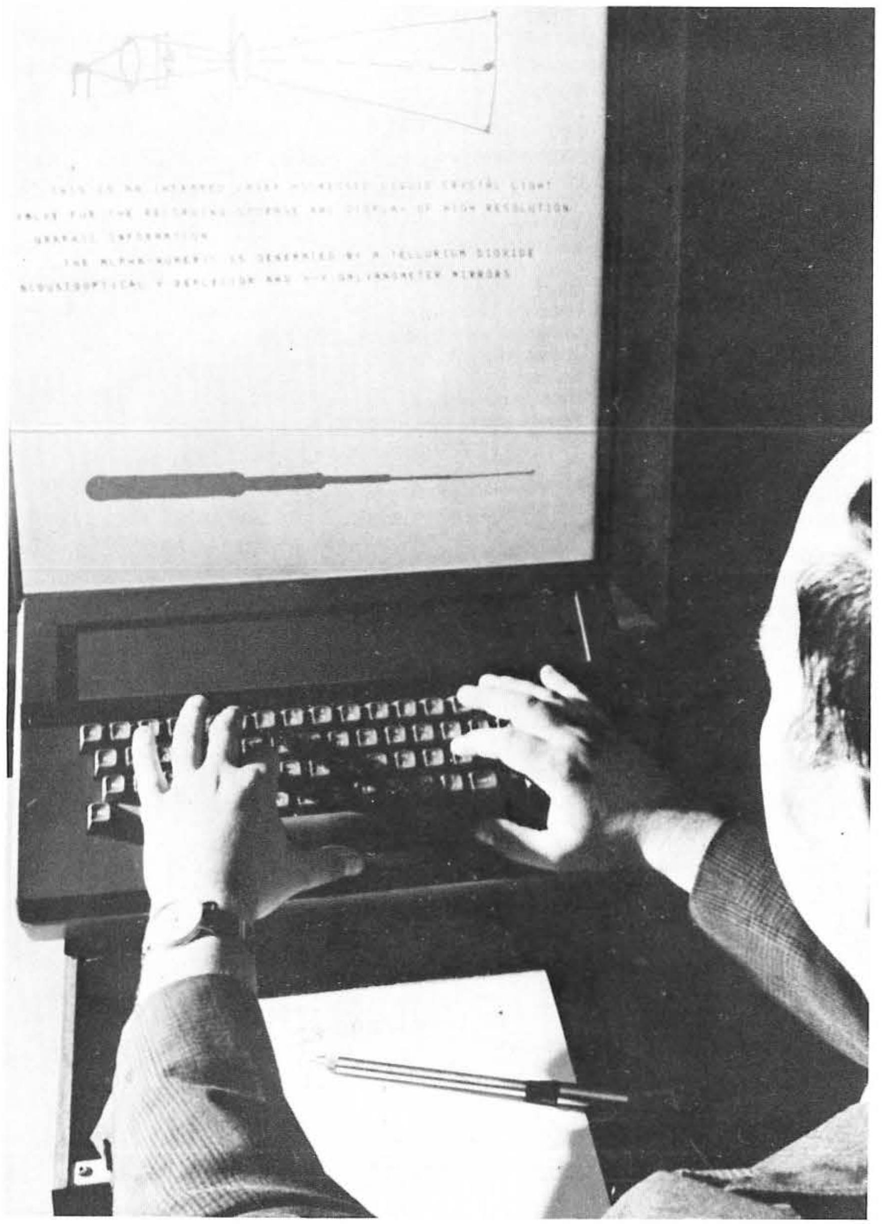
The liquid crystal used is a transparent chemical fluid that becomes frosted when momentarily exposed to concentrated doses of heat.

Laser-driven liquid crystal displays are now being considered for use at Bell Labs in an experimental "remote blackboard" system for transmitting and receiving handwritten information over the Bell System telephone network.

A liquid crystal cell could be used at the receiving end of such a system, where coded pulses of information are used to direct a laser beam over a light sensitive medium. Laser "writing" in this system can then be projected on a wall or screen.

Sandwiched between two glass plates, the liquid crystal molecules of the Bell Labs device can be rearranged selectively by heat from a low-powered laser beam to form numbers, letters and drawings. Information stored in the liquid crystal can be erased by applying an ac voltage to electrodes on the glass plates. This voltage forces the liquid crystal (LC) molecules back to their original well-aligned positions and restores cell transparency.

Bell Labs scientists Hans Melchior, Fred Kahn, Dan Maydan and Dave Fraser point out that liquid crystal displays could serve the same function as cathode ray tubes and other similar "read-out" devices in computers and graphic viewing terminals. Because laser-driven LCs can retain an image almost indefinitely, they do not have to be continuously replenished to avoid flicker problems, as with conventional cathode ray tube displays.



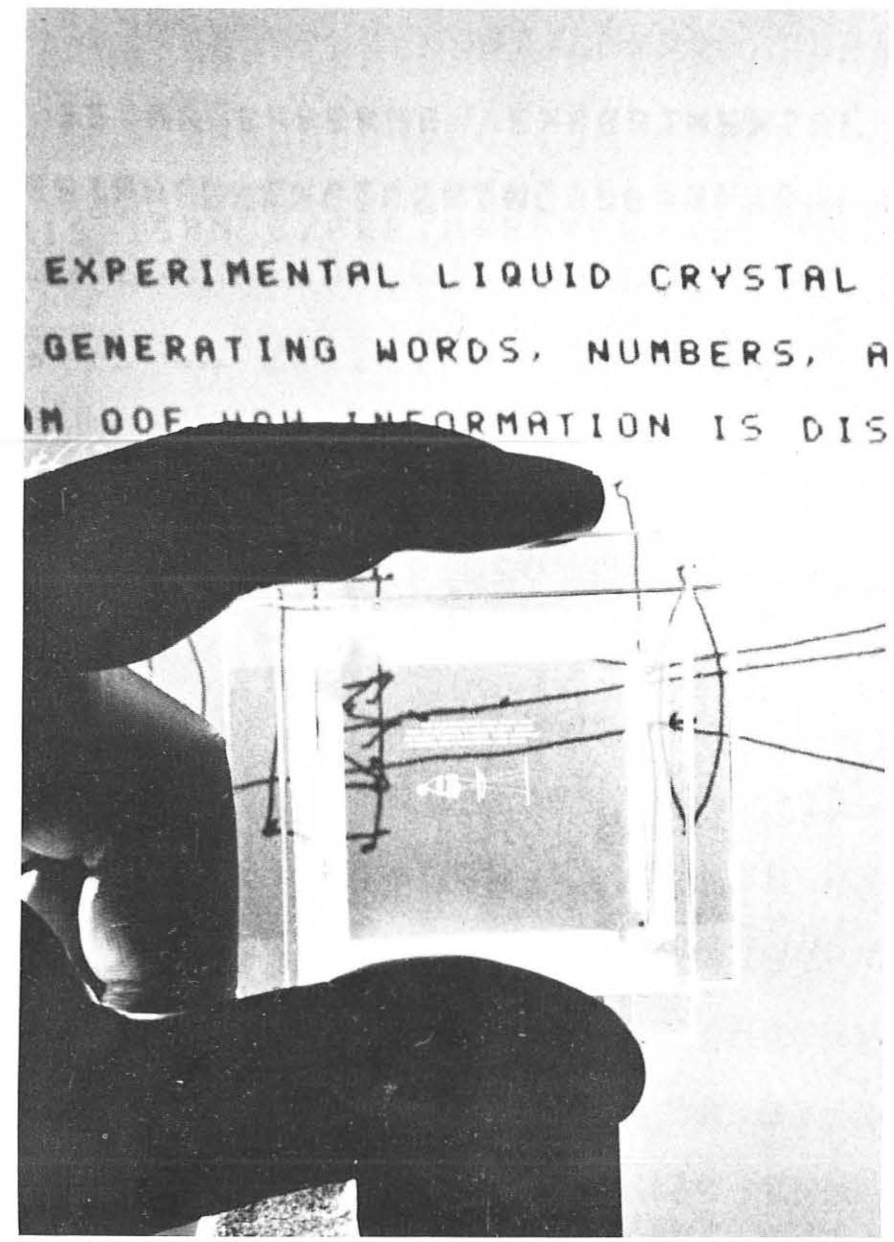
Demonstrating how words and drawings can be projected through a glass filled with a liquid crystal chemical compound.

In an experimental display fabricated by the BTL scientists, a liquid-crystal light valve about the size of a 35 mm slide is used. The inner surface of the glass plates is coated with a thin film—indium-tin-oxide—that absorbs light from a focused infrared laser beam, and converts it to heat. The coating also serves as a conducting electrode for the erasing voltage.

Information is stored in the light valve by "writing" on it with the focused laser beam. Local heating by the beam temporarily raises the temperature of the liquid crystal in the addressed region of the light valve. A hysteresis effect associated with a "phase transition" takes place, changing the chemical compound's appearance from clear to frosty white.

If the light valve is located in an optical system no more complicated than an ordinary slide projector while this is happening, the pattern being written on the glass plates can be projected on a wall or screen. The projected image will appear as black lines on a white background.

The black lines correspond to regions of the light valve where heating has disordered the liquid crystal molecules. These disordered, "frosty" regions scatter the projection light and prevent it from reaching the screen.



Liquid crystal slide containing information written by laser light.

An audio-frequency voltage, applied to the plates, reorders the disturbed regions and clears the display.

Information on how to write individual characters in the Bell Labs display is stored in a "memory" circuit in the form of electronic pulses. When the display is in operation, these pulses are fed to two devices—a scanning galvanometer and an acousto optic deflector-modulator.

The galvanometer scans the laser beam in a horizontal direction across the surface of the light valve. The deflector sweeps the beam in a vertical direction and at the same time turns the light source on and off during character generation.

The interaction of these two devices enables letters, numbers and any other graphic information to be generated in the display at a rate of speed up to several thousand characters per second.

About 1/10 gram (1/300 ounces) of a mixture of 90% MBBA (p-methoxybenzylidene-p-n-butylanaline) + 10% cholesteryl nonanoate is used in the Bell Labs experiments. This cholesteric liquid crystal material is sandwiched as a thin film between two fused silica glass plates (2½" x 2") coated with transparent conducting electrodes (indium-tin oxide) and an additional coating of organic material (silane) to orient the liquid crystal molecules. Thermal writing is carried out by deflection of a Nd:YAG laser beam at 1.06 micron wavelength. HeNe or GaAs lasers could also be used.

Power absorbed from the addressing beam locally heats the liquid crystal above its isotropic-cholesteric phase.

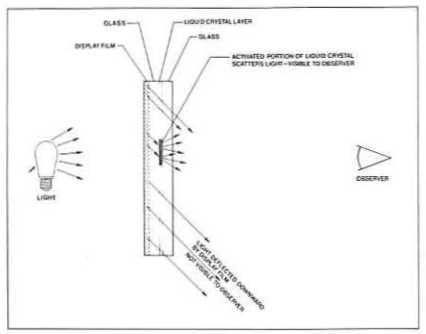
Visible light is strongly scattered by the disordered regions. Linewidths of 15 microns or more are readily obtained by moving a 5mW laser beam (absorbed power) at speeds up to 10 cm/sec across the liquid crystal cell.

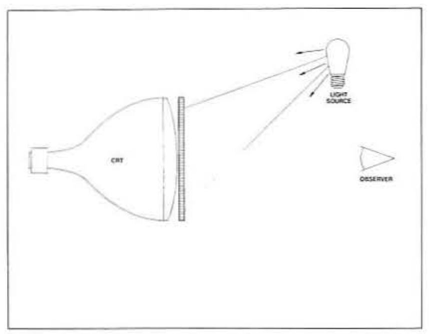
Written images can be viewed for hours, days or weeks with minimum loss in resolution or contrast. Erasure is accomplished by applying a 35 V 1.5 kHz voltage between the transparent electrodes.

NEW PRODUCTS

SID SID SID SID

Louvred Film Sharpens Image On Low Light Level Displays





One problem of the electronics age—that of ambient light interfering with vision while observing low light-level displays—has now been solved by a new display film which is utilized in vulnerable areas such as liquid crystal displays, cathode ray tubes, aircraft cockpit displays, hospital patient machines and television screens.

3M Brand Display Film, manufactured by 3M Company, is a thin sheet of clear plastic containing closely-spaced opaque microlouvres, which function like miniature venetian blinds, allowing light to pass through at a predetermined angle. The result is highly-increased contrast in light-emitting or backlighted display applications, making them easier to read when ambient light is present.

"One of the most timely applications of the display film has been in liquid crystal graphic and advertising displays," said J. E. Johnston, department manager, Display Products.

"The display film's specially angled louvres allow light to pass through from behind to illuminate the liquid crystals, while providing the necessary opaque background for the viewer, either black or in colors if desired," Johnston explained.

In liquid crystal applications the film is placed between the light source and the liquid crystals. (See figure 1) In self-lit, low-light displays such as cathode ray tubes, the display film is placed directly over the display surface. (See figure 2) In this type of application the film shades the subject from ambient light, which usually comes from above, while allowing a clear visual path for the viewer. Many variations of the film are available, and it can be designed for specific applications.

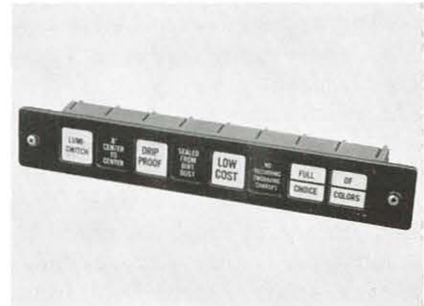
The film itself can be produced in standard thicknesses, from .020 to .040 inches in thickness, while the louvres can be slanted at angles up to 45 degrees.

All of these variables make it possible to control light for specific applications more accurately.

Various decorative effects also can be achieved by changing the color of the louvres or the film itself. Standard colors for both film and louvres are red, white, green, yellow and blue. For highest-efficiency light control, black louvres are the most effective.

Circle #101 on Readers Service Card

The "Cue-Switch"



Industrial Electronic Engineers announces the "Cue-Switch" Product Line Series 1400-1 & 2, In-Line, Bezel Mounted Switches and Annunciators, in both lit and unlit adaptations.

This unique switch unit consists of matrixed conductors embedded in TRANSPARENT plastic membranes. Without mechanical linkages, springs or buttons, the totally reliable switch elements are sealed to dirt and moisture, offer exceptionally low mass and profile to designers. Color filters may be used for visual effect.

Circle #102 on Readers Service Card

1" O.D. High Resolution CRT

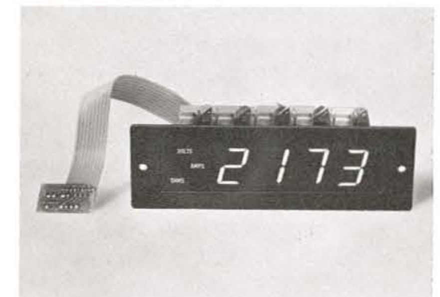
Video Products, Inc. announces the availability of a 1" O.D. high resolution CRT. Operating in the 5 to 10 KV range with a minimum of 850 lines, the CRT is capable of at least 350 ft-lmbts (P-1 @ 7KV) output from a useful area of 0.6" x 0.6". All phosphors are available. Magnetic deflection enables high resolution applications and spot sizes to 0.6 mils. The flat face permits simplification of associated optical systems. Sub screen, black screen, and fiber optic screens are optional. All leads, including the anode lead, exit from the base for streamlined design.

Circle #103 on Readers Service Card

7 Bar-Segment Display

Industrial Electronic Engineers, Inc., manufacturer of rear-projection readouts, is now offering a Seven-Bar Segment display, the Series 1080.

This "easy-to-read" unit features as standard, based lamps for ease of installation and replacement (front or rear), optimum single plane viewing, choice of screen colors (red, blue, green, grey or amber), and it's a plug-in package with no external hardware.



Available options include: versatile caption display with up to 6 message areas, conventional rear-projection 12 message display, decimal points and/or colon and module with + and − overflow "1".

A wide variety of display configurations are stocked, including a 9 bar configuration for 16 output hexadecimal applications displaying 0-9 and A-F.

Circle #104 on Readers Service Card

Position Write-Yoke

The CELCO LY916 Position-Write Yoke is designed to minimize the objectionable "cigaring" effect on Alpha-Numeric Displays, thus eliminating the need for electrostatic deflection plates. The LY916 is a high-speed, High-Q Ferrite core Deflection Yoke featuring fast position and write, and is excellent for resonant circuits.

Circle #105 on Readers Service Card

new products

Control of Rotating Displays

A spring return potentiometer providing continuous control of rate in rotating displays and machines is now available from Measurement Systems, Inc., of Norwalk, Ct.

The pot can be rotated ± 30° producing a resistance change of ± 1k ohm. When released, the wiper returns to the center of the 5k ohm infinite resolution element.

The integral 1.25 dia. knob features fluted sides of black plastic with satin finish aluminum facing. It is conveniently mounted using only one hole to clear the ⅜ - 24 threaded bushing.

The Model 510 Spring Return Pot is available from stock.

Circle #6 on Readers Service Card

Systron Analyzer Display

Systron-Donner has announced a Spectrum Analyzer Main Frame with a variable persistence CRT display. According to the manufacturer, the unit can store an image for up to 6 hours, or can be used in a non-storage mode.

The display unit has been designed for use in audio and baseband spectrum analysis. Scans can be held on screen and reviewed, analyzed, or recorded.

Circle #107 on Readers Service Card

Hand Held Calculator Available in Kits

MITS has made a four-function "mini-calculator" available to the kit enthusiast. This 1200 series pocket calculator has the same fine circuitry and accuracy of its larger counterparts, but its compact size and battery operation mean it can be taken anywhere.

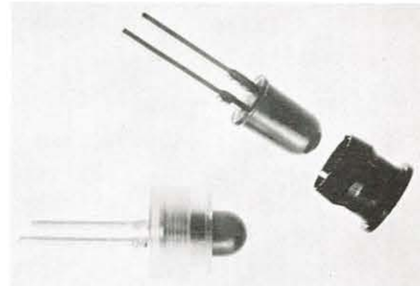
This calculator features a keyboard which employs key travel comparable to desk-top models. It is battery-operated but has provisions for an AC converter. An automatic display cut-off is designed to save battery life. With alkaline cells the unit operates about 150 hours in the stand-by mode and 50 hours in the computation mode before fresh batteries are needed.

The calculator performs four functions: addition, subtraction, multiplication-division function. The six, nine or twelve digit readout has true credit balance and additional indications show display overflow as well as calculation overflow.

The kit is comprised of American-made components and silk-screened printed circuit boards. These boards are completely plated through for ease in soldering and represent the very finest in circuit boards. The plated-through boards were originally developed for use in the space program to promote reliability and miniaturization. A completely illustrated instruction manual with step-by-step assembly procedures and schematics accompanies the kit.

Circle #108 on Readers Service Card

Full Flood Panel Mount LED Lamp



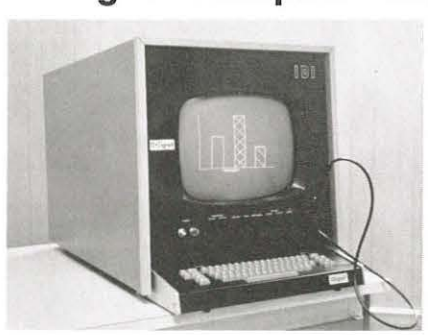
RL-4403 and RL-4440 new LED solid state lamps from Litronix provide a large, full flood viewing red light and are equivalents to the H.P. 5082-4403 and H.P. 5082-4440. The new RL-4403 and RL-4440 contain a gallium-arsenide-phosphide LED in a newly designed red - diffusive molded package. They are also available in red clear, water clear, and white diffusive molded lens. The viewing area extends .140 inches beyond the face of the mounting clip allowing wide angle viewing. The radiating area is 0.2 inches in diameter and presents an ideal visual display for indicating functions on instruments and control panels. The mounting clip is available in black or clear plastic.

For easy installation, the RL-4403 and RL-4440 leads are .025 square for wire-wrapping, soldering or P.C. board mountings.

In addition, these devices operate on only 1.7 volts at 20 milliamps. The RL-4403 is rated at .8 MCD minimum at 20 mA and 1.5 MCD typical.

Circle #109 on Readers Service Card

"Idigraf" Computer Graphics System



IDIgraf is a low cost, buffered, refreshed CRT display for producing graphic displays with combinations of vectors and alphanumerics. The IDIgraf has stroke-writing hardware character and vector generators, 17" CRT, MOS refresh memory, two intensity levels, blink, and two character sizes. Approximately 3000 characters, 3000 inches of vector, or combinations of both can be displayed flicker-free. Display addressability is 1024X by 1024Y. Hardware 2D scaling and translation is included. Keyboards with hardwired programmable function keys (for hardware editing, text and graphics, and cursor control), multiple monochromatic or color displays, light pens, 21" CRT, direct parallel computer or serial (communication line) interfaces are among the optional features.

Circle #110 on Readers Service Card

Light Emitting Film

Of the technologies presently under consideration, the Light Emitting Film undoubtedly offers the simplest manufacturing process and can produce digits at the lowest ultimate cost.

The process is highly mechanized. One operator could produce approximately 15,000 digits in a single four-hour shift. The Light Emitting Film has a highly competitive materials and labor base.

Without going into detail, the LEF process consists of vacuum deposition of a thin film, composite layer onto a single plate of double-strength window pane. The resulting device is a capacitor with a transparent front electrode. When an AC potential excites the dielectric it emits light which can be seen through the transparent front electrode.

This is, of course, an oversimplification, but the process is currently producing small calculator displays at the lowest cost in large OEM quantities — less than $.75 per digit!!

Circle #111 on Readers Service Card

Circle #8 on Readers Service Card

Circle #9 on Readers Service Card

Balanced Menu Promised by ACM

ACM '73 (Association for Computing Machinery) shows promise of being one of the most balanced and well planned annual conferences of ACM. It is set for Atlanta, August 27-29. Some of the highlights of the conference include the keynote address to be given by Dr. Lewis M. Branscomb, Vice President and Chief Scientist of the International Business Machines Corporation. His address will highlight the theme of the conference, "Computers in the Service of Man".

The technical program balances theoretical presentations and business data processing applications. Approximately fifteen sessions will be devoted to presentations in insurance, banking, transportation and other business data processing applications.

Sessions are provided for the communication of computer science research abstracts, both in industry and academic dissertations. The commercial program will feature presentations by hardware and software firms on the availability of the latest products. It will provide an atmosphere in which in-depth discussions may be carried on between the participants and the industrial concerns. The opportunity for both users and suppliers to discuss all aspects of pertinent products is unparalleled. For information contact ACM, P.O. Box 4566, Atlanta, Ga. 30302.

Beam Penetration

Continued from page 11

The 8001 color monitor combines the 7004 plus deflection and focus correction circuitry to provide a complete 4 color high resolution graphics monitor. The inputs required by the 8001 are simply (1) X, Y deflection voltages, (2) intensity (video), (3) 2 bit color word, (4) unblank (optional) and (5) 115VAC. Key specifications are colors: red, orange, yellow, green, resolution less than .025" on worst color (red) over 10" x 10" area. Write rate and light output are 2μsec/inch at 25 foot lamberts for worst case red. All color switching and correction are complete in 15μsec.

Activities SID SID SID SID SID SID

From the National Office

Vi Puff

By its very nature a society is like an iceberg. Only a part of it is visible. The visible portion—local meetings, conventions and publications—requires a great deal of support both from the officers and from the national headquarters. Administering SID is for more than maintaining a mailing list.

Let's review some of the many headquarters' activities and the services that are available to you. Naturally much activity is administrative. We assist the executive board, committee chairmen, chapter chairmen, publication editors, accountant and attorney. Files and records must be kept, and supplies ordered. Then there are those monthly and quarterly tax statements—even for a non-profit society.

Communications are important, too. We open, read and distribute incoming correspondence—and handle many of the requests. We mail over 100 letters each month. Many people phone for information. During peak periods—such as before the annual symposium—the phone rings all the time. And, if we don't have the answers, we try to get them for you.

Membership is SID's main asset. We take particular care to keep accurate records so that you receive your journal and other information on time. It's not an easy task. Many SID members are nomadic, it seems. The 1973 renewal period brought 350 address changes. That's about 20 percent each year. It's especially important to make new members feel welcome—to make sure their address is correct, and their name is spelled right.

Other people are interested in our symposia and technical meetings. To let them know what's happening, we obtain mailing lists from other societies, supervise mailings, and assist with promotion. There has been a tremendous amount of interest in SID's new publications department. We sold and mailed over 800 publications last year. About 50 percent of the orders are from foreign countries'. A course in German, French, Italian and Japanese would be helpful. We manage the translations, somehow, but dread getting our first order from Gabon. That's when we'll head for Berlitz.

The 1972 Digest was our biggest item with 253 copies sold last year. We still have issues of the '70, '71 and '72 Digests in stock. If you don't have these important references in your library, order them today. They serve as detailed indexes to many of the full-length papers published in the quarterly proceedings.

An attractive new publications catalog has been prepared describing the publications that are available through SID. If you'd like to have one, drop me a note and I'll put one in the mail. If you have other questions about SID, let me know. That's why we're here.

VI PUFF
National Office Manager

LA Chapter Sees Honeywell System

The Los Angeles Chapter of the Society for Information Display on Wednesday, 30 May, 1973 visited the Honeywell Marine Systems Division, California Center, West Covina, California to see the Honeywell S-50 Graphic CRT Display System and Universal Navigation Training System.

The hosts were Bob Mueller, Marketing Manager, and Hal Jewett, Chief Engineer-Electromechanical Design.

Honeywell has designed and is manufacturing a high-speed interactive display system, the S-50, to satisfy a variety of display requirements demanding flicker-free performance and high-density data. Its unique features facilitate operator interaction with computation devices for applications such as computer-aided design (CAD) and simulation. We will be seeing the S-50 in a CAD demonstration and as a component of the USAF Universal Navigation Training System (UNTS) which will have its first delivery in June of this year. In both instances, it will be interfaced with the new Honeywell 716 computer.

SID CHAPTER NEWS

SAN DIEGO

San Diego SIDians were given a behind-the-scenes look at the Space Theatre in San Diego, April 13. Theatre projects simulation of of starry heavens on indoor dome. SID members saw the control consoles, projectors (including wide screen) the Star Field Ball, and Planet, Sun and image projectors. Wide screen projector uses a fisheye lens.

NEW ENGLAND

The Simulation Labs of the Navy Underwater Service Center at Newport (R.I.) were the late-afternoon objective of the April 24 meeting of the New England Chapter of SID. Following the field trip, chapter members enjoyed dinner at Raytheon's Plant 1, Portsmouth. To round off an intensive evening, following the two-hour dinner pause, members heard an "overview" of Sonar System Display Technology, given by D. Crockett.

The May 16 meeting was to be a joint one with the Society for Photographic Systems Engineers, on the topic "Pickup Tubes and Display Devices with Negative Electron Affinity Emitters."

SID Welcomes The Following New Members

Robert Baron, Student, Amherst, Ma.; Frank W. Bennett, Hughes Aircraft, Fullerton, Ca.; William Berson, CBS, Inc., Stamford, Ct.; Iver A. Brodersen, North American Rockwell, Fullerton, Ca.; Don L. Camphausen, Xerox Corp., Webster, N.Y.; Don M. Casto, Master Specialties, Costa Mesa, Ca.; Calvin K. Clauer, IBM Corp., San Jose, Ca.; Robert Czakowski, Science Applications, Inc., La Jolla, Ca.; Olean B. Dangerfield, Philco-Ford, Santa Clara, Ca.; Michael DiPrizito, Meria Systems, Inc., Acton, Ma.; John P. Dobbins, North American Rockwell, San Marino, Ca.; Dr. Kent E. Erickson, Keuffel & Esser Co., Morristown, N.J.; Dennis E. Florence, Chrysler Corp., Dearborn, Mi.; Lawrence A. Goodman, RCA, East Windsor, N.J.; Henry A. Grieco, Airco Industrial Gases, New Providence, N.J.; Jame E. Hargis, American Appraisal Co., Denver, Co.; Hugo Hsiung, McDonnell-Douglas, Niles, Il.; Toni B. K. Ivergard, Ergolab, Stockholm, Sweden; Kenneth J. Kendall, Bendix Corp., Fairfield, N.J.; Robert S. Kennedy, U.S. Navy Missile Center, Camarillo, Ca.; Takahiro Kubo, Mistubishi Electric Co.; Amagasaki, Japan; Dr. B. L. Landrum, Northrop Corporation, Palos Verdes Peninsula, Ca.; Jeffrey A. Lasky, Univ. of Minnesota, Minneapolis, Mn.; Arie Leider, Haifa, Israel; Donald A. MacAllister, A-F Sales Eng., Inc., Pasadena, Ca.; James B. McNeely, Litronix, Inc., Cupertino, Ca.; Paul R. Malmberg, Westinghouse Electric Corp., Pittsburgh, Pa.; Steve J. Mildenberger, University of Saskatchewan, Saskatoon, Saskatchewan, Canada; David P. Miller, Tektronix, Inc., Lutherville, Md.; Osamu Nakahara, Tokyo Sanyo Electric Co., Japan; James B. O'Neill, Stewart-Warner Co., Palos Verdes, Ca.; John K. Patberg, Western Electric Co., Princeton, N.J.; Jonathan S. Perel, Richmond, Va.; Robert Poon-Lun Lee, Student, Los Angeles, Ca.; Theodore E. Posch, Singer-Librascope, La Canada, Ca.; Patrick D. Pratt, Honeywell, Minneapolis, Mn.; Philip Rosten, Electro Vision Industries, Beverly Hills, Ca.; Edward L. Saenger, URS/Matric Co., Huntsville, Al.; Joel T. Salz, Lockheed-California Co., Los Angeles, Ca.; Walter Sidas, Hazeltine Corp., Richmond Hill, N.Y.; Richard C. Siebold, IBM, Kingston, N.Y.; George W. Smith, III, Beckman Instruments, Inc., Hacienda Heights, Ca.; John J. Stapleton, Hughes Industrial Products, Oceanside, Ca.; George D. Summers, Alexandria, Va.; Lawrence E. Tannas, Rockwell International Corp., Orange, Ca.; John E. Thompson, Master Specialties Co., Costa Mesa, Ca.; Roger W. Thompson, General Electric Co., Houston, Tx.; John A. vanRaalte, RCA Research Labs., Princeton, N.J.; J. R. Whitlow, Radiation, Inc., Melbourne, Fl.; R. Woolard, Litton Industries, Rexdale, Ontario, Canada; John D. Writer, Aydin Corp., Ft. Washington, Pa.; Yamada, Yahiko, Hitachi Central Research, Mountain View, Ca.; and John E. Yule, Honeywell Marine Systems Div., West Covina, Ca.

Moved?

Have you moved? To avoid delay in receiving SID publications and news, please advise the National Office of your new mailing address.

600 Attend Meeting

continued from page 12

Members of SID who did not attend the Symposium may obtain an illustrated DIGEST OF TECHNICAL PAPERS, consisting of 800-1,000-word condensations of papers, plus introductory comments on sessions. The DIGEST, distributed free to registrants at the Symposium, is available at $20 per copy to SID members. Write to National Headquarters, 654 N. Sepulveda Blvd., Los Angeles California 90049.

The annual 3-day exhibition, held in the Symposium hotel, in space contiguous to rooms in which papers were presented, included exhibits of dynamic operational systems, equipment and accessories.

If You Heard 'Em, Lucky. If You Didn't, Too Bad

To communicate to SID members the variety and types of programs being made available to members of SID chapters, here is a selection from recent chapter meetings:

LOS ANGELES
February 22, 1973
Speaker: Dr. Al Waxman, Vice President/Engineering, Princeton Electronic Products, Inc. *Subject:* "The PEP 400 Storage Terminal."
April 25, 1973
Speakers: Joseph Cogan — Lawrence Crowley. *Subject:* "DC-10 Automated Flight Tests" (McDonnell-Douglas DC-10 aircraft).

DELAWARE VALLEY
March 13, 1973
Speakers and Topics: George Holz, Burroughs Corp., "Gas Discharge Plasma Technology." Muzio Luce, Optel Corp., "Liquid Crystal Displays." Patrick Farina, RCA, "Incandescent Displays." Dr. Richard Ahrons, Opcoa, Inc., "LED Displays." Moderator, Dr. Mort Lewin, Rutgers University. Note: This was a joint meeting with IEEE.

SAN FRANCISCO BAY AREA
February 22, 1973
Speaker: Wendel Chase, Sr. Scientist, NASA. *Subject:* "Man/Machine Interface As Applied to Flight Simulators." Note: The meeting was held at the NASA-Ames Research Center, Sunnyvale.
March 21, 1973
Speakers: Members of Training Section, Federal Aviation Authority (FAA) and Air Transport Command. *Subject:* Movie and tour of facility at FAA Air Traffic Control Center.

NEW ENGLAND
March 13, 1973
Speaker: W.D. Hett, Raytheon. *Subject:* "Enroute Displays in the National Airspace System."

SOUTHWEST (Dallas)
March 8, 1973
Speaker: Bryan Holgate, Tektronix. *Subject:* Demonstration of new Tektronix display system.

SAN DIEGO
March 13, 1973
Speaker: Craig Stephens, Hughes Aircraft. *Subject:* "A High Resolution Meshless Storage Tube."

SID Sustaining Members

ALLGEMEINE ELEKTRICITATS—GESELLSCHAFT
AEG-Telefunken
Vorstandssekretaruat
6 Frankfurt/Main-Sud
West Germany
AEG Hochhaus

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

CONRAC CORPORATION
330 Madison Avenue
New York, New York 10017
SIEMENS AG

DuMONT ELECTRON TUBES DIVISION
Clifton, New Jersey

FERRANTI ELECTRIC COMPANY
Plainview, New York

GML CORPORATION
594 Marrett Road
Lexington, Massachusetts 02173

HUGHES AIRCRAFT COMPANY
Culver City, California 90230

IBM CORPORATION
Armonk, New York

INFORMATION DISPLAYS, INC.
Mt. Kisco, New York

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

OY NOKIA AB ELECTRONICS
Helsinki, Finland

PHILCO-FORD CORPORATION
Palo Alto, California

PHOTO RESEARCH DIVISION
KOLLMORGEN CORPORATION
3000 N. Hollywood Way
Burbank, California 91505

STEMENS AG
Tubes Division
76 St. Martinstr
Munich, West Germany

SINGER-LIBRASCOPE
Aerospace & Marine Systems Group
808 Western Avenue
Glendale, California 91201

SYNTRONIC INSTRUMENTS, INC.
100 Industrial Road
Addison, Illinois

TEKTRONIX, INC.
Information Display Products
P.O. Box 500
Beaverton, Oregon 97005

THOMAS ELECTRONICS, INC.
100 Riverview Drive
Wayne, New Jersey 07470

THOMSON-CSF
Paris, France

XEROX DATA SYSTEMS
El Segundo, California 90245

Photophysics Appoints

Robert K. Swanson has joined Photophysics, Mountain View (Cal.) as engineering manager. Joseph John Bullock has joined the firm as manufacturing manager. Photophysics makes a line of hard copy computer terminals for end users, and electrographic copiers for sale to other manufacturers.

CORRECT SPELLING OF OFT-MISSPELLED WORDS
It's Persistence, not Persistance.
It's Aperture, not Aperature.

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