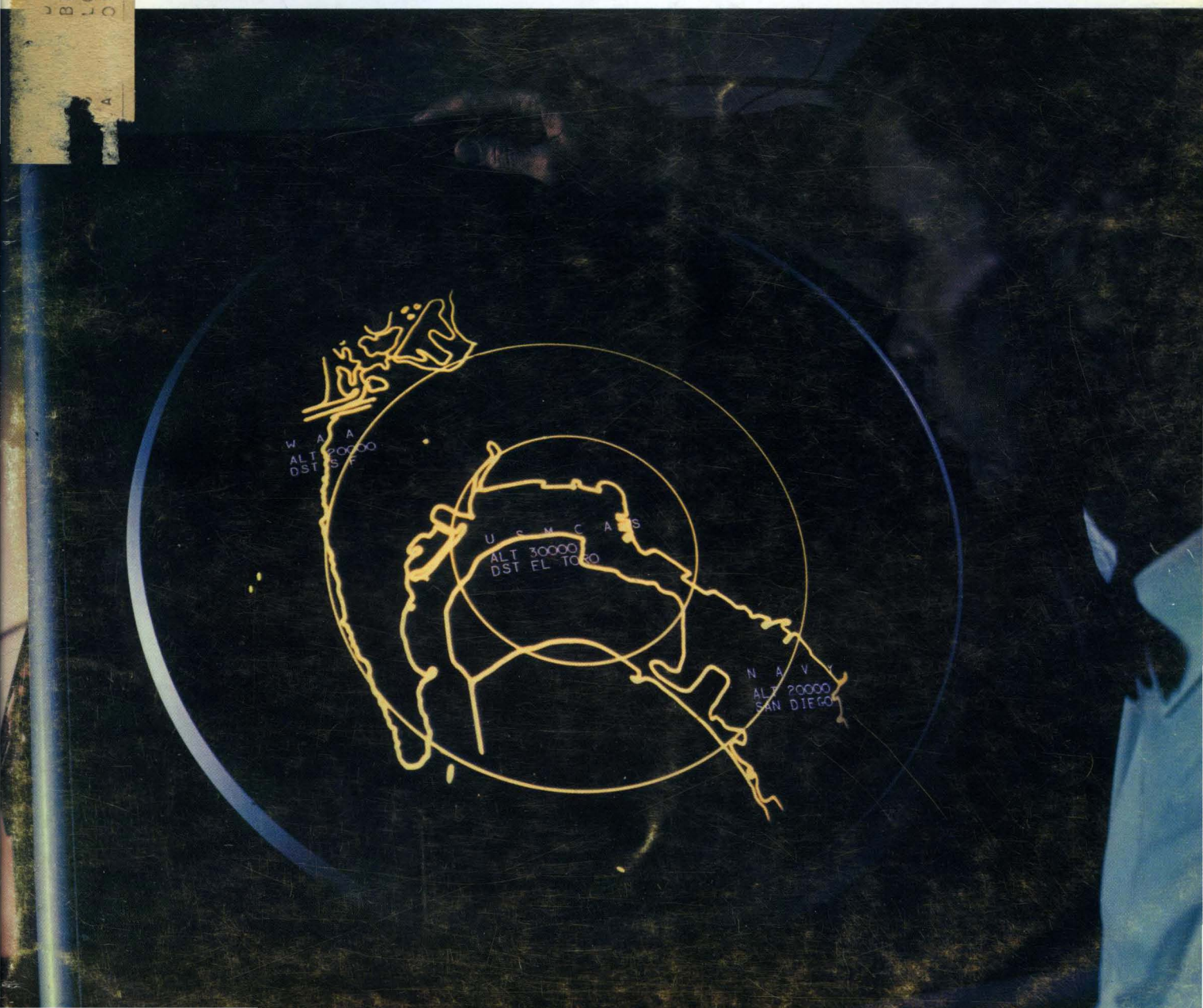
May, 1964

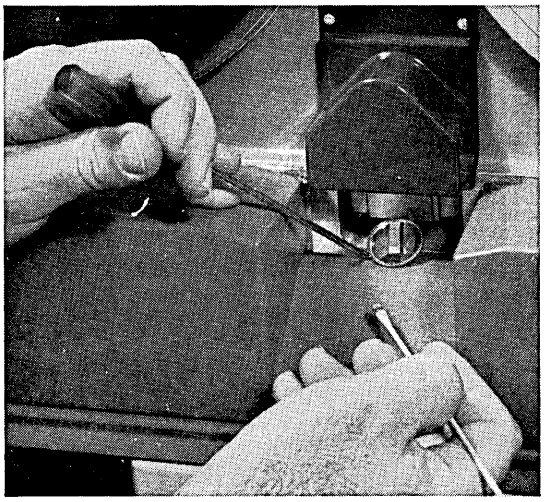
computers and automation

uter Displays: *Dissolving the Man/Machine Barrier*



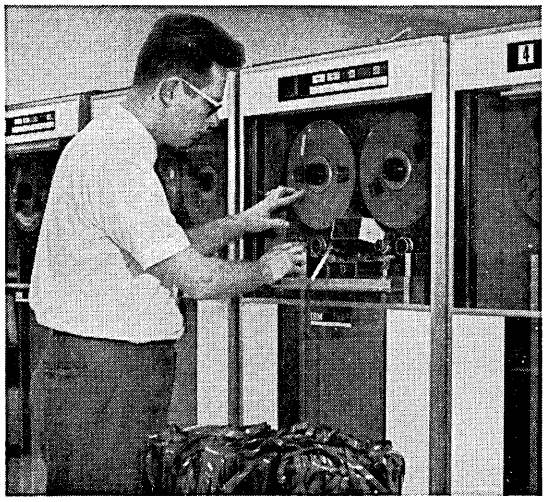
4 REASONS FOR BUYING ONLY PREMIUM TAPE

(Memorex, of course!)



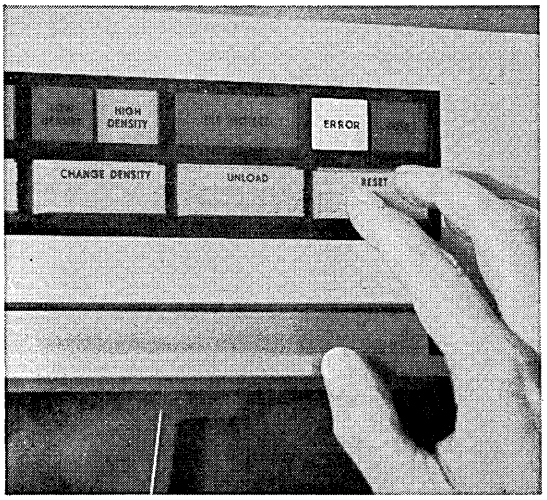
Reduced maintenance down-time. Premium tape increases head life and reduces head replacement. Its better adhesion of oxide coating and tougher, smoother coating surface minimize operating interruptions resulting from oxide build-up on heads and guides.

Memorex magnetic tape is premium tape.



Longer life. Premium tape minimizes tape stripping. It assures error-free performance long after inferior tape breaks down and becomes loaded with dropouts. The more severe the use, the more the economies afforded by premium tape's tougher, smoother coating.

Memorex magnetic tape is premium tape.



Greater reliability. Premium tape remains error free — pass after pass, reel after reel — and provides greater security of data in demanding routines. Despite the somewhat higher price of premium tape, few users can afford to miss the economy inherent in its greater reliability.

Memorex magnetic tape is premium tape.

No rejects. Premium tape provides freedom from rejects because it is always read-pass perfect — reel after reel. Its price is higher, perhaps. But its effective cost is less because premium tape delivers machine-time savings by eliminating pre-testing and maximizing error-free operation.

Memorex magnetic tape is premium tape.

Memorex tape is premium tape. No need to pre-check it. You can place Memorex computer tape directly in service — reel after reel.

Memorex certification means what it says: Memorex computer tape is error-free. Extra care, extra steps and scrupulous attention to every detail make it that way. We know the importance to you of having a tape you can depend on.

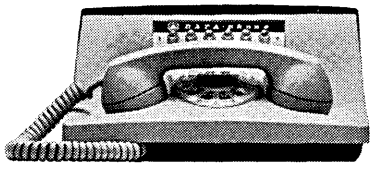
Are you on our mailing list to receive the Memorex Monograph Series of informative technical literature? Write 1176 Shulman Road, Santa Clara, California

MEMOREX

PRECISION MAGNETIC TAPE

Circle No. 5 on Readers Service Card

If you're using your telephone service only for "people talk"... you may be only half using it!



Once, business phones were strictly for people-to-people communicating.

Not so today. Bell System DATA-PHONE service has changed that. It has made it possible to speed volumes of operating data—payrolls, invoices, inventories—over the same telephone lines you use to plan a meeting or arrange a business luncheon.

Combine DATA-PHONE transmission with your regular telephone service—and you achieve an integrated information-handling system that can help you save time, control costs and minimize paperwork throughout your operation.

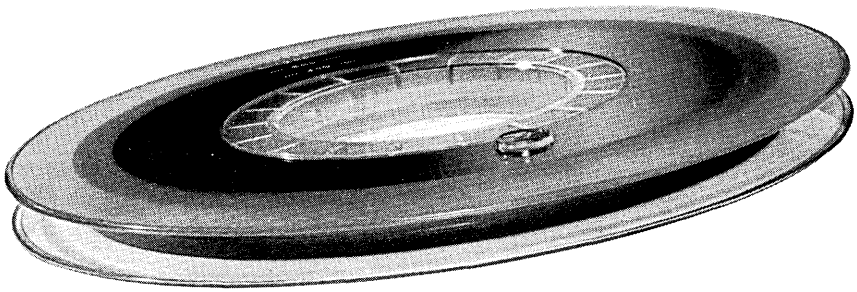
One of our Communications Consultants will bring you all the details. Just call your Bell Telephone Business Office and ask for his services.

Bell Telephone System

Serving you

Circle No. 6 on Readers Service Card

This is Computape reel #8741-11



Case History: Reel #8741-11 was part of an order shipped to the Engineering Department of a leading University. There it was selected at random and subjected to a continuous wear test. In 268,853 passes no permanent dropouts were experienced.

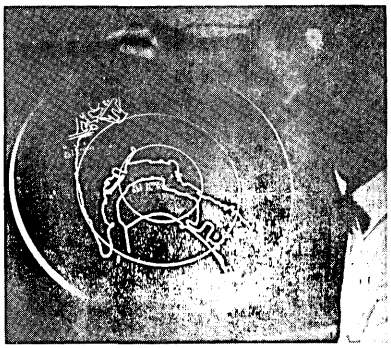
Exceptional? Yes, outstanding . . . But another example of the longer wear qualities of Computape. Longer wear, less static build-up, greater reliability than ever before.

Test it yourself. Against any other tape.

COMPUTRON INC.
122 CALVARY STREET, WALTHAM, MASSACHUSETTS

Circle No. 7 on Readers Service Card

Our front cover shows a multi-color computer-controlled display made by General Dynamics. The man is looking at a map of the San Diego region projected on the screen from a slide in the rear of the cathode ray tube. On this map immediate data on aircraft in the region is displayed electronically, directly under the control of the associated computer. More information on this and other display devices is contained in the articles by Johnson and Weisberg in this issue.



computers and automation

MAY, 1964 Vol. XIII, No. 5

computers and data processors:
the design, applications,
and implications of
information processing systems.

REPORT ON COMPUTER DISPLAYS

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COMPUTERS AND AUTOMATION IS PUBLISHED MONTHLY AT 815 WASHINGTON ST., NEWTONVILLE 60, MASS., BY BERKELEY ENTERPRISES, INC. PRINTED IN U.S.A. SUBSCRIPTION RATES: UNITED STATES, $15.00 FOR 1 YEAR, $29.00 FOR 2 YEARS, INCLUDING THE JUNE DIRECTORY ISSUE; CANADA, ADD 50c A YEAR FOR POSTAGE; FOREIGN, ADD $1.50 A YEAR FOR POSTAGE. ADDRESS ALL EDITORIAL AND SUBSCRIPTION MAIL TO BERKELEY ENTERPRISES, INC., 815 WASHINGTON ST., NEWTONVILLE, MASS., 02160. SECOND CLASS POSTAGE PAID AT BOSTON, MASS.

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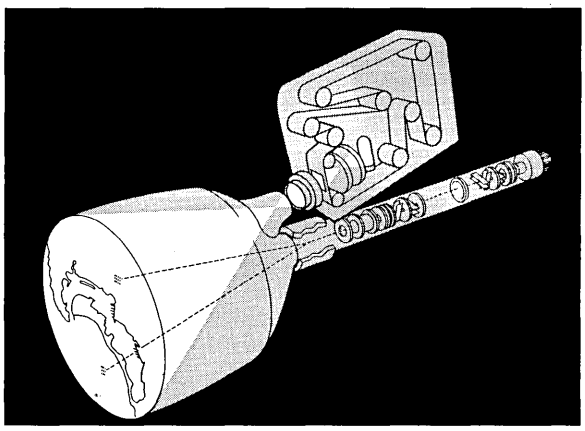


See new "rear window" display console at Spring Joint Computer Conference

The first public demonstration of a unique new display console will take place in Washington April 21 to 23 at the Spring Joint Computer Conference. It is the new S-C 1090 which combines simultaneous cathode ray presentations and film frames on the face of the same tube.

A prime advantage of the new display console is that valuable computer and dynamic display time is not wasted on infrequently changing background data. Maps, business or engineering forms, etc., may be projected on the face of the tube from the inside, in color or black and white, using the built-in film projector. Changing information is superimposed on this image by a CHARACTRON® Shaped Beam Tube. Specific film frames can be selected manually or automatically by the computer.

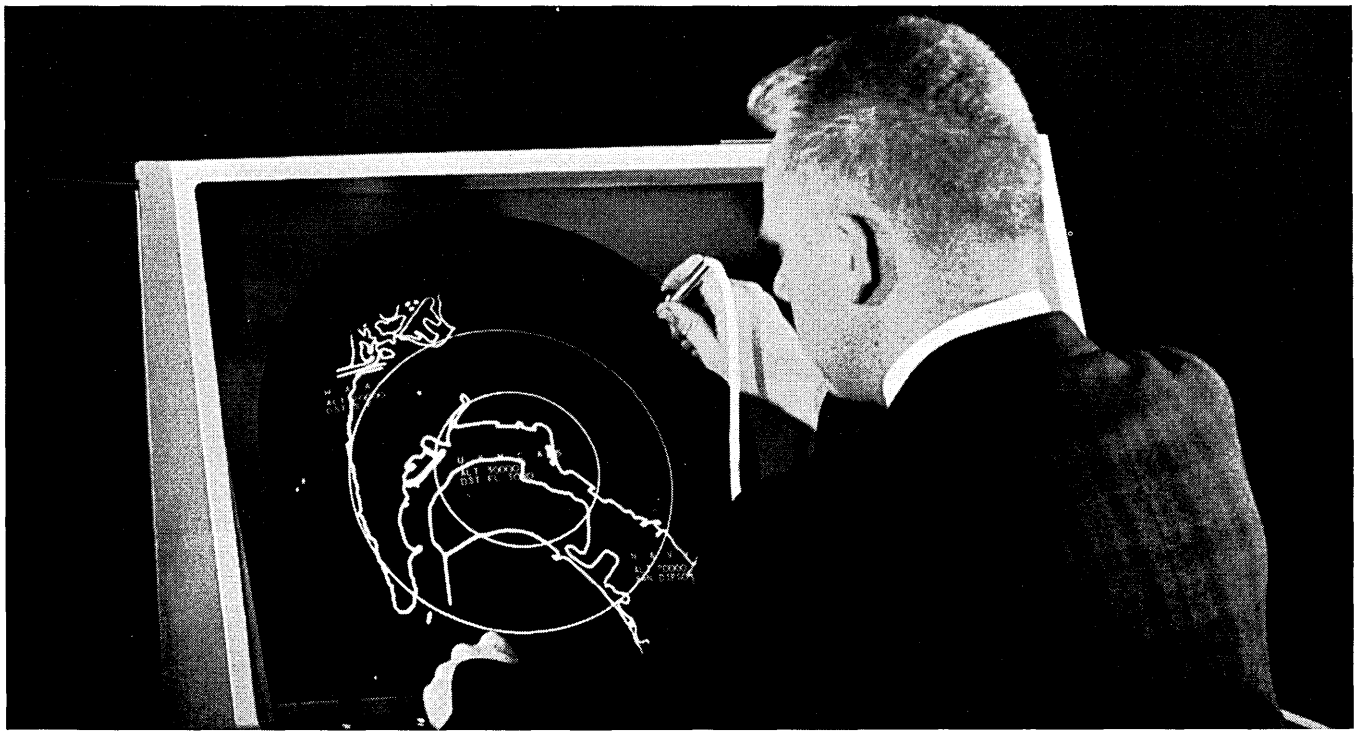
The new development uses a "rear window" tube, so called because the filmed data is projected through a small window located next to the cathode ray gun. The film image is projected onto the inner phosphor-covered surface of the tube from the back and is easily visible from the outside.

The special CHARACTRON Shaped Beam Tube forms alphanumeric or symbolic characters for display on the face of the tube at high speeds. A metal matrix placed within the neck of these tubes produces characters of great clarity. A bright, high resolution spot writing beam is also available to display data from analog inputs simultaneously.

In a typical application, such as tactical air operations, various maps of the tactical area can be produced on film and projected on the screen of the S-C 1090 Console. The computer is then free to present only dynamic data such as movement of aircraft with associated descriptive information.

In business or engineering applications, forms may be projected onto the tube face and filled in with alphanumeric data by the character generator. This compact film projector is offered as a custom option on the standard S-C 1090 Direct View Display Console. For additional information, write to Dept. E-26, General Dynamics | Electronics, Post Office Box 127, San Diego, California 92112.

GENERAL DYNAMICS | ELECTRONICS GD SAN DIEGO



Circle No. 95 on Readers Service Card

"What Happens to the Quality and Character of an Intellectual Job When it Gets Mechanized?"

This important question is asked in a stimulating editorial by Robert Colborn, editor, in the April 1964 issue of "International Science and Technology" published by Conover Mast Publications, New York, N. Y.

He gives several examples:

- Information retrieval—
  "What happens in an automated library to the serendipity that every browser among documents has experienced, finding the right answer in the wrong document?"
- Automated measuring instruments:
  "I know at least one physicist who is sitting on a massive set of computer calculations he's unwilling to publish . . . there is no way he can tell what it means that the figures go one way rather than another . . . he says, 'The aim of science is to understand, not to raise a specific question and get a specific answer.' "
- The artificiality of focusing data into a chance to get at the computer:
  ". . . the time in the forties when Von Neumann worked partial differential equations by monitoring an early computer's intermediate results, changing the input assumptions as he went along—how many get a chance to work that way today?"

Colborn concludes: "We had damned well better understand and allow for the characteristics of automated thought."

A number of things happen to the quality and character of an intellectual task when it gets mechanized, and nearly all of them are for the better.

When an intellectual task is capable of being mechanized, and is placed on a computer, it becomes more definite, more anchored to reality, it becomes less fuzzy, less insubstantial. This aspect of thought is alluded to in the words of Leonardo da Vinci:

> It seems to me that those sciences which are not born of experience, the mother of all certainty, and which do not end in known experience—that is to say, those sciences whose origin or process or end does not pass through any of the five senses—are vain and full of errors.

and in the words of John Ruskin:

> The work of science is to substitute facts for appearances and demonstrations for impressions.

As a result of the mechanization of many intellectual tasks, there is less room for hunch, armchair thinking, opinions, feelings, authoritative pronunciamentos, the so-called considered judgments of experienced persons, etc. Instead, there is the fact that with computers a proposed theory (mathematical, logical, scientific, etc.) can be tried out by the hundreds and thousands of cases, to see how it works—to see if a proposed solution will actually meet the given requirements. This change is advantageous. Methods for going from a poor solution to an improved solution, methods of successive approximation, can be used with great power and great effect. Computer people are familiar with Monte Carlo methods, linear programming methods, critical path methods, and other methods for dealing with intellectual tasks which for the first time became practical with large numbers of variables because of the powers of modern computers.

Even if there is an automated library, it does not require the non-automated library to disappear. People who wish to browse in books will still be able to browse in books. But browsing with a computer facility at your elbow is likely to become ten times and perhaps a hundred times more efficient than ordinary library browsing. It will be as if you had the world's most informed and most patient professor at your elbow, able to answer almost any kind of sensible question that you can ask him.

In regard to automated measuring instruments, and their reports, it is quite possible to give the readings to a computer and entrust it with a most sophisticated technique for searching and analysis, so that it will glean the understanding that one seeks to gain. The astronomer Johann Kepler spent over ten years calculating with the observations of Tycho Brahe, in order to propose his three laws of planetary motion; with the aid of a modern computer, an astronomer nowadays should be able to discover laws much faster than that.

As to the artificiality of focusing data into an opportunity for access to the computer: the increase in the number of computers, the availability of secondary time, the decrease in the cost of computer time, and the growth of time-sharing on computers—all are making it easier and not harder to obtain computing power just when one wants it. This obstacle is only temporary.

In fact, the way in which Dr. von Neumann used the computer for mathematical investigation by interacting with a computer's "quick looks," will in a few more years become one of the regular ways of using a computer (see "The Time-Sharing of Computers" by Edward Fredkin in the November, 1963 issue of *Computers and Automation*).

Several thousand years ago almost no one could read and write, and so the memory of minstrels was very extensively trained, in order that they might recite and chant epics for hours at a time, as they entertained an audience in the evening, gathered around a fire in the great hall. As the new technique of reading and writing became more widespread, think of the dislike and distrust it received from the minstrels!

We need to be perceptive to the advantages and disadvantages of each new technique that comes along to affect human thought. There is no escaping from change. And there is no rule that says we must stop using memory, or pencil and paper. If we remain sensible and adaptable, we should be able to gain benefits from automated thought without losing benefits from unautomated thought.

Edmund C. Berkeley
EDITOR

c & a
READERS' & EDITOR'S FORUM

KEEPING ONE'S "FEET ON THE GROUND" AND COMPUTERS

1. From Otis Minot

Minot Informatic Devices
1776 Massachusetts Avenue
Lexington 73, Mass.

In reference to your editorial "Let's Keep Our Feet on the Ground" in your February issue, while I agree that ten years from now we shall probably still have men driving buses, it does seem possible that the jobs of many bus drivers will be affected considerably by computers. I would not go along with "Fortune" and say the jobs will be "very different," but this is disagreement on degree.

We can envision computers as tied in with:

1. Reservations for and scheduling of bus trips, especially in long distance service, and local charter service.
2. Bookkeeping concerned with maintenance, repair, economy, etc. of buses.
3. Production of bodies, engines, controls, fuels, parts, etc., which will be reflected in over-all design, comfort, speed, rates, etc.
4. Ticketing, fare collection, luggage registration, carrying of packages, etc. (particularly as trains disappear).
5. Pay, promotion and other bookkeeping.
6. Recording of times, distances, speeds, economics, etc. by automatic device, with records fed to computers.
7. Concentration of business, schools, etc. partly in response to the desirability of central data processing facilities. (Maybe the communication industry will free us from this worry, but communication still costs money).
8. Computer-aided studies of traffic.
9. Computer control of traffic.
10. Automatic control of bus steering and automatic collision prevention, on major routes, involving various computing systems or parts.
11. Personnel testing, health records, health examinations, etc.

Surely it seems, however, that the person-to-person aspects of the job will remain similar. Unless they are all reading *Computers and Automation,* the students will probably all be scuffling, singing and shouting. Or will the computer have proved that a TV set in every bus is economically sound, its cost being 1/10 that of wear and tear on bus and driver?

II. From the Editor

Many of the observations of Mr. Minot are certainly correct, and the job of a bus driver will certainly be influenced to some extent by the growth of computer technology. But ten years from now, a man will still drive a school bus, in spite of computers.

In regard to Point 10 above, the automatic control of bus steering on major routes, and automatic collision prevention, seem to be a very remote possibility; the easy way to accomplish this is to put the buses on rails, and this of course produces a railroad. As to the disappearance of trains, this is most unlikely for something as useful and efficient as they can be; even the ordinary wooden lead pencil has not disappeared; and the hourglass of the ancients may be found today in a department store as a three-minute egg timer.

"SPLATTER DIAGRAM" COPIES

Eugene Smith
Electronic Associates, Inc.
Long Branch, N. J.

In reference to requests from your readers for copies of the "Splatter Diagram," which was used as the front cover for *"Computers and Automation"* in August, 1963, and which won your first prize in your computer art contest:

Our company does have prints of this diagram available, and we shall be glad to supply copies to your readers on request. They are available, thus correcting your remarks in the March, 1964 issue, page 8.

c & a EDITOR'S SCRATCHPAD

THE MEANING OF THE THIRD GENERATION:....
....ARE BIRTHDAYS IN ORDER?

This issue carries a rather extensive report on the much anticipated new IBM computer series, the System/360.

The announcement date for this computer, April 7th, has been hailed by IBM as the birthday of a new concept in computers. Is this a fair assessment?

Certainly the new IBM System/360 represents a new concept in the administration of a computer system development project. The System/360 combines over three years of R & D efforts at IBM Laboratories in Stockholm, LaGaude (France), and other foreign centers as well as from San Jose, Calif., Yorktown, Fishkill, Endicott, Poughkeepsie, and Kingston, N.Y. and other U.S. IBM research groups. This is a remarkable accomplishment in itself.

Certainly the System/360 represents a new concept in computer system announcement planning. With admirable efficiency, IBM's huge marketing force presented the details of the System/360 to over 200 reporters at a press conference in Poughkeepsie, to over 90,000 customers and prospects in 165 U.S. cities, and to over 50,000 foreign customers and prospects in 90 cities, all in the same day.

Certainly, the System/360 represents a major step forward in offering mass memory capacity with access times compatible with computer operation speeds. With any of 8 million directly addressable characters available in 8 usec., one can do a whale of a lot of high-speed data structuring and sorting (although at a lease cost of $13,000 per month per two million characters).

Certainly the System/360 represents a major plunge ahead in tunneling through the input/output cost and capacity barriers. One example is the offering of a low cost inquiry display terminal ($275 per month) and another is the expansion in the capacity of selector channels so that the System/360 can communicate and control up to 256 I/O units per channel.

However, the idea of a compatible family of computers is not new as the existing GE 400 series will attest. The idea of using hybrid circuits is not new, for both hybrid and fully integrated circuits have been offered in several aerospace computers for over a year now.

The system organization of the System/360 is not new but rather follows the classic pre-ENIAC computer organization, with modifications to reflect the need for high-speed storage registers to hold intermediate results.

The System/360 is an impressive achievement by the leading manufacturer in the computer field. However, we feel that it falls short of being a new concept in computers...rather it notes a new mark of maturity in the development of versatile, economic computer systems. We are happy to welcome it to the computer field.

SYSTEM/360 RESHUFFLES COMPUTER ORDERING PATTERN

Regular readers of our monthly computer census will note we have moved the cut off date for this month's installment back to April 6th. This was done for two reasons: (1) we are printing this issue early in order to have copies ready for the Spring Joint Computer Conference, and (2) we don't feel that reasonably reliable "on order" figures can be compiled during the dynamic computer ordering activity immediately following the IBM System/360 announcement on April 7th.

However, in an effort to get some feel for ordering activity on the System/360 we made a telephone survey of a random selection of EDP users during the three days following the April 7th announcement. We found that the System/360 is apparently being warmly received by current 7000 series users. The higher end of the System/360 offers compiling capacities from 15 to 20 times that of the largest computers in the 7000 series, and 6 to 10 times the throughput for equivalent system costs. The model 50 processor system is being rather heavily ordered by the 500 or so existing users of the IBM 7044 and 7070, 2, 4 computer systems. Several 7090, 4 users mentioned that they are ordering the model 50 to be linked up with a model 70 in a multi-computer system.

Among 1400 series users, the System/360 is being received with considerably more hesitation. The model 30 processor offers about four times the throughput of the 1401 for equivalent system costs when programs are written specifically for each system. IBM is offering a 1401 "emulator" on the models 30 and 40 which allows those processors to accept 1401 programs and interpret them in System/360 processing steps through the use of a special read-only storage. However, processing efficiency in the mod-

els 30 and 40 is cut in half when handling 1401 instructions in this manner.

The rapid appearance of computers with 1401 program translators and 1401 simulators such as the H-200, GE-415 and B200 series is causing many 1400 series users to consider carefully the advantages of converting currently to a competitive system rather than waiting eighteen to twenty months for a System/360 which might be behind the state-of-the-art when ready for delivery.

NEW COMPUTER LOOK-AHEAD

IBM judiciously chose to start the numbering on the central processors of the System/360 at 30 and end at 70 to allow for upward and downward expansion.

Upward expansion is already underway as IBM is currently negotiating for orders to build two prototypes model 90 super-scale systems, which it believes will become the most powerful computers in the world. As though by reflex, IBM is proposing one of the systems to the people at the Lawrence Radiation Laboratory to add to their collection of "most powerful" computers (currently including LARC, STRETCH, and the CDC 6600).

Honeywell is planning to announce at the SJCC what it now calls the H-200S, a scientific version of the highly successful H-200. The word length is 24-bits, and the processing speeds will be in the vicinity of 2 usec. for a fixed point addition and 8 usec. for a floating point multiply. System rental cost for the new computer is expected to be about $4,000 per month.

3C has just unveiled its newest computer, the DDP-224. This machine is considerably faster than the DDP-24 (260,000 additions per second vs. 100,000; 6.4 usec. multiply time vs. 31 usec.; 1.9 usec. memory cycle time vs. 5 usec.). The new computer features special options which make it possible to combine several 224's into a multi-computer system with common memory, control and arithmetic. The 224 with 4096 words of core memory sells for $96,000, or just slightly more than the $87,000 basic price for the 24, although the 224 has from three to four times the throughput capacity of the 24. To reflect this difference, 3C is believed to be planning to lower the price on the 24 shortly.

A COMPUTER BY ANY OTHER NAME....

One of the special arts in the genial trade of news release reading is the ability to quickly perform a code conversion and data reduction processing on an incoming release. The goal of this processing step is to deflower the verbal greenery, and deflate the promotional superlatives so that each piece of news information can be treated with a relatively balanced outlook.

However, sometimes our mental processing comes up with a blank when some eager beaver press release writer has been able to envelop his product in cryptographic terms for which, try as we may, we can find no key. An example of the latter occured recently in a news release which described its subject as a device which "performs the same operations for rocket design as a room full of electronic computers, both digital and analog. In essence, it is a computer that is inexpensive and can be used at a desk or in the field. In fact, it is a roomful of computers that the engineer can carry in one hand"!!

What can it be?...a marvel of microelectronics?...a miniature optical computer compacting millions of bits of information in a laser beam? No... further searching reveals it to be nothing more wondrous than a book of nomographs! Who says that the word computer is being spread too thin!!

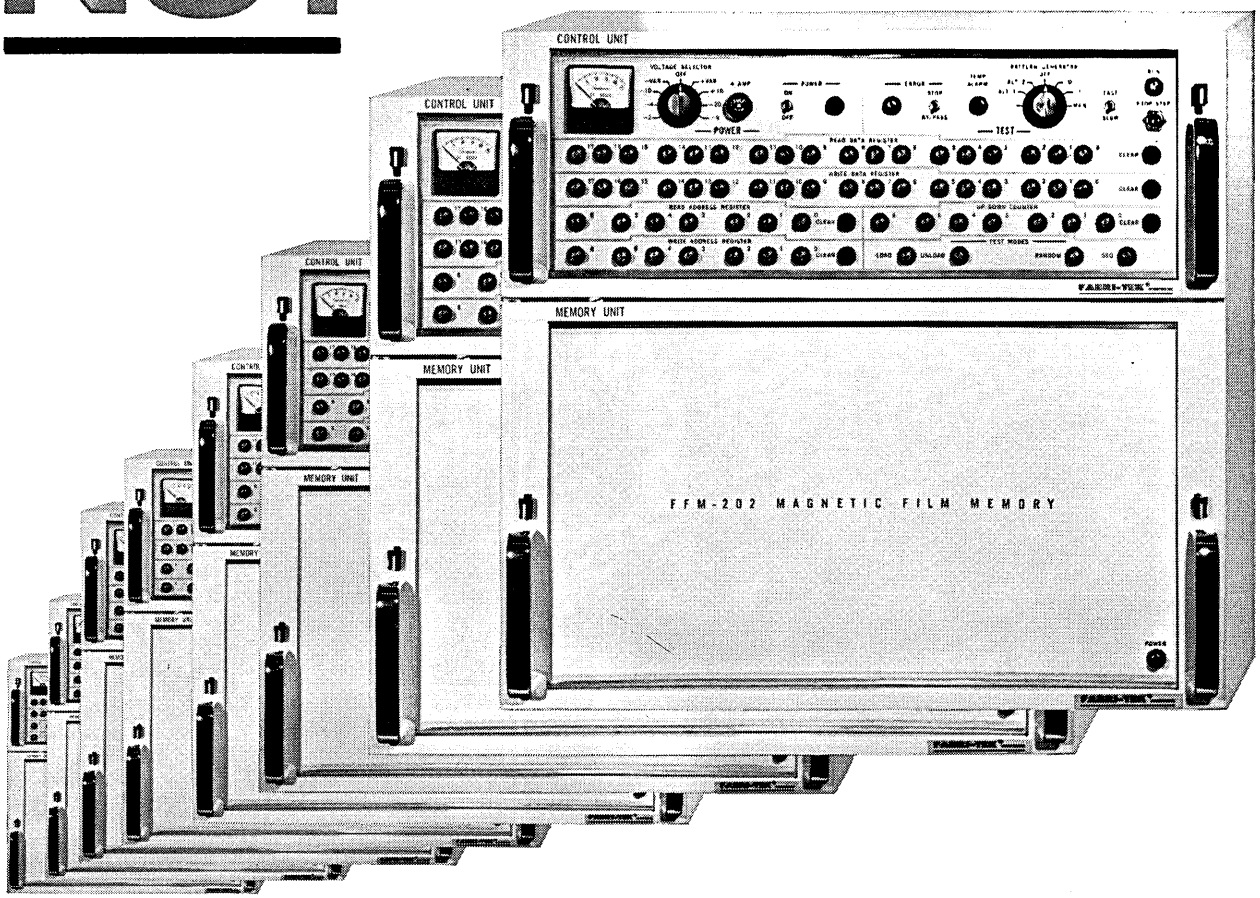
MEANWHILE, BACK AT COMPARISONVILLE...

Readers of our February, 1964, issue will remember Norm Statland's article on "Methods of Evaluating Computer Systems Performance" which offered some very sensible suggestions for yardsticking the effectiveness of a particular computer system on a proposed application. Norm, who works for the Auerbach Corp., has kindly given us permission to publish some of the results of the computer system performance measurements his group has been making for their reference series, the Standard EDP Reports, published by Info, Inc., a subsidiary of the Auerbach Corporation. The chart below gives the results of computer system performance comparisons on two data processing activities, one a general file processing problem, and the other a matrix inversion. For users interested in getting a gage on the processing power of some medium class computer systems currently available, this chart provides some interesting perspectives.

SYSTEM PERFORMANCE COMPARISONS – MONTHLY RENTAL BETWEEN $10,000 AND $30,000

SYSTEM IDENTITY	CONFIGURATION NUMBER (See Users' Guide 4:030.100)	MONTHLY RENTAL, $	GENERALIZED FILE PROCESSING PROBLEM A (See Users' Guide 4:200.100)			MATRIX INVERSION (See Users' Guide 4:200.300)		
						Standard Estimate		
			Activity			Array Size		
			0.0	0.1	1.0	10	20	40
			Minutes per 10,000 Records			Minutes		
Honeywell 1400	VI A	14,530	1.6	2.8	20.	0.035	0.26	2.0
RCA 301	VI A	12,880	1.5	4.3	32.	0.020	0.15	1.0
GE 225	VI A	12,805	1.6	2.5	25.	0.033	0.24	1.7
Honeywell 1400	III	12,290	1.6	2.8	20.	0.16	1.2	8.5
IBM 1410	III	12,240	1.4	2.0	20.	0.17	1.3	9.0
GE 235	III	11,870	1.5	2.5	25.	0.07	0.47	3.5
IBM 1460	III	11,735	1.4	3.6	26.	0.17	1.3	– –
IBM 1401	IV	11,540	2.0	2.6	20.	0.33	2.5	– –
Honeywell 1400	II	11,150	1.6	3.7	24.	0.16	1.2	8.5
Honeywell 400	VIA	11,005	2.0	3.0	20.	0.15	1.0	8.0

This is NOT a new product!



Fabri-Tek's 300-nanosecond thin-film memory system has been on the market for well over a year now, so we refuse to call it "new." Some people are just catching up to the memory system technology we offered last year, but they still haven't caught up with the Fabri-Tek Series FFM-202 Magnetic Film Memory System.

If you have such applications as scratch pad storage, index registers, real time data processing, or any of the new exotic data processing problems where high speed with reliability is needed, then here is your answer.

• 300 nanoseconds full cycle • 200 nanoseconds read or write only • 150 nanoseconds access time • Read only, write only, read-restore, read-modify-write operating modes • Capacities up to 512 words of 36 bits each • Full Fabri-Tek quality, realiability, and maintenance ease

Why wait for others to announce their new products when you can have the answer to your high-speed memory problems today. Write, call, or wire Robert E. Rife, Fabri-Tek Incorporated, Amery, Wisconsin. COngress 8-7155 (Area 715). TWX: 715-292-0900.

FABRI-TEK

Circle No. 8 on Readers Service Card

DIGITAL DATA DISPLAY SYSTEMS: AN ASSESSMENT

Robert W. Johnson
Data Display, Inc.
St. Paul 8, Minn.

Digitally commanded cathode-ray-tube displays have found increased applications with computer systems since the mid 1950's. At present an industry within the computer industry exists for the production of these devices. For 1963 this display industry probably accounted for a sales volume of more than 40 million dollars.

The bulk of the applications of digital data displays have been oriented to the defense effort or are related to other government-sponsored programs. These have ranged from complex, multiple-station, on-line displays for command and control systems to single recording displays used to record graphical and tabular data from scientific computations.

The commercial use of display systems has only recently become significant. Commercial applications, such as information retrieval programs, data-processing recording, etc., are beginning to become a significant part of the display industry.

A digital data display system is a device which receives digitally encoded command information from a computer or other digital data source, and transforms these commands into visible displays of symbolic or graphical information. The primary output media of these displays is the cathode ray tube, although other media have been investigated or have found relatively limited applications.

Along somewhat arbitrary lines, the digital data display may be divided into three functionally distinct types of systems:

1. The General-Purpose Console Display
2. The High-Speed Film Recorder
3. The Information Retrieval System

The distinction between these groups is not always present, since more than one function may be combined in a single system. The functional configuration of each of these display types is shown in Figure 1.

The General-Purpose Console Display

This kind of system is typified by the console stations in a large-scale military command-and-control system. The systems may range all the way from a set of complex displays with symbol and vector generation, buffer memory, keyboards, light pens, switch inputs, and background generators—to a single unbuffered display able to present a single symbol or point capability only. Some typical systems in this category are shown in Figure 2.

The key element of the general purpose console is the technique of display generation. Typically this consists of functionally separate units to generate characters or symbols and vectors (or line segments) and the techniques of symbol generation are typically proprietary to each display manufacturer.

Each of these techniques may be rated in terms of repertoire, speed, and quality. The display repertoires of typical General Purpose Displays allow a set of 64 or 128 symbols to be selected, and the symbol generation speeds range from 25,000 to 200,000 symbols per second. Short persistence phosphors are normally used for the console displays and a refresh rate of 40 cycles per second or more is required to avoid flicker when used in normal lighting conditions. Therefore the speed range of 25,000 to 200,000 characters per second enables simultaneous display of 600 to 5,000 symbols.

The generation of lines or vectors under computer control is accomplished by simultaneously varying the horizontal and vertical deflection signals to the CRT drive, in synchronization with control of the beam brightness. The requirement for straight lines with precisely controlled terminations and line width, in combination with a high writing rate, is the design challenge for the vector generator. In order to control the relative intensity or line width

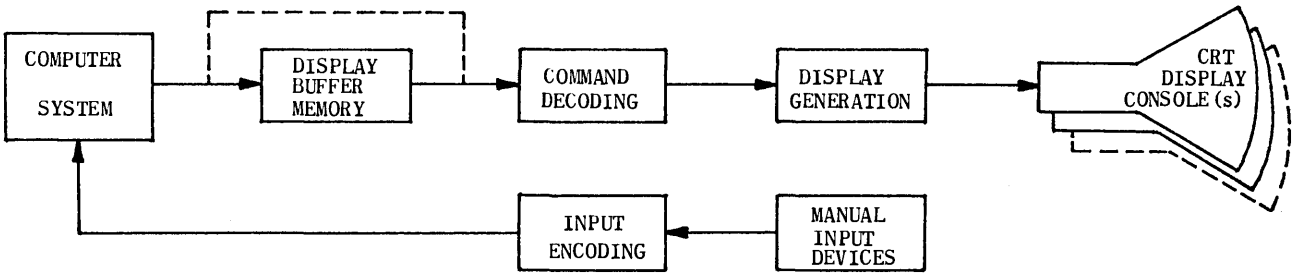


Figure 1a. The general purpose console display.

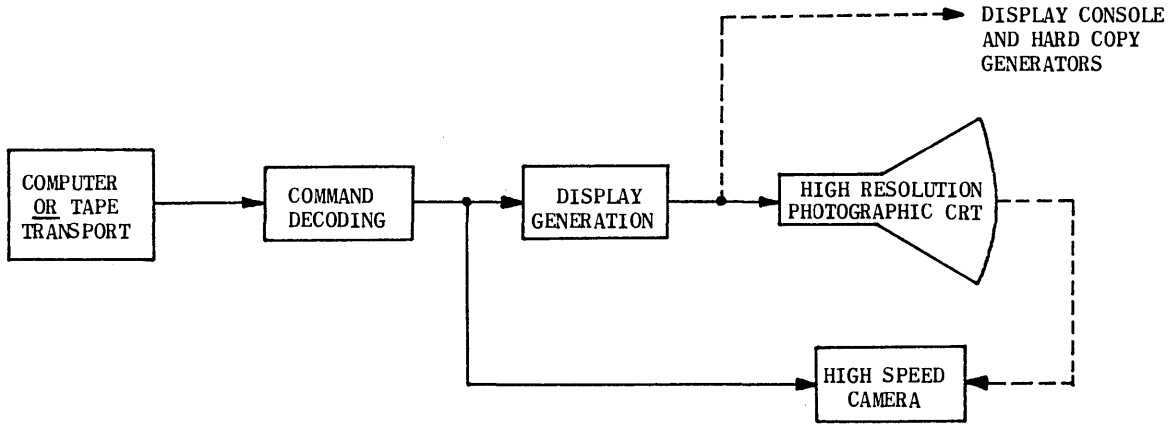


Figure 1b. The high speed film recorder.

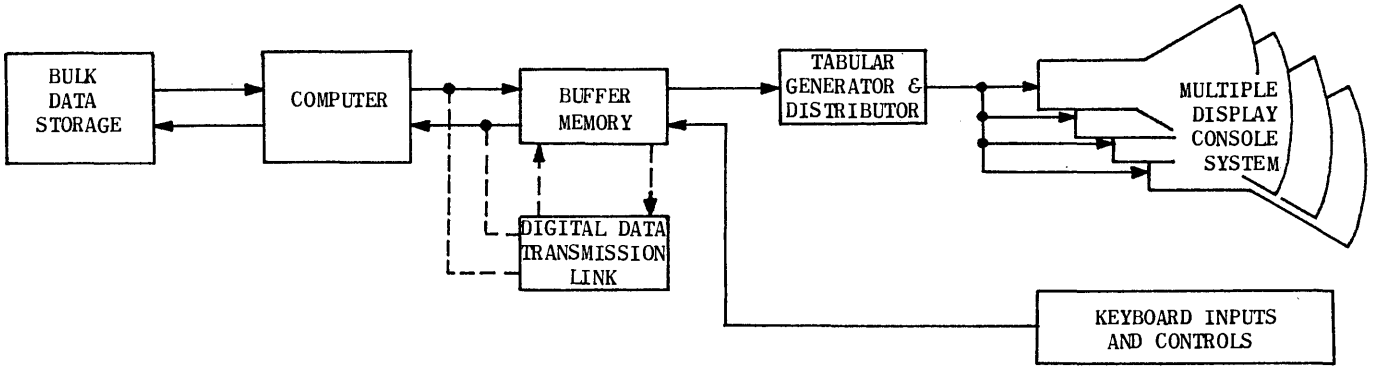
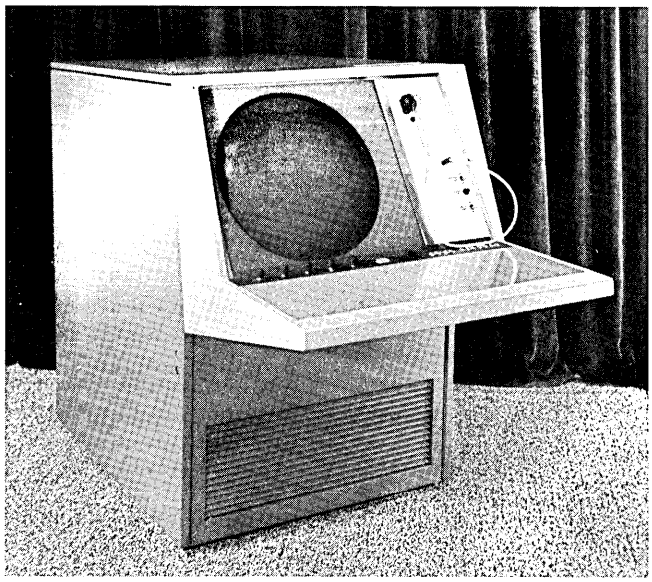
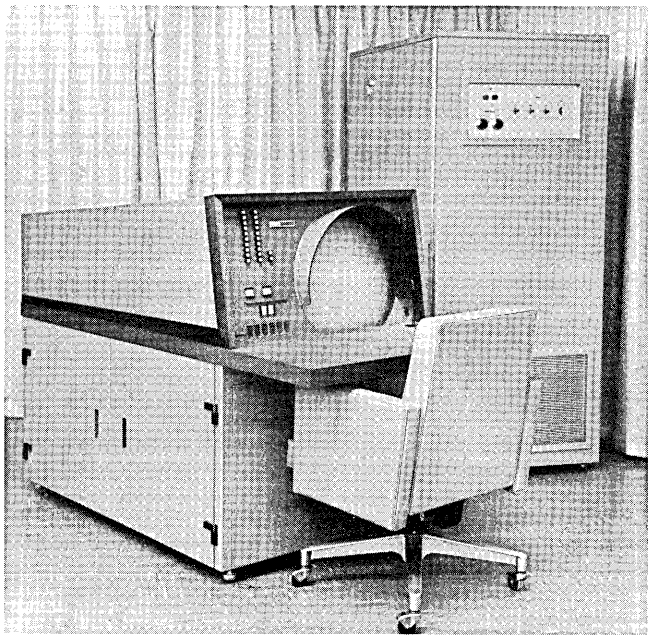


Figure 1c. The information retrieval display system.



General Dynamic's SC1090



Data Display dd13

Figure 2

of simultaneously displayed vectors, the vectors are drawn at constant writing rate, or have a programmed means of varying the intensity signal as a function of vector length. The vector generation techniques which are available under these design conditions allow generation at speeds of 0.1 to 3.0 inches per microsecond.

Command Decoding

The basic format for generation of a display specifies a position, a character and certain other information in each word transmitted to the display. For example, Format (1) may consist of a 30-bit machine word:

X / Y / C / M

where X and Y are unsigned 10 bit numbers specifying the location of the character on the rectangular display area of the CRT, C consists of the bits specifying the character, and M is a set of control bits which may establish: the character size; if the character is intensified; if it is to blink; and other control functions.

If a vector generator is included, two basic methods are used to specify these parameters. One method is to use Format (1) above and to designate with M (or with a reserved character code) that a vector is to be drawn from the previously specified X-Y (in the preceding word) to this (final) X-Y position. The second method would use the M code to designate a different interpretation of the data word, in this case using Format (2):

$\triangle X_1$ / $\triangle Y$ / $\triangle X_2$ / $\triangle Y_2$ / M

Using the $\triangle X$, $\triangle Y$ format a vector is drawn from the previously specified X-Y position in the direction specified by $\triangle X$ and $\triangle Y$.

Each pair of $\triangle$'s are digitally accumulated to define the starting point of the following vector. Typically, this method of specification limits the vector length to a percentage of the full display screen dimensions. This format is efficient where a large number of connected segments are to be drawn, such as map displays or curved line configurations. The first method (end point specification) typically allows any vector length within the display area to be specified, and is most efficient for grid systems and displays utilizing long vectors.

If the display is to contain a considerable amount of textual or tabular information, Formats (1) and (2) are inefficient. Thirty or more bits would have to be transmitted to the display to position and specify each character. Also the computer would be required to compute an X-Y for each character and to assemble words in Format (1). So, instead, a "typewriter-like" format is used allowing the efficiency of the display to be increased; in this case Format (3) is:

C_1 / C_2 / C_3 / C_4 / C_5

Here the position of C_1, or the initial character in a string, is specified in a Format (1) word, which also specifies an M code. Subsequent words are interpreted in Format (3). Each character in the Format (3) word is then automatically spaced in a distance X from the previous position and displayed in sequence. This continues until a reserved character code, i.e., a program-escape character, is encountered, and the following word is again interpreted according to Format (1).

Many features may be added to the typewriter format, Format (3), to allow some degree of control without leaving this mode. For example, a reserved character code may cause a "carriage return" to the initial X position and "line feed" or "change" in the Y position. "Tab" codes, codes to change brightness, to select italics or to perform other operations may also be reserved.

For specific General Purpose Console applications, these possible formats, and others, may be considered and selected on the basis of the information to be displayed and on the computer requirements and capabilities. The display system with a simple minimum command format will cost significantly less than a display with a sophisticated command structure.

Time-Sharing-Multiple Monitors

Since the cost of a display system is a function of its elements, the ability to time-share a central buffer and display generator between several stations is an economical approach to systems where several independent displays are required.

Normally this method of time-sharing is simple: all of the display fields are painted in sequence by a centralized display generator, and the common deflection signals are transmitted directly to each of the consoles. The intensity, or unblank signals are selectively gated to each console according to a digital control, such as the use of the M bits

in Format (1) and an independent display on each console results. This method of time-sharing is illustrated in Figure 3.

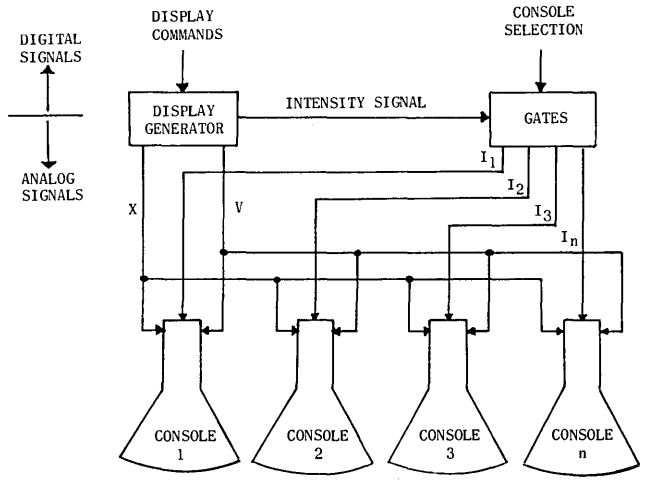


Figure 3. Method for time sharing a central display generator.

The time-sharing technique is most valuable where the display generation speeds are capable of maintaining the desired amount of flickerless information on each console. However, the technique also has cost advantages when multiple, centrally located display generators are used to drive many consoles.

The Buffer Memory

The primary use of a buffer memory is to unload the computer or data source by refreshing the display. For example, if a display field of 2,000 symbols is to be refreshed at 40 cycles per second, 80,000 words assuming Format (1) must be transmitted from the data source to an unbuffered display each second. This rate and duty cycle would normally tie up a buffered output channel on a modern computer.

With a display memory buffer, the load on the computer output channel may typically be reduced by a factor of a thousand, even for a display whose content is rapidly changing. The choice of a buffered vs. unbuffered display is therefore a function of display loading, the characteristics of the data source, and the cost of a buffer unit. There are also positive reasons to use the available core memory in a general purpose computer as a display buffer memory, if this is possible from a cost and performance viewpoint.

Display memory buffers are typically of the core memory type and are less often recirculating delay lines, discs, or drums. The core buffer is used because the times to accomplish varied display operations such as indicated by Formats (1), (2), and (3) may vary over a range of 10 to 1, and significant compromises in display rate or format would be required to use a synchronous type memory. The effective cycle times of the core memory do not have to exceed the display rates, and typically range from 5 to 10 microseconds. A method of interleaving the loading from the computer with output to the display generator is normally included in the buffer memory logic in order to avoid a perceptible blink upon loading.

Special logical features may be incorporated to facilitate the use of a buffer memory. For example, it would be an unnecessary burden on a computer to fill a memory with non-display instructions when a display using only part of the buffer capacity is stored. A memory jump instruction allows this problem to be effectively handled, and also allows the display programmer flexibility for other operations. If this jump instruction is predicated on the settings of switches on the console, the console operator may now easily select and assemble varied display fields. Another common feature of the buffer memory is the ability to select an address upon loading.

In some systems, the buffer memory is also used to accumulate information for transfer from manual input devices to the computer. A string of keyboard character codes may be accumulated into a message before transmission, etc. The payoff for this use of a memory is a reduction in interrupt signals to the computer. This is a relatively small advantage in comparison to the amount of special logic required to provide an input buffering capability and restrictive input procedures are also inferred.

At some point the use of a small general-purpose computer for input and output buffering and for manual input functions becomes attractive. This is particularly so where the data source is a telephone bandwidth channel or is otherwise restricted in transmission capacity. Such a buffer/computer may perform light-pen tracking, message assembly, format conversion, and other operations as well as perform as a buffer.

Manual Inputs

In addition to its unique characteristics as a data-output device the general-purpose display console has facility for effectively accepting manual inputs, related to the displayed information.

The light pen (also called a light pencil or light gun) is a manual input device unique to a cathode ray tube display system. Figure 4 illustrates the functional operation of a light pen. The light pen consists of a pen shaped assembly attached to the display console by a wire or fiber optic cable. It has a small field of view—projecting longitudinally from its point—and detects a rapid change of light intensity within this field of view.

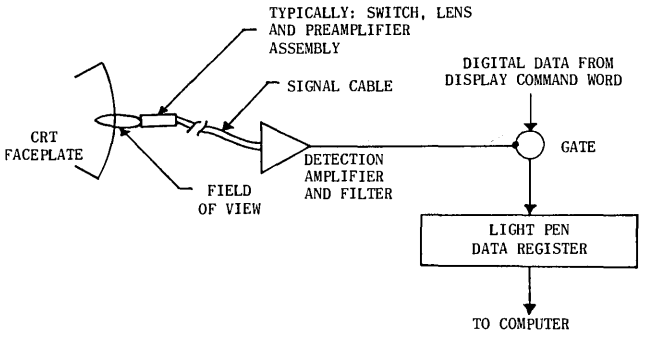


Figure 4. Functional arrangement of a light pen.

The light pen is positioned by the console operator to view a displayed point that he wishes to designate to the computer. The pen is aimed and at the time of detection (resolved within microseconds), the display command word and/or current memory address are gated into a light-pen data register (if the display is refreshed from a computer, the light pen may be required only to interrupt the computer and halt the display sequence). The computer may therefore receive information as to the X and Y position of the designated item, character code, or the command word in memory. Subsequent action may be taken by the computer program to "feed-back" to the operator the results

of his operation, such as blinking or intensifying the selected symbol, calling up additional related data, moving the display center to the designated point, etc.

The light pen may be used in numerous programs to achieve input effects. A tracking program, for example, will allow an operator to input points or draw curves at high, but controlled rates. A cursor feedback program will cause a special displayed symbol to accurately follow the light pen's position. Many general purpose consoles incorporate special raster generating instructions to additionally facilitate operations with a light pen.

The trackball consists of an assembly such as is shown in Figure 5, mounted in the console shelf so that the upper portion of the 3-inch phenolic sphere protrudes from the shelf and is easily moved by the operator in any direction.

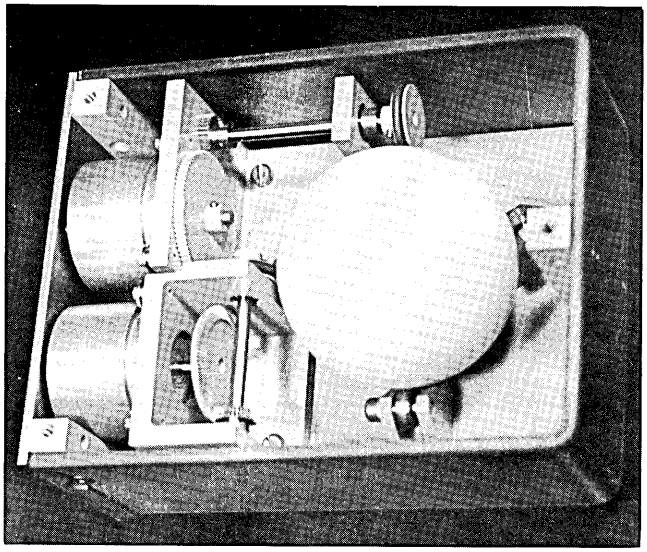


Figure 5

Rotation of the ball around the two orthogonal axes is directly coupled to drive two digital shaft encoders. The computer may sample the outputs of these encoders and may, in turn, at regular time intervals display a cursor symbol at the position coordinate corresponding to the shaft encoder outputs. If this is accomplished at a sufficiently high rate, in excess of 10 times per second, the cursor will appear to continuously follow the trackball input, and the operator will be able to precisely position the cursor. Operation of switches or a keyboard in conjunction with the cursor will allow functions similar to light pen operations to be performed.

Other manual input devices include typewriter-like keyboards and switch/indicator units used with coded snap-on overlays for flexible function marking. The general purpose display console operates effectively with these devices as well, since it is adapted to perceptibly instant feedback of the input effects on the CRT display.

The general purpose CRT display may be suitable to many applications requiring on-line communication between operations and a computer system. By design selection of the features included in the display system, it may be easily optimized for specific tasks without loss of its general purpose display characteristics. It is well adapted to changing with varying requirements of applications, both by modification of its supporting software, or its hardware feature.

The High-Speed Film Recorder

The combination of the high-speed digital CRT display and a digitally controlled recording camera results in a computer output device combining speed and a very high degree of flexibility. These systems are typified by the General Dynamics SC4020 and the Data Display model dd80 shown in Figure 6 and 7. The display generation principles for the film recorder are the same as for the general purpose console, except that information is typically recorded onto film in a single display pass without repetition. Operation may be off-line from a magnetic tape unit as well as on-line.

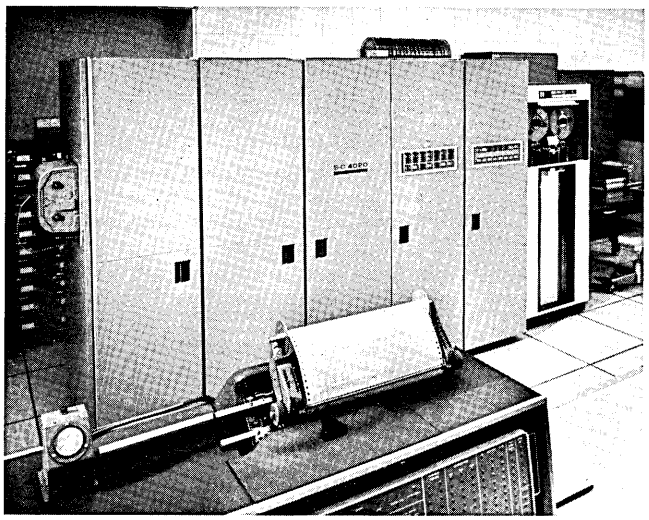


Figure 6

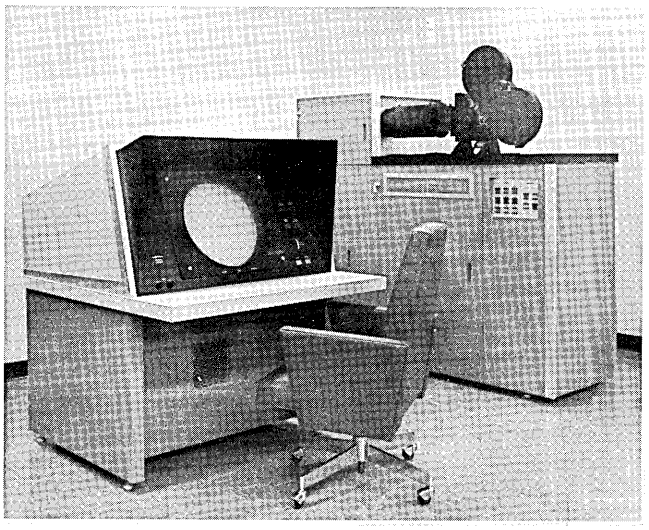


Figure 7

The High-Speed Film Recorder may effectively perform data recording conventionally accomplished by two devices: the high-speed printer, and the electro-mechanical graph plotter. A tabular comparison of the features of these three systems is presented in Table 1.

The features of each type of device are difficult to compare on an exact basis except for very specific applications. However, the film recorder offers some very significant advantages in terms of over-all speed, format flexibility and general purpose capabilities. It also possesses inherent disadvantages in its inability to directly record multiple copy in page-size hard copy, although film may be copied rapidly and inexpensively.

Accompanying this article are illustrations of output from high-speed digital recorders, and they show the ability of this type of system to record both tabular data and vectors.

TABLE I

COMPARISON OF RECORDING DEVICES

	High Speed Line Printer (1000 line/min.)	Electromechanical Graph Plotter	High Speed Film Recorder (100,000 Char./sec.)
1. Character or Symbol Set	64	8-10 typically	128
2. Type Variation (Digitally Controlled)	None	None	size, italics, intensity
3. Characters per Line	130+	---	128 typically
4. Speed in Lines per minute	1000	---	30,000 approximately
5. Format	line-at-a-time	page-at-a-time	page-at-a-time
6. Speed: Vectors per sec.	None	5-10	50,000 typically
7. Graphic Accuracy	---	0.1% Absolute 0.05% Relative	1.0% Absolute 0.2% Relative
8. Output Availability	Seconds	Seconds	From minutes to hours, except seconds with hard copy units
9. Multiple Copy Capability	Yes	No	No - except by processing methods
10. Media	Paper	Paper	Film or photographic paper

Applications in fact have gone to the point where recording system users are producing stereographic movies of three-dimensional constructions (the November issue of *Computers and Automation* shows one half of a stereo pair produced on a film recorder).

The film recorder may also be made to operate as a general purpose display console through addition of a large screen display. Devices to produce page-size hard copy rapidly and directly, but without the throughput capability of film are offered as options. The SC4020, for example, offers a dual hard-copy option with both a quick-look capability and an off-line developing option.

Approximately 50 high-speed film recording systems are now in operation, primarily used for scientific computing operations. Extensive software is available for many of these units when operated with specific computer systems. The major obstacle to extensive commercial use is effective integration of the recorder techniques into office systems. Commercial applications also involve consideration of film storage and retrieval methods, printing methods, and other operational procedures.

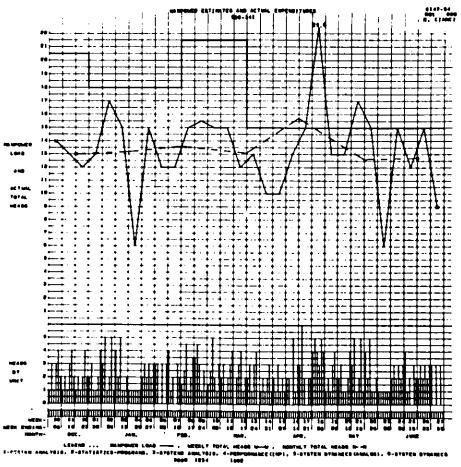
The Digital Information Retrieval System

Triggered by the development of low-cost mass-memory techniques, a new generation of digital data-display systems has evolved: the information retrieval display system. This system allows many operators at physically separated stations to simultaneously interrogate a large memory. The prime consideration in this type of system is to achieve a low cost per station, and this in return dictates a fixed display format of alphanumeric data only. Each station of an information retrieval display system is independent and fully buffered and allows entry from a typewriter-like keyboard into the memory.

Typically, one station in this type of information retrieval system would have the following sequence of events occur in an inquiry process:

1. The operator types in a coded inquiry and observes it on his screen.
2. He commands the transmission of the inquiry from the display memory to the computer.
3. The computer interprets the inquiry, retrieves the requested data, formats the reply, and transmits the reply message to the display memory.
4. The operator views the reply message on his screen.

The time from step (2) to step (4) is typically less than a second. One of the significant advantages of the CRT display for information retrieval is this high speed in accepting a response (typically 10,000 to 100,000 characters per second). Because of this speed, total retrieval problems may be solved with significantly fewer stations (and operators) than for slower retrieval techniques.



The ability to drive a large number of stations with independent, buffered operations on each is basic to the digital information-retrieval display system. Also, these stations may have to be remote from the central computer/memory equipment. Design tradeoffs are specifically required in this type of display to allow stations to be remoted at distances to several thousand feet. Long-distance remote operation, i.e., greater than a mile, requires compatibility with telephone data transmission equipment, and generally the storage and display generation equipment must also be located at the remote termination. The transmission rates of a voice-grade telephone channel limit the display acceptance to 200 to 300 characters per second; this rate is normally sufficient to retain the significant speed advantage of the information retrieval display.

Important, perhaps even revolutionary, applications of digital display devices are on the way, and specialized techniques to meet the requirements are rapidly evolving.

FASTER. NEW DDP-224 COMPUTER

New 24-bit word DDP-224 features: 1.9 μsecs (0.8 access) memory cycle, plus powerful command structure, equal 260,000 computations per second. Transfer rates up to 325,000 words per second. 3.8 μsecs add. 6.46 μsecs multiply. 17 μsecs divide. 4096-word memory expandable to 32,768. Typical add time with optional floating point hardware 7.6 μsecs (24-bit mantissa, 9-bit characteristic). User services. Comprehensive software. Fully program compatible with DDP-24.

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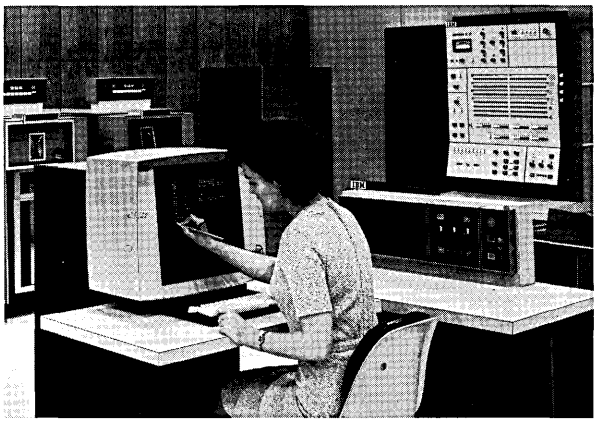
DISPLAY SYSTEM PICTORIAL REPORT

S-C 1090 DIRECT VIEW DISPLAY CONSOLE
General Dynamics/Electronics
San Diego, Calif.

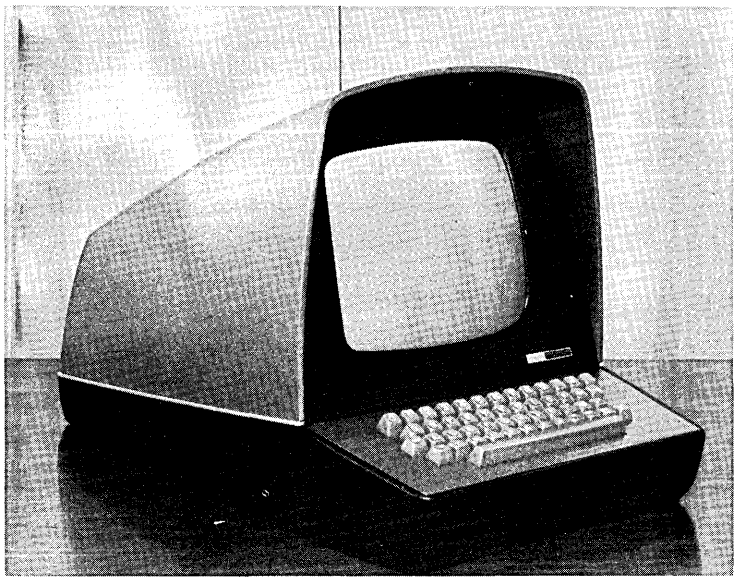
A special version of the CHARACTRON® Shaped Beam Tube enables the S-C 1090 Direct View Display Console to simultaneously present computer-generated information and film-projected data. The special cathode ray tube, capable of generating a million alphanumeric characters per second, has an optical window built into the rear of the tube. Film frames projected through the window onto the inner phosphor-covered surface of the tube face are visible from the outside. The film frames are thus superimposed over the information generated by the computer. In an air traffic control application, various maps of the traffic area can be produced on film and projected on the display screen. The computer is then free to present only changing data such as identification and movements of aircraft in the area. In other applications, business and engineering forms may be projected onto the tube face. The computer is only required to present changing alphanumeric information to complete the form. In addition, a multicolor display may be presented by using colored film.
(For more information, circle 76 on the Readers Service Card.)

IBM 2250 DISPLAY UNIT
IBM Corporation
White Plains, N.Y.



The IBM 2250 display unit provides a visual presentation of information stored in the computer or in storage files, drums and tapes. It is designed to operate with the new IBM System/360 described elsewhere in this issue. The 2250 can be used as the computer operator console, for engineering record keeping and updating, as a time-shared scientific computing terminal, for information retrieval, data acquisition monitoring, data reduction display, process control supervision, order entry, inventory inquiry and updating. Corrections may be made directly on the displayed information with a built-in electronic marker, and the corrections are immediately stored. The major element of the 2250 is a console with a 12-inch square display screen (a 21-inch cathode ray tube) on which tables, graphs, charts, alphanumeric characters, or the lines and curves of drawings can be displayed as a series of points. When the full display area is used, 3848 alphanumeric characters can be viewed. Buffer storage is available in 4096 and 8192 character capacities. These units may be read from or written at a maximum rate of 238,095 characters a second. The 2250 also has a typewriter-like keyboard for entry of all alphanumeric information and control of the electronic marker; a light pen for communication between the operator and processor; the IBM 2840 display control which permits up to eight display units to operate in a time-sharing configuration; a keyboard which makes interpretive operations possible; and an operator control panel for processors where the display is used in place of the typewriter control console.
(For more information, circle 78 on the Readers Service Card.)

dd 10 DATA ENTRY AND RETRIEVAL SYSTEM
Data Display, Incorporated
St. Paul, Minn.

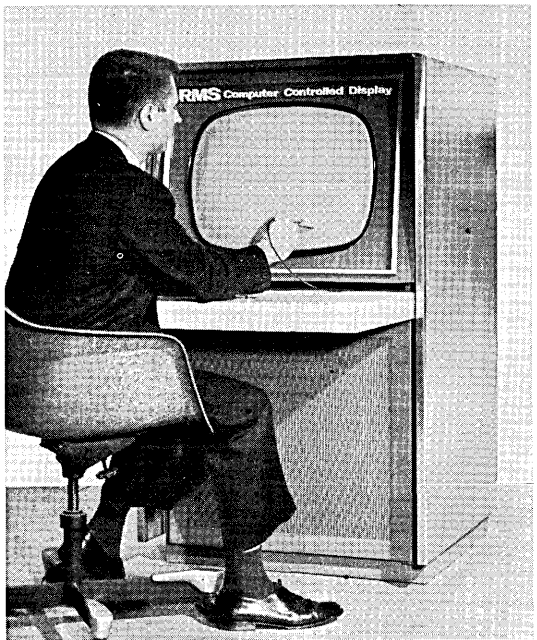


The dd 10 system permits a console operator to enter and retrieve data from a central digital data source in a fraction of a second. It operates independently of the computer until the message has been verified, then goes on line to retrieve data at on line speeds. The dd 10 displays a 500 character message on a cathode ray tube in less than a second. The system may consist of up to 64 electronic typewriter input devices with cathode ray tube displays connected to a central control unit. The control unit is capable of handling more than 20,000 operations per hour. Interfaces are available for most digital computers, mass memories and telephone subsets. The flexible dd 10 may be used in any situation where there is frequent reference to a central data source such as airlines, insurance companies, financial institutions, and governmental agencies.
(For more information, circle 77 on the Readers Service Card.)

TYPE 340 PRECISION INCREMENTAL DISPLAY
Digital Equipment Corporation
Maynard, Mass.

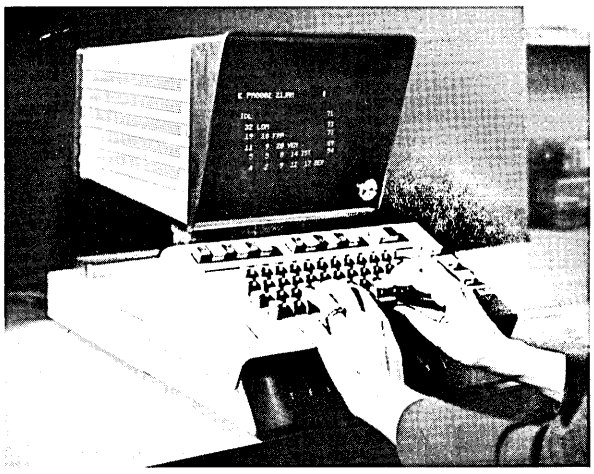
Digital computer data is rapidly converted into graphic and tabular form by the Type 340 Precision Incremental Display. It has an incremental plotting rate of 1.5 microseconds per point and a random plotting rate of 35 microseconds per point. Four operating modes provide flexibility and make it suitable for a wide range of applications. A random point plotting mode allows points to be plotted at random locations on the tube face; an increment mode permits rapid plotting of curvilinear data output; a vector mode provides a fast means of displaying straight lines between two points without specifying in-between points; and an optional character mode is available to display up to 128 different alphanumeric characters. The Type 340, with built in control and power supplies, requires only logic level inputs for operation. It can be easily connected to any digital system. It is shown at the right on-line with a Programmed Data Processor-4 computer.
(For more information, circle 81 on the Readers Service Card.)

COMPUTER CONTROLLED DISPLAYS
RMS Associates, Inc.
Mount Vernon, N.Y.



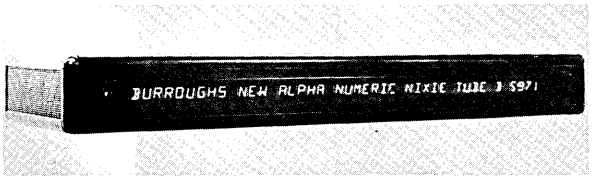
RMS Computer Controlled Display systems plot a point at a location designated by the computer. Optional character and vector writing features allow the computer to program charts, graphs, maps and other presentations. Four basic systems are available: the standard speed and high speed MONOFLEC Displays (no electrostatic channel) and the standard speed and high speed DUAL-FLEC Displays (with electrostatic channels). Customized systems to meet almost any requirement can be assembled from the basic displays by adding optional features. Interfaces are available for most 12, 18, 24 and 36 bit data word computers. Up to 2300 points or formatted characters can be plotted at a flicker-free rate of 30 frames per second on the high speed Display. Continuous line symbols, generated by the CURVILINE® character generator (up to 100,000 characters per second), can be any size between 3/32" to 1/2" without breaking up into illegible dots or scanning lines. Simulation, computer monitoring and trouble-shooting, and machine-aided design are some of the applications for the large screen (21" rectangular) display systems.
(For more information, circle 80 on the Readers Service Card.)

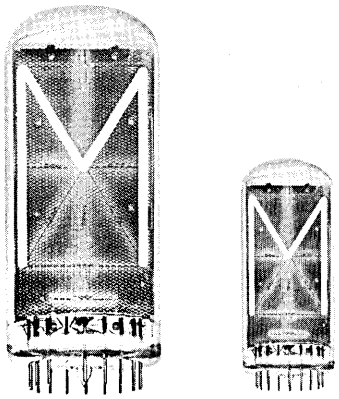
SERIES 100 & 200, INFORMATION RETRIEVAL SYSTEMS
The Teleregister Corp.
Stamford, Conn.



Individually buffered CRT Inquiry Stations are used as the terminal devices of the Series 100 and Series 200 Information Distribution Systems. Both series are fully adaptable to a wide range of on-line real time information systems, and will operate in conjunction with any of the currently available general purpose computer systems. Messages, queries and replies to and from the computer are composed on the alphanumeric keyboard and confirmed on the CRT screen. The Cathode Ray Tube output sections of the various models can display up to either 128, 256, 288, 384 or 768 characters. One to 36 CRT Inquiry Stations may be operated off a common Station Control Unit which is linked to the computer either by direct cable connection or through normal communication networks.
(For more information, circle 79 on the Readers Service Card.)

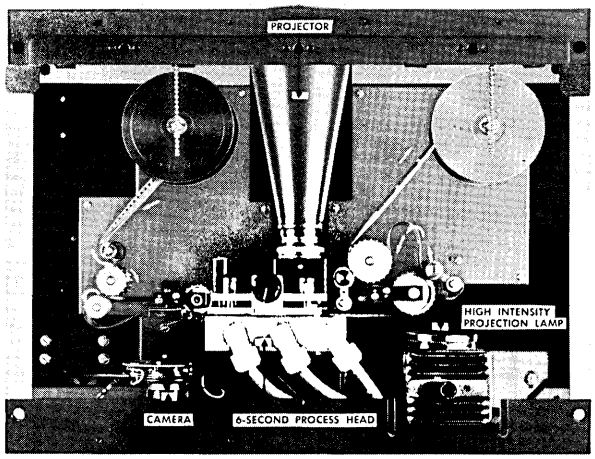
CUSTOM-DESIGNED ALPHA-NUMERIC DISPLAY SYSTEMS
Burroughs Corporation
Plainfield, N.J.





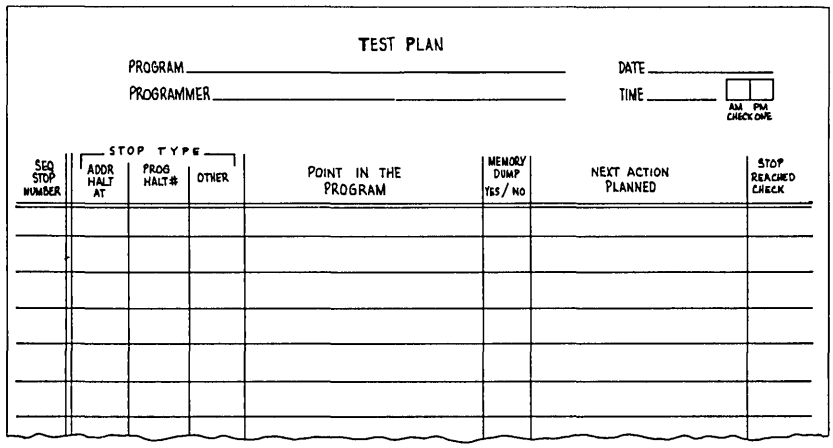
A modular concept is used in the design of these Alpha-Numeric Display Systems. The display element is Burroughs' recently developed Alpha-Numeric NIXIE® Tube, (shown at the right), a segmented, cold-cathode, glow-discharge type display. It is available in three different character sizes (3/4", 1 1/4" and 2 1/2") to satisfy viewing distance requirements from a few feet to over 90 feet. The memory drivers use a semiconductor latching technique to provide up to sixteen bits of memory for the various alpha-numeric segment configurations. The decoder/encoder used in conjunction with the memory modules decode 6-bit binary to one out of 64 possible combinations. Display presentation is varied by changing the address or tube selection mechanism. Presentation formats ranging from random update to pre-programmed types are available for use in applications such as arrival-departure schedule boards, stock quotation displays, score boards, and tabular situation displays. System interface and control circuitry are tailored to meet specific requirements.
(For more information, circle 82 on the Readers Service Card.)

SERIES 380 RAPID FILM PROCESSOR
OPTOmechanisms Incorporated
Plainview, L.I., N.Y.



Series 380 Rapid Film Processor is a device used for the acquisition and display of data — as well as to provide a permanent, fully-processed photographic record of the event under study seconds after it has taken place. Total time required is six seconds. The device, combining a data recording camera, film processor and projector in a single package, is available either self-contained or suitable for mounting within the user's console for interfacing with a CRT and rear-projection screen. (The processing equipment is leak-proof by virtue of its negative-pressure fluid system.) In its most usual form, a switch closure starts an exposure, the processing cycle follows through on an internally timed program and the film image is presented as a bright display on a front, or rear projection screen of virtually any size. Various modes of operation may be obtained to suit the user's system requirements. Series 380 is suitable for use in a wide range of applications such as time-stop sequence photography in biological and chemical experiments, air traffic control, instrument face dial readings, anti-submarine warfare, electronics and allied industries, etc.
(For more information, circle 83 on the Readers Service Card.)

STANDARDS FOR COMPUTER PROGRAMMING (Part 2)



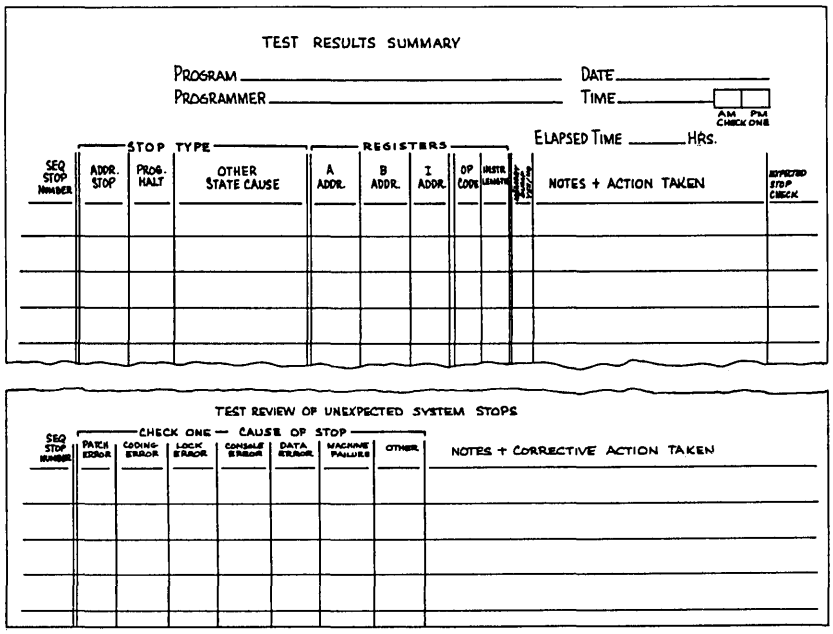
TEST PLAN

PROGRAM _____ DATE _____

PROGRAMMER _____ TIME _____ AM PM CHECK ONE

SEQ STOP NUMBER	STOP TYPE: ADDR HALT AT	STOP TYPE: PROG HALT #	STOP TYPE: OTHER	POINT IN THE PROGRAM	MEMORY DUMP YES / NO	NEXT ACTION PLANNED	STOP REACHED CHECK

Test Plan. (*Courtesy*, The Diebold Group, Inc.)



TEST RESULTS SUMMARY

PROGRAM _____ DATE _____

PROGRAMMER _____ TIME _____ AM PM CHECK ONE

ELAPSED TIME _____ HRS.

SEQ STOP NUMBER	STOP TYPE: ADDR. STOP	STOP TYPE: PROG. HALT	STOP TYPE: OTHER STATE CAUSE	REGISTERS: A ADDR.	REGISTERS: B ADDR.	REGISTERS: I ADDR.	REGISTERS: OP CODE	REGISTERS: INSTR. LENGTH	REGISTERS: ARITHMETIC STATUS	NOTES + ACTION TAKEN	EXPECTED STOP CHECK

TEST REVIEW OF UNEXPECTED SYSTEM STOPS

SEQ STOP NUMBER	CHECK ONE — CAUSE OF STOP: PATCH ERROR	CODING ERROR	LOGIC ERROR	CONSOLE ERROR	DATA ERROR	MACHINE FAILURE	OTHER	NOTES + CORRECTIVE ACTION TAKEN

Test Results Summary. (*Courtesy*, The Diebold Group, Inc.)

Computer Programming Standards, Part 1 (see *"Computers and Automation"* for April), discussed programming standards that should be established for logical analysis and coding. Programming is often equated with coding; however, the more important aspects of programming are testing, and ultimately documentation. This article continues with methods standards for program testing and program documentation.

Many programmers writing their first program assume that it will run correctly the first time it is placed on the computer. It probably will not, and may not for the next fifty times. Rigid standards for testing will improve the probability of successful operation.

Program testing has two basic purposes:

1. To determine that the program has been coded correctly, and that the coding matches the logical design.
2. To determine that the logical design matches the basic requirements of the job, as set down in the job specification.

Because a program can contain as many as 30,000 distinct and separate instructions, and must handle all possible input and output conditions, the number of errors may be very large. Such errors fall into the following categories:

- Systems analysis errors
- Misinterpretation of the requirements of the job
- Errors in logic
- Misinterpretation of the machine's functions
- Clerical errors

The number of errors in a program often averages one for each hundred instructions, even assuming that the programmer has been reasonably careful in doing his coding. The number of permutations and combinations of conditions in a program may reach into the billions before each possibility has been thoroughly checked out. It is therefore a practical impossibility to check out each and every combination of conditions.

The fact that the program is operative and reaches end-of-job satisfactorily does not imply that all of the exceptional conditions, and their permutations and combinations, have been tested; many programs may reach end-of-job after very few tests. However, the exceptions programmed to deal with a small and unusual percentage of the input, often account for a large percentage of the instructions. It is therefore quite possible to reach end-of-job with only ten per cent of the program checked out.

Types of Testing

Certain testing procedures must be performed to find most of the errors. These procedures occur chronologically after the coding is completed.

STATE STREET BANK & TRUST CO.
DEMAND DEPOSIT APPLICATION SYSTEM
DAILY TRANSACTION MERGE PROGRAM

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Table of Contents—Sample Program. (*Courtesy*, The State Street Bank and Trust Company *and* The Diebold Group, Inc.)

Dick H. Brandon
Brandon Applied Systems Inc.
New York, N.Y.
and
Frederick Kirch
The Diebold Group Inc.
New York, N.Y.

• *Desk Checking.* The first step consists of a detailed review of the program by the programmer. Desk checking itself consists of two parts; the first is a review of the general logic for completeness. The second part of desk checking is a "dry run" in which sample data is used, and the programmer "plays computer."

• *Program Preparation.* After the coding has been checked, the program is ready for input preparation. It often pays to perform some punched card machine operations on the program deck to catch clerical errors. It is possible, for example, to sort the deck by operation code and to match the deck on a collator against a master deck of acceptable codes; this will insure that the operation codes used are valid and thus will be properly translated by the assembly program. This type of procedure often saves computer time at the much lower expense of punched card operator time.

• *Assembly or Compilation.* The third step in the testing procedure is to assemble the symbolic entries and to translate them into machine language. All assembly programs will validate the operation codes and operands, since an invalid one would prevent translation; many also incorporate the ability to catch machine violations, or to flag instructions that might cause a problem.

• *Program Testing.* After assembly errors have been corrected (which may require a second assembly), the program is ready for testing. The program is loaded into the computer and allowed to operate on fabricated test data, designed to simulate a number of input conditions. The number of test "shots" required will vary. Smaller programs may be completed in three to ten shots while a larger program may require 100 distinct test shots to purge the program of all possible errors. Much of this depends on the thoroughness of the programmer in coding and particularly desk checking. A sloppy or "fast" programmer loses a great deal of time in testing. A "tricky" programmer is sometimes endlessly trapped in his own schemes.

Errors found in program testing appear in many different ways. For example:

—An endless loop may be caused by an incorrect test of the end-of-loop counter.

—The machine may attempt to make reference to areas beyond memory; this is a result of faulty address modification.

—The machine may stop at an illegal operation code.

—The machine may stop because of illegal conditions caused by clerical errors, misassumptions, or execution of invalid instructions.

Regardless of the way in which the error appears, it must be traced to its cause and removed. This is most often begun with a print-out of memory (a "dump") at the point of error

occurrence. The error can then be traced, after the machine test, and carefully and accurately corrected. Beginning programmers often create added errors when making corrections. Their inexperience with "in-memory" corrections ("patches"), causes errors in the use of machine addresses or locations.

• *Production or Volume Testing.* When the program can operate correctly on all of the test data, it has essentially been determined that the program works in the manner in which the programmer has decided to make it work. To further validate the fact that the design matches the requirements, the program is production-tested using ("live") actual operating data. This will insure that input layout assumptions are correct, and that provision has been made for all conditions of input. The systems analyst should assist in production testing, so that he can test his assumptions about the way in which the program should operate.

• *Systems Testing.* After completion of production testing, it can be assumed that the program is in operating condition. In those cases where the program is only a small part of the over-all system, the entire system must be subjected to a rigid test, to determine that the linkage between programs has been correctly made. It is also necessary to determine that all conditions of invalid input are checked for throughout the system.

• *Parallel Operation.* The final test of the entire system occurs after conversion, when the old system is run in parallel with the new computer system. Both systems produce output on a regular basis. The output of the old system is assumed to be correct and is used to validate the new output. When the new output has proved accurate for a period of time, it is then substituted as the "prime" output and the old is used as a check. Finally, the old system is terminated and full computer operation begins.

Testing Standards

Methods standards established for all phases of testing must take into account the complexities of the machine and the system involved. General rules can be established, however, which are applicable to the entire testing program. Such as:

Desk Checking

1. After coding the programmer shall desk-check his program. The program shall be checked for clerical errors, missing labels and general legibility of symbols.

Taking a minimum of two sample cases, the programmer shall trace the flow of data through the program.

2. The program shall be reviewed by a second programmer to:

Familiarize a second person with the program
Minimize the number of errors
Optimize the techniques used
Educate both programmers in techniques and methods
Review the adequacy of the logic

Program Preparation

1. After the program has been punched, it shall be completely verified and interpreted.

2. All programs shall be assembled using the standard symbolic program. Errors flagged by the assembler shall be investigated and corrected. If more than ten errors are found by the assembly, the program shall be reassembled before testing.

3. Reassemblies shall be made periodically, based on the number of errors found. A reassembly shall be made after every ten test shots, or after the number of machine language correction card entries exceeds twenty-five. After the program is completely tested, the final assembly shall be retested using the complete set of test data.

Test Data Preparation

1. Test data shall be prepared to:

Check out each block of the program, and

Validate the manner in which system requirements are met.

2. The programmer is responsible for creating test data.

3. The programmer shall use the micro-block diagram as a basis for creating test data.

Test Data Sequencing

1. For initial tests, test data shall be organized in sequence by block; the test data will be set up in such a way that an error is pinpointed to the block in which it occurs, based on the test data item being processed.

2. After initial tests have proved the validity of individual program blocks, the test data shall be reorganized, to check out linkages between the blocks.

Program Testing

1. Prior to all tests on the machine, the programmer shall complete a Test Plan form indicating *anticipated program stops* and *actions required* when stops are reached. The form has been designed for "remote testing." If a memory dump is desired at an anticipated stop point, it is indicated on the form.

2. During testing the machine operator will complete a Test Results Summary form which indicates stops which did occur and the sequence in which they occurred. The console condition is indicated at each stop point, and the action taken is recorded, so that test conditions can be reconstructed and the error located.

3. The second half of the Test Results Summary is filled out by the programmer as he corrects his errors. For each stop the programmer indicates the cause of the condition, and the action which he has taken to prevent its reoccurrence. The main purpose of this form is to prevent programmers from ignoring error conditions, in the faint hope that they will not occur a second time.

4. All corrections made during testing will be made in machine language, unless the number of instructions required for a single correction *exceeds fifty.*

5. At the same time that corrections are made in machine language, corrections to the symbolic program deck also shall be made.

6. The program shall be reassembled each time that the total number of individual patch cards *exceeds 100.*

7. Retention of test materials shall be limited to:

Test Plan for each test sequenced by date and time
Test Results Summary, in the same order
Last two memory prints at hang-up time
Last memory print taken at the end of program loading
Input data listing
Most recent output listing

8. To facilitate in-memory corrections, when organizing a program prior to assembly, a separate area, preferably in lower memory, will be set aside for corrections. This area shall not exceed the area required for 200 instructions, and shall be removed prior to the final assembly.

9. The techniques described below may be used for testing, if the program does not require all of memory.

Blank exit points may be inserted into the program at various locations to facilitate the addition of instructions during testing. These exit points will generally take the form of a NO-OP instruction with an operand of 00000, so that a JUMP, BRANCH or TRANSFER instruction can be inserted into that "reserved" location. If additional instructions are required in the routine in which the NO-OP exists, a jump can be made to upper memory without destroying any of the instructions in the routine. To allow easy removal of these testing aids, a column of the symbolic entry card should be punched with an identifying punch, so that the symbolic deck can be sorted on this punch and testing aids removed automatically before the final assembly.

10. All machine language correction cards shall be punched on a card with a different corner cut from the condensed program deck and shall carry the following identifying information.

program number and phase
date of correction (to reference the test results summary)

11. If a correction is made in error, or a correction must be further corrected, the original must be removed and replaced. A correction may not be made "on top of" another correction; reshuffling of the card deck will completely destroy the intent of the multiple correction.

12. When a logical error is found, a correction must be made to the block diagram at the same time that the correction is made to the program. The block diagram should be maintained current during testing.

Testing of Documentation

To validate accuracy of the documentation it shall also be tested. After completion of documentation the operator's instructions shall be turned over to an operator who has never operated the program before. Using the test data prepared for the production test, and including some test data which will cause programmed stops, the operator shall operate the program, without assistance, following the exact instructions in the manual.

Documentation Standards

The most important standards for program documentation specify the extent to which the programmer should support his efforts in writing. After testing is completed, the program will work, whether it is documented or not. As a result there have been too many instances where documentation has been completely neglected, or written in a haphazard manner. Since documentation is a vital part of the requirements of a computer installation, *its importance and necessity cannot be overstated.*

Documentation Contents

The following describes in general terms the contents of the manuals which should exist for each program. Minimum standards should be established and rigidly enforced for each installation.

1. All documentation shall be provided with a permanent-type cover and a suitable label indicating the program name, number, date and revision level.
2. All documentation shall be given a title page, indicating the program name, number, the programmer's name, the date and revision number, and the copy number, if more than one copy is prepared.
3. All documentation shall have a revision page. This page shall show the revision number for each change,

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II. OPERATING INSTRUCTIONS

A. Initial System Setup

1. 1402 Card Read/Punch - Turn ON the read and punch. Place the "Daily Transaction Merge" program in the read feed. The last cards of this deck are the ledger table control cards. The last of these cards is punched with nines in columns 1-9 and a T in column 80.

Place the two current control cards behind the program in the reader. The first control card is the (H in 80) Date Header Card; the second is the (F in 80) Files Control Card.

2. Set up the CONSOLE function and sense switches as shown on the Operators Control Sheet. Then depress the Check Reset and Start Reset keys. Depress the Load key on the 1402 Read Unit and the program will start loading.

3. 1403 Printer - Mount the "Daily Transaction Merge" carriage tape. Mount one part 14-1/2" x 11" stock form.

4. Magnetic Tape Files - Mount the "Sorted Daily Transaction" input tape files on tape units 1, 2 and 3. Remove the file protection rings from these files before mounting. When using 2 files - mount only tape units 1 and 2, dial 3 off. When using 1 file - mount only tape unit 1, dial 2 and 3 off. Mount "PAL" system work tapes on tape units 4, 5 and 6. Set the file protection rings in these files before mounting. Check the external labels on these reels to insure that they are available for use as output tapes. Place new external labels on these reels identifying their new contents and today's date.

Tape unit 4 - "Daily Transaction Merge - Merged Output"
Tape unit 5 - "Daily Transaction Merge - Short List Output"
Tape unit 6 - "Work Tape"

5. 1402 Card Read/Punch - Place the detail card input (if any) in the read feed. Fill the punch feed with blank stock cards. Then depress the 1402 Start key to start processing.

B. Operating Notes

1. The program begins by initializing itself and reading in the control cards. If any of these cards are invalid a programmed halt will occur. All of these halts are in the 600 series. If any of these halts occur, the program will have to be reloaded after correcting the invalid control card.

2. Halt H701 is a printer check halt. The printer will have printed the following data; the number of input tape files, the current tape date and the current report date. The printer has skipped the form to channel 1 after printing.

If start is pushed, the same data will be printed again, the form will again skip to channel 1, and H701 will reoccur.

Check the printer alignment (all data must be printed on the forms, and the skip to channel 1 must have occurred properly). Check the printed dates for accuracy. Check the number of tape input files printed. When satisfactory, set sense switch B on and push the start key to enter the main program.

3. The only other programmed halt which should occur is H899, end of job. When this halt occurs, the message "End of Job" will have been printed on the last page of the report, and all of the tape files will be rewinding.

If any other programmed halts occur, an error or exception condition exists, and the manual should be consulted for the corrective action to be taken.

C. Completing the Program

After Halt 899 (End of Job), the operator should remove all materials as follows:

1. Magnetic Tape Files

a. Dismount the input tape files from tape units 1, 2 and 3. Each must have an external label indicating "Daily sorted transaction input" and today's date. These tapes are to be preserved for five days and then will become available as "PAL" system output tapes.

b. Dismount the output tape files from tape units 4, 5 and 6. Immediately remove the file protection rings from these tapes.

Each must be properly externally labeled as indicated in the Initial System Setup section.

Tape unit 4 - "Merged Output" will be used on the "Daily Posting Run" program.
Tape unit 5 - "Short List" will be used on the "Daily Short List" program.
Tape unit 6 - "work tape" is of no further value to the daily operations, and is immediately available as a "PAL" system output tape.

2. 1403 Printer

Remove the listing and hand-label as the "Daily Transaction Merge Journal and Ledger Balance" report.

Remove the carriage tape and place it on the 1403 carriage tape rack.

3. 1402 Card Read/Punch

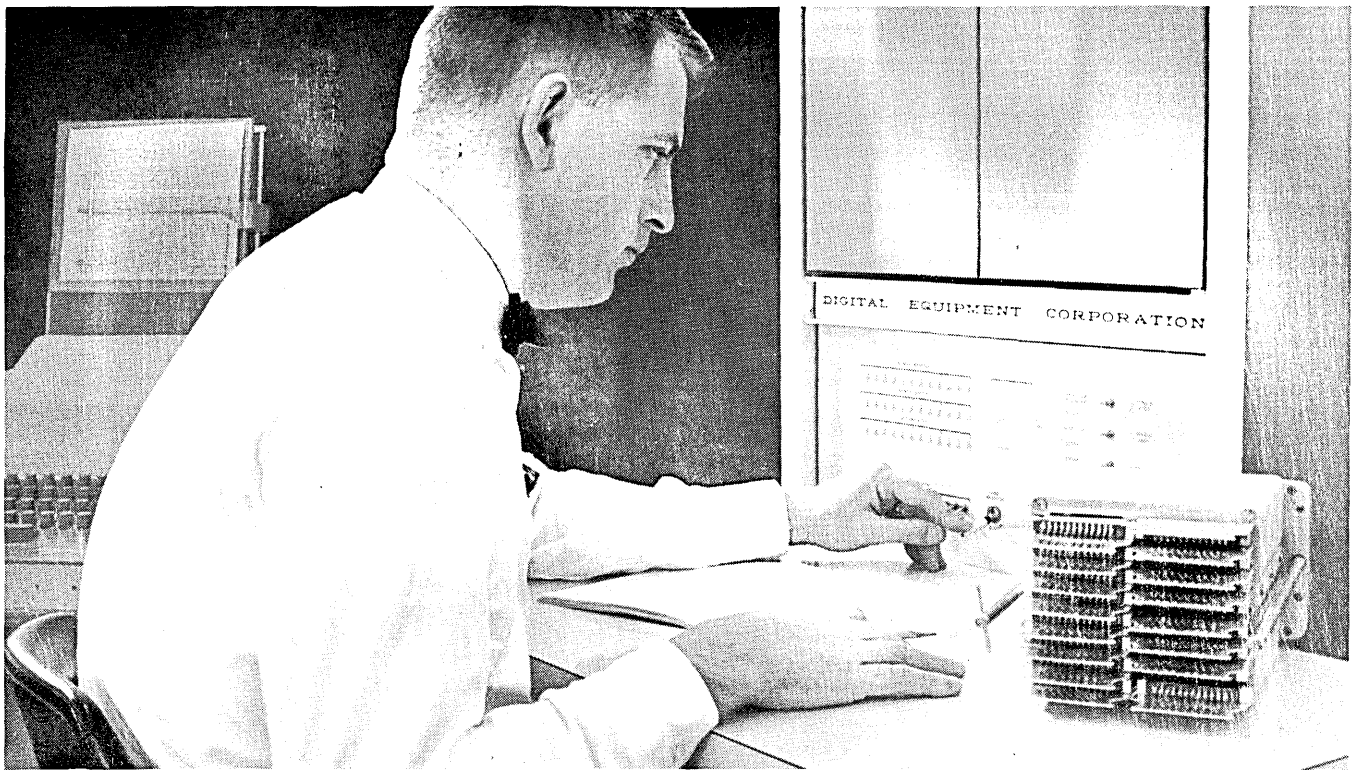
Normal Punch Pocket. Any cards in this pocket are copies of invalid input cards. Manually label, date and file as "error inputs - Daily Transaction Merge".

Normal Read Pocket - the Merge Program. File in the "Daily PAL Program" file.

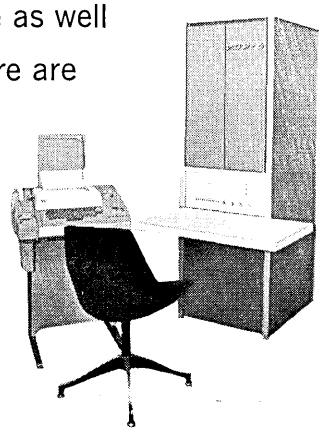
Read Pocket 1. Label and file as "Daily Transaction Merge - Detail Card Inputs".

Read Pocket 2. These are the date and file control cards. These cards may be destroyed.

Sample Operating Instructions. (Courtesy, The Diebold Group, Inc.)



You can own the PDP-5 computer for what a core memory alone used to cost: $27,000. This general purpose computer is ideal for scientific computations, system and process control, and data collection and reduction. Don't let the low price fool you. The PDP-5 has features and capabilities many higher priced computers wish they had. A six-microsecond memory cycle and fully parallel processing, for example, permit a 55,555 additions-per-second computation rate as well as real-time data compilation and processing or recording. Then there are the 4096-word random access magnetic core memory (or 1024-word memory for $3,000 less), 12-bit word length, and 24-bit arithmetic. Add to these a two-megacycle bit input via built-in data channel, program interrupt for input-output devices, and a complete software package—including FORTRAN. Price includes keyboard-printer, paper tape reader, and punch. Impressed? Then let's get together soon and talk computers.



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affected sections, date of the revision and the name of the person who made the change and updated the manual.

4. All documentation shall have a Table of Contents.

Operating Manual

The program manual consists of two sections: the operating manual, used for machine operation and set-up, and the programming manual, used to make changes to the program. It is not necessary to give the machine operator the entire program manual; his interest is in the operating manual—the sections outlined below.

Abstract or General Description—The first section of the manual should be a brief general description of the program, its function, its features, its options, and its basic inputs and outputs. It should describe the program in layman's language so that the operator will understand each phase and properly distribute the outputs to the next functions.

Flowchart—The next section of the manual should be a flowchart which:

—defines the input and output,
—establishes timing for a sample run, to assist in scheduling and program testing,
—provides a brief synopsis of the program functions, and
—lists the minimum configuration on which the program can be run.

Operating Instructions—It is common to see a programmer spend hours in refining a subroutine to save a few microseconds. But the same programmer may be seen writing his operating instructions on a piece of scrap paper without any regard for the waste of machine time which will result.

Operating instructions, to be fully effective, should include:

Over-all Console Set-Up Summary Page—The set-up summary should provide the operator with a check list of all required inputs and outputs specifying printer forms, carriage tape, types of input cards (quantity and sequence), and which console switches are used.

Set-Up Instructions—Following the set-up summary should be a detailed list of sequenced set-up instructions. It is the programmer's responsibility to specify the exact sequence in which the machine is to be set up.

Normal Operating Notes—Messages and halts which will occur should not come as a surprise to the operator. To operate efficiently the operator should know exactly what to expect from the normal operation of the machine. This will also enable him to recognize abnormal conditions, and to take required action with a minimum waste of time. Operating notes should include halts and messages which should be expected, and whatever action the program will take to signal end-of-job.

Take-Down Instructions—Most programmers make the reasonable assumption that the operator will be able to remove output and input files correctly, but even so it is important to specify the sequence in which this should be performed. For example, a tape file may be completed in the middle of a program and its removal overlapped with the completion of the run. Then the drive may be used to set up the next problem.

Abnormal Conditions—An error may be assumed to be an abnormal condition. When it occurs, the program generally communicates to the operator by typing or printing a message; frequent repetition of the condition may warrant operator intervention. If the error is correctable, a procedure for this should be documented; if it is not, the operator should be instructed to call his supervisor, the programmer, or a maintenance engineer (depending upon the cause of the error).

Messages—A listing of program messages should be provided for each program. If a message is followed by a program halt, the halt number should be referenced in the message. The cause of the message should be explained, and if a halt occurs at the same time, operator action should be indicated.

Halts—Programmed halts should be documented carefully. An operator error at the time a halt occurs may be misconstrued or misinterpreted as a machine or program failure. As a result, the operator should be instructed, in detail, as to what action is required.

Programmed halts should be kept to a minimum, since the program should make most decisions. Ideally, there should be no halts, except verification halts for printer line-up or tape label checking. Nonetheless there are occurrences of machine errors, where the maintenance engineer should be called, or data errors where the data coordinator should assist. In these cases, the options which are available should be carefully outlined.

Sense Switches—Most computers provide switches that may be used to alter the course of the program or specify the use of options. Since these switches or keys can be left in the wrong position, the program should tell the operator which options it is selecting before proceeding. The documentation should clearly state the purpose of each switch, and its effect on any section of the program. Complete documentation of both sides of each sense switch is an important part of the operator's instructions.

Layouts—The operating manual should include layouts of input cards and output forms. This will enable rapid location of input and output errors and prevent the use of the wrong card file or the wrong report form. It is not necessary to include tape records or memory layouts in the operating manual since these would serve no useful purpose to the operator.

Sample reports and sample card forms should be included. The layout of the carriage tape for the printer should be included if a special tape is required.

Tape Layouts—Tape layouts should be included in the program manual for each tape used in the program.

Tables—Tables or data arrays should be carefully documented, since they are apt to be subject to considerable change. If no method is programmed for updating the table, some indication should be given in the table documentation of the sequencing and of the controls on which the program relies. A part of the table documentation should describe how the table may be changed by deletion, by addition, or by replacement of data items.

Detailed Description—Perhaps the most important element of the program documentation is the detailed description of the program and its functions. This should describe in detail the functions of each of the logical blocks or segments that constitute the total program.

Diagrams—Macro-block diagrams and micro-block diagrams should be included.

Lists—To assist programmers in making changes, the documentation should provide various items in list form, including:

Electronic switches used by the program
Counters or accumulators used
Special constants and their designations
Buffer areas and other significant factors

Features, Cautions and Modifications—A section should be included in each manual which describes special features included in the program such as the use of special techniques, the derivation or method used to program the formulas, areas for future changes or improvements, cautions about tight routines, and perhaps the areas where modifications must be made periodically.

Assembly Listing—Part of the basic documentation of the program is the latest assembly listing, carefully marked

(*Please turn to page 43*)

COMPUTER-CONTROLLED GRAPHICAL DISPLAY: ITS APPLICATIONS AND MARKET

David E. Weisberg
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Bedford, Mass.

Every data processing task has three major steps, whether for a business or scientific application. One needs to get the data into the system, process it, and get it out again. Hopefully the last step will present the data in a form in which it can be easily and efficiently used.

In the past the middle stage of this process has received the greatest amount of consideration in the development of data processing systems. Recently, additional stress has been placed on data preparation methods and on output presentation. Perhaps the most important of these new techniques is the use of graphical input/output equipment oriented around the use of cathode ray tubes devices.

The use of graphical display equipment originated with the advent of large scale military Command Control systems of the late 1950's. Nevertheless, graphical display has been slow in becoming a major factor of data processing due to problems of high initial costs, equipment reliability, and a lack of appreciation of the power of this technique. There has been a large upsurge of interest in this area the past year as demonstrated by the applications described below. The use of display equipment may well become a major segment of the computer industry by the late 1960's with a annual market of close to $100,000,000.

Scientific Computation

There are many scientific data processing applications which result in literally many yards of output data. Before it can be useful, this information must frequently be manually translated to a graphical form. This could take the form of bar charts, curves, or diagrams. The time lag and cost of preparing this data is often a critical element of the entire process. Also, it is often very error prone. Rapid on-line preparation of the data can considerably increase efficiency especially where feedback to the computer can be immediate. For example, a scientist enters his problem into the computer and observes the results on a display screen. Evaluation of the visual presentation may suggest a change in certain parameters and he can immediately request a rerun of his problem. When after several iterations he is satisfied with the results, he can request a hard-copy of the solution. By this method he can solve a problem in a half-hour session which may have taken several days with normal turn around time. When new time-sharing techniques such as those being studied in project MAC at MIT are considered, the actual computer time required is not excessive. Additional hardware costs and machine running time are often a minor expense compared to the value of having a solution much more quickly than currently possible.

A typical display system for the above type of problem solving would be Digital Equipment Corporation's Type 30 Precision CRT Display and Type 32 Light Pen connected to either a PDP-1 or PDP-4 computer. Also, IBM's recently announced 2250 Display Unit will probably be extensively used for information presentation and feedback in scientific installations.

In using computers for weather forecasting and research, a constant problem has been what to do with the vast reams of data generated. Until recently the data had to be plotted manually or by means of a electro-mechanical digital plotter. Burroughs Corporation has developed a CRT display system for the Weather Bureau's new weather mapping and distributing system. Data enters the display system from the computer in terms of X and Y coordinates, character codes and control information. This data is then used to create a pictorial representation of isobar and isotherm information. The data is placed on the CRT and combined optically with a fixed overlay of a land mass and recorded to produce the familiar weather maps issued by the Weather Bureau.

There are certain types of scientific data processing problems which consider a particular environment in a number of sequential states, both continuous and discontinuous. It is important to present the resultant data in a form which can be easily visualized. One technique is to prepare movies similar to animated cartoons. Formally, this required a vast amount of manual drafting. Bell Telephone Laboratories has developed a procedure using an IBM 7090 computer and the General Dynamics SC 4020 high speed microfilm printed to prepare movies of satellite motion in relation to the earth. The procedure requires about 8 minutes of 7090 time to produce one minute of 16 frame-per-second film. There are many other types of problems where it is desirous to observe the motion of one object in relation to others without the need to build expensive models or prototypes. Typical examples occur in mechanical linkage and in wave mechanics.

The use of graphical display systems in scientific data processing should expand considerably in the next few years. This assumption is based upon decreased equipment costs as volume increases, greater availability of equipment for different computers, and advances in the programming technology of time-shared systems.

Printing

There has recently been a considerable increase in the use of computers in the printing industry. Such problems as line justification and hyphenation have been tackled. The output has often been in the form of punched paper tape which is then fed into typesetting equipment. This works quite well for applications where the volume is relatively low. For the preparation of bulk information such as census reports or telephone directories, the Mergenthaler Linotype Company and CBS Laboratories are developing a photocomposition device which will operate at 1000 characters a second. It is called "Linotron" and costs approximately $1,000,000. A system of this type can set the information on a standard book page into type in three-to-four seconds. The Manhattan telephone directory can be set in 10 hours starting from scratch. Data from the computer is projected onto a CRT and is then photographed.

Command Control Applications

Many military Command Control systems are highly display oriented. These vary from small weapon control devices to national-level strategic systems. The most common similarity is the need to display information in a form in which it can most rapidly be used. Most of these systems today utilize digital computers to accept, process, and prepare data for output.

An airplane flying at MACH 3 does not allow an air defense system much time to determine if it is friend or foe. Radar data is processed by the computer and presented to a weapons control officer on a small individual console of the type described by R. Johnson elsewhere in this issue. By use of a light pen he can indicate to the computer the action to be taken. The computer can then formulate and transmit messages to missile sites and interceptor aircraft. The weapon control officer could monitor this action and, if necessary, call for additional weapons to be deployed. Systems of this type have been developed by the Navy, Marines, and Air Force. In fact, SAGE (Semi-Automatic Ground Environment) was the first large scale application of display equipment and many present display devices and techniques have resulted from its development.

As well as the detailed control of weapon systems, Command and Control requires the presentation of large amounts of rapidly changing status information. A number of photographs of the Strategic Air Command's Command Control Center have been released showing a group of large screen displays used for presenting status information. This data would include information on weather, base locations, airplanes disposition, missile readiness, and other key facts. The raw data is processed by a very fast computer and the output directed to a CRT. It is then photographed and the film is projected on a screen which can be viewed by a large group. This data may be location oriented in nature and projected simultaneously with a map slide for reference. By using a number of slides of the same area containing different types of data, and displaying them through different color projection devices, it is possible to achieve multiple color displays. This significantly increases the ease with which data can be assimilated.

Some Command Control systems combine both types of data display in their operation. Examples are NORAD (North American Air Defense) and the Army's ARTOC (AN-MSQ-19 Army Tactical Operation Center).

The use of display in military operations can be expected to increase in the future as volume production makes the cost more feasible. The Army's Command Control Information System (CCIS-70) and the Navy's Operations Control (OPCON) are two major projects which are in their infancy at the current time. It is probable that by 1970 every Army organization of division size and larger and every major Naval vessel will have a substantial numbers of display devices together with the necessary digital computers.

Business Applications

Business data processing is rapidly evolving from the handling of payroll and other accounting problems into which is referred to as "Management Information Systems." In this respect, they are taking on some of the aspects of military systems in the preparation and presentation of status display. Although no Corporate Board Room has yet been constructed along the lines of a SAC Command Post, it is not inconceivable that such will happen as the cost of display equipment lessens. Organizations which do have display equipment in their computer complexes are using them for preparing graphs and charts. One such application has been the plotting of PERT diagrams using microfilm printers such as the SC 4020.

Computers with display output devices are being used in a number of information retrieval systems including several in the stock exchange field. This application consists of a central computer which maintains a master file of stock data. The user's inquiry station is connected to the computer over normal communication lines. If the user desires information on a particular stock such as its current selling price, he keys in the stock code and depresses a button for the type of information desired. The resultant data then appears on the screen in front of the user.

Although there appears to be a substantial market for display devices in business applications, it is felt that the growth will be slower than in scientific and engineering applications. Most of the initial market will probably be in the area of small inquiry stations scattered throughout an organization for the collection and dissemination of data.

Programming Applications

The use of a graphical display device as a programming aid is quite old. Several early computers such as the General Precision LGP-30 used small CRT's to display register data in binary form. The more recent Control Data 6600 has two CRT's on its console for information display. These provide a means of communicating with the operator at a much faster rate than could be possible with the normal inquiry typewriter. This technique has been extended to the point where some installations are doing program debugging on small machines by use of a CRT. This has proved to be much more effective for console debugging than the use of an inquiry-typewriter.

Another use of computer display is on-line programming. The reduction of elaborate mathematical formulae to FORTRAN statements is a time consuming and error prone operation even for full-time programmers. A more efficient approach would be to create the actual formulae on a display device using keyboard and light pen techniques. This would enable one to use subscripts, superscripts, integrals, cross products, simultaneous equations, etc., in their normal mathematical form. This is another application which will benefit from advances in time sharing. It is conceivable to visualize the scientist of several years from now working at a display console, requesting data from storage devices to be displayed, indicating computations to be performed, observing the results and requesting changes to be made, and documenting the end product. The limiting factor at this time appears to be the high cost of individual consoles.

Engineering Design Applications

Probably the most important non-military use of display devices in the future will be in the area of engineering design. This application has been the subject of major projects at MIT ("Sketchpad: A Man Machine Graphical Communication System" Sutherland, I. E.; *AFIPS Confer-*

ence Proceedings, Spring Joint Computer Conference 1963), and at Control Data Corporation through their Digigraphic System.

Already, computer aided design has been applied to building layout. The designers drew hypothetical layouts on the face of the display, then called on the computer to evaluate known traffic patterns and correlate them to the proposed floor plan. The designer could then modify the layout until he found one which was responsive to the traffic patterns. The particular example used was a hospital, but the technique is applicable to other structures such as schools, office buildings, stores, and terminals.

The Norden Division of United Aircraft Corporation has developed under an Air Force contract a computer aided technique for circuit design. The procedure involves the use of a DEC PDP-1 computer with CRT and light pen. The procedure accepts basic input data concerning the circuit, applies appropriate topological rules, and displays the result on the CRT. The circuit designer can modify the layout on the CRT with the light pen. The best configuration, in terms of electrical engineering as well as geometry, can be achieved through this man-machine combination. One circuit analysis that would normally take a circuit designer several months was accomplished in 28 minutes using this approach.

This approach will probably be extended in the future to allow the computer to prepare parts lists. If a circuit is changed, the parts lists will be updated and the computer programmed to prepare output for all manuals and personnel concerned. A further extension can be the preparation of wiring lists and wiring programs. Some work in this area has already been done, but without the feedback from a display device and light pen or keyboard. Another logical step would be to use this data to program an automatic wire wrap machine. The equipment to perform this task is available today. The major challenge will be in the programming.

The field of mechanical and structural design will become in the next few years a major application area for computers. Computers are used today to perform many of the routine computations involved in this type of design. The major drawback is in entering the data into the computer, monitoring the results, and making modifications. Using a light pen, it is possible to sketch a design directly on a CRT. If it is a structural design problem, the computer can apply the proper stresses and display the results. The designer could then accept the design or make modifications. Complex structures such as entire bridges could be analyzed by this technique. Parts lists, drilling diagrams, and detail drawings could also be changed as the over-all design changes. If a mechanical linkage were being designed, the designer could observe its rotational characteristics. Symbols used repetitively need not be drawn each time, but can be stored as a set of standards and retrieved and used through the use of keyboards and light pens. From a long range point of view, it may eventually be possible to go automatically from a designer's sketch to prepared input for automatic machine tools.

Conclusion

The current non-military use of display systems can be considered to be in its infancy. The above descriptions of present and proposed applications hardly scratch the surface. At the present time commercial display volume has been estimated by various sources at between $25,000,000 to $35,000,000 per year. It is not inconceivable that by 1970 this will grow to over $200,000,000. Much research still remains to be done in the areas of hardware development and application programming. However, a sufficient amount has already been done to indicate a very promising future for computer-controlled graphical display.

THE IBM SYSTEM/360

Neil Macdonald
Assistant Editor

IBM drew back the veil from its long awaited new computer system this past month in what IBM Board Chairman Thomas Watson described as "the most important product announcement in the company's history." In doing so, IBM revealed an integrated series of computing and data processing systems built with microelectronic circuitry and designed for extensive flexibility in handling input/output requirements.

The new series, called the IBM System/360, is described by IBM as essentially a single system offering 19 combinations of graduated speed and memory capacity in its central processors. The name 360 was chosen to indicate that the new single system is designed to encompass all angles of the data processing market. The low end of the System/360 starts at $2,700 per month for basic configurations, and offers between three to four times the EDP performance of the 1401 at equivalent costs. The high end of the system can go up to $115,000 for a typical multicomputer configuration, and offers a processing power of 2.5 million 32-bit word additions per second, or five to six times the processing speed of the 7094II.

To give the new system an expanded capability in breaking-down the current costly input/output barriers for many information processing applications, IBM announced at the same time twenty-six new peripheral units especially designed for the system. These, when added to existing IBM peripheral equipment, bring to forty-four the number of peripherals which can be tied into the System/360.

Main Features

Some of the most notable features of the new IBM System/360 include:

Solid Logic Technology. Microelectronic circuits—product of IBM's Solid Logic Technology—make up the system's basic componentry. System/360 is the first commercially available data processing system whose design is based on the use of microminiaturized computer circuits.

These tiny hybrid circuits operate at speeds ranging from 300 down to six nanoseconds. Transistors and diodes mounted on the circuits are only 28 thousandths-of-an-inch square and are protected by a film of glass 60 millionths-of-an-inch thick.

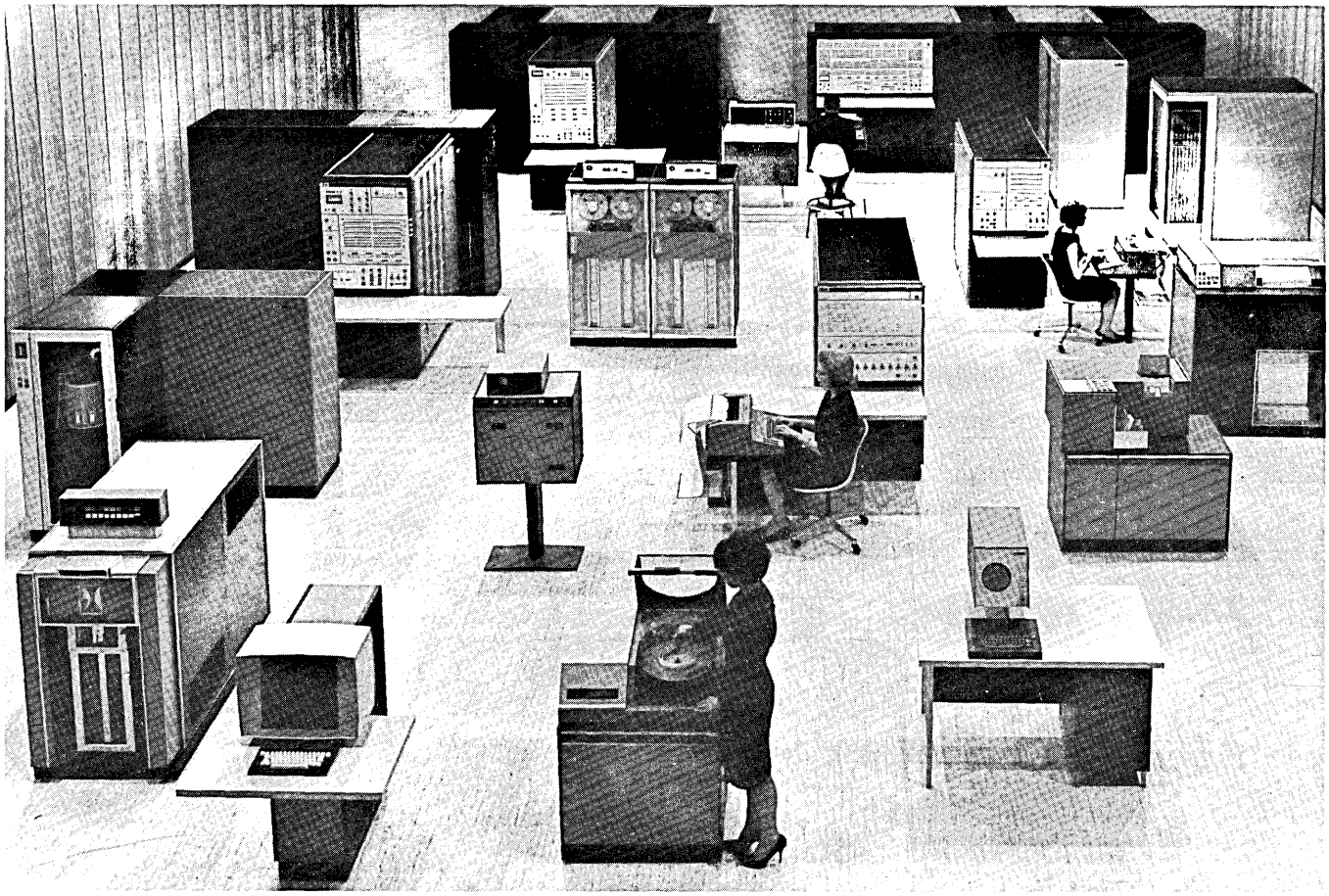
Memory Power. A hierarchy of memories within System/360 makes information in core storage available at varying speeds. Small local store memories operate in as little as 200 nanoseconds. Control memories operate in as little as 250 nanoseconds. Powerful main memories—containing up to 524,000 characters of information—range in operating time from 2.5 to one microsecond.

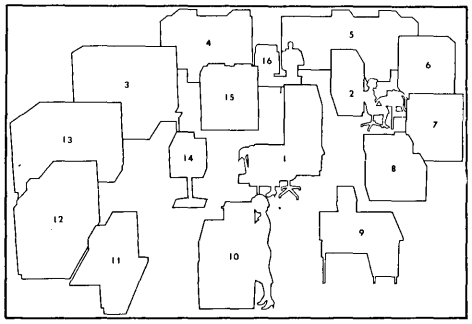
A major new development provides 8,000,000 characters in bulk core storage—each character available in eight microseconds and each at the direct command of a computer instruction. This is over sixty times more directly addressable characters than were previously available in IBM computers.

Business and Scientific Computing. The System/360 can process work through binary, decimal or floating point arithmetic facilities. The programmer is free to choose which of these can best handle his problem—or any one of several parts of his problem. Therefore, the same System/360 configuration can handle commercial work, scientific work, or a combination of the two, with equal effectiveness.

Communications Capability. Continuously prepared to accept messages from remote locations, a System/360 multiplexor channel makes it possible for the computer to com-

PORTRAIT OF SYSTEM/360





Some of the key elements of the new IBM System/360 are displayed here. The individual units, keyed to numbers on the diagram at left, include processing units (Nos. 1 through 5) which make available 19 combinations of memory capacity and speed. Other equipment which is part of System/360 includes: No. 6—Core Storage of up to two million characters. Multiple units can be linked to a system to link more than eight million characters of information to a system at microsecond speed; No. 7—A high speed printer, one of several available with the system; No. 8—One of several available units to read and punch cards; No. 9—A display terminal to display visual replies to inquiries; No. 10—A disk storage drive using removeable disk packs storing up to 15 million digits; No. 11—A display unit which visually presents information stored in the system. An operator can modify this information using this unit; No. 12—Hypertape, which reads and records information on cartridged magnetic tape at up to 680,000 digits a second; No. 13—A data cell drive which makes up to 800,000,000 digits available to the system in random sequence. Multiple drives can provide multi-billion character storage; No. 14—An on-line data collection terminal to feed information into System/360 from the factor floor; No. 15—New nine-channel tape drives with a wide speed range, from 22,500 to 90,000 letters and numbers a second up to 180,000 digits a second; No. 16—A console from which an operator can control System/360.

municate simultaneously with up to 248 terminals. There is automatic communication-to-computer code conversion. The system's monitor program automatically handles inquiries to the computer at any time—even when a batch processing job is being run.

1401 Compatibility. A feature that makes System/360 logic compatible with the 1401 helps users accomplish a transition from present equipment to System/360. Most programs written for the 1401 can be run on System/360 without change. This feature smooths the transition of 1401 users into the new IBM system. A program translator for current 7000 series users is expected this summer.

Program Compatibility

All programs written for the System/360 can be run on any of the processing units—as long as there is sufficient storage and input and output units, and no timing dependence in the programs. The 142 operation codes of System/360 machine language are accepted by all processing units. Input and output equipment such as tape drives, disk files, data cell drives, printers and card read punches can be attached to various processing units.

The differences in processing units are the range of memory sizes, the operating speed of the functional parts of the processor and the width of the data path—that is,

the number of characters the machines move at one time. For instance, the smallest processor moves only one character at a time while the largest moves eight. (See Table 2 for comparison of processing units.)

Memory Facilities

Large memory availability is a major advance in System/360. In fact, to satisfy diverse needs, System/360 will make use of a "hierarchy of memories." This includes a selection of core memory storage ranging in cycle time from .2 to 8 microseconds. It extends to external storage devices such as drums, disks, tapes, and strip files with access times that range from microseconds to tenths of a second. These units provide the ability to store hundreds of millions—even billions—of characters of information on-line with System/360.

For main memory, all models of System/360 employ core arrays in various sizes. Cores are small (as little as 0.013" inside diameter by 0.019" outside diameter), are more densely packed on planes and are driven and sensed by microelectronic circuits located much closer to the cores. This accumulated compactness helps the main memories achieve the fast read-write cycle times of 2.5 to 1.0 microseconds. (See Table 2 for comparison of memory performance.)

One of the most important components in the System/360 hierarchy of memories is the new IBM 2361 core storage. It provides core storage units of one or two million character capacity with an eight microsecond cycle time. As many as four 2361 units can be attached to the largest models of System/360—providing over 8,000,000 characters of storage—all directly addressable, at a lower cost to the user than ever before. This core storage is suited for storing subprograms and less-frequently used routines such as those needed for scientific and engineering problems.

Another memory feature of System/360 is storage protection. It allows several programs to reside in core storage at the same time while one is being executed. It also allows transfer of data from peripheral equipment to memory while other programs already are in memory. Storage protection eliminates the danger that one program would inadvertently be placed over, and thereby destroy, another program.

Local Store

Local store is used by System/360 as a "scratch-pad" in keeping track of addresses in index registers and for storing results of intermediate arithmetic. Local store also provides a place for control words of the programs residing in core storage.

To help avoid a good deal of the transferring of intermediate processing results back and forth from main memory, System/360 processors are equipped with sixteen 32-bit general purpose registers. There are also four 64-bit floating point registers for accumulating floating point results. They range in speed from eight microseconds to 200 nanoseconds.

In addition to reducing unproductive register shifting, the added number of registers also makes possible far larger direct addressing capabilities. System/360 is designed so that up to 16,000,000 characters can be directly addressed.

System/360 Organization

Each model of the IBM System/360 consists of a central processing unit, a system console and input/output equipment. System/360 includes Models 30, 40, 50, 60, 62 and 70.

Table 2. IBM SYSTEM/360 CHARACTERISTICS CHART

Characteristic \ Processor Model	30	40	50	60	62	70
Word Size in Data Bits	8	16	32	64	64	64
Memory Size Range in Characters	8K-64K	16K-256K	64K-256K	128K-512K	256K-512K	256K-512K
Main Memory Cycle Time	2.0u	2.5u	2.0u	2.0u	1.0u	1.0u
Machine Cycle Time	1u	.625u	.5u	.25u	.25u	.2u
Speed of Logic Circuits	30n	30n	30n	10n	10n	6n
Cycle Time of Sixteen Gen. Purpose Registers	8u	1.25u	.5u	.25u	.25u	.2u
Fixed Point Add Time (32 Bits)	29u	7.5u	3.3u	1u	.9u	.4u
Fixed Point Multiply Time (32 Bits)	303u	83u	28u	5.8u	5.6u	2.7u
Floating Point Multiply Time	312u	77u	21u	5.3u	5.1u	2.2u
Monthly Rental for Typical System *	$4200	$9600	$18,000	$35,000	$50,000	$70,000

u = microseconds n = nanoseconds * C&A Estimates

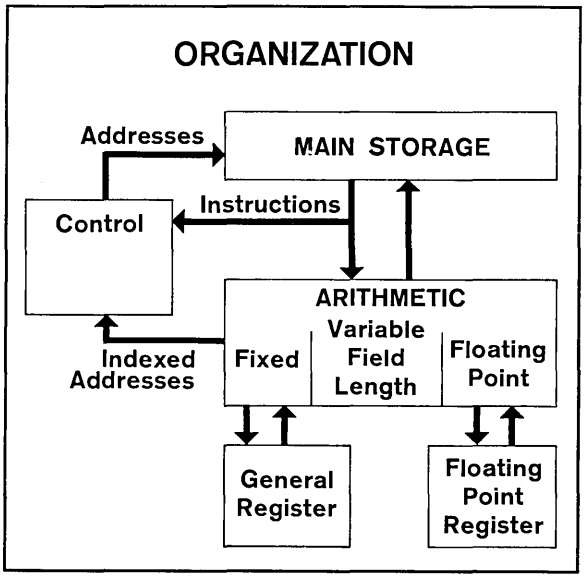


Figure 1 shows the organization of all processing units available with the System/360. Each processor has a main memory; a local store in which index and address registers and arithmetic results are kept; an arithmetic section where additions and comparisons are actually done; and a control section which, in all but one processor, uses read-only storage to tell the arithmetic unit how to accomplish a desired task.

Space for local store—the equivalent of several hundred characters—is supplied by either core storage facilities, as in the Models 30, 40 and 50, or by circuits, as in the Models 60, 62 and 70.

Microprogramming

All models of System/360 operate under the same set of instructions through the help of the microprogramming technique. A user of the System/360 can acquire a more powerful processor and increase the number of tape or file units. Or, conversely, should he want to add small regional computing centers to a large centrally-located processing headquarters, smaller System/360 installations could interpret his programs. This type of "downward compatibility" is possible providing adequate memory and input/output units are available and the programs are not time-dependent.

Execution of the same set of 142 operation codes by all models of the System/360 is achieved through the use of stored logic, or microprogramming, and carried out in five models by what is known as "read-only storage." When codes are directed into the read-only storage, they are translated to a pattern of signals which set up the circuits in a processor to perform the desired operation. The processing units carry out these orders in different ways.

Compatibility with the IBM 1401 data processing system has been made possible with a special feature in System/360 Models 30 and 40. Stored logic, or read-only storage, is used for translation. The 1401 machine language operation codes are directed into a read-only storage. There they are translated into signal patterns that will cause the same things to happen—an add, a move to storage, the reading of a card—that would have happened in the 1401.

Processing Operations

Basic to all models of the System/360 is a set of 88 operations which include binary and logic operations. This is the so-called "standard set."

A floating point set of operations includes 42 additional operations to accomplish arithmetic with floating point notation. Finally, decimal arithmetic includes a set of eight operations to accomplish arithmetic with decimal numbers.

In addition to these 138 operation codes, there are two codes for memory protection and two to get an outside device to read or write without going through a channel.

Variable length instructions are used. Some have no addresses. Others have one or two addresses. The programmer selects the instruction best suited to the operation he wants to perform and location of data he wants to use. This tends to speed programming, to reduce the size of programs, and make machine operation more efficient.

Coding System

The IBM System/360 uses an eight-bit binary coding system which permits double packing of decimal digits. Alphabetic characters and special symbols take eight bits with a ninth bit used for odd parity checking. Decimal digits use only four bits, so that two digits can be packed into each eight-bit unit. Decimal arithmetic is actually performed in this double-density format, thus conserving processing time. The nine-bit code is employed on all input and output equipment. Tape drives are equipped with nine-channel heads.

While the tight-bit code—with a ninth parity bit—is standard mode for this system, the processing units will accept the seven-bit American Standard Code for Information Interchange (ASCII). This code will not permit double-density packing of decimal digits, but will otherwise be handled just as the System/360 code is.

Input/Output Equipment

The forty-four peripheral units with the System/360 include storage devices, visual display units, communications equipment, card punches, printers, a paper tape reader, and character recognition devices.

Twenty-six of the peripherals are available for the first time. Among the new peripherals are several storage devices. These include the IBM 2321 data cell drive, a random access device that can store 400 million alphanumeric characters or up to 800 million decimal digits. Eight data cell drives, with up to 6.4 billion digits, can be linked to one control unit. Additional files can be linked to other control units in the same system. Each drive is designed so that data cells are removable and interchangeable in increments of 40 million characters or up to 80 million digits.

Information is stored on and retrieved from magnetic strips, which are held in cells mounted vertically around a rotating cylinder. To retrieve or write information, the data cell drive's positioning system rotates the cell cylinder to locate the specific 10-strip group needed and place it beneath an access station. At the station, the particular strip containing the desired information is withdrawn. The strip is moved past a read/write head for transfer of data to the computer, and the strip then is returned to its original location. This process requires approximately 450 milliseconds. Each group of 200 strips, or 40 million characters, is called a data cell and can be removed and replaced by another group.

The magnetic tape strips used for storing information measure 2¼-inches wide by 13-inches long by 0.005-inch thick. Each strip has an individual coding tab, identifying its position among the 200 strips in a data cell.

The 2321 has a five-position, 20-track read/write head. Each strip has 100 addressable recording tracks providing storage of approximately 200,000 (eight-bit) characters of information. Access time varies from 95 milliseconds to 600 milliseconds, depending on the addressed strip position and data arrangement in each data cell. Access time is the

time required to position the mechanism to read a strip, which includes locating the strip on the drum, reading, writing, and write-checking it.

Other new storage units are the new ultra-high speed IBM 7340 hypertape drives which are designed to read or record information at a rate of 340,000 alphanumeric characters a second or up to 680,000 digits a second. This represents the fastest commercially available magnetic tape system in the world. The drive operates at either of two densities—1,511 or 3,022 bits an inch. Also available is a hypertape drive that operates at 170,000 alphanumeric characters a second, or up to 340,000 digits a second.

Read backward, which speeds tape sorting by eliminating certain rewinds, and automatic threading and unthreading of tape are standard features on the 7340.

Still another new unit is the IBM 2400 series nine-channel magnetic tape unit which reads and records information in nine data tracks across ½-inch wide tape. Also available with the 2400 series is a seven-track compatibility feature which enables reading and writing of data at high speeds.

The 2400 series is available in four types. Each type comes in three models, with different information transfer rates. These models are: 22,500 alphanumeric characters or up to 45,000 digits a second; 45,000 alphanumeric characters or up to 90,000 digits a second; and 90,000 alphanumeric characters or up to 180,000 digits a second. The read backward feature is standard on all 2400 drives.

Other storage devices available in the System/360 include the new IBM 2311 disk storage drive, an improvement on the well accepted 1311 disk unit of the 1400 series. Each removable disk pack holds 7.25 million alphanumeric characters, or up to 14.5 million digits. Up to eight 2311 drives can be attached to one control unit to provide an on-line capacity of 58 million characters or up to 116 million digits. Average access time is 85 milliseconds versus 160 milliseconds for the 1311.

The IBM 1302 disk storage unit is available for the System/360 in two models. One model contains 25 disks and two access mechanisms to 112 million alphanumeric characters. The other model offers twice the storage capacity of the first.

Two drum storage units are available for the System/360. One, the IBM 2301 drum storage, has a capacity of four million alphanumeric characters. Its information transfer rate is 1.2 million characters a second.

The other drum storage unit is the IBM 7320 with a capacity of 808,000 alphanumeric characters available at a rate 203,000 characters a second.

Visual Display Units

The new IBM 2250 display unit provides a dynamic visual presentation of information stored in the computer or in storage files, drums and tapes. An operator at the display can monitor the progress of his program or solution, and can modify and intervene as necessary.

The major element of the 2250 is a console with a 12-inch square display screen (a 21-inch cathode ray tube) on which tables, graphs, charts, alphanumeric characters, or the lines and curves of drawings can be displayed as a series of points. When the full display area is used, 3,848 alphanumeric characters—the contents of a page of information—can be viewed. A built-in electronic marker helps the operator edit messages. When the display console is used as a point plotter, it can plot graphs, charts and drawings with the precision of a square matrix of 1,024 points, or more than one million individually addressable points. (For picture of this unit, see Data Display Pictorial Section.)

Buffer storage for the 2250 is available in 4,096 and 8,192 character capacities. These buffer storage units hold points, lines and position instructions which may be read from or written at a maximum rate of 238,095 characters a second.

The IBM 2840 display control permits up to eight display units to operate in an economical time-sharing configuration. Up to 16,384 characters of storage are available with the 2840.

The new IBM 1015 inquiry display terminal is designed to operate as an inquiry device for System/360 Models 30, 40 and 50.

Information is placed into the computer through the 1015's alphanumeric keyboard and is simultaneously displayed on its four-inch-square screen. The 1015 then displays a reply to the inquiry on its screen.

Information is displayed at a rate of 600 characters a second, about 40 times faster than that produced for an operator by means of a type-out. The viewing area has a 30-line capacity of 40 characters each. To reuse the display, once 1,200 characters have been displayed and the inquiry has been answered, requires only a push of the "erase" button. The standard 36 alphanumeric characters (A through Z, 0 to 9) plus 23 special characters are available.

Communications Equipment

The new IBM 1070 process communication system is designed for on-line data transmission between remote process locations and a central computer.

Through the use of a multiplexor terminal unit, the 1071, the system can connect, via four transmission lines, up to 98 terminal stations to the central processor. The processor controls all transmission sequences to and from the terminal stations, performs, checks and handles the required calculations. Input/output devices such as storage files, magnetic tapes, visual displays and printers also can be attached to the processor. These terminal stations are designed to handle a user's standard control system input/output devices and transducers. They will convert the signals between the 1070 and the devices in the process.

The transmission of data to or from the terminal stations is performed on multi-drop transmission channels in half-duplex mode at speeds of 134.5 or 600 bits a second, which corresponds respectively to 14.8 or 66.6 characters a second. The transmission is buffered into the processor for greater system efficiency.

The new IBM 7772 audio response unit can be attached to System/360 Models 30, 40 and 50 through their multiplexor channels. It links the processor with a telephone network to provide a recorded voice response to inquiries made from telephone-type terminals. The audio response is assembled from a vocabulary which is pre-recorded in a digitally coded voice on a disk storage file connected to the computer.

The new IBM 2701 data adapter unit provides System/360 with expanded input/output device capability. It provides direct connection for a variety of remote and local external devices—the 1050, teletypewriter terminals, telemetry terminals, test instrumentation and data acquisition equipment.

The unit attaches to a selector channel or multiplexor channel. A selector channel handles high-speed input/output devices. It is overlapped with other selector channels and a multiplexor channel, in a processor's input/output control element, to provide simultaneous operations.

The maximum data rate capability of the 2701 generally is specified by the particular transmission interface adapter used, the input/output channel capacity and the over-all systems configuration.

The IBM 2702 transmission control, which operates at lower speeds than 2701, is designed for use with System/360 Models 30, 40 and 50. It directs and controls information that flows between the processor and many remote terminals such as the 1070, 1050, 1030 and 1060 data communications systems.

Outgrown your s

Move up to the new GE-415—
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1. How long will it take to convert my present programs? With the new GE-415, the change-over can be immediate, depending on the type of computer system you are replacing. Chances are you can run your present programs *as is*. Rewrite them only if you want to, and when you want to. This immediate change-over is made possible by General Electric's unique Compatibility Option, based on the G-E CAPACITRIX memory. Available on the entire General Electric Compatibles/400 family of computers—GE-415, -425, -435, -455, -465.

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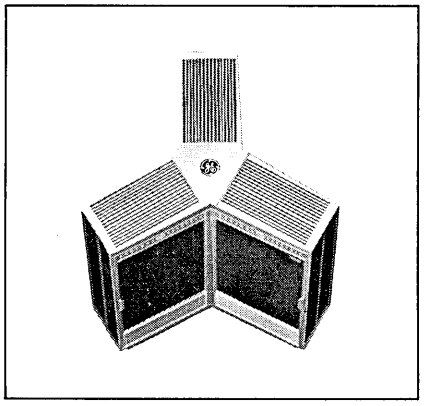
The new GE-415 gives you far more performance than any other low-cost computer. For example, the GE-415 has a cost/performance advantage over the most popular computer up to 9 to 1. This can mean savings of over $150,000 in 5 years. GE-415 systems start at $4,770 per month.



4. What kind of help will I get from the manufacturer? When you get a new GE-415 (or any other G. E. computer) you get systems analysts and applications engineers who will help you plan a data processing operation—or a total, integrated information system. We call these men The Problem Solvers—and for good reason. They bring you General Electric's great reservoir of computer experience. We use *more* computers (185) than any other company. And, of course, General Electric instructors and product service people will make sure your system gets started—and keeps going—smoothly and efficiently.

5. What if I need still more capacity later on? If I intend to grow—and to expand my computer applications—will I have to go through this whole change-over business again?

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Compare the new GE-415
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Processor Features
- Program interrupt
- Multiple level indexing
- 200 instructions
- Indirect addressing
- Simultaneous read/write/compute
- Scatter/gather

Memory
- Up to 131,072 characters
- Memory cycle equivalent to 2.3 microseconds/character

Program Compatability Option
- No pre-passes or re-programming on programs written for the most popular small computer now in use
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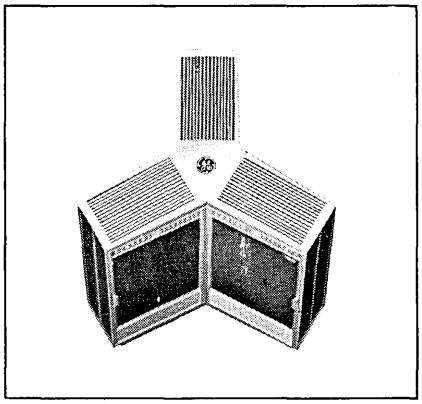
- GE-400 operating system
- Automatic I/O coding
- Media conversion program
- Simultaneous media conversion and production run
- Sort & Merge generators
- Report program generators



Peripherals
- CR-20 card reader—900 CPM
- CP-10 card punch—100 CPM
- PR-20 printer—1200 CPM, 136 cols.
- COMPATIBLES/400 line magnetic tape subsystems up to 83KC
- Single and dual-channel tape controllers
- PS-20 perforated tape reader/punch (reads 5, 6, 7, 8-channel tapes at 500 characters/sec. Punches 150 characters/sec.)
- DS-20 disc storage unit stores 23.5 million 6-bit characters
- MR-20 magnetic reader/sorter reads and sorts 1200 MICR documents per minute
- DATANET-20 single line data transmission controller
- DATANET-25 multiple processor/adapter for coupling COMPATIBLES/400 computers
- DATANET-30 Data Communication Processor for high-volume data processing and high-volume data communication functions

Upward Compatability
- All programs and peripherals upward compatible with other COMPATIBLES /400 systems

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The 2702 utilizes the multiplexor channel of the processor. The link with the remote terminals is via private and commercial common carrier transmission facilities.

Existing communication terminals which will be available for use with the System/360 Models 30, 40 and 50 are the 7770 audio response unit, the 1030 data collection system, the 1060 data communication system, and the 1050 data communication system.

Other Peripherals

A new IBM 2201 model 3 printer which produces up to 1,100 lines a minute of alphanumeric information is announced for the Models 30, 40 and 50 of System/360. By using a preferred character set, it is possible to achieve 1,400 lines a minute. Also available for printing are the existing 600 lines a minute IBM 1403 model 2, and the 240 line a minute IBM 1443. All printers are being manufactured in Endicott.

A new IBM 2671 paper tape reader reads five to eight-track paper tape at up to 1,000 characters per second. The reader is controlled by the IBM 2822 paper tape reader control unit, which provides status and data information to System/360 from the 2671.

Software

Programming support for the IBM System/360 includes a comprehensive package of programs.

FORTRAN IV and COBOL and programs such as report program generators, sort/merge and utility programs will be available to users. All are designed for operation under a comprehensive monitor or control program. The control programs handle job-to-job transition, control of input and output units and other functions which formerly had to be executed by the computer operator.

Included in System/360 program support will be a compiler for a new program language which will combine FORTRAN-type mathematical statements with the ability to handle complex logic and data manipulations, such as the ability to define and operate on character strings and bits, permitting the user to handle a variety of input data. It will also offer facilities for handling complex logical requirements such as those in information and control systems. The details of this new language are expected to be defined by the fall, 1964.

Software for the System/360 is developed around the operating systems concept, the objective of which is to have the computer schedule itself, so that it can operate continuously, with little or no manual intervention. This is done by a group of control programs that handle the transition from one job to another and supervise the use of all input and output equipment. These control programs contain many routines that would otherwise have to be put into each individual program. Such routines include those for handling error conditions, interruptions from the console or interruptions from a communications terminal. There are also routines for handling input and output equipment.

Operating system programs conform to specific standards, so that control programs will have an identical interface with all processing programs. These standards are documented so that user-written programs can follow the same conventions. The user is free to supplement IBM-supplied programs to meet special situations. By following the rules indicated in the standards, portions of control or processing programs can be changed or replaced in modular fashion.

Communications

Real-time data communication service is a major characteristic of the IBM System/360. Advances designed into the system include simultaneous message handling, code conversion and channel facilities for up to 248 communications lines supporting hundreds of terminals.

Manufacturing management and control, on-line savings accounting, hospital information, process control, remote scientific problem solving and sales order entry are typical of the applications the communications-oriented IBM System/360 can handle.

To facilitate these applications, each channel on System/360 is an independently operating device which serves both as a data path and as the controller for all data traffic to and from the input and output devices attached to it. There are two types of channels: the selector and multiplexor channels.

The selector channel is designed primarily for such devices as tape units and disk files. When the selector channel is directed to make connection with one input or output unit, all other units on that channel are locked out until the first unit is released.

The selector channel is capable of handling high-speed units overlapped with processing, so that a stream of data can be fed to storage while the processing unit is performing arithmetic or logic operations for another phase of the program.

Each selector channel can support up to eight control units. Through these it can address up to 256 input/output units. Selector channels have a character transfer rate of 250,000 to 1,250,000 characters a second, depending on the model of System/360.

By linking certain input or output units to more than one channel, a variety of ways are open to reach the device, even if other units are occupying one or more of the available channels. A single unit can be linked through channel switching to one channel at the start of processing on a job, and then to another channel at the end of processing of the same job.

Multiplexor Channel

A multiplexor channel is part of System/360 Models 30, 40 and 50. These are the configurations which will most effectively be used to control card read punches, printers, and communications terminals.

The multiplexor channel allows attachment of up to eight data communication units. Up to 31 communications lines can be attached to each of these units. And literally hundreds of terminals can be attached to each of the communication lines.

In place of the communications lines, printers, card units and data terminals can be attached to the multiplexor channel.

The multiplexor channel resolves the high speed of the processor with slower input and output equipment by permitting many input or output devices to communicate with the processor simultaneously.

The multiplexor channel receives a message from an input unit one character at a time in its usual method of operation. In between these characters, the multiplexor channel sandwiches a character from each of the other units that also want to communicate with the processing unit. There can be up to 248 messages interleaved together on this channel. Operating in this fashion, the channel will transfer up to 40,000 characters a second between the processor and any one peripheral unit. All messages are tagged and are separated and assembled within storage by unit control words. Only after being assembled is the message actually serviced by the processing unit. Outgoing messages are tagged so that they are directed to the proper peripheral unit. This channel produces a time-sharing effect, so that

{Please turn to page 40}

Special Report

MICROELECTRONIC CIRCUITRY OF THE IBM SYSTEM/360

Microelectronic modules one-half-inch-square make up the basic circuitry of the new IBM System/360.

The modules are the product of IBM's Solid Logic Technology. A complete logic circut can be contained on a single module, or several modules can be linked to form a circuit.

Logic circuits provide the paths which carry and control electrical pulse that represent numerical data. Computers perform complex mathematical operations by directing pulses over different circuits in rapid sequence. Reduced size and complexity of a circuit reduces the distance a pulse must travel, thus contributing to the increased speed of the computer.

The new modules, which use transistors and diodes 28 thousandths-of-an-inch square, are mounted on circuit cards, which in turn are installed in System/360 equipment.

Production of this miniature componentry is accomplished at IBM's East Fishkill, N. Y., plant. Technicians, working in dust and humidity-free rooms, operate specially built precision machinery. Tolerances are so small that high-powered magnification devices are needed to observe some of the processes.

The transistor and diode chips are manufactured from silicon crystals "grown" in crucibles at extremely high temperatures. A crystal (Photo A) eventually is converted into hundreds of thousands of chips.

The crystals are grown at temperatures of 1420° C. and then sliced into wafers 1¼-inches in diameter and three-hundredths of an inch thick.

The silicon remains in wafer form throughout the chip fabrication process, at the end of which it is diced into up to 1,100 completed diodes or transistors.

Photographic and etching techniques are used to form the surfaces of the individual chips on a wafer. Work is performed under yellow safe-light to prevent exposure of light-sensitive emulsions.

The wafers receive a film of photo-resistant solution (Photo B), after which they are marked by a series of negatives containing different patterns which form the final surface.

The connecting copper pins then are inserted through 12 holes pre-punched in each tile. An automatic machine pins four circuits each second, with pins spaced an eighth of an inch apart to a tolerance of one-thousandth of an inch. Later the pins will connect completed modules to circuit cards for installation in units of System/360.

To insure good connections between the pins and the printed circuit, and to provide the solder which will join the chips to the module, the substrates then are immersed in a solder bath.

The printed resistors, treated to resist the solder bath, are trimmed to their proper electrical specifications by an automatic sand-blasting device (Photo F). Tiny nozzles the size of hypodermic needles precision-trim the resistors to a tolerance of one per cent.

The circuit modules then are ready to receive the transistor and diode chips. A specially built machine performs this operation automatically at tolerances so close that the copper contacts, less than a sixty-fourth of an inch apart on each chip, make perfect electrical contact with circuit paths only a hundredth of an inch wide (Photo G). The IBM-designed machine can position chips at a rate of six every one-and-a-half-seconds.

Another precision operation is the manual positioning of special devices, such as crossovers, on the printed circuits. Crossovers—15 thousandths of an inch wide—are placed on some modules by technicians using needle-thin tweezers and high-powered microscopes. The crossovers enables paths of the printed circuit to intersect, further reducing the required space for a circuit.

The entire element is heated until the solder connects the copper pellets to the circuit. Finally, the circuit modules are coated with plastic, for protection when installed in a computer (Photo H).

The mask is precisely positioned, then the wafer is exposed to ultra-violet light. After the photo-resistant solution is washed away, the undeveloped portions are etched.

After etching, gas diffusion introduces impurities into the wafer to provide the diodes and transistors with their electrical characteristics. A pattern of electrical conductors, replacing the hair-like wires on conventional transistors and diodes, also is diffused onto the wafer.

A film of glass, 60 millionths-of-an-inch thick, then is applied to the wafer in a centrifuge and bonded in an oven (Photo C). It provides a protective covering for hundreds of elements at a time, eliminating the need for the metal "cans" and encapsulation common to conventional transistors and diodes.

Further wiring is eliminated by using microscopic copper pellets to connect the transistors and diodes to the circuit modules. The connection is made through pinpoint holes, invisible to the naked eye, which are etched in the glass film and then diffused with solder and conductive metals.

The pellets, five thousandths-of-an-inch in diameter are positioned in the holes through a perforated screen which drops a pellet in each of over 3,000 holes in the wafer. (Photo D)

The wafer next is diced by a precision cutting tool to product up to 1,100 transistor or diode chips. Another specially built machine automatically tests each and every chip for size, speed and reliability. The chips are aligned by a vacuum, tested, and sorted into miniature bins according to their characteristics.

Fully enclosed in glass film, except for protruding copper connectors, the chips then are ready for mounting on miniature solid logic circuits.

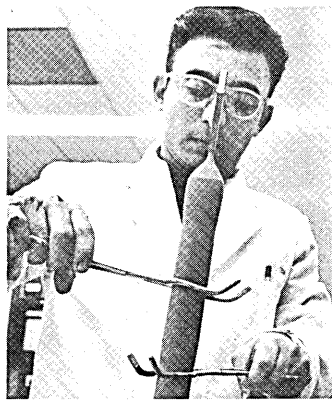
The circuit modules themselves are produced on blank, half-inch ceramic squares, six-hundredths of an inch thick.

Unlike typical computer logic circuits, the new miniature modules have no wires. A complete circuit and resistor pattern is printed on the tile with conventional screening techniques.

The ink, containing gold and platinum, conducts electric current across the circuit. After the automatic screening operation, the substrates are baked so that inked circuits and resistors adhere to the ceramic. (Photo E)

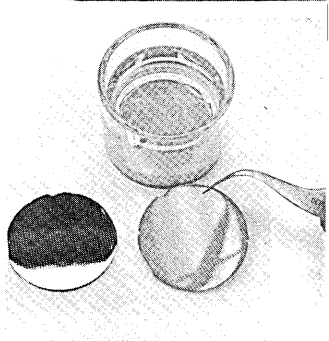
A

B

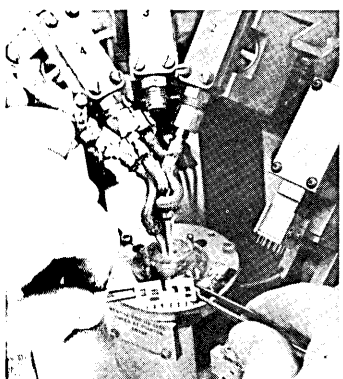


C

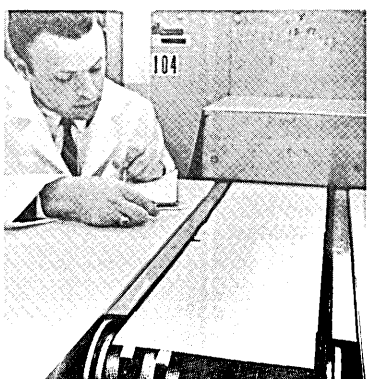
D



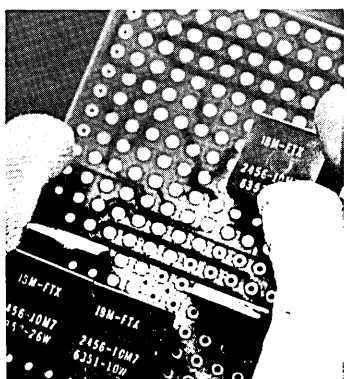
E



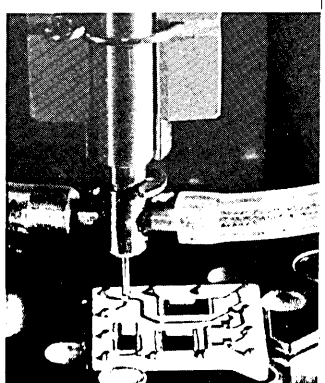
F



G



H



A GLOSSARY OF DROLL DEFINITIONS
COBAL —
COMPUTERDOM'S ONE BASIC AUTHORIZED LANGUAGE

The editors are pleased to offer the following collection of sagaciously unorthodox definitions of common terms in the computer field. We are grateful to the people at the Computer Division of the Philco Corporation, a subsidiary of the Ford Motor Co., who have prepared this comic glossary and who have given us permission to reprint it from their booklet of the same name.

A

ACCESS TIME
A period during which you either make it or you don't.
ACCUMULATOR
The Internal Revenue Service.
ADDER
A variety of snake: HALF ADDER—a seriously wounded snake.
ADDEND
Where you put on weight.
ADDRESS
ABSOLUTE—The one you get if she likes you.
INDIRECT—The one you get if she isn't sure.
RELATIVE—Where you wish your mother-in-law would go.
ALGOL
First part of a quotation ending in: "is divided into three parts."
ANALOG COMPUTER
Machine to measure the timber in a virgin forest.

B

B BOX
A hive.
BATCH TOTAL
Bureau of Census reports on unmarried men.
BIQUINARY
A distillery on a bicycle.
BIT
12½ cents.
BLOCK DIAGRAM
Simple instructions for a children's game.
BOOLEAN ALGEBRA
Algebra taught at Yale.
BUFFER
A way of cleaning certain mammals.
BUS ADDER
A transportation merger.

C

CHARACTER
Someone interested in computers.
CHARACTER READER
A fortune teller.
CLOSED SUBROUTINE
What is done *before* a submarine dives.
COBOL
Two people having fun.
CODE
A respiratory ailment.
COMMON LANGUAGE
Lack of linguistic class.
CONDITIONAL JUMP
(See Jump Table)
CONSTANT
Pertaining to criticism.
CHECK ROUTINE
Paying end of the month bills.
CLOCK
A precision, large scale analog time indicating instrument.
CONVERTER
An evangelist.
CORE
Part of an army.
CROSS REFERENCE
An angry distinguished citizen.
CROSS TALK
Unwanted signals from your boss.
CRYOGENIC FILM
A sad movie on hygiene.
CYCLE
Half of a bicycle.
CYCLIC CODE
A Friday and Monday respiratory ailment.

D

DAMPING
Keeping spirits from getting too high.
DC
Location of the Accumulator.
DEBUGGING
Making a hotel room safe for conversation.
DECADE COUNTER
A ten-year clock.
DECODING
Winter rest in Florida.
DETERMINANT
A stubborn insect.
DIAD
A Southern word, as in: "He is diad."
DIODE
An elegy: TUNNEL DIODE—Elegy to a miner.
DISC STORAGE
Spare parts department for surgeons.
DOUBLE PRECISION
Having ten fingers on each hand.
DOWN TIME
Shedding season for ducks.
DUODECIMAL
A dozen ulcers in the upper intestine.

E

ECHO CHECK
One that comes back.
EDIT
Consumed, as in: "I edit."
END AROUND CARRY
Sign of advanced obesity.
END FILE
A collection of obituaries.
EXCESS THREE
A rock 'n' roll group.
EXCHANGE
Contents of your pockets after your wife's been through them.
EXECUTIVE ROUTINE
Olives or onions for lunch.

F

FEASIBILITY STUDY
Market research for fixed fee contracts.
FERRITE CORE
A well trained group of small, furry animals.
FILE MAINTENANCE
Keeping abrasive tools abrasive.
FIXED WORD
Not guilty.
FLIP FLOP
A wisecrack that lays an egg.
FLOATING ADDRESS
Location where a pilot expects to find his aircraft carrier.
FORMAT
Tee box.

G

GANG PUNCH
A rumble.

H

HASH TOTAL
Measuring leftover beef and potatoes.
HEXADECIMAL
Bending a turn around punch card.
HIGH SPEED BUS
A contradiction in terms.

I

INFINITY
Scandinavian vacation resort.
INTERLOCK
Where the key goes.
INTERNAL PRIMARY STORAGE
The stomach.
IRE
Anger.
ITERATIVE PROCESS
Repeating to get closer and closer to a desired objective.

J

JUMP TABLE
(See Unconditional Jump)

K

KEYBOARD
New York Stock Exchange.
KILOCYCLE
A thousand wheel bicycle.

L

LATENCY
Normal arrival at work.
LOGICAL OR
A smart, Cockney businesswoman.

M

MACROCODE
Pneumonia.
MAINTENANCE MANUAL
A Mexican handyman.
MARGINAL CHECKING
Checks written before payday.
MATRIX
Leftover April Fool's Day pranks.
MEMORY DUMP
Nostalgic shanty.
MINUEND
18th-century dance.
MNEMONIC
A hard to remember word used to describe hard to remember symbols that represent harder to remember codes.

N

NON-VOLATILE STORAGE
Drums which have been emptied of gas.
NUMBER SYSTEM
Prescribed methods for using your fingers.
DECIMAL—System based on using fingers of the hands.
OCTAL—System based on using your fingers with your thumbs cut off.

BINARY—System based on using your fingers with your fingers cut off.

O

OBJECT PROGRAM
TV Viewer reaction.
OPERATIONS RESEARCH
Nielsen rating on Ben Casey.
OR GATE
Metal gate for Fort Knox.
OVERLAY
Produce too many eggs.

P

PARAMETER
Approved method of counting paramours.
PARALLEL
Two Ilel's.
PARALLEL OPERATION
Casey and Kildare on competing times.
PARITY CHECK
A farmer's Christmas Club.
PATCH PANEL
Wives discussing children's clothing.
PLUG BOARD
A tired horse.
POINT
Something very hard to make.
FIXED POINT—The opinion of your wife.
FLOATING POINT—The opinion of your boss.
BREAK POINT—Discussing money with your wife.
BREAK POINT SWITCH—The next minute.
PROGRAM
Group in favor of a leading evangelist.
PSEUDOCODE
A sniffle.
PULSE TRANSFORMER
Well stacked broad.

R

RANDOM ACCESS
Promiscuous.
REAL TIME
Length of a dance.
REGISTER
What you do with a complaint.
REWIND
Lull between speakers.
RING COUNTER
Mercenary girl.
RING SHIFT
Indecisive boy.
ROLLBACK
What you expect to get in the next race.

S

SCALE FACTOR
A way to estimate the length of a fish.
SEMI-CONDUCTOR
Man who runs a bus for midgets.
SENSE
What if we had more of would have kept us from doing this.
SERIAL
A breakfast food.
SERVICE ROUTINE
Uniformed training after Boy Scout tour of duty.
SIX BIT CHARACTER
A bum with seventy-five cents in his pocket.
SOLID STATE DEVICES
Sure revenue producers, such as a sales tax.
SUBROUTINE
Peacetime anti-sub warfare.

T

THIN FILM MEMORY
Can't remember Fatty Arbuckle.
TIME SHARE
Punch clock for user's group meeting.
TRANSFER
Mink coat with a rabbit base.
TRANSISTOR
A hypnotized relative. MESA TRANSISTORS—A lot of hypnotized relatives.
TROUBLE SHOOT
What happens when a wedding doesn't come off.
TRUNCATE
What the crocodile did to the elephant when it was drinking.

U

UNCONDITIONAL JUMP
(See Iterative Process)
UPDATE
Girl with a second floor apartment.

V

VARIABLE WORD LENGTH
Stammering.
VOLATILE MEMORY
A wife on her wedding anniversary.

W

WORKING STORAGE
Digestion.
WRITE HEAD
Morning decision for two-faced person.

X

X
Breakfast for mathematicians, as in "Bacon and X."

Y

Y
That's what we've been asking ourselves.

Z

ZERO SUPPRESSION
Absolute freedom.

THE IBM SYSTEM/360

{Continued from page 36D}

many terminals are being served although each terminal appears to have the processor to itself.

The multiplexor channel can also operate like the selector channel in what is called burst mode. This restricts communication to one unit but boosts speed to 200,000 characters a second. Such an operating mode is useful when a large batch of information, perhaps from a large file, must be transferred.

Inter-System Communications

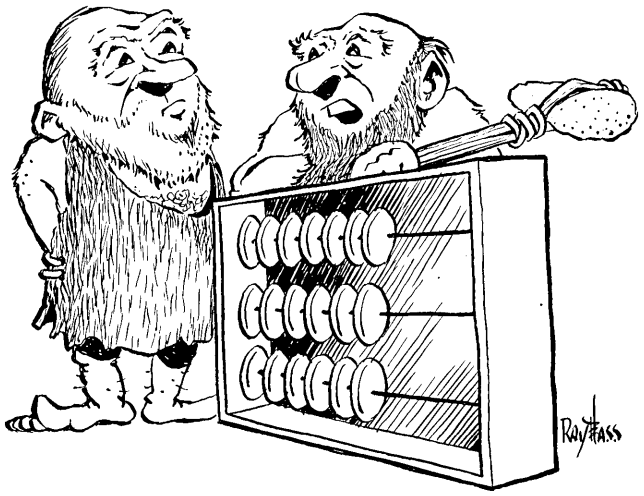
The performance differences of various System/360 models enables the user to select a configuration suitable for each data processing environment. Model 30, for instance, is designed for the preparation of input information for larger configurations. It is also well able to edit computational results and direct the printer that actually puts the results on paper.

On the other hand, the largest configuration, Model 70, is designed to handle massive engineering, scientific and commercial processing tasks. It can store and manipulate large files of data, large programs and large mathematical models.

Users can install systems of different sizes to meet a diverse number of data processing problems. And in many cases it is desirable for the two configurations to be linked so that the flow between the two environments need not be slowed by mechanical transfer.

The user of certain System/360 configurations will be able to join two configurations together. Any two configurations can share input and output devices or be linked channel to channel. Some configurations can be linked through main or large core storage.

A QUESTION OF PERSPECTIVE



"Philosophically speaking — what do you think it will do to the unemployment problem?"

The Spectrum . . .

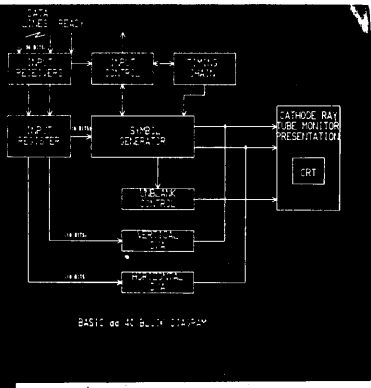
. . . of

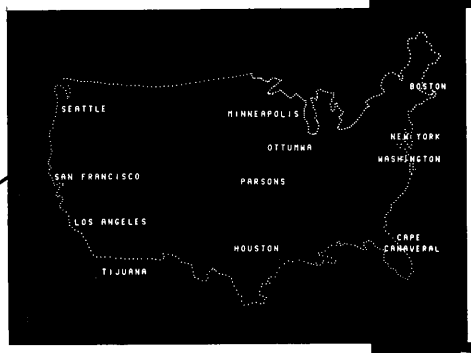
DATA DISPLAY, INCORPORATED

CRT Systems

On-Line Soft Copy:

Display of memory contents; problem oriented output; program debugging information; and operator instructions. Simultaneous display of more than 2,000 symbols and vectors — *dd 19, dd 20, dd 26, dd 40, dd 51, dd 52, dd 60, dd 74G*



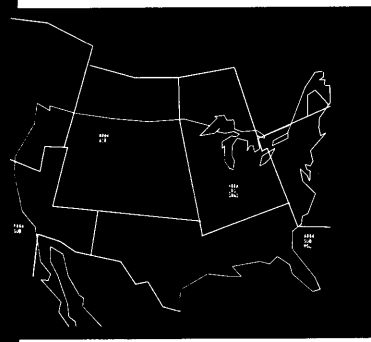


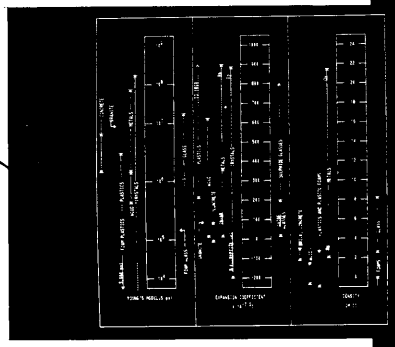
Point Plotting:

200,000 points per second. 16 to 19 inch display CRT. High speed light pencil. Indexing command formats — *dd 16, dd 20*

Command and Control:

Real time monitoring of military and business surveillance inputs. Man-to-computer communication devices including typewriter keyboard, light pencil, and trackball are available — *dd 13, dd 19, dd 40, dd 73, dd 79*



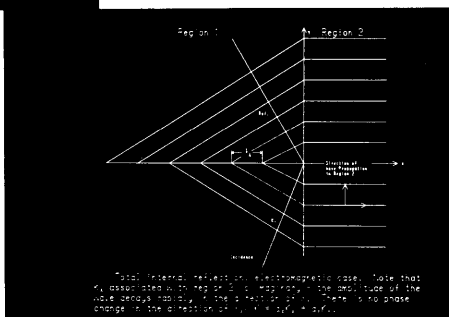


Microfilm Recorder:

Records alphanumeric and graphic computer output at on-line speeds of 110,000 characters, 170,000 vectors, and 220,000 points per second in page-at-a-time format on 35mm microfilm — *dd 40, dd 80*

Information Retrieval:

Typewriter keyboard input to a buffer memory; off line verification; block transmission and receipt of data; telephone subset compatibility — *dd 10, dd 39*

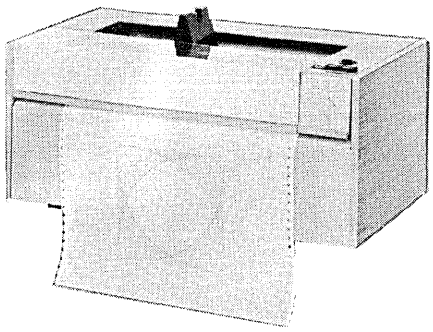


DATA DISPLAY INCORPORATED

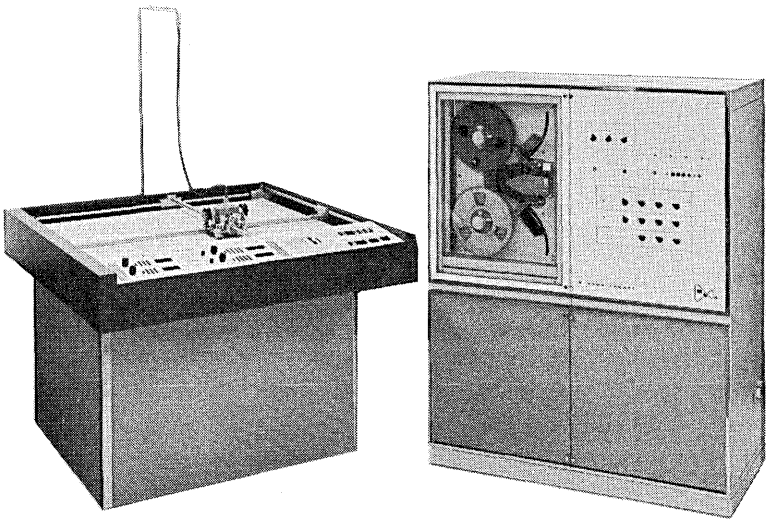
1820 COMO AVENUE SAINT PAUL 8, MINNESOTA

Circle No. 97 on Readers Service Card

from COMPACT



When you pick a plotter, choose one that will do exactly the job you want. Don't pay for more, don't accept less. With Benson-Lehner's new and complete line of digital plotters and plotting systems, no job is too small or too large. The DRAFTOMATIC Incremental Plotter (shown above) is a compact, ruggedly built, precision instrument capable of drawing speeds up to 18,000 steps per minute and a high resolution of .005 inch. Designed for on-line or off-line operation with any medium scale general purpose digital computer, the DRAFTOMATIC Incremental Plotter can automatically produce fully annotated plots under computer control. Magnetic tape plotting system also available with this model plotter. ■ The new ELECTROPLOTTER II (shown below) furnishes a precise balance of speed and accuracy, permitting the broadest scope of application at the lowest cost in computer and programming time. Benson-Lehner's exclusive new double warranty policy gives you six months of factory service at no charge. It's backed by the nation's largest field service organization specializing in computer-graphic equipment. **Output:** Final, multi-color and/or multi-line width drawings of engineering quality and precision, including 48 character alpha-numeric printing. Size: 30 x 30 or 42 x 58.



to COMPLEX

benson-lehner corporation

14761 CALIFA STREET • VAN NUYS, CALIFORNIA

Circle No. 17 on Readers Service Card

STANDARDS FOR COMPUTER PROGRAMMING
(Continued from page 28)

with the date of assembly and the revision number.

Memory Dump—To assist in correction of latent errors, a core dump should be provided. This could allow an immediate assessment of corrections included in machine language, and may provide a comparison to the memory dump taken by the console operator at the time of failure.

Test Data—Test data used to make the final determination that the program is operational should be included. This test data should be maintained with all changes, and all such data should be used to test the program after any change. This will insure that the change has not affected other sections of the program.

Conclusion

Development of necessary standards to prescribe required documentation should be implemented as a part of the over-all standards manual. To assist the staff in the development of appropriate documentation, and to provide a clear illustration of organization of the program manual, a sample manual should be included, or referenced, as a distinct part of the standards manual.

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.

American Telephone & Telegraph Co., 195 Broadway, New York 7, N.Y. / Page 3 / N.W. Ayer & Son, Inc.

Ampex Corporation, Redwood City, Calif. / Page 46 / Cunningham & Walsh, Inc.

Autographic Business Forms, 45 E. Wesley St., So. Hackensack, N.J. / Page 25 / Venet Advertising Agency, Inc.

Benson-Lehner Corp., 14761 Califa St., Van Nuys, Calif. / Page 42 / Leonard Daniels Advertising

Brandon Applied Systems, Inc., 30 E. 42 St., New York, N.Y. 10017 / Page 44 / —

Burroughs Corp., Detroit, Mich. / Page 66 / Campbell-Ewald Co.

Careers Inc., 770 Lexington Ave., New York, N.Y. 10021 / Page 45 / Mohr & Eicoff, Inc.

Clapp & Poliak, Inc., 341 Madison Ave., New York, N.Y. 10017 / Page 63 / James R. Flanagan Advertising Agency

Computer Control Co., Inc., Old Connecticut Path, Framingham, Mass. / Page 18 / de Garmo-Boston, Inc.

Computron, Inc., 122 Calvary St., Waltham, Mass. / Page 4 / Tech/Reps

Control Data Corp., 8100 34th Ave. So., Minneapolis 20, Minn. / Page 72 / Erwin Wasey, Ruthrauff & Ryan, Inc.

Cyber-Tronics, Inc., 915 Broadway, New York, N.Y. / Page 31 / Jordan, Reeves, Inc.

Data Display, Inc., 1820 Como Ave., St. Paul 8, Minn. / Page 41 / —

Datamec Corp., 345 Middlefield Rd., Mountain View, Calif. / Page 45 / Ellis Walker

Digital Equipment Corp., Maynard, Mass. / Page 27 / Loudon Advertising, Inc.

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General Dynamics/Electronics Corp., P.O. Box 127, San Diego 12, Calif. / Page 6 / Phillips-Ramsey, Inc.

General Electric Computer Dept., P.O. Drawer 270, Phoenix, Ariz. / Pages 36B, 36C / Foote, Cone & Belding

Information International, Inc., 200 Sixth St., Cambridge, Mass. / Page 67 / Tech/Reps

Information Processing Systems, Inc., 200 W. 57th St., New York, N.Y. 10019 / Page 24 / Pritchard, Wood, Inc.

J. Gerald McElroy, 530 Baltimore Pike, Springfield, Pa. / Page 43 / Baer-Corcoran Advertising

Memorex Corp., 1180 Shulman Ave., Santa Clara, Calif. / Page 2 / Hal Lawrence, Inc.

National Cash Register Co., Main & K Sts., Dayton 9, Ohio / Page 69 / McCann-Erickson, Inc.

National Security Agency, Fort George G. Meade, Md. / Page 70 / —

Reeves Soundcraft Corp., Great Pasture Rd., Danbury, Conn. / Page 68 / The Wexton Co., Inc.

RMS Associates, Inc., 102 E. Sandford Blvd., Mt. Vernon, N.Y. 10550 / Page 43 / Harrison, Finch & Kline, Inc.

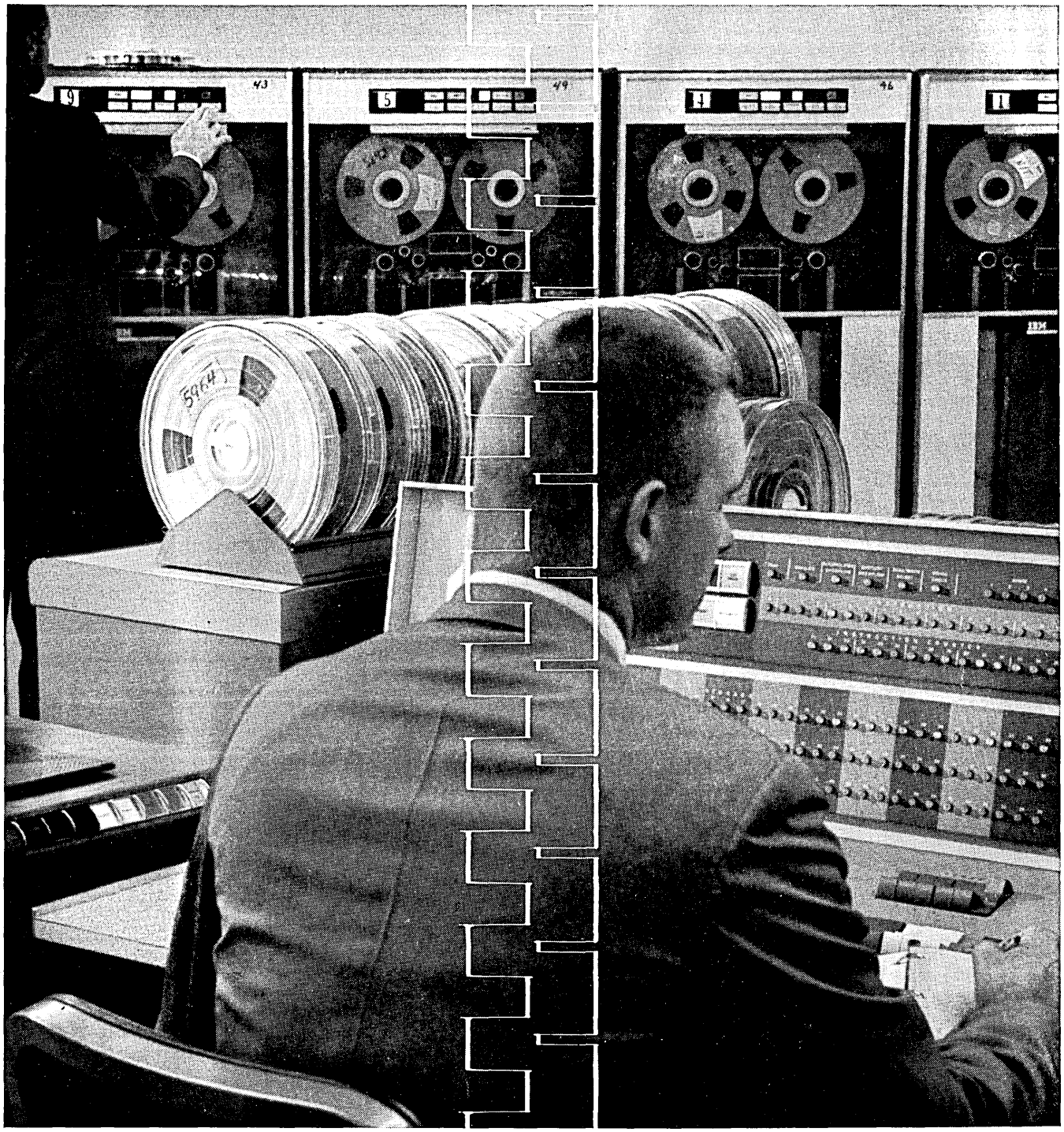
Standard Products Corp., 21 West 18 St., New York 11, N.Y. / Page 35 / Manston Advertising Agency, Inc.

Systemat Div. of National Personnel Center, 1107 Spring St., Silver Spring, Md. / Pages 39, 40 / Spectra Associates

Triton Electronics, Inc., 62-05 30th Ave., Woodside 77, N.Y. / Page 71 / A.B. Landau, Inc.

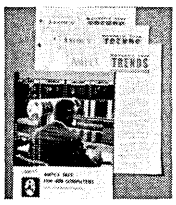
Univac Div. of Sperry Rand Corp., Univac Park, St. Paul 16, Minn. / Page 48 / Deutsch & Shea, Inc.

Valley Consultants, Inc., 716 York Rd., Baltimore 4, Md. / Page 24 / —



Now: who's got news for everyone with an IBM computer system? AMPEX

The news is inside an eight page booklet. It tells the what, the why and the how of Ampex computer tape—the tape that provides superior performance in IBM computer systems. If you think you might find the booklet helpful, just write and ask for it. Also, we'll put your name on our mailing list and regularly send you our informative periodical, "Tape Trends." It's a good way to keep abreast of the fast changing tape technology. In it, the latest tape developments are clearly explained by Ampex tape experts—the same experts who application-engineer Ampex tape to your system. This is just one of the many ways we assist you in obtaining maximum system efficiency. In addition to engineering the tape to your system, Ampex digitally checks each reel from end to end, and guarantees its performance. Write for free booklet, "Ampex Tape for IBM Computers," and your copies of "Tape Trends." Ampex Corporation, Redwood City, California. Sales and service engineers throughout the world.



AMPEX

Circle No. 98 on Readers Service Card

c & a
CAPITAL REPORT

A Special Report from C&A's Washington Correspondent

THE GENERAL ACCOUNTING OFFICE HAS RECOMMENDED that Department of Defense amend its Directive 4105.55 to require consideration of the purchase of computing equipment installed at a contractor's plant when a substantial part of the cost of such equipment is part of Government contract prices. This recommendation came in another GAO report to Congress on unnecessary costs in leasing EDP equipment, this time at Martin Marietta's Aerospace Division in Denver and Orlando, Fla.

As it now reads, Directive 4105.55 covers only computing equipment acquired and used at Government installations or at contractors' plants where the equipment is operated solely to process Government data at Government expense. The GAO recommendation would extend the coverage to contractors engaged predominantly in Government work. GAO also said that possibly the contractor should pay a charge for its use of the equipment in its non-Government activities.

Also mentioned in the report is the fact that Defense is considering revision of its rules to limit the amount of money it reimburses a company for funds spent on leasing EDP equipment used on a Government contract to the equivalent of contractor ownership costs.

Turning to Martin, GAO said that unnecessary costs of about $7.7 million over a five year period will be incurred because Martin will pay rentals greater than the full purchase and maintenance cost of IBM computers in three locations. At the end of six years, the amount will increase to about $13 million and to $37 million at the end of ten, GAO said.

In summary, GAO recommended that Defense either purchase the equipment installed at Martin or limit the amounts Martin is permitted to charge to Government contracts to "an appropriate allocation of the cost of ownership."

EVER WONDER HOW THE SERVICES USE THEIR COMPUTER TIME? Here is a breakdown of Navy's most popular computer applications, supplied by Edmund D. Dwyer, chief of the Navy Management Office, at a recent management luncheon in Washington. Dwyer said 30 per cent of Navy's computer time is concerned with supply management (logistics); another 30 per cent with either manpower or scientific and engineering applications; 25 per cent with financial management; and the final 15 per cent with workload planning and management.

Dwyer also mentioned that Navy has revised its procedures governing its entire digital computing equipment program. These new procedures supersede those issued in April 1959. In selection of computing equipment, the new rules state that controlling factors are time and cost; if these are equal on two or more competitive pieces of equipment, the manufacturer with the best service gets Navy's nod. These new Navy procedures apply to digital computers, punched card equipment of two categories, and data transmission facilities.

DEPARTMENT OF DEFENSE PEOPLE ARE BECOMING MORE EDUCATED about computers and their ways. As the biggest user of computing equipment in the world, DOD in the past has been able to educate only those people directly responsible for the management and use of EDP. Now, however, it is starting at the top to instill an understanding of computers in the older, high-level military and civilian executives in DOD and the three military departments.

This education will consist of classes at a new Computer Institute at the Navy Yard in Washington, operated by Navy under guidance of the Director of Defense Research & Engineering. Institute head is Capt. Horace S. Foote, USN.

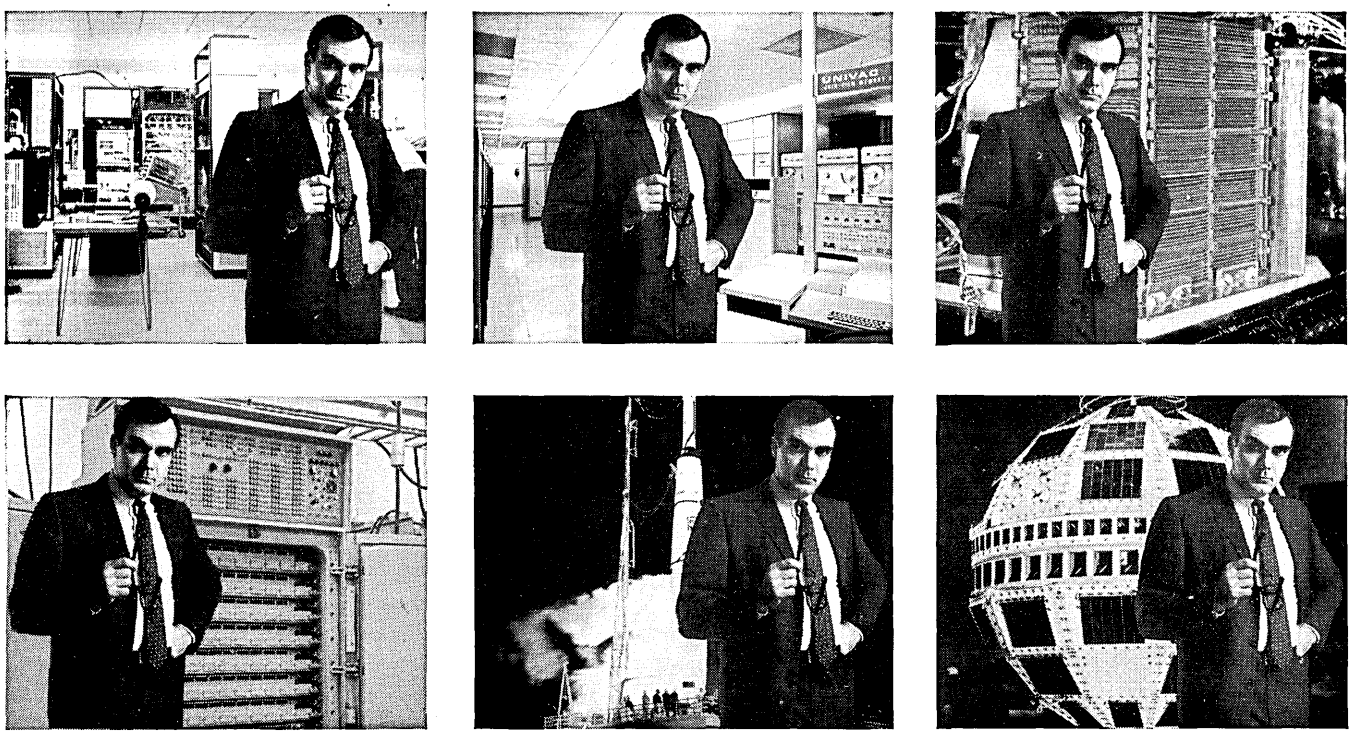
Until the Institute gets on its own feet with its own faculty, a group of top consultants from industry are teaching. This group includes Willis Ware and John P. Haverty, Rand Corp.; Bart J. Lombardi, IBM; Robert L. Patrick, private consultant from California; George Chapin, Univac; John Proctor, Mitre; Victor LaBolle and James Singleton, System Development Corp., and Isaac Mehana, Bellcomm.

Initially, classes will be limited to generals, admirals and their civilian counterparts. Later this year, a longer course will be added for colonels, Navy captains and equivalent civilians.

THE GOVERNMENT PRINTING OFFICE, biggest publisher in the world, is taking steps toward automation, of part of its vast printing system by order of a high-speed photocomposing system. The system will be supplied by Mergenthaler Linotype, which developed it with CBS Laboratories.

Ironically, the need for the system arises from GPO's receipt of EDP output that is generally unsatisfactory for printing without being converted. GPO receives tons of this each day from Government agencies and from Congress.

Mergenthaler's system is called Linotron and is capable of generating photocomposition at speeds of 1000 characters per second. The system works from most magnetic tape units and uses an electronic tube device to generate characters in eight different point sizes from a character grid containing 256 typographic symbols. Page output is up to 8" by 10-1/2".



AT UNIVAC NO PROGRAMMER IS TYPECAST

He can't be. There are too many diverse contracts in the house to permit stagnation to exist.

Here at UNIVAC-Twin Cities men can move around all over the programming map. For example: into Phase III of Nike work, onto real-time software systems relating to aircraft and missile tracking, into target discrimination, intercept programming, missile guidance, command and control systems, simulation preliminary to hardware design, missile and aircraft flight and computer simulation for design evaluation. Much of this work involves multi-processors. The areas of mechanized design and compilers and language processors are receiving special attention.

The professional environment is complete in every respect. Systems programmers work on their own machines. Development engineers have their own. Software men have a chance to see that hardware design limitations are corrected. Creative interplay between hardware and software R & D activities is a matter of course. The technical content of the work borders on the outer limits of today's knowledge of computer technology. And, programmers can move around geographically as well as professionally.

All in all, UNIVAC-Twin Cities probably ranks as unequalled in industry for its all around environment for the programmer.

PROGRAMMING SUPERVISORS To plan, organize and supervise programming projects, formulate techniques and procedures of programming systems. BS or MS in Math or Science with various combinations of experience in the display engineering activities and 5-10 years' experience.

APPLICATIONS PROGRAMMERS To define, analyze and design solutions to problems, and translate methods developed into computer techniques. BS or MS in Math or Engineering with 3-5 years' large-scale data processing applications experience.

COMMAND AND CONTROL PROGRAMMERS To design real-time information retrieval computer program for AF Intelligence and Command Control Computer Systems. Requires BS in Math, or Science with 3-5 years' sound programming experience.

INTEGRATED PROGRAMMING SYSTEMS Requires BS or MS in Math, Statistics or EE and 2-4 years' experience in programming large-scale digital computers. Must know generative and operational elements and be familiar with auxiliary memory devices.

SYSTEMS PROGRAMMERS To develop large-scale software packages. Requires BS in Math and 2 years' experience in digital computer programming including symbol manipulation, input-output or basic utility routines.

RADAR SYSTEMS PROGRAMMERS BS or MS in Math or Engineering with 2-5 years' experience in systems checkout, radar control, I/O routines, simulation, dynamic radar tests, or executive control to work on advanced real-time systems.

LIBRARY SYSTEMS PROGRAMMERS BS in Math or Science and 2 or more years' experience in assembler-compiler development, simulators (computers, radar/missile), range safety, input/output, mathematical subroutines, or executive control systems.

For more information about these or other openings, or to apply, send your resume to Mr. R. K. Patterson, Employment Mgr., Dept. D-12, Univac Division of Sperry Rand Corp., Univac Park, St. Paul 16, Minn. An Equal Opportunity Employer.

UNIVAC

DIVISION OF SPERRY RAND CORPORATION

"ACROSS THE EDITOR'S DESK"

Computing and Data Processing Newsletter

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NEW APPLICATIONS

STATISTICAL RECONSTRUCTIONS OF THE PAST — BY COMPUTER

The legal world has discovered another use for the electronic computer — the statistical reconstructions of the past that might have been. These reconstructions by computer reveal the probable statistical results of tax judgements, trust fund administrations and public utility rate decisions other than those actually undertaken in the past. Thus, it becomes possible to assess more accurately the financial effect decisions different from those actually made by administrators or officials would have had for plaintiffs of defendants in court.

C-E-I-R, Inc., Washington, D.C., is currently engaged in a number of projects for legal clients which involve the reconstruction of events as they might have been. Using a large-scale IBM 7090/1401 computing complex, the company is reworking large masses of historical data for these legal clients and tracing out the likely effect of alternative decisions in the past. Previously, attempts to evaluate alternative effects of different decisions by hand or even by accounting machine were largely futile because of the great amount of data to be considered in many cases and the vast range of possible effects.

The computer application makes it possible for lawyers to better assess the damages for past managerial mistakes in administering trust funds; for tax and regulatory commission decisions made, enforced and later reversed; and in a number of other areas. Up to now, amounts of these damages have largely been "guesstimates". Use of the computer has enabled this work to be put on a scientific basis. (For more information, circle 26 on the Readers Service Card.)

COMPUTER-AIDED TECHNIQUE DESIGNS ADVANCED LINEAR CIRCUITS

The Norden division of United Aircraft Corporation, Norwalk, Conn., has successfully designed advanced linear circuits by means of a new computer-aided technique. The development, which could lead to the nearly complete automation of the manufacture of functional electronic blocks, was reported by Norden scientists to the Manufacturing Technology Division of the Air Force Materials Laboratory at Wright-Patterson Air Force Base, which is sponsoring a program to speed availability of new circuits.

The Air Force work is an extension of previous Norden efforts to use computers in the design of circuit types not available elsewhere in integrated form. The report indicates that the Norden program has demonstrated some of its long-range goals are attainable. These are: fast reaction time from circuit requirement to production; low cost; increased yield; and flexibility.

The Norden system, in its present state, works in the following manner. An incoming engineering requirement is studied and a preliminary basic circuit devised. Breadboarding is eliminated by assigning the electrical analysis to the computer. (One analysis that would normally take a circuit designer several months was accomplished in 28 minutes on the computer.)

Layout is simplified by application of topological rules being accumulated and codified by Norden scientists. Several hundred rules have been developed. Eventually there will be thousands to cover all possible designs and processes for production. It has been demonstrated that these rules can be programmed by any modern digital computer. Typical rules are: Provide for maximum separation of input and output. Break the circuit at the most negative potential and tie into the isolation moat. Place symmetrical elements in proper location. Keep sensitive elements away from regions of power dissipation.

The computer technique is aimed at the development of a system which is basically the application of geometry and is independent of the material used in the circuit. It produces a "topological tree", or circuit mask, that can be displayed on a cathode-ray tube. The designer can modify the layout on the CRT with a light pen. According to the report, the best configuration, in terms of electrical engineering as well as geometry, can be achieved through this man-machine combination. Eventually, the entire operation of developing a new circuit will be

performed with computer participation — the designer monitoring the process on a display console and intervening only for creative purposes.

MORE COMPUTERS AT THE FAIR

Visitors to the U.S. Pavilion at the New York World's Fair will leave with more than a memory of what they have seen. At the conclusion of a tour of the building, visitors will enter the American Library Association's Library/USA exhibit, which serves as the pavilion's information center. Those who desire more facts about subjects they have seen in other areas of the pavilion may question a librarian who will consult one or more of the 2000 reference books on hand — or — the librarian may ask the UNIVAC computer. The computer will consult information pre-stored in its memory and print — in four seconds — a 700 word essay on the particular subject.

If more detailed information is desired, the computer will supply annotated reading lists and compilations of periodical listings. Five lists will be available, each on a different educational level: elementary, high school, adult, college-popular and college-research. In addition, the computer has been 'taught' to reply in four different languages — English, Spanish, French and German.

At the NCR Pavilion, the theme is "Man and His Records". Everywhere in the pavilion will be various tools of communication — some simple, some complex — and every one of them being used to record or process incredible amounts of business information. Displays from every land will show the many ways of keeping track of man's daily transactions — at the supermarket, in the bank or at the office.

The inner walls of the NCR pavilion will show graphically the many languages used in the world of machines. Visitors will be able to operate a specially constructed machine which will demonstrate the conversion of conventional arithmetic to "binary" or computer-language mathematics.

A special "game room" also will be available to visitors to the Pavilion where both adults and children will have a chance to operate various types of business machines and to match wits with them.

For other uses of computer equipment at the New York World's Fair, see Computers and Automation, February 1964, p. 8.

NEW CONTRACTS

AIR FORCE & NAVY AWARD MULTI-MILLION DOLLAR CONTRACTS TO UNIVAC

Contracts in excess of $2 million by the U.S. Air Force and a $6.4 million contract from the U.S. Navy, have been awarded the UNIVAC Division of the Sperry Rand Corporation, Washington, D.C.

The U.S. Air Force contracts call for the integration of a data processing system into the Limited Warfare Intelligence Reduction Complex (LWIRC) under development by the Rome Air Development Center, N.Y. The modular system is designed to analyze and interpret reconnaissance data gathered and recorded by high speed jet fighter aircraft. UNIVAC computers (a modified Univac 1218 computer with 32,768 words of core memory) will be used to improve present methods of intelligence gathering, and permit quicker reaction to shifting tactical environments. The first prototype system to be delivered this summer will serve as an evaluation model.

The U.S. Navy has contracted for 19 data processing systems in support of many of the nation's forthcoming missile and space ventures and other high priority programs. The contract calls for twelve Univac 1218 computers and seven Univac CP-642-B computers. A number of paper and magnetic tape units plus other miscellaneous auxiliary equipments also have been ordered. Some of the systems have been delivered; others will follow through this year.

GERMAN AIRCRAFT COMPANY ORDERS MARK III

The Junkers Aircraft Company, Munich, Germany, has ordered a MARK III general analog computer from Computer Products Inc., South Belmar, N.J. The contract is in excess of $101,000.

The computer will contain 120 operational amplifiers, 20 multipliers, diode function generators, sine-cosine generators and electronic mode control. An electronic digital voltmeter will also be supplied as an integral part of the computer. Delivery is scheduled for June.

DDP-24 ORDERED FOR SPACECRAFT FLIGHT EQUATIONS

ACF Electronics Division of ACF Industries has ordered a DDP-24 general purpose digital computer from Computer Control Company, Inc., Framingham, Mass., for an ACF Research and Development program. Flight parameters for high performance aircraft and spacecraft sub-systems will be programmed on the DDP-24 for the real-time simulation application. The computer also will be used for a variety of scientific/engineering computing tasks.

SYLVANIA TO STUDY ADVANCED TECHNIQUES FOR USE IN FUTURE MILITARY COMPUTERS

Sylvania Electric Products Inc., New York, N.Y., has been awarded a $146,000 Army contract to study advanced techniques for use in military computers of the future. Sylvania is a subsidiary of GT&E Corporation.

The award was made by the U.S. Army Electronic Materiel Agency, Fort Monmouth, N.J. to Sylvania Electronic Systems, a division of the company. The study will explore modular designs, new devices and programming language concepts.

LINK RECEIVES NASA CONTRACT FOR SPACE DATA HANDLING SYSTEM

The Link Group of General Precision, Inc., Binghamton, N.Y., has been awarded a National Aeronautics and Space Administration contract from the California Institute of Technology's Jet Propulsion Laboratory to design, develop, and build a Spacecraft Television Ground Data Handling System (STGDHS). This equipment, a major element of the Spacecraft Television System, will be used in the Jet Propulsion Laboratory's Space Flight Operations complex.

The primary purpose of the Spacecraft Television System is to support scientific investigations of the moon and the planets by providing visual observations of their surfaces. The purpose of the Spacecraft Television Ground Data Handling System which the Link Group

will produce, is to support Space Flight Operations by recording the spacecraft television data and to produce accurate image material for the scientific community from spacecraft television transmissions.

Coordination of activities during the system development will be accomplished by a system management design and control team located at General Precision's Link Group Facility in Palo Alto, Calif.

NASA HEADQUARTERS CONTRACT TO COMPUTER DYNAMICS

Computer Dynamics Corp., Silver Spring, Md., has been awarded a cost plus incentive fee contract to provide data processing services in support of the National Aeronautics and Space Administration's Headquarters Computer Facility. Under the new contract, CD's professional analysts and programmers will participate with NASA in the development of a wide range of data systems for financial management, payroll and leave accounting, budgeting, procurement, personnel, security and statistical operations.

The "cost plus incentive fee-type" contract is expected to provide NASA with better program definition, improvements in contract specifications and other cost saving measures being adopted by NASA in its contractor relationship.

NEW INSTALLATIONS

U.S. ARMY CORPS OF ENGINEERS INSTALLS GE-225 SYSTEM

The Rock Island District, U.S. Army Corps of Engineers (Ill.) has installed a General Electric 225 computer for use in solving problems in structural design of dams, levees and reservoirs, and in flood control studies on the rivers and streams of the Upper Mississippi River Basin. The newly installed system also will be used to figure the stability of earth sections for authorized dams currently in design, and for hydrologic studies required to determine the need for new flood control structures in Iowa, Wisconsin and western Illinois.

The Rock Island District computer system consists of a central processor with an 8192-word core memory, a 1000 character-per-second paper tape reader, a paper tape punch with a capacity of 110 characters-per-second and an output typewriter.
(For more information, circle 27 on the Readers Service Card.)

FIRST 1604-A COMPUTER SYSTEM DELIVERED TO GERMANY

The first Control Data 1604-A computer system to Germany recently was airshipped directly from Minneapolis, Minn., to the Hannover Technical College in Germany. The high-speed 1604-A computer system was purchased by the German Research Council and is on loan to the College. Peripheral equipment used in the system includes five magnetic tape handlers, a high-speed printer, card reader and punch control equipment.

The computer will be available to the four faculties of the Hannover Technical College. These are: (1) Natural Sciences and Philosophy; (2) Civil Engineering; (3) Machine Design and (4) Horticultural and Agricultural Engineering.

EAI TR-20 ANALOG COMPUTER SOLD TO TRINITY COLLEGE

Electronic Associates, Inc., Long Branch, N.J., has announced that its first solid-state, desk-top computer, PACE TR-20, was delivered to Trinity College, Hartford, Conn.

Professor Edwin P. Nye, chairman of the Department of Engineering at the College, said that the computer will be used in various courses throughout the four-year engineering curriculum.
(For more information, circle 28 on the Readers Service Card.)

KUWAIT IMPORTING FIRM INSTALLS NCR 390 SYSTEM

Saleh Jamal & Co., Kuwait, a large importing firm, has become the first organization in this Middle East country to install a National Cash Register 390 electronic data processing system.

The company is using the computer to process data for purchase accounts, for accounts receivable updating and billing, and to keep track of 35,000 inventory items. The system also prepares the payroll for 400 employees and performs other accounting functions.
(For more information, circle 29 on the Readers Service Card.)

EUROPEAN ELECTRONICS FIRM ORDERS CDC 3600/3200 SYSTEM

Control Data Corporation, Minneapolis, Minn., has announced that Philips GLOEILAMPENFABRIKEN N.V. has ordered a large computer complex to be installed at its data processing center at the company's headquarters in Eindhoven, Holland. Philips is one of the world's largest manufacturers of electrical and electronic equipment, with 57 world-wide companies and 230,000 employees.

The complex will consist of two of Control Data's computer systems: the large-scale 3600 and the medium-scale 3200. The 3600 will serve as the main business data processing and scientific computing unit, with the 3200 being used in pre-processing and digesting all input-output information for the larger machine.
(For more information, circle 30 on the Readers Service Card.)

OLD NATIONAL TO INSTALL ELECTRONIC BANKING SYSTEM

Old National Bank, Evansville, Ind., will install an electronic banking system early next year that will give tellers a direct communications link to a central computer. It is one of the first commercial banks in the nation to order IBM's 1460 computer equipped with an "on-line" communications network.

The 1460 system, to be located in the main bank, will be equipped with random access "disk files". It also will use magnetic tape units. The combination of tape and disks will give the bank virtually unlimited data storage capacity.
(For more information, circle 31 on the Readers Service Card.)

AIR FORCE INSTALLS TWO C-135B FLIGHT SIMULATORS

Two C-135B Flight Simulators — the first military flight simulators to use complete digital computation — have been accepted by the U.S. Air Force Aeronautical Systems Division. They have been installed at McGuire Air Force Base, N.J., and at Travis Air Force Base, Calif.

The simulators were developed by Link Division, General Precision Inc., Binghamton, N.Y., and will be used to train crews who will transport cargo and troops in the C-135B aircraft, military version of the Boeing 707, the first U.S. jet passenger transport. Each flight simulator consists of an exact replica of the C-135B flight deck, a Link Mark I digital computer which completely duplicates aircraft performance characteristics, a Link-developed three-point motion system that provides realistic airborne simulation, 350 programmed radio aids, and auxiliary equipment.

HONEYWELL GETS $3 MILLION IN COMPUTER ORDERS FROM AUSTRALIA

The Australian subsidiary of Honeywell's EDP Division, Wellesley Hills, Mass., has received three computer orders totalling more than $3 million. All of the equipment is scheduled to be shipped during 1964.

The orders include:

— Sale of a large-scale Honeywell 1800 and a smaller Honeywell 200 to the Australian Post Office department for installation in a new computer center being built in Sydney. The $1.6 million of equipment will be used for telephone and telegraph accounting and service, and for advanced statistical work for the post office. (The Post Office department in Australia is the regulatory agency for the nation's telephone and telegraph systems.)

— Sale of over one million dollars in additional equipment to the Australian Department of Defence, which presently has two Honeywell 800 computers. Additional equipment will include memory units, magnetic tape equipment, printers and other devices; it will be used to expand the Department's data processing and scientific computing facilities.

— Sale of a Honeywell 400 data processing system to Felt and Textiles of Australia, Ltd., a diversified manufacturer of woolen goods, carpeting and other floor covering, plastics and footwear. The system is valued at about $400,000.

Honeywell has been marketing computers in Australia through its subsidiary, Honeywell Pty. Limited, since 1962.
(For more information, circle 32 on the Readers Service Card.)

UNIVERSITY OF MISSOURI SCHOOL OF MEDICINE INSTALLS IBM 1410

The University of Missouri School of Medicine has initiated a new program designed to investigate the proper role of electronic data processing techniques in the teaching and practice of medicine. The new program is made possible through the installation of an IBM 1410 computing system which includes a central processing unit, five magnetic tape drives, and peripheral punch card equipment. All significant laboratory data is now being recorded, analyzed, and stored by the IBM 1410 computer to be immediately available for teaching, research and patient care purposes.
(For more information, circle 34 on the Readers Service Card.)

AAI ORDERS TWO DDP-24 COMPUTERS

Aircraft Armaments, Inc., Cockeysville, Md., has ordered two DDP-24 general purpose digital computers from Computer Control Company, Inc., Framingham, Mass.

One of the computers will be used as the digital computer portion of a radar digitizing system implementing a part of the Project BEACON Report of the Federal Aviation Agency. The system will be a tool for testing air traffic control procedures and will also be used for equipment evaluation.

The second DDP-24, a leased machine, will be used in a program to develop advanced real-time simulators and also for general purpose scientific and engineering computation.
(For more information, circle 33 on the Readers Service Card.)

PACIFIC AIRLINES INSTALLS INSTANT RESERVATION SERVICE

A new passenger service in which a computer system instantly confirms reservations for any PSA flight, has been installed by the Pacific Southwest Airline, San Diego, Calif. The electronic reservations service is built around an NCR 315 "on-line" computer. It is the first NCR system to link reservation-recording machines directly to a computer.

With the new system, any PSA agent at any office can instantly confirm passenger reservations on any flight for up to a month in advance. In their new reservations center, PSA operators record reservation data phoned in by agents

on special NCR inquiry machines which are directly connected to the NCR 315 computer in an adjacent room. In less than a second the computer checks seating space for any flight and indicates by signal light on the operator's machine "OK" or "Flight Booked". (PSA's 35 outlying ticket agents are linked via a private telephone network to the reservations center.)

In addition to keeping track of reservations, future tasks planned for the PSA computer installation include payroll, parts maintenance and inventory, and ticket billing.
(For more information, circle 35 on the Readers Service Card.)

ORGANIZATION NEWS

MINNEAPOLIS-HONEYWELL PLANS TO SHORTEN NAME TO HONEYWELL INC.

Minneapolis-Honeywell Regulator Co. plans to shorten its corporate name to Honeywell Inc., Board Chairman Paul B. Wishart announced recently.

Shareholders will be asked to approve the action at the annual meeting in Minneapolis on April 28. If approved as expected, the new title would become effective April 30.

A major factor in the company's decision was awareness of the popularity and long usage of the single name "Honeywell" by customers and the general public. A year ago the company began emphasizing the single

word Honeywell in all forms of communications except those requiring the full legal name, such as on contracts, checks and other official documents. Thus, advertising, sales promotion and literature, packaging, plant signs, telephone listings and stationery were redesigned to carry the simpler version.

Stockholder approval will complete the official changeover.

BRITISH PETROLEUM CO., LTD. ACQUIRES INTEREST IN C-E-I-R (U.K.) LTD.

British Petroleum Co., Ltd., London, England, has acquired a 60 per cent interest in C-E-I-R's wholly-owned British subsidiary, C-E-I-R (U.K.) Ltd., at a cost of $980,000. It also has an option to purchase a further 20 per cent holding within two years.

The London-based firm will now operate as C-E-I-R, Ltd., and according to the agreement, will join with C-E-I-R, Inc. in establishing new C-E-I-R research and computing centers in other countries outside the United States. C-E-I-R, Ltd. will continue to operate under its present management and will cooperate with C-E-I-R, Inc. in development of mathematical and operations research techniques, as well as electronic computer programs and data processing applications.

SPECIALIZED DATA PROCESSING MANAGEMENT SERVICE COMPANY

Dick H. Brandon, formerly Director of Data Processing Services for the Diebold Group, Inc., has announced the formation of a new company for the purpose of providing specialized management services in the field of data processing. The new organization, known as Brandon Applied Systems, Inc., has offices in New York City, N.Y.

Brandon Applied Systems, Inc. will specialize in technical consulting services to manufacturers and users of data processing equipment. Comprehensive technical assistance to management in the development and use of standards in data processing is provided by this group. Other services include: feasibility analysis; equipment selection and contract negotiation; implementation guidance; programming and systems services; and technical and sales manuals. The company also has developed a complete range of specialized training courses in data processing techniques and installation management.
(For more information, circle 36 on the Readers Service Card.)

AGREEMENT SIGNED BY GE & ANDERSEN LABS.

The General Electric Company has announced the signing of an agreement with Andersen Laboratories, Inc., West Hartford, Conn., in which Andersen has been granted a license relating to sonic delay lines, developed by General Electric's Specialty Devices Operation, Syracuse, N.Y.

The agreement licenses technical information and know-how pertaining to magnetostrictive, piezoelectric and dispersive delay lines, and also provides for the transfer to Andersen of certain manufacturing tooling.

DATA PROCESSING CARDS AND FORMS MANUFACTURERS ASSOC.

Due to the growth in the use of forms in the data processing field, the Tabulating Card Manufacturers Association amended the name of their national organization at their Winter Meeting, to the Data Processing Cards and Forms Manufacturers Association and established two divisions: Data Processing Cards and Data Processing Forms.

According to Mr. Paul O. Wilson newly elected vice president in charge of the Data Processing Forms Division, and president of Baltimore Business Forms, Inc., "the purpose of the new forms division shall be to promote the general welfare of the industry engaged in the manufacture of data processing forms; to create a forum for the exchange of ideas in the rapidly growing data processing field; research and development; to collect and disseminate industry data so that members can observe changes in growth patterns and trends and to provide industry cooperation with all government agencies in the interests of public welfare." Initial plans and activites for the Forms Division were adopted by the charter members.

The next meeting is scheduled for New York City, May 25-27, 1964.

CONTROL DATA ACQUIRES TRANSACTER BUSINESS FROM GENERAL TIME CORPORATION

Control Data Corporation and General Time Corporation recently announced the acquisition by Control Data of the Transacter business of General Time's Stromberg Division (producers of the Transacter Data Collection System) for an undisclosed amount of Control Data stock. The Transacter is a management tool used in industrial and government operations to automatically collect in-plant production, warehouse, cost control, and inventory information which is then converted into computer language and later processed for daily management reports.

Control Data will expand the engineering and marketing efforts for the Transacter Data Collection System and assumes responsibility for the service and support of present and future Transacter installations. Transacter operations will become a part of the Company's Industrial Data Processing Division.

The sale involves only the Transacter business. Stromberg Division will continue to manufacture and sell time equipment including recorders, industrial and institutional time systems and related devices.

HONEYWELL RESEARCH LAB TO BE LOCATED IN BOSTON

Honeywell has announced that it will establish a research laboratory in Boston, Mass., as a branch of its Military Products research department. The laboratory will be located in the company's Aeronautical Division facility, and initially will employ some 25 to 30 persons.

Applied research work will begin in the fields of laser techniques, infrared and ultraviolet detection, optical processing and other general applications of electro-optics. Effort will be directed to improving such devices as star trackers, horizon scanners and sun sensors.

Dr. Finn J. Larsen, vice president in charge of research and development, said that Boston was chosen as the site for the new laboratory because of the educational institutions in the Boston area, the availability of skilled manpower, and the desirability of working in close cooperation with the Aeronautical Division in Boston.

Newsletter

COMPUTING CENTERS

ESTABLISH COMPUTER SHARING EXCHANGE AND SERVICE CENTER

A Computer Sharing Exchange and a Computer Service Center have recently been established at the National Bureau of Standards (U.S. Department of Commerce) on an experimental basis. The new facilities were created in response to a request of the Bureau of the Budget, which has found that great savings in both time and money can be realized through computer sharing.

The Sharing Exchange will coordinate requests of Federal Government agencies in the Washington, D. C. metropolitan area for help in locating appropriate computer time and services for their essential work. The Exchange will maintain records of the availability for sharing purposes of the electronic computer facilities of these agencies.

Because the Washington, D.C. area has the largest concentration and diversification of computers in the United States, the Bureau has made available its Computation Laboratory as a Service Center in conjunction with the Sharing Exchange. This Center will provide its electronic equipment and personal services at cost to participating agencies to the extent permitted by present equipment and staff provided appropriate arrangements can be made. Requests will be considered for business, scientific, engineering, and other types of computer services. Services of the Center will be available either directly or through the Sharing Exchange. Unused time on the computer facilities of the Center will be available to the Exchange for sharing.

The Sharing Exchange and the Service Center will operate for a trail period of 18 to 24 months. (For more information, circle 37 on the Readers Service Card.)

H-800 & H-400 GIFT TO USC BY HONEYWELL

The largest equipment gift ever made to the University of Southern California — two electronic computers valued at $1,764,000 — was announced jointly by Dr. Norman Topping (USC President) and Walter W. Finke (President of Honeywell's EDP Division). The Honeywell 800 and 400 computers are installed in USC's Computer Sciences Laboratory. They will be used primarily for teaching and research, but will also be used for data processing of student registration, maintenance of alumni records and faculty and staff payrolls.

The Computer Sciences Laboratory is conducting more than 100 scientific research projects. Some of the wide-ranging studies being done on the Honeywell computer installations are: a study of effects of smog on animals; a comparison of facial shapes of young people having their teeth straightened; effects of sewage disposal on ocean pollution; scattering of protons by carbon in a linear accelerator; predicting success in algebra; marine geology of the Monterey submarine canyon; personality analysis of suicidal and non-suicidal subjects; behavior of consumers; and design of a low-thrust, liquid propellant rocket engine.

Dr. Topping said the gift from Honeywell provides USC with one of the nation's major university computer laboratories

MONTANA'S LARGEST COMMERCIAL COMPUTER CENTER ESTABLISHED BY BANCORPORATION

The largest non-military data processing center in Montana has been established at Central Bank of Montana. The center, built around an NCR 315 computer system, will automate deposit accounting for eight affiliated banks in Montana and also offer data processing services on a subscription basis to outside business firms.

Bancorporation of Montana banks include Central Bank of Montana, Great Falls; Citizens Bank of Montana, Havre; Miners National Bank, Butte; Farmers-Merchants Bank, Rudyard; Farmers & Stockmen's Bank, Valier; First State Bank, Chinook; Liberty County Bank, Chester; and Northern Montana State Bank, Big Sandy.

In processing depositors' checks each bank will use NCR machines which verify the accuracy of the transaction and automatically punch pertinent data into paper tape. Punched tapes, sent to the processing center daily, will be fed into the computer through a paper tape reader. Data is transferred by the computer to depositor accounts stored on magnetic cards in the system's Card Random Access Memory (CRAM). At the end of the month the transactions recorded on the CRAM cards are printed on depositors' statements at a speed of 900 lines a minute.

Businesses which subscribe to the service will accumulate basic input data in punched paper tape. Reports to be prepared for outside firms include sales analysis, payroll, production control, market research, forecasting, billing, statistical analysis, and related accounting functions.

Central Computer Center includes an NCR 315 processor, additional internal memory, paper tape reader-punch, two CRAM units, and a high-speed printer. (For more information, circle 38 on the Readers Service Card.)

EDUCATION NEWS

ONE-WEEK STUDY COURSE TO BE PRESENTED AT CASE

A special one-week study course in Digital Control Systems Engineering will be presented this summer at Case Institute of Technology, Cleveland, Ohio, from June 15 to 19. The course, designed for military and industrial engineers, will stress advanced technology in the areas of military guidance, control and data systems, as well as industrial digital process control systems, and manufacturing process systems with numerically-controlled machines.

It will consist of 15 lectures plus five laboratory exercises in the synthesis of logical subsystems. Academic Director of the course will be Dr. Harry W. Mergler, Professor of Engineering at Case. Lectures will be given by members of the Case Digital Systems Engineering Laboratory. Laboratory exercises will be performed on Case's Digital Systems Synthesizer.

Registration for the course is open to a limited number of qualified persons. The deadline date for receipt of applications is May 15. (For more information, circle 39 on the Readers Service Card.)

HIGH SCHOOL INTEGRATES GE-225 INTO DATA PROCESSING COURSE

In a new mode of attack on unemployment, the Allegheny County School System, Pittsburgh, Pa., is teaching high school students how to program and operate computers. Dr. Alfred W. Beattie, superintendent of the Allegheny schools, said the most recent phase of the program is the opening of the Steel Valley Technical and Trade School in West Mifflin Borough, where a General Electric 225 computer system has been installed. (A similar program, established earlier by the system at the Forbes Trail School, was the first computer programming instruction to be introduced in this country on the high school level.)

At Steel Valley, 85 students in the 11th and 12th grades each will receive about 1000 hours of training in problem analysis, computer programming and operation. At graduation, these students will be qualified to work as programmers, salesmen, computer operators and methods and procedures analysts.

Each applicant, selected from students at various allegheny system schools, is reviewed carefully and interviewed thoroughly by school staff members, including a psychologist. For every student accepted, one applicant is eliminated. Such selectivity has been worth while. Several industry employers have reported that Allegheny system programmers are as capable as some of their college trained people.

— Shown here checking the results of a project which just came off the printer are Judi Kupec and Jean Lesko at the General Electric high speed printer, part of the GE-225 system at Steel Valley Technical and Trade School.

Encouraged by the success of the present system, Dr. Beattie is planning an expansion of the computer program. If state and federal government authorities grant permission, a minimum of 1600 hours in computer instruction at night will be offered to unemployed adults in the area — including supporting mathematics instruction.

Another goal is the establishment of computer classes for students in the technical schools who are majoring in other subjects (such as civil engineering, electronics and marketing), in order that they may learn how computers can aid them in their specialties.

Dr. Beattie said that the school system is looking to the computer and computer experts to aid the school in finding many new ways to fit data processing into the high school education program. He and other school officials of the Allegheny county system believe that the more realistically the Technical and Trade school program is adapted to the changing world of technology, the sooner attendant unemployment problems will be conquered.
(For more information, circle 40 on the Readers Service Card.)

TRENTON JUNIOR COLLEGE TO OFFER NORTHEAST'S FIRST COMPUTER DEGREE

Dr. John P. Pritchett, president of Trenton Junior College, Trenton, N.J., has announced that the two-year institution will become the first in the Northeastern United States to offer an Associate in Science Degree in Computer Technology.

A course, organized under a new department of Computer Technology and Services, has been designed to train computer programmers for careers in industry and business. The curriculum will enable graduates to qualify for positions as managers or systems analysts in data processing installations, or to transfer with credit to four-year colleges or universities. Similar programs are currently offered by leading two-year educational institutions in Florida and California.

The school is equipped with modern electronic data processing equipment, including an IBM 1620 computer and a representative group of commonly used business machines. Nine courses in data processing and accounting will be offered. The courses will extend over five semesters — four regular sessions and one in the summer between the first and second years.

The department also will offer a comprehensive program of computer services to industry, business and government agencies.
(For more information, circle 74 on the Readers Service Card.)

NEW PRODUCTS

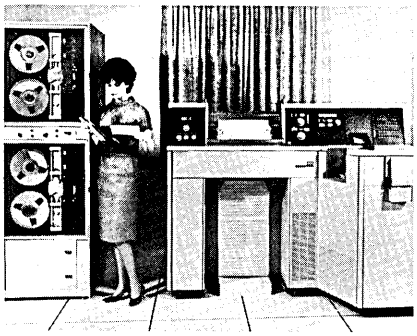
Digital

NEW LOW-COST DATA PROCESSING EQUIPMENT ANNOUNCED BY UNIVAC

Two low-cost data processing systems, named UNIVAC 1004 II and UNIVAC 1004 III Magnetic Tape System, have been announced by UNIVAC Division of Sperry Rand Corporation, New York, N.Y. At the same time the company announced a Paper Tape Reader and Punch which, it said, will be optional on all 1004 systems.

The UNIVAC 1004 II is a completely new system capable of reading cards at 600 per minute and printing 600 lines per minute — 50% increases over the speed of earlier models. The system's core memory cycle time of 6.5 microseconds is 19% faster than the earlier model. Modifications necessary to convert existing UNIVAC 1004 Card Processors to 1004 II's can be made in the field. Optional equipment for use with the UNIVAC 1004 II includes an auxiliary card reader, a card punch and Data Line Terminal equipment.

The UNIVAC 1004 III Magnetic Tape System has the added ability of processing data recorded on magnetic tape. This is especially suited for punched card system users who find that they need the increased capacities and input/output flexibility provided by magnetic tape storage. A maximum of two magnetic tape servos can be used with each 1004 III system. More processing power can be made available by adding any of the optional equipment for the UNIVAC 1004 III — paper tape reader and paper tape punch, a card read/punch unit, auxiliary card reader, card punch, and the Data Line Terminal.



— UNIVAC 1004 III Magnetic Tape System can be used as an independent data processor, a satellite system for large-scale computers, or operate on-line with the UNIVAC 1107 or the 490 computers.

The paper tape punch produces a variety of tapes such as communications tape for Teletype transmission and tapes for tape-operated typewriters. The paper tape reader accepts tape prepared by communications equipment, cash registers and other business machines.

First deliveries of the 1004 II are scheduled for June, and the first 1004 III delivery is scheduled for August.
(For more information, circle 41 on the Readers Service Card.)

INTERNAL PROCESSING SPEED OF IBM 7044 INCREASED

IBM Corporation, White Plains, N.Y., has announced a 20 per cent increase in the internal processing speed of the IBM 7044 data processing system. A new technique reduces the system's memory and processor reference time from 2.5 microseconds to 2 microseconds.

The feature will be incorporated at no additional charge in all 7044's shipped after April 1, 1964. All 7044's shipped before April 1 will be converted in the field.
(For more information, circle 42 on the Readers Service Card.)

GE-415 — FIFTH AND SMALLEST OF COMPATIBLES-400

The General Electric Company, Phoenix, Ariz., has introduced the fifth and smallest member of its compatibles-400 family of computers (see Computers and Automation, January 1964, p. 32) — the GE-415. A special optional hardware unit, also was announced, that permits the entire 400 family to accept programs written for small data processing systems, and use them without re-programming or pre-passes.

The GE-415 is described as a small-to-medium class computer. It is available with memory sizes from 16,384 characters to 131,072 characters. Magnetic tape handlers and controllers offered with the computer (and available for all of the 400-family) provide a choice of eight different character transfer rates, ranging from 83KC down to 7.2 KC. Tape recording densities offered are 800, 556 and 200 bits per inch. Tape handler speeds are 150, 75 and 36 inches per second. Memory cycle time is equivalent to 2.3 microseconds per character.

A high degree of input/output simultaneity is provided for the GE-415 — and for all members of the family. This permits a peripheral program to be run at the same time as the main computer program and makes possible multi-media conversion.

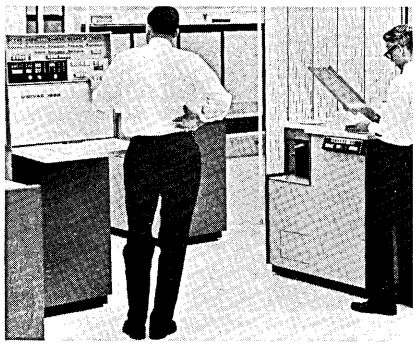
All five members of the computer family (GE-415, 425, 435, 455 and 465) are upward compatible. As users move up the scale to larger systems, they can continue to use the same programs. General Electric's program compatibility unit uses a fixed memory called the CAPACITRIX, in which a simulator has been permanently stored. (CAPACITRIX is derived from "Capacitive Matrix".)
(For more information, circle 43 on the Readers Service Card.)

UNIVAC 1050 FAMILY COMPOSED OF SIX MAJOR SERIES

UNIVAC Division of Sperry Rand Corporation, New York, N.Y., recently announced its new family of small and medium scale computers, composed of six major series. The computing systems are: UNIVAC 1050-C Card Series; UNIVAC 1050-T Tape Series; UNIVAC 1050-M Mass Storage Series; UNIVAC 1050-S Satellite Series; UNIVAC 1050-R Real-Time Series; and the UNIVAC 1050-4 1004 On-Line Series.

Computing power can be ontinually matched to the data processing requirements of the user because of the hardware flexibility and the software compatibility inherent in the new 1050 family. Major modifications, such as the addition of core memory to the Central Processor or the inclusion of different peripheral devices to accommodate new computing needs, can be made quickly in the field.

Two models of Central Processors are used in the UNIVAC 1050 Series — each with an expandable internal core memory. The 1050 Central Processor Model III has a basic 4096 character core memory that can be enlarged to 32,768 characters. Minimum internal memory size of the Central Processor Model IV is 8192 characters which can be increased by the addition of core modules to a maximum of 65,536 characters.



— The basic system of the UNIVAC 1050 Series can easily be expanded to form a real-time data communications system, a mass storage system or a satellite system for another computer.

Every UNIVAC 1050 System will be delivered with software in a variety of assemblers, control routines, operating systems, report generators, sort, and satellite routines. For those systems which require such programs, compilers also will be provided.
(For more information, circle 44 on the Readers Service Card.)

LC-820 DIGITAL COMPUTER

President and general manager Fred W. O'Green, Guidance and Control Systems, division of Litton Industries, Woodland Hills, Calif., has announced the completion of a digital computer for the Flight Dynamics Laboratory of the USAF Research and Technology division. The computer, designated LC-820, is capable of performing more than 30 million additions or subtractions per minute. It makes possible a completely integrated flight control system for extremely high performance aircraft. (Four of these systems will be delivered, by the division, to Wright Patterson AFB.)

The LC-820 computer in space flight performs functions such as

determination of boost cut-off, orbit injection, hypersonic air data analysis, re-entry energy management and path control through the atmosphere. In addition, the computer controls the inertial navigation platform during both the alignment and inertial operation phases.

To achieve the high computational speeds required for aerospace control, the LC-820 uses two separate memory systems with no moving parts. Access to all of the 177,000 memory cells can be made at any time. Most of the memory is devoted to some 6000 instructions which provide the sequence of operations for the computer. These are of the two-operation kind such as "add and multiply" or "store and transfer" and are entered into the computer by electrical signals when the aircraft is on the ground.

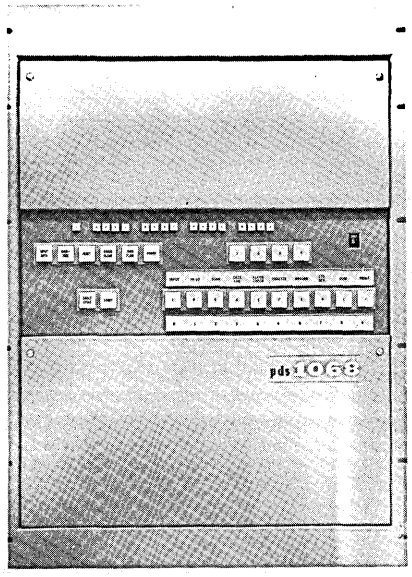
Provision is made for an increase in the LC-820 program memory up to 30,000 dual instructions. This is accomplished by including up to five of the self-contained memory modules. The size of the computer, including airborne input-output equipment and power supply, is one and a half cubic feet plus one cubic foot for each memory module.
(For more information, circle 46 on the Readers Service Card.)

PDS 1068 DIGITAL SYSTEMS COMPUTER

A full scale digital systems computer, designed for standard 19" rack mounting, has been introduced by Pacific Data Systems, Inc., Santa Ana, Calif. (Pacific Data is a subsidiary of Electronic Associates, Inc.) This new computer, called the PDS 1068, has over 40 basic commands, a flexible interface, complete input/output electronics and 1024 words of memory.

PDS 1068 has both parallel and serial input and output capabilities and can perform variable field-length arithmetic. A hardware index register allows indexing of operations inside the computer, thus doubling the instruction-storage capacity. The most important characteristic is its ability to operate independently or under varying degrees of operator control.

Through the use of 10 special function switches and 4 sense switches in the control panel, the operator may interrupt the process, change the mode of operation, feed new instructions, terminate or start a program — all at the touch of a button.



— PDS 1068 systems computer is adaptable to data logging, process control, automatic check-out and on-line quality control.

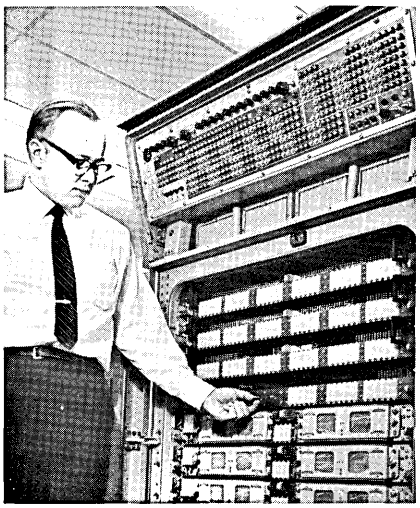
The PDS 1068 may be incorporated into existing systems or equipped with optional equipment to perform as a completely independent unit. Optional equipment includes a 15 char/sec input/output typewriter; 50 char/sec paper tape reader; 50 char/sec paper tape punch; and numeric input keyboard.
(For more information, circle 45 on the Readers Service Card.)

CP-667 MILITARY COMPUTER

The UNIVAC Division of the Sperry Rand Corporation, Washington, D.C., has developed a military computer, which while compact, is comparable in speed and memory capacity to the largest commercial machines presently available. The UNIVAC CP-667 is contained in a cabinet measuring just three feet square by six feet in height. It has been developed under contract with the U.S. Navy, Bureau of Ships. The first computer has been accepted by the Navy — a second one will be delivered in June.

The 60 cubic foot volume of the CP-667 computer includes the entire memory, all input and output circuitry, and cooling equipment. While its size approximates that of the UNIVAC CP-642A computer (also developed for the Navy and now used extensively aboard ships and in other applications), the CP-667 is eight times as fast and has four times the memory capacity. It can accept or present data at twelve times the rate of its predecessor.

The CP-667 has three types of memory: (1) an internal core memory with a storage capacity of 131 thousand 36 bit words, any one of which can be referenced in one millionth of a second; (2) a separate magnetic thin film control memory which can store and then retrieve information in 400 nanoseconds; (3) a smaller nondestructive memory, also constructed of films, which is used to automatically initiate certain operations by reading instructions from external devices. The computer's nanosecond circuitry, working with the high speed memory, can perform 500 thousand additions per second.



— UNIVAC CP-667 military computer. The thin film memory can be tested by a flip of a margin switch, shown here by a UNIVAC design engineer. The upper four roll-out chassis contain semi-conductor integrated circuits. The remaining eight chassis house the main memory of almost five million cores.

Packaging concepts involve the use of hybrid microelectronic circuits and account for the increased capability of the computer without a boost in its physical size. Using this technique a number of electronic circuits are reduced and packed into a can no larger than a typical transistor.

The UNIVAC CP-667 has been designed to meet all Navy environmental specifications. Anticipated reliability is over 1000 hours between failures.
(For more information, circle 48 on the Readers Service Card.)

Newsletter

Data Transmitters and A/D Converters

DEVICE LINKS MAN IN FIELD TO REMOTE COMPUTERS

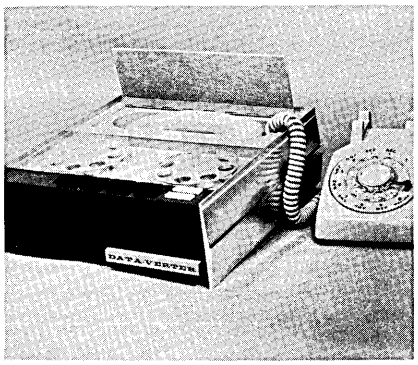
The Digitronics Corporation, Albertson, N.Y., has recently announced the development of a portable device which links personnel in the field to the computer at a remote point. It records data in both human and machine language, and transmits the latter over regular telephone lines.

The new device, called the Data-Verter System, consists of a recorder and transmitter, each about the size of a portable typewriter. It will be available in five different models, each designed for a different application. Data-Verter is now being field-tested and production deliveries are expected to begin by Fall of this year.

The first model will be field-tested for a nationally known food manufacturer. A second model has been designed for a large trading stamp company, linking hundreds of redemption centers to one central computer. A third model will be used by a railroad to prepare exacting information for a computer. A fourth will record time and attendance information from employee badges, and will transmit the information to a central computer.

— Shown above is a salesman entering product inventory, pricing and display position into his Data-Verter recorder. At the end of the day, he uses a Data-Verter transmitter to send his information over telephone lines to company headquarters.

A more dramatic use of Data-Verter will be made in July by one of the country's largest daily newspapers. A reporter at the national political conventions will type his story on a typewriter Data-Verter. As the story is being typed, it will also be recorded in machine language, after which it will be transmitted over telephone lines to a paper tape Dial-o-verter terminal in the office of the newspaper. The tape will then be fed into linecasting machines, completing the almost instantaneous link from the reporter at the conventions to machines setting type thousands of miles away.



— The Data-Verter system transmits data over telephone lines. Data is entered into the recorder on magnetic tape and in machine language. The tape cartridge is then inserted into the transmitter (shown above) and is sent over telephone lines to the remote computer, at speeds up to 500 words per minute.

The recorder and transmitter represent just two pieces of equipment in an entire array of variations which are being developed for the Data-Verter System. The basic equipment is flexible enough to permit almost any kind of input for the system requirements which vary from company to company. (For more information, circle 49 on the Readers Service Card.)

SPEEDS TO 240,000 WORDS PER MINUTE CAPABLE WITH NEW DATA TRANSMISSION TERMINAL

A new, high-speed magnetic tape terminal, capable of transmitting data at speeds from 22,500 to 240,000 words per minute, has been developed by the Digitronics Corp., Albertson, N.Y. The new Dial-o-verter D521 terminal is designed basically for Telpak transmission and transmits over voice-grade telephone lines, or over broadband communications facilities. A line utilization factor of 95% is achieved by overlapping transmission time with tape reading and writing time. The terminal is completely self-contained. It does not require any expensive computer time for transmission.

When transmitting over voice-grade telephone lines, the D521 operates at speeds from 1500 to 3000 words per minute. Transmission over Telpak A channels provides speeds from 22,500 to 51,000 words per minute.

The terminal provides high-speed magnetic tape communications between computer sites with error-free data reception. Optionally, it can exchange data with other Dial-o-verter magnetic tape, paper tape or punched card terminals on an interchangeable basis. Available options include: fixed or plugboard-controlled code translation, Telpak/voice subset switching, increased record size (1600 or 4090 characters), second tape handler for uninterrupted operation, variable length binary data handling, higher tape density (800 bpi), or non-IBM tape format. (For more information, circle 50 on the Readers Service Card.)

DATAPORT, SELF-CONTAINED CODE CONVERTER

The Dataport, a small, self-contained code converter, has been developed by Data Communications, Inc., Moorestown, N.J. The device uses a small magnetic-core memory to perform code conversion in digital systems by table-look-up process. The Dataport can be easily programmed, within the limits of input and output character lengths, to perform under a variety of code conversion rules. In operation the Dataport accepts input data in parallel form and transmits converted output data in serial form under the control of an external clock.

The Dataport is available in 2 models. Model DP-2500 has a capacity of 64 code combinations of 16 bits each and a conversion rate of 2500 characters per second. Model DP-5000 has a capacity of 128 characters of 8 bits each and a conversion rate of 5000 conversions per second. Both models operate over a temperature range of 0° to $+50^{\circ}$C and are available for free standing applications with internal fan or without fan for rack installation. (For more information, circle 51 on the Readers Service Card.)

Software

SOFTWARE TRANSLATES SPS PROGRAMS FOR B200

Burroughs Corporation, Detroit, Mich., has developed new software that automatically translates IBM Symbolic Programming Systems (SPS) programs into programs for Burroughs B200 computers. The new B200 Symbolic Translator converts programs written for the 1401, 1401-G, 1410 and 1440. Average running time is 10 minutes.

V. J. Ford, Burroughs data processing sales manager, said the translator has been tested on more than 300 live programs. Translations of programs written for punched card systems run 50-100 per cent faster on the B200 and translations of tape programs run as much as 25 per cent faster.
(For more information, circle 54 on the Readers Service Card.)

COMPUTER PROGRAMS FOR CONSTRUCTION SCHEDULING

A new package of computer programs for the construction industry has been developed by IBM Corporation, White Plains, N.Y. The programs enable contractors to schedule construction projects (using the critical path method), update and modify project schedules, and produce a variety of reports on project status.

The new package, called Project Control System, consists of 24 programs for use with the small-scale IBM 1440 data processing system. It allows the computer to accept data describing a project network in either the conventional arrow diagramming format or a new precedence diagramming format. The precedence network permits contractors to define more readily and accurately the sequence of work activities and eliminate a large number of restriction type activities that must be described in the arrow diagramming method.

Using a 1440 computer equipped with two random access memory devices, a contractor can store all programs and information on up to twenty separate construction projects. Two thousand activities can be handled within the framework of the system. The Project Control System includes a monitor program which controls the entire system, calling into use the appropriate programs needed to process specific jobs. It also can control additional programs developed by the user for estimating, project cost control and analysis, cash flow and related accounting applications.
(For more information, circle 55 on the Readers Service Card.)

PROGRAMS FOR THE MONROBOT XI

Monroe Calculating Machine Company, a division of Litton Industries, Orange, N.J., has announced a library of mathematical programs for the Monrobot XI. The programs are designed for use by engineers, designers, surveyors, statisticians and teachers in solving such problems as analysis of variance, traverse closure, least squares approximation, linear programming and other complex calculations. In addition, a newly available symbolic assembly system allows pre-programmed mathematical routines to be organized to fit any formula.
(For more information, circle 56 on the Readers Service Card.)

EXPANDED LP CODE

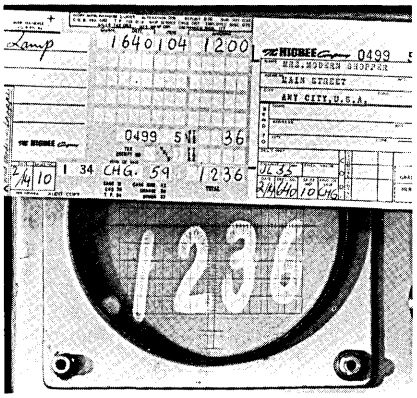
An expanded Linear Programming code has been developed by C-E-I-R Inc., Washington, D.C. C-E-I-R's LP code has been increased by over 30 new proprietary routines which permit, among other things, "separable" programming (inclusion of non-linear restraints in equations). New applications opened up for linear programming by these additions include design engineering and oil field tapping. Company officials consider the code to be the most powerful of any now commercially available for IBM 7090 or 7094 computers.
(For more information, circle 57 on the Readers Service Card.)

Input-Output

EXPERIMENTAL MACHINE RECOGNIZES HANDWRITTEN NUMBERS

Sales checks of customer's purchases are being read and processed by a machine which recognizes handwritten numbers, in an experiment at The Higbee Company, Cleveland, Ohio, department store. The machine, an experimental optical reader developed by the Advanced Systems Development Division of IBM Corp., White Plains, N.Y., reads handwritten numbers from a sales check and enters them into a computer for processing.

As customers make purchases at Higbee's, sales clerks in participating departments write all pertinent information on a specially-designed punched card sales check. This handwritten information indicates the quantity, department number, merchandise number and amount of the transaction. The sales check is used for all types of transactions — cash, C.O.D. or time payment accounts. When the store closes, sales checks are collected from the participating departments. They are then scanned optically by the experimental IBM reader and processed by an IBM 1401 Data Processing system. Reports on the previous day's transactions are available to store management at the opening of business each day.



— The total from a handwritten sales check, $12.36, is displayed on an oscilloscope after the four numbers have been scanned by an experimental IBM optical reader.

The experiment is being conducted jointly by IBM and Higbee in an effort to find new ways of applying advanced information handling techniques within the retailing industry. A main goal of the experiment is to demonstrate the feasibility of capturing merchandising and accounting information from a single source document — the sales check. The first IBM experimental reader was demonstrated in July, 1962, at Tufts University, Medford, Mass., where preliminary optical recognition tests were made using handwritten documents of students and non-students. (See Computers and Automation, August 1962, p. 1 and 17.)
(For more information, circle 58 on the Readers Service Card.)

Newsletter

DIGITAL INTRODUCES NEW MAGNETIC TAPE TRANSPORT

A new Magnetic Tape Transport Type 570 has been developed by Digital Equipment Corporation, Maynard, Mass. The transport, designed to operate with Digital's PDP-1 and PDP-4 computers, has an electro-pneumatic drive that reduces tape stress and wear. The tape is moved by contra-rotating, porous capstans, against which the tape is forced by air pressure. Motion is stopped when the tape is lifted off the capstan by back pressure from within the capstan, and the tape is forced against a brake, also by air pressure.

The 570 has a multiplex interface which permits time-shared use of the transport by two tape controls on the same or different computers. This permits the user to establish a tape pool of given capacity with fewer transports than would be needed in a non-sharing system. In addition, one tape control under program control may use a number of transports for split or merge operations — returning the transports to the pool only when the split or merge is complete.

The new transport records at densities of 200 and 556 characters per inch at speeds of 75 or 112.5 inches per second. Maximum transfer rate is 62,000 characters per second. The format is NRZ1 and is compatible with IBM 729 I- VI. (For more information, circle 59 on the Readers Service Card.)

LT/FM RECORDERS

The Geotechnical Corporation, Garland, Texas, has introduced the first models in a product line of multi-channel magnetic-tape recorders designed specifically to meet the requirements for recording surveillance data. (Surveillance data are those obtained from the recording of sub-audio signals for long periods of time.) The LT/FM recorders have low purchase prices, provide tape-cost savings, and may reduce operational costs.

A conventional instrument records at a minimum speed of 15/16 of an inch per second. By contrast, the Geotech Model 17554 can record as slowly as .03 inches per second. In surveillance recording applications, the conventional recorder will require a minimum of 28 reels to complete one operational cycle of four weeks. The LT/FM device uses only two reels for the same period. LT/FM recorders can operate continuously and unattended for up to thirty-three days.

A newly developed flux-responsive playback system permits exact reproduction of the recorded signal at the ultra-slow speeds used in the LT/FM units. The dynamic range necessary to extract intelligence from the signals is equal to that obtained in the audio frequencies. Flux-responsive playback also permits the devices to be accurately and easily calibrated, and the data signals to be routinely monitored during operation.

The new recorders are expected to prove well-suited to the requirements of meteorology, oceanography, geomagnetics, seismology, and medicine, as well as the oil, gas, and electrical utilities industries.
(For more information, circle 60 on the Readers Service Card.)

VOICE-WARNING SYSTEM

A new voice-warning system, that aids in eliminating operator error in responding to alarm conditions, is being marketed by TEL-A-DEX Corporation, Monrovia, Calif. The new system is applicable to any process control operation. When off-normal conditions arise, coded electronic impulses are interpreted by the computer and in turn initiate a pre-recorded voice-warning alarm and corrective message to a Standby operator.

Although the voice-warning system is capable of interfacing with any electronic computer, it is not limited to computer operated installations. Tel-A-Dex voice-warning systems can be electronically programmed for use with any type of processing system.

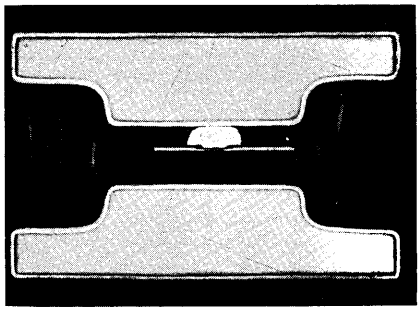
The system, pre-recorded at its maximum capacity, can deliver up to 256 eight-second messages. It is also adaptable to the end user's needs. Installations requiring fewer alarms may increase the message-time to 30 seconds. (For more information, circle 62 on the Readers Service Card.)

Components

NEW DIODE FROM HUGHES HAS DOUBLE-GLASS SEAL

A new diffused-junction diode, called "Microglass", has a double-glass seal construction which provides a greater assurance of hermeticity than has previously been possible. The new diode, developed by Hughes Aircraft Company's semiconductor division (Newport Beach, Calif.), is designed for application in computers, missiles and space systems. It is already in volume production at Hughes' semiconductor plant.

In construction, the silicon die (approximately 20 thousandths of an inch square) is sealed with a layer of glass. The die itself is epitaxially constructed to give it improved electrical performance. It is also whiskerless, utilizing a large area silver bump contact which is metallurgically bonded through a window in the glass layer to the junction area. The "glass-ambient" silicon die is then inserted into a package consisting of a glass ring and two metal end caps to form the final Microglass package. This pill-shaped pellet — which measures about 60 thousandths of an inch in diameter and is about 30 thousandths of an inch high — eliminates unnecessary structural components and offers simplicity of design as well as minute size and mass.



— Double-sealed glass diode. This diffused-junction epitaxial diode, called the Microglass diode, attains design flexibility by adding any type of lead for direct replacement of current diode types.

The result of these two glass seals is a device virtually impervious to all contaminants such as moisture, gasses and solid particles. Operating temperature of the device is -65° to +175°C, and all parts have matched thermal coefficients of expansion. In addi-

tion, the large area metal end caps provide a high inherent heat dissipation capability.

— Sparkling diodes.... Looking every bit like bubbling champagne is this glass of "Microglass" diodes, described as perhaps the "ultimate" single-unit diode, the missing link between conventional diodes and microelectronic integrated circuits.

The Microglass diode is available in 10 different types covering ranges up to 100 volts and 300 milliamps, and with 2 nanosecond switching speeds. It can replace any conventional diode currently in use by substitution of the Microglass unit with the appropriate leads. It can also be used without leads as a double-hermetically-sealed pellet fully compatible with current dimensions of microcircuit modules. Prices are said to be competitive with those of comparable existing diodes.
(For more information, circle 65 on the Readers Service Card.)

MEMORY EXERCISER, SSE-2000

An automatic system for laboratory analysis and production testing of complete memory systems, including all of the electronics of the memory as well as the storage elements, has been developed by Computer Test Corp., Cherry Hill, N.J. The SSE-2000 Exerciser's versatility enables it to simulate as nearly as possible an actual computer environment during development, prototype, and production testing of full scale memories.

The SSE-2000 inserts predetermined data into memory systems, exercises the memory through successive locations and then reads the data out again. It automatically checks for reliability in interrogation and storage of information by comparing the two sets of data. Errors cause the Exerciser to stop and indicate the address location and bit position of the error, or, if not stopped, to tally the errors in a counter.

The machine can be programmed to detect, locate and count defective addresses automatically in memories ranging up to 16,384 words, with up to 64 bits per word. Complete cycle time can be varied over the range of 1 to 100 microseconds so that different speed memories can be precisely accommodated. In addition to internal timing pulses, there are six general purpose pulses available for use in the memory under test. Pulse widths are variable from 200 nanoseconds to 70% of the cycle time.
(For more information, circle 66 on the Readers Service Card.)

AUTOMATIC TYPE CLEANER FOR EDP PRINTERS

Autographic Business Forms, Inc., South Hackensack, N.J., has developed a new method for automatic cleaning of high speed data processing printers. The product, called Data Type Cleaner, eliminates the hour or more of downtime usually associated with type cleaning of high speed equipment.

Data Type Cleaner is supplied as a 14-7/8" x 11" continuous form which consists of a chemically treated soft fibrous material. Dirt and ink embedded in type clings to the surface of the cleaner as it is run through as a regular form, using a test deck or heavy concentration deck. Edges are pin punched for automatic machine feeding and it is perforated at the folds for easy removal. The cleaner sheet can be cut in half to run on one set of pins on narrow machines.
(For more information, circle 67 on the Readers Service Card.)

METAL TAPE FOR PROTECTION OF COMPUTER HEADS

The Precision Metals Division of the Hamilton Watch Co., Lancaster, Pa., has developed a non-magnetic metal tape — Havar®. Use of a non-magnetic tape minimizes the major wear problem on the magnetic heads of computers caused by the abrasive particles on the magnetic tape which passes the head at high speeds. The metal tape acts as a barrier between the magnetic tape and the head.

Havar®, a cobalt base, non-magnetic, corrosion resistant tape, is furnished on plastic spools and can be passed continuously between the magnetic tape and the computer head at a slow rate of speed because of the high resistance to abrasion, as compared with plastic tape. Havar® tape can be supplied with thicknesses as low as .001" and the width can be made to conform to the user's particular specifications.
(For more information, circle 68 on the Readers Service Card.)

NEW LITERATURE

DATA PROCESSING SERVICE DIRECTORY

The Association of Data Processing Service Organizations (ADAPSO) has completed, printed, and made available for distribution, a directory of Data Processing Service Centers. This directory, which is the second one issued by ADAPSO, lists data processing service organizations by city and state. The name of the chief executive of each center, as well as its telephone number and address, are provided. Membership in ADAPSO is also indicated.
(For more information, circle 73 on the Readers Service Card.)

MEETING NEWS

DR. PERLIS TO SPEAK AT 1964 ANNUAL MEETING OF POOL

The 1964 annual meeting of POOL (the organization of users of General Precision computers) is being held May 12-14 at the Palmer House, Chicago, Ill.

A thorough look at three associations that serve the computer industry and its customers will be provided by representatives of the Association for Computing Machinery (ACM), the Data Processing Management Association (DPMA), and the Joint Users Group (JUG).

Dr. Allen J. Perlis, president of ACM, will describe in detail how ACM represents all sections of the computing industry, including many special-interest groups.

James Adams, director of education for DPMA, will discuss the management of data-processing installations and other areas in the computer field served by DPMA.

JUG, a special organization within ACM that represents all computer users groups such as POOL, will be described by its chairman, Howard Bramberg.

The general session for these presentations will be held on the morning of May 13.

BUSINESS NEWS

FIVE STEP PROGRAM PROPOSED TO INCREASE PROFIT FROM COMPUTER USE

Operating management must take greater responsibility for the profitable use of computers during the next decade, Arthur A. F. Aschauer, Executive Assistant to the Senior Vice President for Marketing, of the UNIVAC Division of Sperry Rand Corporation, commented at a recent Minneapolis region seminar of the Data Processing Management Association. In his talk, he offered a five-part action program for improved computer management.

Mr. Aschauer's first point was that the tendency of computer users "to abdicate responsibility for computer results to the vendor is a pernicious practice which waters down result performance, and any manager who concludes that someone else can run his business bettern than he, is suspect." He added that in urging use of value-analysis to improve EDP purchases, he was not advocating change for the sake of change, but "hard-headed, objective analysis" in computer selection.

The second of his five-step action program urged management to apply a balanced profit-center concept to all computer work. This would force careful definition of objectives and improved performance, and would remove "the halo effect surrounding computers as omnipotent problem-solvers, and place them in a businesslike framework."

Third, he urged computer users to fix specific executive responsibility for computer results, and suggested appointing an EDP executive reporting to general management to eliminate "bumbling in computer results".

Fourth, Mr. Aschauer said that line operating people must "get into the computer act". Dominance by the EDP technical staff of computer projects, leaves the operating people the role of "disinterested spectators and outright antagonists". The EDP management job ought to be filled by an operating man with broad knowledge of the business.

Finally, Mr. Aschauer pointed to the variety of profitable uses for computers by putting them to work on closed-loop operating problems — from order-entry, to production, to shipping and accounting — rather than bits and pieces of this network, as well as in engineering-scientific calculations and operations research. He concluded that the 16,000 computers put into operation during the first ten years of their use by business, has shown that "speed, capacity or cost isn't the limitation....but their management is the problem".

HONEYWELL ESTIMATES $100 MILLION IN 1964 EDP SHIPMENTS

Paul B. Wishart, chairman of the board of Honeywell, said that scheduled shipments for 1964 of the company's electronic data processing division are in excess of $100,000,000. "To date, Honeywell has already shipped in excess of $160,000,000 in solid-state commercial EDP systems," Mr. Wishart said.

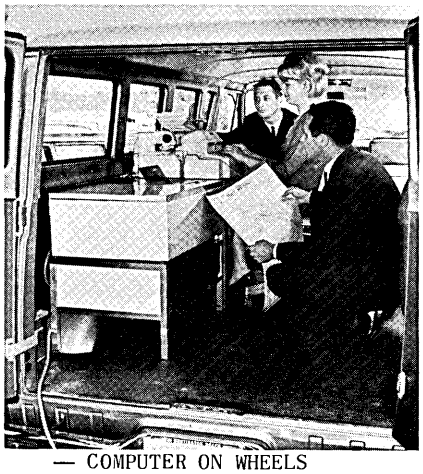
Production of the H-200 is now "running several weeks ahead of schedule," according to Walter W. Finke, president of Honeywell's EDP division. The first two production models of the H-200 were installated at the division's headquarters in Wellesley Hills in March. Customer shipments of the H-200 will begin in early July.

Mr. Finke said that the development of H-200 programming aids is also ahead of schedule. "Liberator" conversion programs, called Bridge and Easytran, are in operation. They are used to automatically convert programs of major competitive systems to H-200 programs.

"DOORSTEP" ERA IN COMPUTER MARKETING HERALDED

The "doorstep" era in computer marketing is under way with the announcement that a general-purpose computer — the LGP-21 manufactured by General Precision, Inc. — is being transported to the customer for a demonstration of how it can solve business and engineering problems. In the past, even the smallest of the large-memory computers were so bulky and heavy that most demonstrations were conducted at special display offices provided by manufacturers in major metropolitan areas. The computers couldn't be moved.

The LGP-21 computer, however, is tailor-made for "mobile" marketing. It weighs 90 pounds and is about the size of a small desk, yet contains a large memory of 4096 words.



— COMPUTER ON WHEELS
Vern Rankin, left, Southern California franchised representative for computers produced by General Precision, Inc., demonstrates a general-purpose LGP-21 computer in his delivery van to a customer, Hugh E. Lutz, manager of Associated Computing Service, Santa Ana. Operating the computer is Connie Dunbar, an Anaheim resident.

Vern Rankin, General Precision's franchised representative in Southern California, is one of the "mobile" marketing practitioners. To make a demonstration, he loads an LGP-21 computer into his light delivery van and drives to a customer's office. Rankin either demonstrates the computer in the vehicle (see picture), or moves the computer into the customer's office.

In many cases, Rankin demonstrates the LGP-21 by actually solving a customer's problem with a standard program developed by General Precision. Programs for solving civil-engineering problems and for computing payroll are typical of those available from General Precision's library of nearly 500 programs.

MONTHLY COMPUTER CENSUS

The number of electronic computers installed or in production at any one time has been increasing at a bewildering pace in the past several years. New vendors have come into the computer market, and familiar machines have gone out of production. Some new machines have been received with open arms by users — others have been given the cold shoulder.

To aid our readers in keeping up with this mushrooming activity, the editors of COMPUTERS AND AUTOMATION present this monthly report on the number of general purpose electronic computers of American-based companies which are installed or on order as of the preceding month. These figures included installations and orders outside the United States. We update this computer census monthly, so that it will serve as a "box-score" of progress for readers interested in following the growth of the American computer industry, and of the computing power it builds.

Most of the installation figures, and some of the unfilled order figures, are verified by the respective manufacturers. In cases where this is not so, estimates are based on information in the market research reference files of COMPUTERS AND AUTOMATION. The figures are then reviewed by a group of computer industry cognoscenti.

Any additions, or corrections, from informed readers will be welcomed.

AS OF APRIL 6, 1964

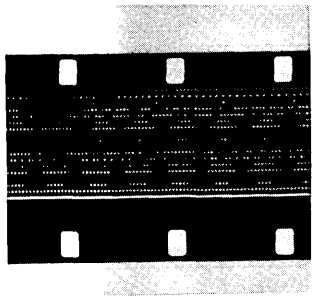
NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Addressograph-Multigraph Corporation	EDP 900 system	Y	$7500	2/61	18	7
Advanced Scientific Instruments	ASI 210	Y	$2850	4/62	16	2
	ASI 2100	Y	$3000	12/63	3	3
Autonetics	RECOMP II	Y	$2495	11/58	72	X
	RECOMP III	Y	$1495	6/61	20	X
Bunker-Ramo Corp.	TRW-230	Y	$2680	8/63	10	X
	RW-300	Y	$6000	3/59	35	X
	TRW-330	Y	$5000	12/60	27	6
	TRW-340	Y	$6000	12/63	3	8
	TRW-530	Y	$6000	8/61	20	X
Burroughs	205	N	$4600	1/54	67	X
	220	N	$14,000	10/58	46	X
	E101-103	N	$875	1/56	134	X
	E2100	Y	$535	8/64	0	160
	B100	Y	$2800	5/64	0	11
	B250	Y	$4200	11/61	43	11
	B260	Y	$3750	11/62	69	58
	B270	Y	$7000	7/62	62	48
	B280	Y	$6500	7/62	83	55
	B5000	Y	$16,200	3/63	28	18
Clary	DE-60/DE-60M	Y	$525	2/60	206	6
Computer Control Co.	DDP-19	Y	$2800	6/61	3	X
	DDP-24	Y	$3080	5/63	13	33
	SPEC	Y	$800	5/60	10	X
Control Data Corporation	G-15	N	$1000	7/55	306	X
	G-20	Y	$15,500	4/61	27	X
	160/160A*	Y	$1750/$3000	5/60 & 7/61	350	25
	924/924A	Y	$11,000	8/61	25	7
	1604/1604A	Y	$35,000	1/60	57	14
	3600	Y	$52,000	6/63	13	19
	3400	Y	$32,000	11/64	0	12
	3200	Y	$9000	5/64	0	38
	6600	Y	$150,000	4/64	1	2
Digital Equipment Corp.	PDP-1	Y	Sold only about $120,000	11/60	50	6
	PDP-4	Y	Sold only about $60,000	8/62	26	13
	PDP-5	Y	Sold only about $25,000	9/63	23	30
	PDP-6	Y	Sold only about $300,000	7/64	0	1
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	25	X
Friden	6010	Y	Sold only about $22,000	6/63	77	88
General Electric	210	Y	$16,000	7/59	72	4
	215	Y	$5500	11/63	16	10
	225	Y	$7000	1/61	162	22
	235	Y	$10,900	12/63	6	10
	415	Y	$5500	10/64	0	60
	425	Y	$6500	7/64	0	28
	435	Y	$12,000	10/64	0	10

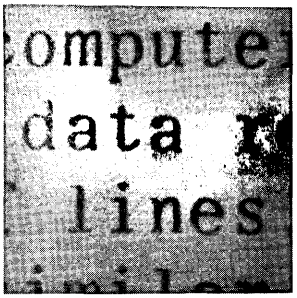
NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
General Electric (Cont'd)	455	Y	$10,000	6/65	0	6
	465	Y	$24,000	6/65	0	3
General Precision	LGP-21	Y	$725	12/62	95	48
	LGP-30	semi	$1300	9/56	435	2
	RPC-4000	Y	$1875	1/61	98	3
Honeywell Electronic Data Processing	H-200	Y	$4200	3/64	4	490
	H-400	Y	$5000	12/61	94	32
	H-800	Y	$22,000	12/60	61	4
	H-1400	Y	$14,000	1/64	5	12
	H-1800	Y	$30,000	1/64	3	5
	DATAmatic 1000	N	--	12/57	5	X
H-W Electronics, Inc.	HW-15K	Y	$490	6/63	3	3
IBM	305	N	$3600	12/57	570	X
	650-card	N	$4000	11/54	430	X
	650-RAMAC	N	$9000	11/54	88	X
	1401	Y	$3500	9/60	6650	740
	1401-G	Y	$1900	5/64	0	780
	1410	Y	$12,000	11/61	295	210
	1440	Y	$1800	4/63	760	2550
	1460	Y	$9800	10/63	190	450
	1620	Y	$2000	9/60	1475	55
	701	N	$5000	4/53	1	X
	7010	Y	$19,175	10/63	30	35
	702	N	$6900	2/55	2	X
	7030	Y	$160,000	5/61	7	X
	704	N	$32,000	12/55	47	X
	7040	Y	$14,000	6/63	32	50
	7044	Y	$26,000	6/63	21	16
	705	N	$30,000	11/55	98	X
	7070,2,4	Y	$24,000	3/60	460	100
	7080	Y	$55,000	8/61	64	17
	709	N	$40,000	8/58	12	X
	7090	Y	$64,000	11/59	70	6
	7094	Y	$70,000	9/62	245	60
	7094 II	Y	$76,000	4/64	3	148
ITT	7300 ADX	Y	$18,000	7/62	8	6
Monroe Calculating Machine Co.	Monrobot IX	N	Sold only - $5800	3/58	169	X
	Monrobot XI	Y	$700	12/60	364	185
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	0
	- 310*	Y	$2000	5/61	46	2
	- 315	Y	$8500	5/62	160	100
	- 390	Y	$1850	5/61	555	195
Packard Bell	PB 250	Y	$1200	12/60	150	10
	PB 440	Y	$3500	3/64	2	10
Philco	1000	Y	$7010	6/63	15	8
	2000-212	Y	$52,000	1/63	6	5
	-210,211	Y	$40,000	10/58	18	5
Radio Corp. of America	Bizmac	N		-/56	4	X
	RCA 301	Y	$6000	2/61	400	152
	RCA 3301	Y	$20,000	7/64	0	9
	RCA 501	Y	$15,000	6/59	94	5
	RCA 601	Y	$35,000	11/62	3	2
Scientific Data Systems Inc.	SDS-910	Y	$2000	8/62	49	42
	SDS-920	Y	$2700	9/62	38	14
	SDS-930	Y	$4000	4/64	0	12
	SDS-9300	Y	$7000	4/64	0	2
UNIVAC	I & II	N	$25,000	3/51 & 11/57	35	X
	Solid-State II	Y	$8500	9/62	38	7
	III	Y	$20,000	8/62	60	80
	File Computers	N	$15,000	8/56	43	X
	Solid-State 80, 90, & Step	Y	$8000	8/58	350	3
	418	Y	$11,000	6/63	4	5
	490	Y	$26,000	12/61	29	20
	1004	Y	$1900	2/63	1100	1050
	1050	Y	$8000	9/63	30	200
	1100 Series (except 1107)	N	$35,000	12/50	17	X
	1107	Y	$45,000	10/62	17	14
	LARC	Y	$135,000	5/60	2	X
				TOTALS	18,409	8,793

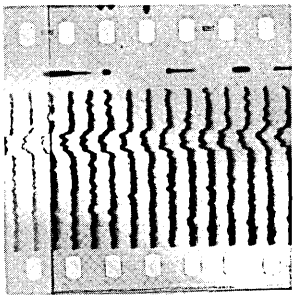
X = no longer in production.

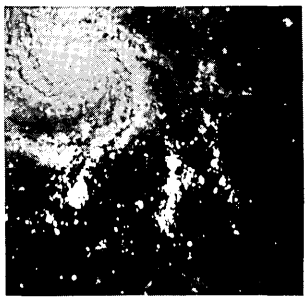
* To avoid double counting, note that the Control Data 160 serves as the central processor of the NCR 310. Also, many of the orders for 7044, 7074, and 7094 I and II's are not for new machines but for conversions from existing 7040, 7070, and 7090 computers respectively.

5000 POINTS PER SECOND









In addition to data recorded on film, data recorded on paper can also be read by means of the film reading system.

Information International, Inc., Maynard, Mass., has developed a fully automatic Programmable Film Reader to read scientific or engineering data recorded on photographic film, paper, or similar media. Readout can be had on IBM-compatible magnetic tape, or in the form of numerical print-outs, graphs or plots, or visual CRT displays. This article describes the system and its applications.

THE FILM READING SYSTEM Using 16 or 35 mm. film as a medium for recording scientific data has many advantages. Because of the small input power and limited storage space that are required, it is particularly suitable for recording data produced by recording devices in space vehicles or aircraft; by wind and current measuring devices; and by other devices of similar nature.

However, reading or transcribing the data from film once it has been recorded has presented many problems in the past. It has generally been necessary for an analyst or researcher to read the data visually from the film and transcribe it by hand. This has been found to be a time-consuming, laborious and relatively expensive operation. In some cases, semi-automatic film reading devices are available. However, these can read only about 5000 points per day and require a human operator.

Information International, Inc., of Maynard, Mass., has now developed a completely automatic computer film reading system which can read film at the rate of approximately 5000 points per second. Scientific data recorded on 16 or 35 mm film can be read completely automatically and printed out in the form of numerical listings or recorded on magnetic tape for further processing and analysis. The film reading system is based on three major elements: A general purpose digital computer, together with a visual display scope; a film reading device; and computer programs for using the computer and film reader.

THE FILM READING PROCESS The film reading process involves the scanning of film by a rapidly moving light point on the visual display scope. The output of this scanning operation is detected by a photo-sensitive device in the film reader and relayed to the digital computer for further processing and analysis. In addition to translating the data itself into a more desirable format, the film reading system can also furnish additional summaries and analyses of the data as may be required.

EXTREMELY FLEXIBLE SYSTEM The flexibility of the film reading system in two respects should be emphasized. First, almost any format of data on film can be read, with appropriate modifications to the basic computer program. This includes data represented in the form of lines, graphs (e.g., radar pulses), points, and other similar forms of data. Second, almost any type of desired output may be obtained once the basic data is obtained from the film. Forms of output which are available include the following:

(i) A print-out or listing of data on paper.

(ii) A record of the data on magnetic tape.

(iii) Visual representations of data. These may take the form of a continuous graph (using a digital x-y plotting device). Or they may take the form of photographs — still or motion — of scope displays.

SYSTEM APPLICATIONS

(i) Analysis of data produced by oscillographs or other types of graphic recorders

(ii) Tracking and analysis of objects for which motion pictures are available (e.g., missile tracking studies)

(iii) Reading of astronomical or astrophysical data recorded on film (e.g., analysis of stellar configurations)

(iv) Reading photographs of cloud chambers, bubble chambers, and spark chambers

(v) Counting of particles (such as blood cells or bacteria) in photographs

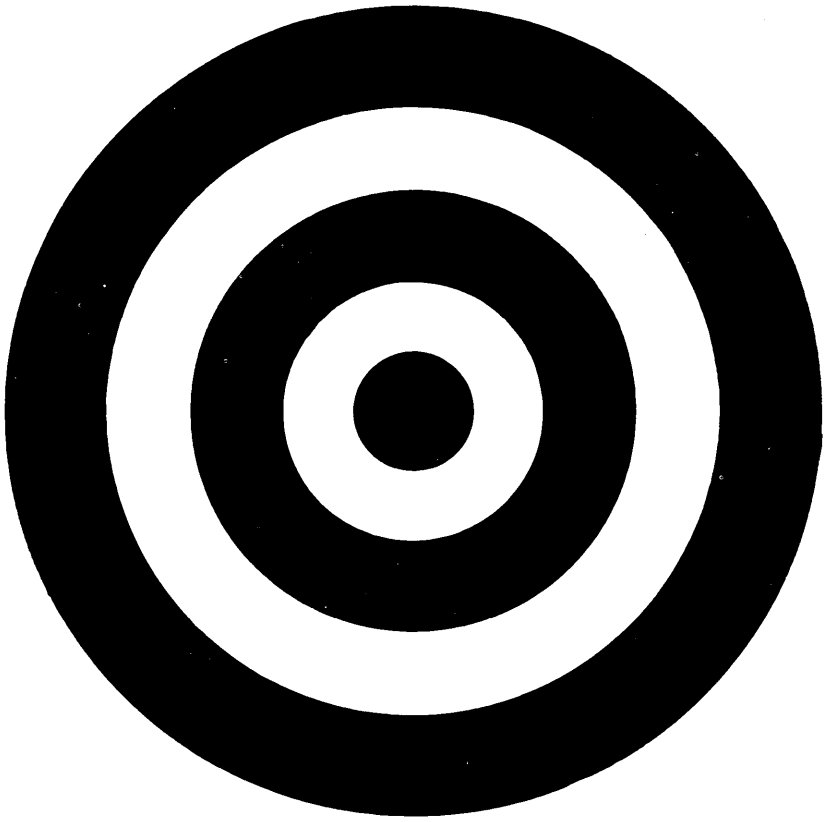
(vi) Character recognition

To the best of our knowledge, Information International is the only commercial firm supplying fully automatic computer film reading systems. We do essentially two things. We develop and manufacture film reading systems for clients to use at their own facilities (as, for example, in the case of radar film reading systems we have developed for Lincoln Laboratory and the U. S. Air Force). And we furnish services for reading films which are sent to us for processing (as in the case of oceanographic current meter film).

III is able to supply equipment to satisfy a variety of customer needs. Customer options include transmittive or reflective input media, binary density decision, multiple level density measurement, local contrast measurement, and various degrees of system resolution.

We can supply a completely set-up, ready-to-run "turnkey" film reading system (including a medium price, general purpose computer). Or we can provide the basic film reading device, appropriate computer programs, or technical consulting to those planning to develop their own film reading systems. The film reading device itself may be used with specialized film reading computer programs, such as those we have developed, which make use of highly sophisticated filtering techniques to minimize the effect of "noise" (dirt, scratches, general illegibility) on the film. As a result, the film reading system is capable of reading film in relatively poor condition. Or, where the quantity of data on film is not great enough to justify investment in a film reading system, I.I.I. can furnish services for reading film and transcribing data on a production basis. A brochure describing the film reader and film reading systems we have developed is available on request.

What is "On Target" Software?



"On-Target" software is a continuing and concentrated programming effort supporting NCR 315 Computer installations. The 315-100 and compatible 315 are designed to fit the small and medium-to-large data processing range. For this reason, we are able to concentrate our software efforts. As a consequence, we have developed "in-depth" computer languages, executive routines, utility programs, plus a wide range of business and scientific programming packages.

The benefits are many: a concentrated effort assures a more complete and usable software product for the business and scientific user—for the newcomer as well as the computer sophisticate. A concentrated effort also assures future software development which will benefit all NCR 315 users. A compatible hardware-software oriented approach means that the user can expand his present or future computing power as needed with minimal programming costs.

NCR's software is zeroed in on the 315. It is operational and presently used by more than 200 customers... some for more than two years. Just remember, when considering your over-all computer requirements, you must consider software. For this, and many other reasons, it will pay you to investigate the NCR 315 Computer with "On-Target" software and programming. For details, call your nearby NCR Office, or write National Cash Register Co., Dayton 9, Ohio.

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CALENDAR OF COMING EVENTS

May 4-5, 1964: 5th National ISA Chemical & Petroleum Instrumentation Symposium, du Pont Country Club, Wilmington, Del.; contact G. H. Robinson Engineering Dept., E. I. du Pont de Nemours & Co., Wilmington, Del. 19798

May 4-6, 1964: 10th National ISA Aerospace Instrumentation Symposium, Biltmore Hotel, New York, N. Y.; contact J. Stotz, Jr., Grumman Aircraft Engineering Corp., Plant No. 5, Bethpage, L. I., N. Y.

May 4-7, 1964: 2nd National ISA Biomedical Sciences Instrumentation Symposium, Student Union, Univ. of New Mexico, Albuquerque, N. M.; contact Dr. P. F. Salisbury, St. Joseph Hospital, 501 So. Buena Vista St., Burbank, Calif.

May 5-6, 1964: 5th National Symposium on Human Factors in Electronics, San Diego, Calif.; contact Wesley Woodson, Convair Astron. Div., San Diego, Calif.

May 11-13, 1964: NAECON (National Aerospace Electronics Conference), Biltmore Hotel, Dayton, Ohio; contact IEEE Dayton Office, 1414 E. 3rd St., Dayton, Ohio.

May 12-14, 1964: Annual General Meeting of POOL (Users of General Precision Computers), Palmer House, Chicago, Ill.; contact Dr. Roebert L. Stearman, C-E-I-R, Inc., 9171 Wilshire Blvd., Beverly Hills, Calif., or Al Erickson, General Precision, Inc., 808 Western Ave., Glendale, Calif.

May 13-15, 1964: Second Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Shamrock Hilton Hotel, Houston, Tex.; contact Chairman, Biomathematics Symposium, Univ. of Tex. Graduate School of Biomedical Sciences at Houston, 102 Jesse Jones Library Bldg., Texas Medical Center, Houston, Tex. 77025

May 18-20, 1964: 7th National ISA Power Instrumentation Symposium, Denver-Hilton Hotel, Denver, Colo.; contact H. A. Van Wassen, Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa. 15219

May 25-27, 1964: 10th National ISA Aero-Space Instrumentation Symposium, Biltmore Hotel, New York, N. Y.; contact J. K. Stotz, Jr., Grumman Aircraft Engineering Corp., Bethpage, L. I., N. Y.

June 2-4, 1964: 13th National Telemetering Conference, Biltmore Hotel, Los Angeles, Calif.; contact F. M. Riddle, 4800 Oak Grove Dr., Pasadena, Calif.

June 23-26, 1964: Data Processing Management Association 1964 International Data Processing Conference and Business Exposition, Jung Hotel, New Orleans, La.; contact Data Processing Management Association, 524 Busse Highway, Park Ridge, Ill.

June 24-26, 1964: 5th Annual Joint Automatic Control Conference, Stanford University, Stanford, Calif.; contact D. A. Rodgers, Consolidated Systems Corp., 1500 Shamrock Ave., Monrovia, Calif.

July 13-15, 1964: 1964 Rochester Conference on Data Acquisition and Processing in Medicine and Biology, Univ. of Rochester, Whipple Auditorium, Rochester, N. Y.; contact Kurt Enslein, 42 East Ave., Rochester, N. Y. 14604.

Aug. 25-27, 1964: ACM Annual Meeting, Sheraton Hotel, Philadelphia, Pa.; contact H. Bromberg, Conference Chairman, C-E-I-R, Inc., Benson East, Jenkintown, Pa.

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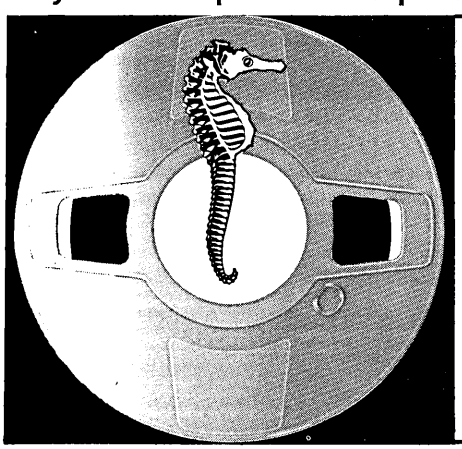

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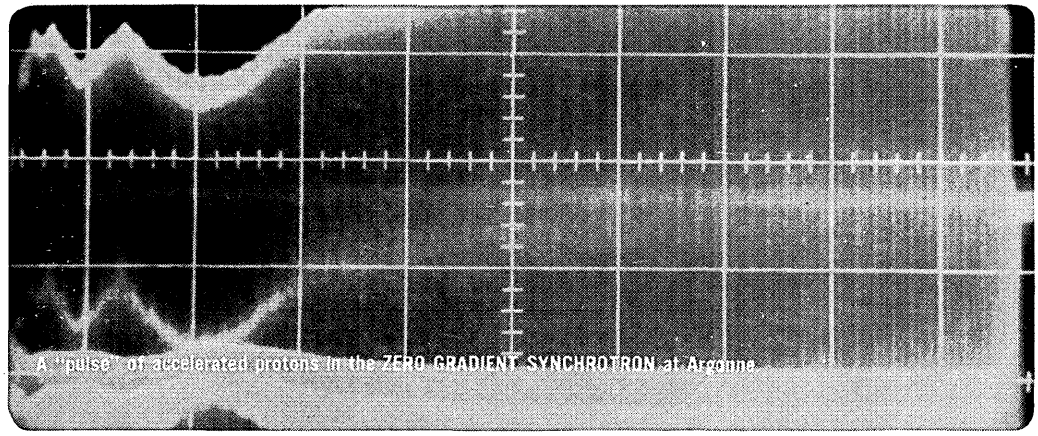
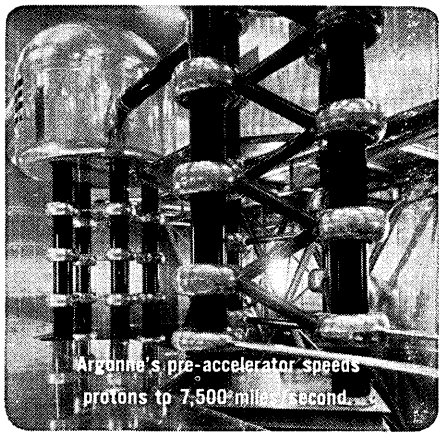
A CONTROL DATA 3600 used with the ZGS at Argonne.



A "pulse" of accelerated protons in the ZERO GRADIENT SYNCHROTRON at Argonne.



Argonne's pre-accelerator speeds protons to 7,500 miles/second.

Photos courtesy Argonne National Laboratory

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