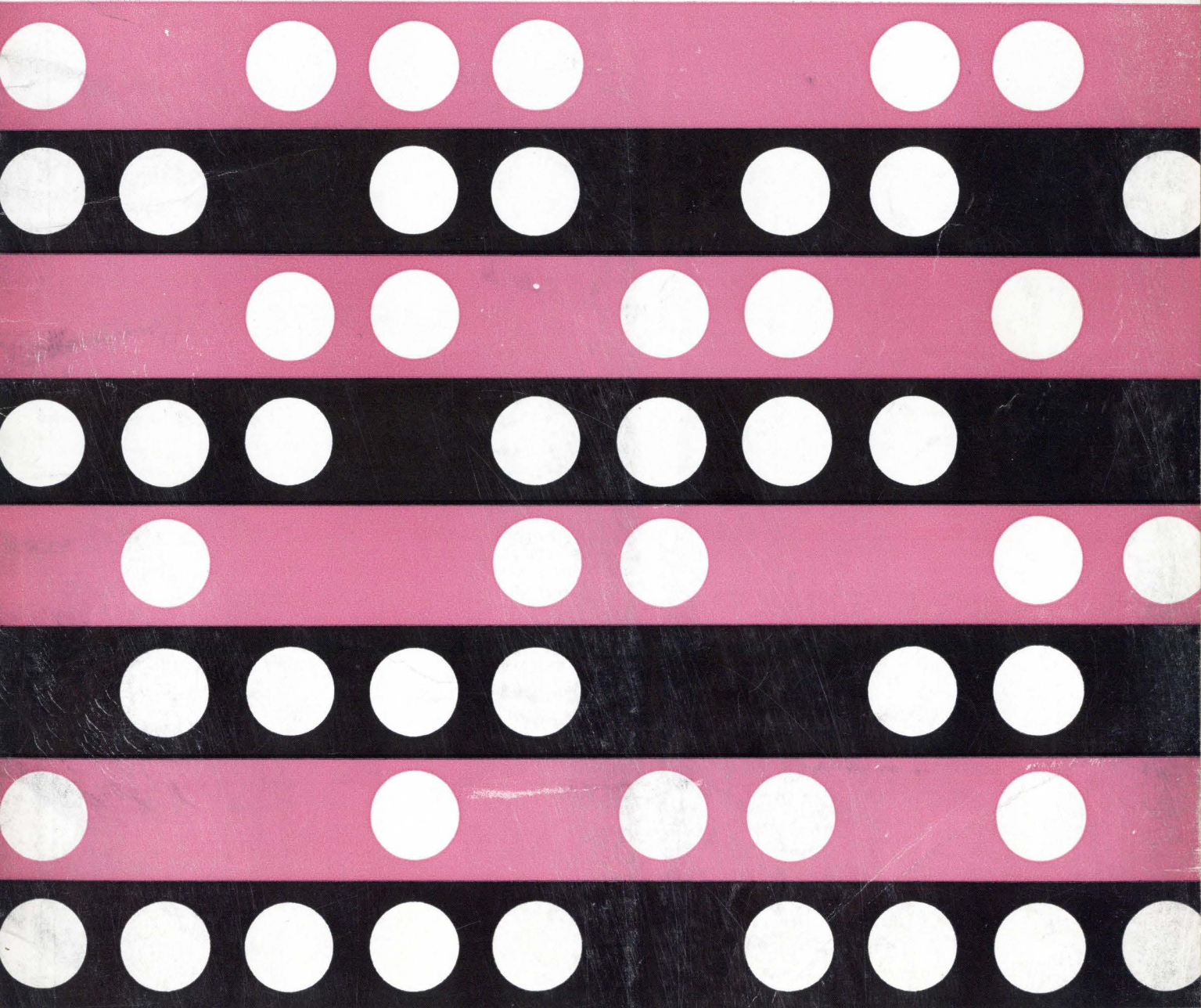


# COMPUTER DESIGN

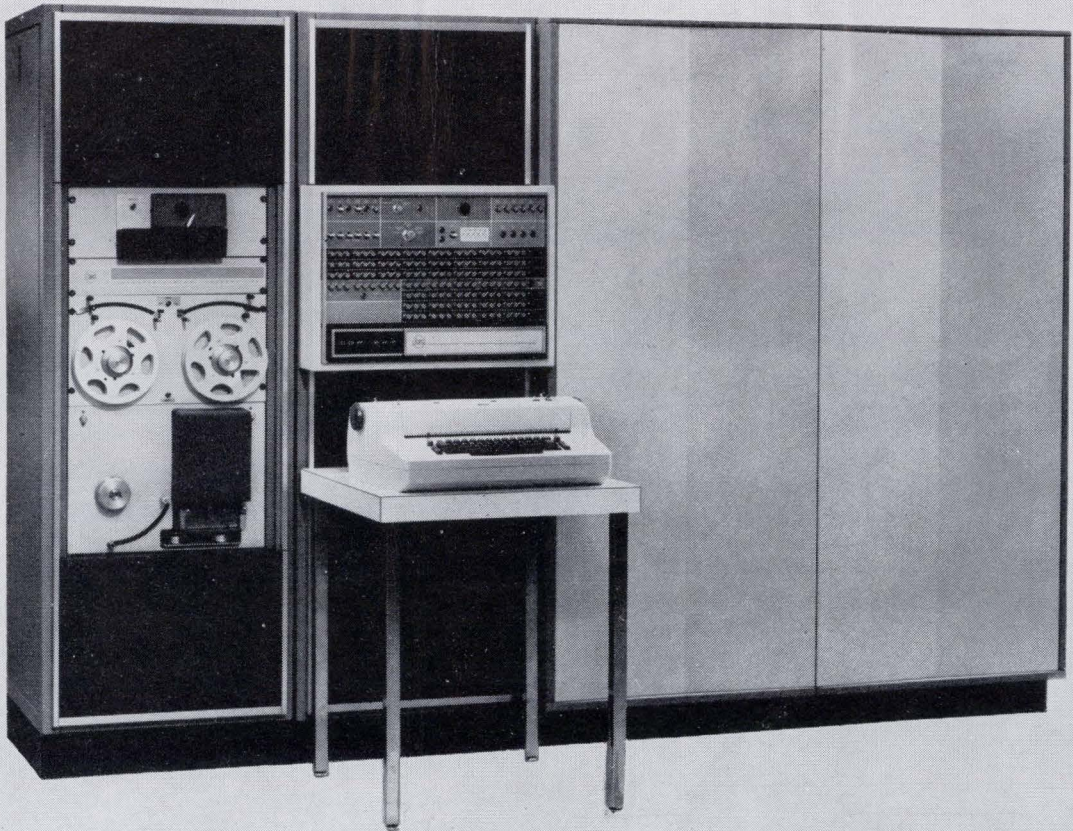
THE DESIGN AND APPLICATION OF DIGITAL CIRCUITS, EQUIPMENT & SYSTEMS

JULY 1965



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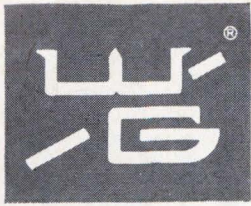


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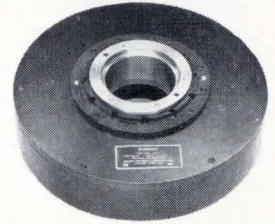
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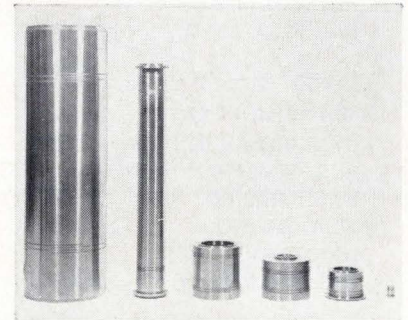
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\*For photographs of ARCSEC Encoders see DIGISEC Units of same diameter.

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#### 36 ULTRA-HIGH-SPEED TRANSISTORS

A highly advanced research group stumbles upon an amazing discovery which you may find difficult to believe.

#### 38 A MODIFIED HARVARD CHART

In the December 1964 issue of COMPUTER DESIGN, a step-by-step explanation of the use of the Harvard Chart minimization technique was given. Here, in this issue, a modified approach that is simpler and less tedious is described.

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Reader inquiry cards ..... opposite page 64

# CALL YOUR WIFE... YOU'LL BE HOME LATE FOR DINNER!



Just read these "worst-case" specs on the new NAVCOR 1mc module line\* and you'll want to revise the specifications on your new design. We realize that your wife won't appreciate your excuse for working late, but your new "brainchild" deserves the best...

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**"DISCUSS-ONLY" SESSIONS  
AT 1965 FJCC**

A significant innovation in conference format has been announced by the program committee of the coming 1965 Fall Joint Computer Conference. At least three major technical sessions are planned as "discuss-only" sessions. About a month before the November 30 opening date, papers for these sessions will be mailed to all those who plan to attend. The attendees will then be able to spend the entire session periods critically evaluating the authors' material. They will be prepared to ask an author to clarify or elaborate on certain points or even introduce new material of their own.

This format was used successfully at a recent IEEE Computer Group symposium and if it works well at the FJCC, the conference planners hope to extend it to cover more sessions in the future.

**COMPUTER DESIGN** enthusiastically endorses this refreshing approach and we believe that the 1965 FJCC program committee, particularly co-chairmen S. Nissim and T. B. Steel, deserves industry-wide commendation and all possible support in making these sessions a real success.

We have offered the committee the use of the editorial pages of **COMPUTER DESIGN** to present the details of these sessions. We have also offered the use of our regular reader service department as a means for our readers to obtain the advance copies of the papers.

Plans are now in the works to bring this information to you in our September issue.

*S. Henry Sacks*

Editor



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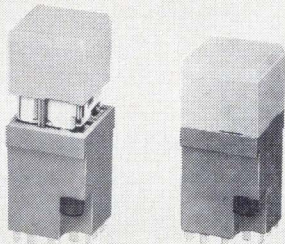
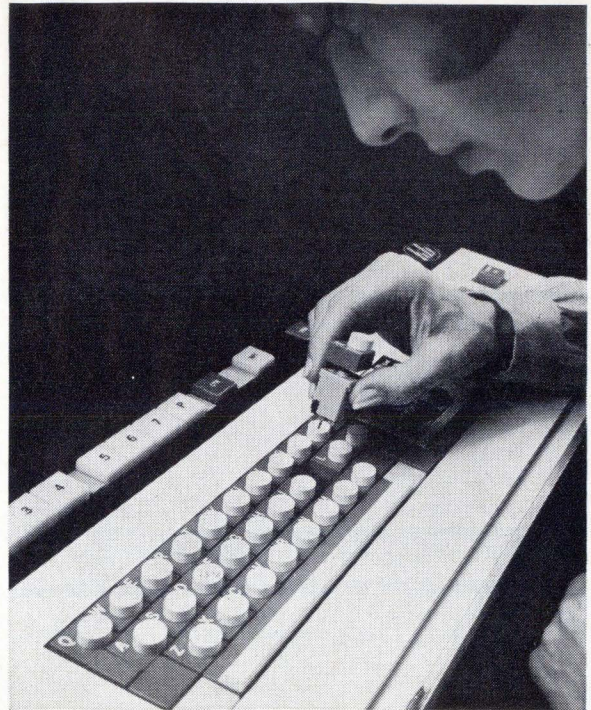
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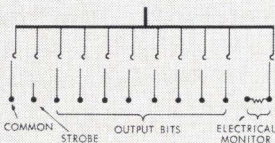
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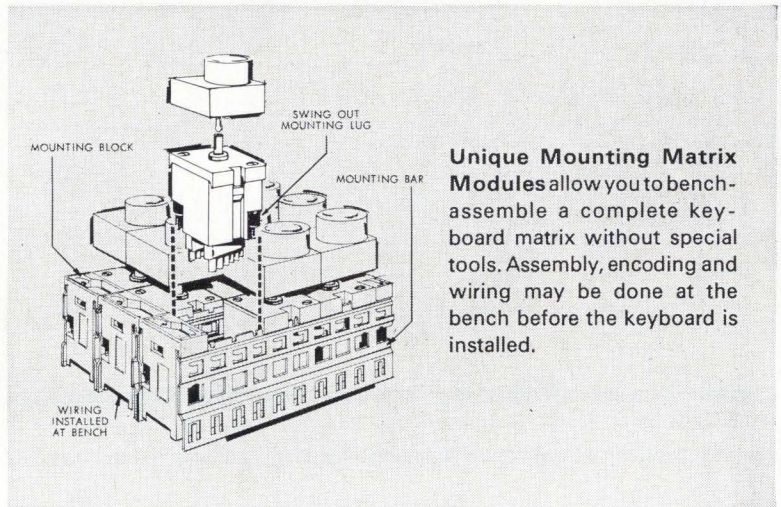
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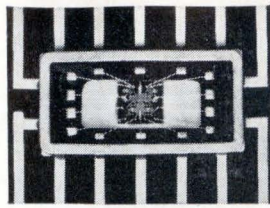
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# TI Series 54 TTL Sets in Saturated Digital

TYPICAL CHARACTERISTICS		
Parameter	Basic Gate	Flip-flop
Propagation delay	15 nsec	40 nsec
Power dissipation	10 mw/gate	60 mw
Fan-out	10	10
D-c noise margin	1 v	1 v
Supply voltage	4.5 to 5.5 v	4.5 to 5.5 v
Temperature range	-55 to +125°C	-55 to +125°C

Figure 1. Typical characteristics of Series 54 TTL integrated circuits

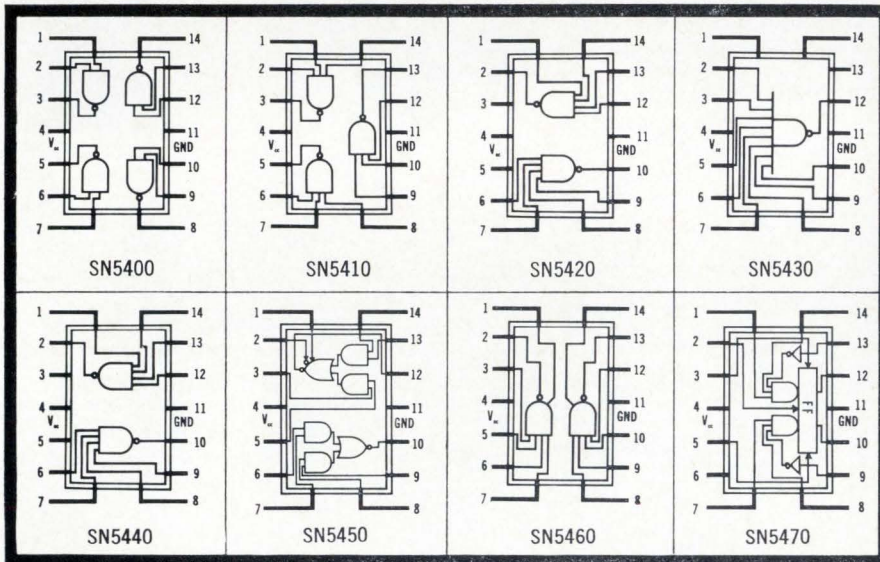


Figure 2. Logic diagrams for Series 54 TTL integrated circuits

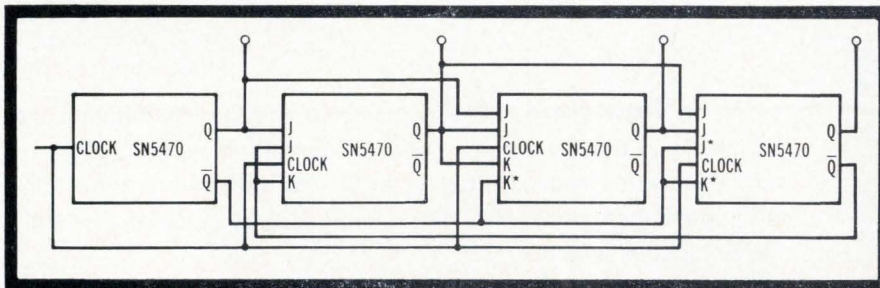


Figure 3. This complete synchronous binary decade counter uses only four SN5470 flip-flops

**Industry's major source for integrated circuits\*— 97 catalog circuits in ten families — offers you high speed with low power dissipation, high noise margin with high fan-out**

Series 54 optimized circuit design gives you an ideal trade-off between speed (15 nsec) and power dissipation (10mw). High noise margin (typically 1 v) is maintained with full fan-out of 10 for each gate. Fan-out of 30 is available from the power gate.

This unique combination of parameters promises to standardize integrated-circuit usage in applications calling for high-performance saturated logic.

### Multi-function circuits for low system cost and improved reliability

In the eight Series 54 networks shown in Fig. 2, TI's multi-function approach to semiconductor-network design and fabrication is used extensively. Up to four circuit functions are built in a single bar of silicon, making possible savings in system cost, weight, and size, while increasing system reliability.

The SN5400, for example, incorporates four 2-input NAND gates in a single package. The SN5450 includes two EXCLUSIVE-OR gates, the equivalent in complexity of six NAND gates. The SN5470 is a clocked J-K flip-flop with two additional inverters in the same structure available for input gating. The synchronous binary decade counter shown in Fig. 3 requires only four SN5470 flip-flops; no auxiliary gates are required.

### TTL at its best

Transistor-Transistor Logic (TTL) fully exploits the inherent capabilities of integrated semiconductor structures, and the TI NAND gate circuit shown in Fig. 4 is TTL at its best.

\*Patented by TI



# a New Industry Standard Integrated Circuits

The multiple-emitter transistor input provides a faster turn-off time than other logic forms, thereby minimizing propagation delay. Because of unique circuit characteristics and exacting process control, propagation delays are almost independent of temperature and loading (see Fig. 5).

The output stage of the circuit provides low line-termination impedance in both logical "0" (12 ohms) and logical "1" (100 ohms) states. This contributes to low propagation delays and preserves undistorted waveforms even when driving large-capacitance loads. The low line-termination impedance also accounts for low susceptibility to capacitively coupled noise.

Typical noise margin for Series 54 integrated circuits is one volt. Guaranteed worst-case noise margin is 400 millivolts for both logical "1" and logical "0" conditions, as shown in Fig. 6. This wide margin for ground- and signal-line noise is made possible by the strong overdrive to the output transistor and by the large  $V_{BE}$  drops inherent in the small transistor geometry.

## Series 54 uses reliable "flat-packs"

TI's standard  $\frac{1}{4}$ " by  $\frac{1}{8}$ " flat package is used for all Series 54 networks. This package — proved by more than 35,000,000 hours of controlled tests and four years of field use — features all-welded construction with hermetic glass-to-metal seals. The thin, rectangular configuration and 14 lateral leads make this package suitable either for high-density equipment or for mounted circuit-card assemblies.

For your added convenience, all TI integrated circuits — including Series 54 — are now shipped at no extra charge in TI's exclusive Mech-Pak carrier. This plastic carrier simplifies handling, and reduces your costs of incoming inspection, testing, breadboarding, storage, and assembly.

Circle 149 on the Reader Service Card for data sheets on Series 54 integrated circuits, or contact your local TI Sales Engineer.

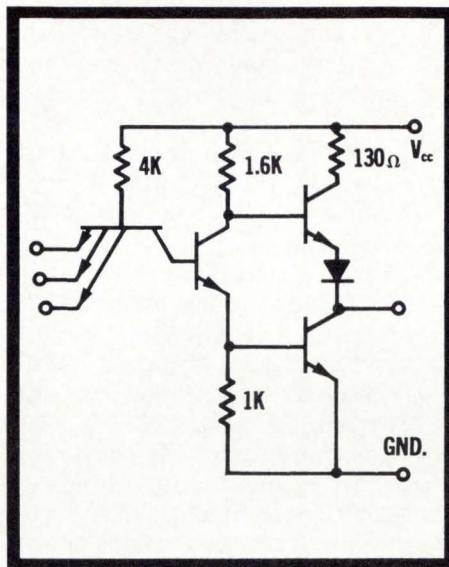


Figure 4. Circuit diagram for basic Series 54 NAND gate

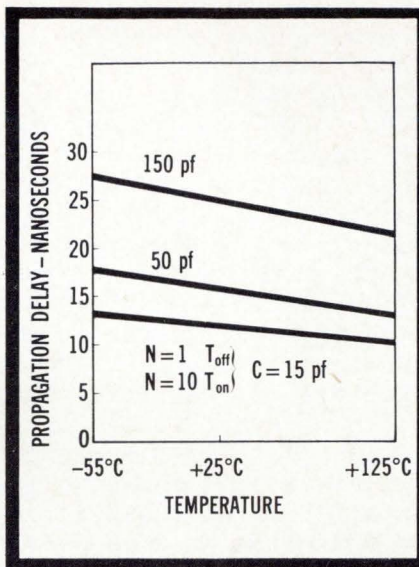


Figure 5. Typical propagation delay vs temperature

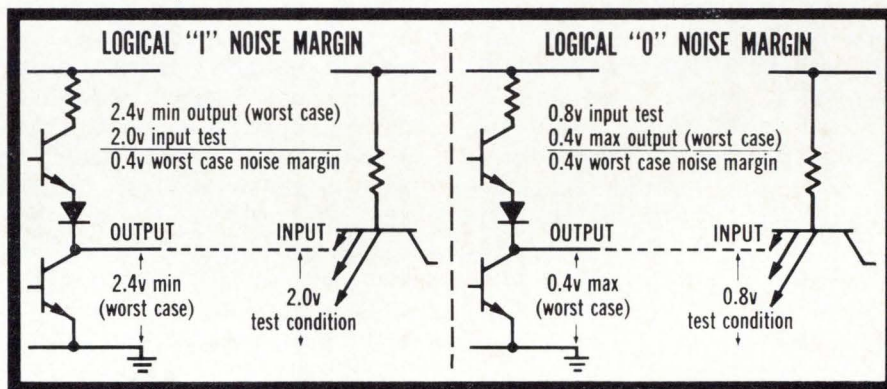


Figure 6. Noise immunity is guaranteed at 400 mv, worst-case, in both logical states



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CORNING GLASS WORKS AND IMPERIAL-EASTMAN CORP. RECENTLY ANNOUNCED A MARKETING AGREEMENT naming the Fluidonics Division of Imperial-Eastman as exclusive distributor in the United States and Canada for Corning's fluid devices. Executives of the two firms say the agreement marks an important turning point in the history of the still-young technology of fluid amplification. The agreement provides for wide availability of fluid amplifiers for the first time on an off-the-shelf basis. The 15 standard Corning fluid devices to be handled initially by Imperial-Eastman are a timer, a binary counter, an AND gate, two sets of fluid resistors, and two sizes each of a proportional amplifier, a load-sensitive bistable device, a load-insensitive bistable device, an OR/NOR gate, and a proportional center dump.

THE MAJORITY OF THE 22,000 ELECTRONIC COMPUTERS IN USE TODAY HAVE LESS-THAN-ADEQUATE RECORD PROTECTION STORAGE FACILITIES, according to a report by the Safe Manufacturers National Association of New York. By some estimates there will be more than 70,000 computers in use by 1970, yet the vital issue of protecting computer tapes, cards, drums, rods, and other information storage media is a mystery to many users, the SMNA revealed. Many of the computer users wrongly feel that pro-

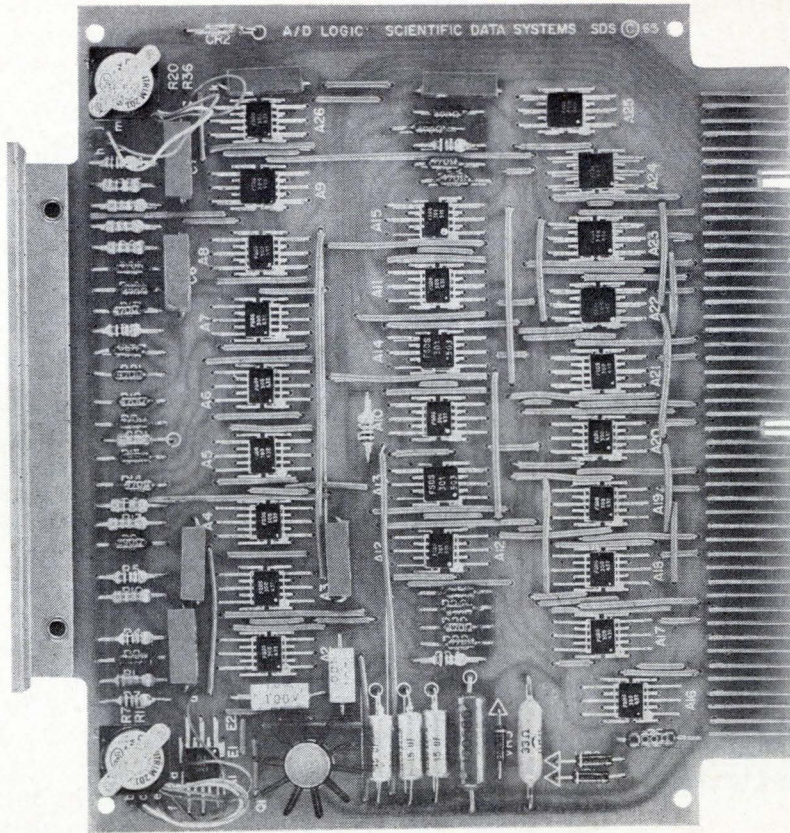
tection afforded paper documents is adequate for computer information storage media, they said. According to the SMNA, paper documents are offered maximum protection — at temperatures reaching 350°F — in specially-insulated file cabinets and record safes bearing the SMNA and Underwriters Laboratories label. Paper is destroyed at temperatures about 350F. But with computer information media, such as magnetic tapes, computer records will be destroyed at temperatures above 150F, a temperature that is barely sufficient to fry an egg. To protect such highly inflammable records against fire, and from moisture, computer users should use data processing tape safes built to far more exacting design specifications, the Association cautioned. Otherwise, the danger of destruction from fire and moisture can be as complete as that which destroyed over 70,000 computer tapes in the fire of 1959 at the Pentagon — which supposedly had complete fire-resistive facilities.

DEVELOPMENT OF A NEW MAGNETIC MATERIAL BY A BRITISH SUBSIDIARY OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION MAY RESULT IN NEW METHODS OF COMPUTATION AND DATA HANDLING. The material, developed at ITT's Standard Telecommunication Laboratories, will switch

the direction of its magnetic field when only a small pulse is applied. ITT-STL engineers explained the phenomenon as follows: The material has only two stable states corresponding to an essentially single magnetic domain throughout. When the field is reversed nothing happens until a critical nucleating field is reached, when a domain wall is suddenly formed. It rapidly sweeps through the material, reversing the direction of magnetization. However, the coercive field required to drive this domain wall through the material is less than the nucleating field, so that the driving field may be reduced during the reversal process. With a suitable display system, a re-entrant hysteresis loop is obtained.

A search was made for such re-entrant hysteresis loops in ferrite systems normally exhibiting rectangular loops. They have been found in magnetically annealed cobalt-containing ferrites of precisely controlled composition. In the best samples the nucleating field has exceeded the coercive field by more than 100 per cent, and no hysteresis loop is obtained until the applied field, either alternating or uni-directional, exceeds the critical value. If the material is biased with a field just below the nucleating value, a small pulse suffices to switch the direction of magnetization. Thus, these materials have promising applications in all-magnetic logic.

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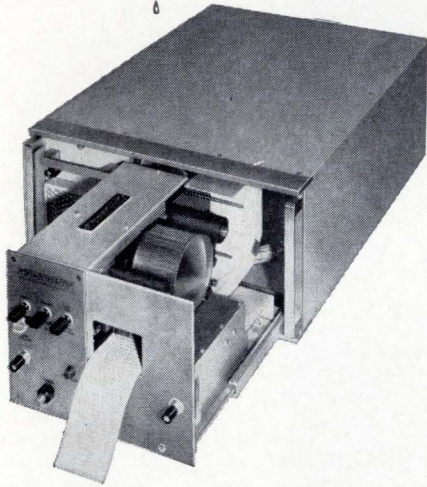
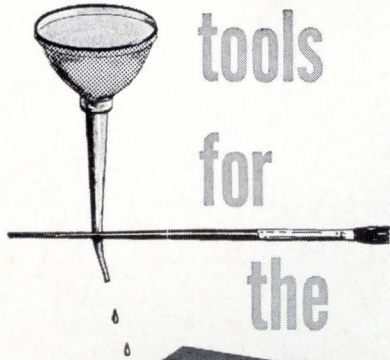
ently of the rest of the primary A to D converter module.

If you'll use the reader service number on the left, below, we'll send along complete specifications on our two new A to D's. We'll also include data on our other five A to D converters. If you'll use the right hand reader service number below, we'll send you a complete SDS logic module catalog. You're bound to need one or the other.

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## INDUSTRY NEWS

THE ELECTRIC UTILITY INDUSTRY'S FIRST INTEGRATED COMPUTER/TELEMETRY SYSTEM WHICH TIME SHARES THE COMPUTER AS PART OF THE TELEMETRY EQUIPMENT HAS RECENTLY BEEN INSTALLED at the Public Utility District No. 1 of Chelan County, located in Wenatchee, Wash. The system, installed by the Westinghouse Power Control Division, includes a "Prodac" 510 computer, operator's and programmer's consoles, high-speed, solid-state digital telemetry and data collection equipment, and analog load frequency control equipment. Any six of thirteen generating units at the Rock Island and Rocky Reach plants on the Columbia River can be selected for control by a unique combination of digital and analog control. Plant base load generation requirement is determined by a digital load frequency control program stored in the computer, and is dispatched via digital telemetry.

THE CENTRAL LOUISIANA ELECTRIC CO. RECENTLY PURCHASED A "PRODAC" 50 COMPUTER SYSTEM FROM THE WESTINGHOUSE POWER CONTROL DIVISION. The computer system will perform scanning, alarming, logging, and performance evaluation of a 230-mw power station unit at St. Landry, La. The equipment includes the computer with 16,384 words of core memory, programmer's console, operator's panel, and four desk-mounted typewriters. The system will continuously and automatically select and measure 300 analog in-

puts under programmed control. Each point will be assigned a numerical identification number and will be compared against a fixed high and/or low alarm limit when specified, at each scan cycle. The scan rate will be a maximum of 40 points per second. Alarming will have a high priority of system functions. Due to the high speed of the computer and its time-sharing features, it will not be necessary to stop its scanning function in order to convert and print the alarm values.

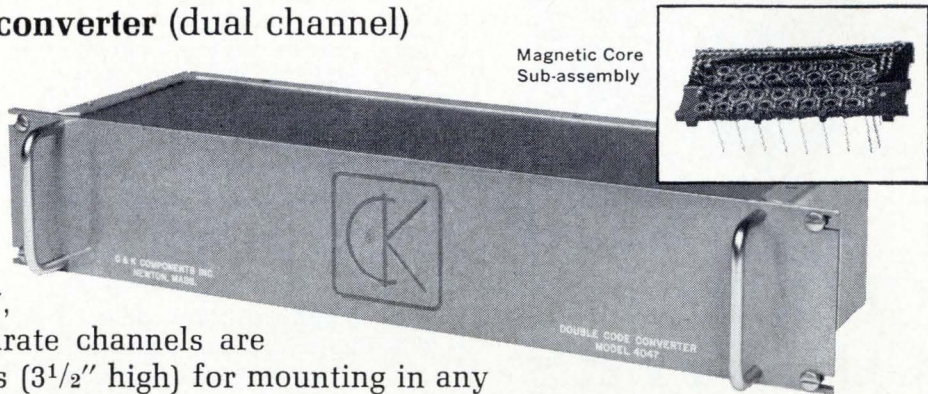
SCIENTIFIC DATA SYSTEMS WILL SOON BECOME THE FIRST COMPUTER MANUFACTURER TO HAVE ITS COMPLETE LINE OF EQUIPMENT PRODUCED AND MARKETED OVERSEAS, it was announced recently at a New York press conference by SDS President Max Palevsky. Mr. Palevsky said that long-term agreements have been signed granting manufacturing and marketing rights for all SDS computers and related equipment to Compagnie Pour L'Informatique et Les Techniques Electroniques de Controle (CITEC), Paris, France, and The General Electric Company, Ltd., (GEC), Wembley, England. Both companies, ranked as two of the largest electronic firms in Western Europe, will begin production of the SDS 92, 930, and 9300 computers in the near future. The SDS 910, 920, and 925 computers will also be available to customers of GEC and CITEC. Terms of the agreements include payment to SDS for all SDS equipment manufactured overseas and reciprocal provisions that provide SDS with manufacturing and distribution rights for GEC and CITEC equipment in the United States, Canada, and throughout the Far East.

A complete series of  
fixed-constant read-only memories,  
function generators, and look-up tables...

# Magnetic Code Converters

## model 4047 magnetic code converter (dual channel)

C & K's **Model 4047** Magnetic Code Converter is designed for use in data processing operations for the conversion of **one** 7, 8 or 9-bit code to **another** 7, 8 or 9-bit code. **Two** separate channels are provided in a single chassis (3 $\frac{1}{2}$ " high) for mounting in any standard relay rack. **Model 4047** utilizes magnetic tape-wound cores (see insert) and silicon circuitry to provide readouts of arbitrary binary functions.



## model 4043 magnetic code converter

**Model 4043** Magnetic Code Converter accepts a parallel 8-bit "argument" as an **input** and produces a parallel 8-bit function as an **output**. The 256 binary "function" numbers are completely arbitrary — they are specified by the user and permanently wired into the 32-bit core matrix.



with cover removed

## magnetic Timers

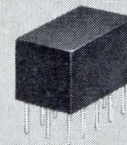
C & K Magnetic Timers provide long counting intervals with very economical power consumption, small size and light weight; they are encapsulated in epoxy resin for maximum mechanical stability.



Model  
4292

## magnetic Logic Elements

C & K Magnetic Logic Elements may be combined to produce magnetic timing and control systems. A complete line of compatible pulse drivers, output code detectors and gating circuits are available!



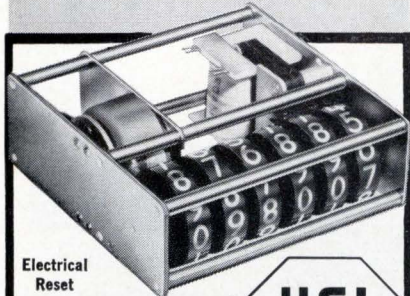
Model  
4333  
(approx. actual size)

**C&K**  
COMPONENTS, INC.

low power digital/magnetic timing and control devices  
101 Morse Street, Newton, Massachusetts 02158  
Telephone: 617 926-0800

*Absolutely  
Reliable*

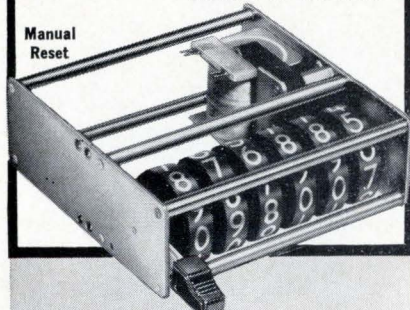
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PLANETGEAR®  
PRINCIPLE!**



**HSI**

## Digital CLOCKS and COUNTERS

*Never Slip, Skip or  
Miss a Count!*



This amazing feat is accomplished because with HSI PLANETGEAR the gears are always in mesh... even while resetting!

You need these trustworthy components if you have applications where there are demands for digital devices which:

- ... offer maximum rapid drum transfer.
- ... give high speed counting (over 2000 RPM).
- ... give infallible accuracy.
- ... long life at high speeds.

HSI has prepared a *gold mine* of scientific and technical data on its PLANETGEAR Pulse Counters and on the revolutionary Digital Stop Clocks and Time Totalizers. Without the slightest obligation write Haydon Switch & Instrument, Inc., 1500 Meriden Road, Waterbury, Conn. 06720 for Bulletins No. 44-1R (Counters) and No. 42-2R (Clocks).

**HSI**

**HAYDON SWITCH &  
INSTRUMENT, INC.**

1500 MERIDEN ROAD  
WATERBURY, CONN. 06720

CIRCLE NO. 8 ON INQUIRY CARD

## INDUSTRY NEWS

THE FIRST UNIVAC 1830, A NEW MICROELECTRONIC MILITARY COMPUTER, HAS BEEN DELIVERED to the Naval Air Development Center (NADC) Johnsville, Pennsylvania, by the Sperry Rand Corporation's UNIVAC Defense Systems Division. Also labeled the CP-823/U (a Department of Defense designator), the computer was developed under a contract with NADC and the U. S. Navy Bureau of Weapons. It will serve as the nucleus of the Navy's A-NEW Program, an improved airborne Anti-Submarine Warfare Tactical Command and Control System. Once integrated with other components of the system in an airborne environment, the miniaturized computer will be required to perform a multiplicity of functions, a decided improvement in accuracy and efficiency over present manual methods.

A VIDEO DATA DISPLAY UNIT FLASHING ANSWERS ON A CATHODE RAY TUBE DIRECTLY FROM A COMPUTER 100 MILES AWAY WAS DEMONSTRATED by RCA at the recent International Federation for Information Processing Congress in New York. The unit permits the operator to visually interrogate and receive answers from the computer, located at Cherry Hill, N. J., on what closely resembles a 14-inch television set. Video interrogation and display systems are an integral part of the real-time capabilities of the new RCA Spectra 70 Series. The RCA video displays handle messages of up to 480 characters — let-

ters, numerals or other symbols — flashed on the 14-inch cathode ray tube screen. The interrogating keyboard makes it possible to write a message on the video display which can be corrected by retyping. Once the message on the screen is correct, the entire message or inquiry is sent along to the computer by pressing a single button.

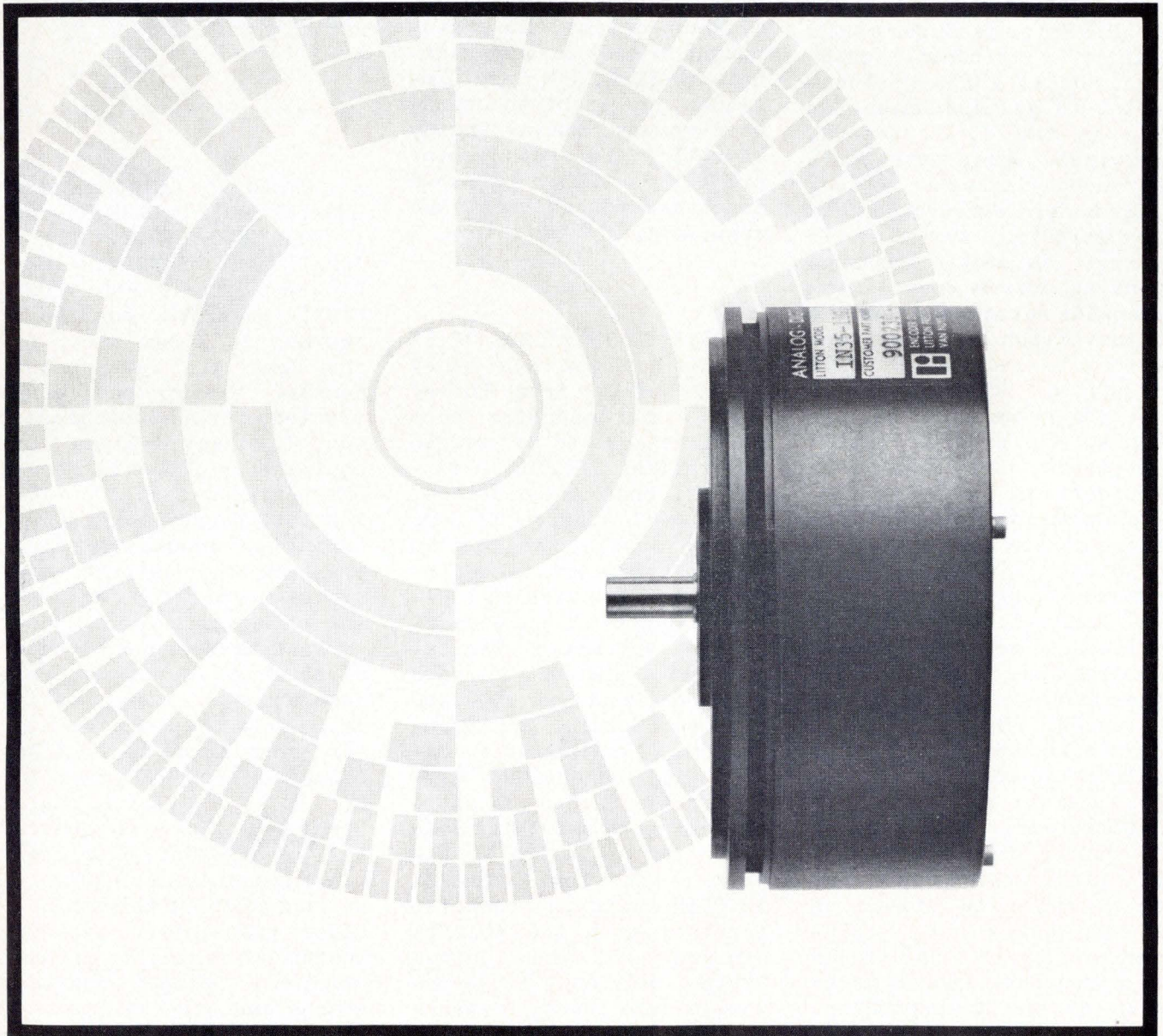
A \$700,000 CONTRACT FOR A FILM DATA READOUT SYSTEM HAS BEEN AWARDED to General Precision's Link Group by the Rome Air Development Center. To extract useful information from a large volume of multi-formatted film data inputs, the system will consist of three functionally discrete stations, each designed to handle various types of film. Station I, the film preparation station, initially receives the unedited but processed film where it is edited, spliced, titled, classified, and dated. At Station II, each film frame is sequentially assigned a number by means of an automatic recording process (equipment to be built by Xerox under sub-contract from Link). The number of each frame is then automatically correlated with its time of exposure and the information documented on paper tape for later computer analysis. The film and punched tape then go to Station III which is primarily a photo interpreter's viewing facility consisting of a control panel, viewing screen, associated electronics, tape reader, and a card punch. The interpreter conducts a frame-by-frame analysis of each film, singling out those frames containing useful data. He then documents on punched cards a complete case history of the frames of interest.

# FIRST SOLID-STATE OPTICAL ENCODERS—NO LIGHT BULBS

Rugged, durable gallium arsenide light sources are used in the new Litton solid-state optical encoders, guaranteeing exceptional reliability under extreme environments. Tungsten lamp instabilities and failures—a chronic problem with conventional photoelectronic shaft-to-digital encoding devices—are eliminated. Both power consumption and heat dissipation are far less than for comparable ordinary optical devices. MTBF—very conservatively rated—is 30,000 hours. The high reliability of all Litton solid-state encoders under adverse conditions is exemplified by the 2<sup>11</sup> incremental Model No. IN35-11G1 shown. It operates dependably and accurately during 70-g shocks and recovers from 105-g shocks. The case,

including associated electronics, is size 35. Operating speed is 480 rpm. Other environmental characteristics meet or exceed applicable military specifications. While especially well suited to applications employing incremental positioning devices, the Litton solid-state optical encoding technique can be applied to absolute position encoders and any code pattern. For details, write: 7942 Woodley Ave., Van Nuys, California. Phone 213-781-2111. New York: 212-524-4727. Chicago: 312-775-6697.

**LITTON INDUSTRIES  
ENCODER DIVISION**



Optical Solid-State Optical Magnetic Contact

CIRCLE NO. 9 ON INQUIRY CARD

## INDUSTRY NEWS

THE DESIGN CONCEPT OF A CIRCUIT SWITCHING NETWORK FOR A HIGH-SPEED, AUTOMATIC RECORD COMMUNICATION SYSTEM which the U. S. Government will begin operating this year was described recently by an ITT engineer. Speaking before the 19th Annual Armed Forces Communications and Electronics Association Convention, John E. Cox, senior project engineer at ITT Federal Laboratories, Nutley, N. J., detailed major features of the circuit switching equipment supplied under subcontract to Western Union for use in the U. S. General Services Administration's advanced record system. This modern electronic data transmission system will permit automatic message sending over a complex nationwide network without the intervention of operators either to start or receive messages. The circuit switching network is intended to provide rapid, automatic, and direct communications channels between various government offices across the country. A major advantage of the advanced record system is that it will allow government offices to send and receive messages during hours when the offices are normally unattended. Many automatic maintenance features are incorporated into the system. For instance, a signal is automatically displayed on a trouble indicator panel if a call is made to an office which fails to switch on automatically its teleprinter, or if a call fails to disconnect upon completion of the transmission. By this means, any teleprinter which is not func-

tioning properly will be automatically brought to the attention of maintenance men when an attempt is made to call that line.

NASA HAS RECEIVED AN ASI 2100 DIGITAL COMPUTING SYSTEM FROM ADVANCED SCIENTIFIC INSTRUMENTS, MINNEAPOLIS, MINN. The ASI 2100 is installed and operating in a hybrid computer system at the Computation Laboratory of NASA's George C. Marshall Space Flight Center, Huntsville, Alabama. It is coupled to an analog computer to facilitate mathematical simulation of a wide range of aerospace systems and allied problems. The system bought by NASA cost approximately \$207,000, and includes an eight-thousand-word memory, multi-density magnetic-tape system, line printer, high-speed punched-card equipment and input/output typewriter.

A CONTRACT IN EXCESS OF \$1 MILLION has been received by Ampex Corp., from Philco Corp., for magnetic core memory stacks to be used in specialized Philco computers. Under the contract, Ampex will supply 192 core memory stacks for use in Philco computers to be installed at 10 overseas locations as part of the Government's Automatic Digital Network (AUTODIN). Each stack consists of 500,000 lithium cores, 22 thousandths of an inch in diameter, and associated circuitry. The Philco computers will serve as switching centers for the AUTODIN network. The ten overseas AUTODIN switching centers, together with the AUTODIN centers in the United States, will constitute the worldwide digital network of the Defense Communication System.

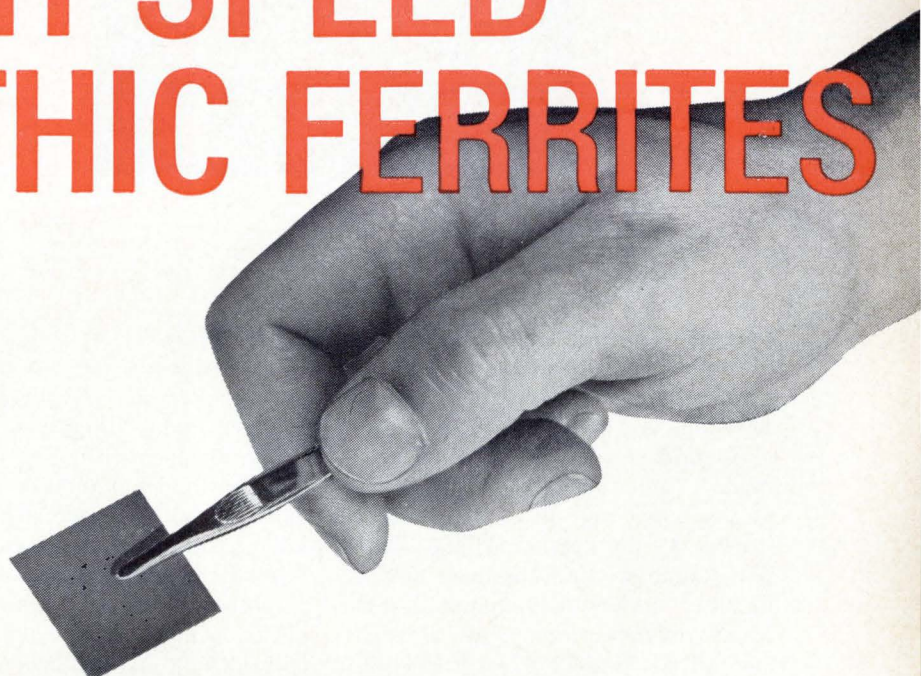
A COMPUTER PROGRAM TO ASSIST ENGINEERS OF THE FEDERAL COMMUNICATIONS COMMISSION TO DEVELOP RECOMMENDATIONS FOR NATIONWIDE ASSIGNMENT OF UHF TELEVISION STATIONS has been developed and delivered to the agency by Sperry Rand Corp's Univac Div. This is the first time that FCC engineers have used a computer for planning allocation of channels. The program was developed by Univac under a competitive bid contract, for use on the FCC's UNIVAC III Computer, installed in 1963. The computer has been used to process applications for the Citizens Radio Service, amateur radio operations, and for broadcast engineering and computational work.

A CONTRACT TO DEVELOP A SELECTIVE PHOTO COPIER FOR USE IN COMPUTER SYSTEMS THAT AUTOMATICALLY TRANSLATE FOREIGN SCIENTIFIC AND TECHNICAL MATERIAL has been awarded to Xerox Corp. by the Rome Air Development Center. Xerox has contracted, for an undisclosed sum, to develop plans for equipment which will separate printed text from illustrative and pictorial material in documents being prepared for computer-assisted translation. According to Benjamin Parran, assistant vice president and director of Xerox systems development, "some estimates show the requirements for translation of foreign documents into English to be almost a million pages per year. To help answer this requirement, character reading equipment which will be used as input to machine-aided translation systems must have the ability to discriminate between charts, graphs and other illustrations from text material to be translated."



**A totally new memory technology from RCA**

# NEW BATCH-FABRICATED HIGH-SPEED MONOLITHIC FERRITES



Each monolithic array contains 4096 "virtual cores" with an effective diameter of only 5 mils within a single, solid, sintered ferrite wafer only 1 in. by 1 in. by 0.005 in.

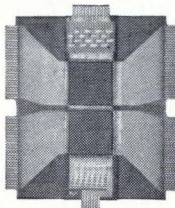
RCA monolithic ferrites offer all the proved advantages of ferrite technology plus:

□ **Potentially much lower cost** than wired core-memory planes because RCA monolithic ferrites can be mass-produced with standard ceramic processing techniques.

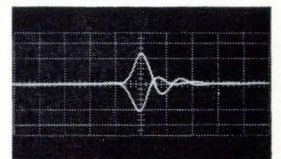
□ **High-density packaging.** Type MF 2100 unit, as shown, is complete with two monolithic memory wafers, and an integral diode matrix assembly. It requires only 3.75" x 4.5" for a memory capacity of 4096 bits in two "core"-per bit linear-select operation.

□ **Very high speed.** Full cycle time (read, delay, write), as low as 0.2 usec for 64 x 64 array.

□ **Low drive current requirement.** Less than present small-core memories: only 400 ma read, 120 ma write for 45 mv output and 35 nsec switching time.



□ **High output voltage.** Equal to conventional cores. Trace indicates over 50 mv each for differential 1 and 0 output. Compare this with other bulk-fabricated systems having output voltages of only 1 or 2 mv.



... and no stringing

TYPICAL PERFORMANCE IN 64 x 64 ARRAYS									
READ CURRENT			WRITE CURRENT			DIGITS		TYPICAL OUTPUTS	T <sub>s</sub>
I <sub>ma</sub>	T <sub>d</sub> (50%) ns	T <sub>r</sub> T <sub>f</sub> ns	I <sub>ma</sub>	T <sub>d</sub> (50%) ns		I <sub>ma</sub>	T <sub>d</sub> (50%) ns	1 & 0 mv	nsec
400	110	45	100	120		30	200	35	60
400	80	30	120	100		30	200	45	35
400	60	30	150	30		30	100	30	35

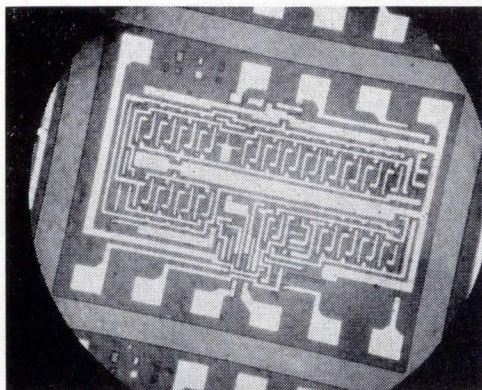
Available now in developmental 4096-bit arrays for testing and evaluation. Call your local RCA Sales Office or write today for information to: RCA Electronic Components & Devices, Memory Products Operation, 64 "A" Street, Needham Heights, Mass. (617) HI 4-7200.



**The Most Trusted Name in Electronics**

CIRCLE NO. 10 ON INQUIRY CARD

## AN MOS INTEGRATED CIRCUIT SHIFT REGISTER REPLACES 21 FLIP-FLOPS



Recently, General Instrument Corp. of Hicksville, N.Y., announced the formation of a new Microelectronics Division which will develop and mass-produce complex MOS (metal-oxide semiconductor) integrated microcircuits and field effect transistors. At the same time, the company announced development of the first two devices — a unique 21-bit MOS microelectronic shift register and an MOS field effect transistor with built-in protection against over-voltages.

The 21-bit shift register contains 110 transistors and 48 resistors built into the silicon wafer in a complex pattern virtually invisible to the naked eye. Almost a complete computer sub-system on a pinhead-size chip, it performs the functions of 21 separate flip-flops. It is one of the most complex microelectronic devices ever produced commercially, according to the company.

The MOS 21-bit shift register is really 3 shift registers in one package sharing common supply and clock voltages. The three can be used either independently or connected in series to give a total of 21 bits of delay to an arbitrary data stream. Each bit of delay has a cross-coupled flip-flop, in order that data might be stored indefinitely between shift pulses. Only a single phase shift pulse has to be supplied; the additional 180° out of phase pulse is generated by an inverter in the chip. The outputs will change on the trailing edge of the shift pulse, that is, when it goes from -10 to 0 volts. However, there is sufficient built-in delay so that an output won't start changing appreciably until the shift pulse is completely to zero, if the fall time of the shift pulse is less than 100 nsec. This delay makes it possible to transfer data from outputs of shift registers to inputs without any difficulty.

The supply voltage for the output stages can have any value between ground and -22 volts. By keeping the supply voltage down to a few volts, it is possible to have this shift register drive other types of low voltage NPN transistor logic. The shift pulse can be regularly supplied from a clock generator or it may be supplied aperiodically through logic networks. The shift pulse amplitude requirement is the same as the required logic swing. It is possible to use the shift register with low voltage NPN transistor logic if desired, however, it is more convenient to use the register with either MOS logic or large voltage swing PNP transistor logic.

The new shift register, according to the company, will cost less than \$75 compared with a total of \$136.50 for 21 flip-flops.

In military applications, the new shift register will also mean substantial cost reductions. According to company reports, the \$97.50 price of the military version compares with a cost of \$735 for 21 flip-flops of military quality. The military units are designed especially for space use — where power drain from batteries can be crucial. Each of the shift registers uses less than one-sixth the amount of power (100 milliwatts) needed by the 21 microelectronic flip-flops it replaces (630 milliwatts).

Because its output is compatible with both RTL and DTL logic, the new shift register can be used in existing systems (as well as new MOS equipment) and in conjunction with associated equipment built of discrete components, or fully integrated or hybrid microcircuits. The systems designer can select, by simple pin connection, the type of output he wants.

Circle No. 103 on Inquiry Card

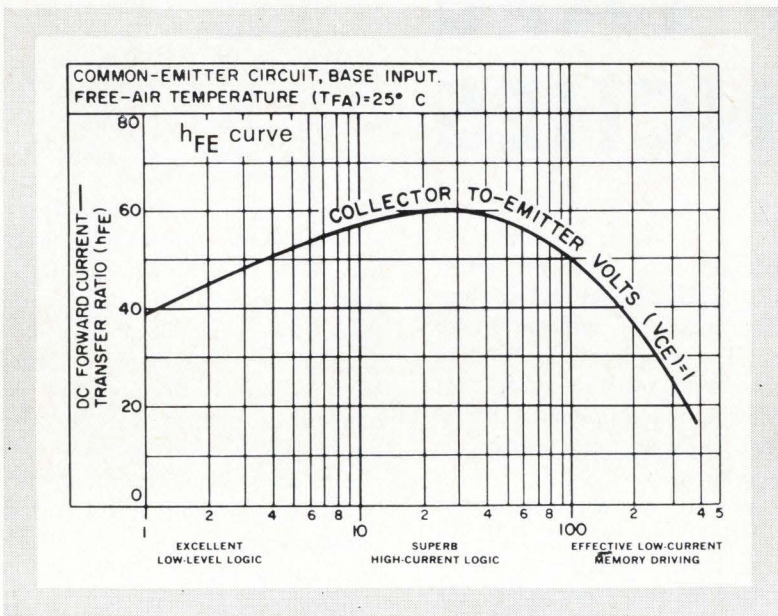
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For additional information on editorial or advertised items  
in this issue . . . . .

Circle numbers on inquiry card opposite page 64.

# NOW YOU CAN DESIGN A WIDER VARIETY OF HIGH-SPEED COMPUTER LOGIC CIRCUITS WITH A SINGLE TRANSISTOR TYPE

## THE NEW RCA 2N3261 COMPUTER LOGIC SWITCHING TRANSISTOR



Provides better high-speed saturated switching performance above 100 ma than any other commercially available transistor

Here's the closest thing yet to a "universal" high-speed computer logic switch: the new RCA silicon N-P-N 2N3261 (formerly developmental type TA2332). Designed for use throughout the entire logic section of a high-speed computer, its exceptionally broad current capability fits it for all functions from low-level logic to high-speed, high-current logic to low-current memory driving. Interdigitated planar epitaxial construction assures low saturation voltages at high currents and extremely low leakage currents, and also provides excellent mechanical and electrical reliability.

**EFFECTIVE CURRENT CAPABILITY** ranges from less than 10 ma to over 250 ma. Because of its high current capability, logic circuits can be operated at higher current levels to minimize

the effects of circuit capacitance. The 100 Mc h<sub>FE</sub> at 100 ma I<sub>C</sub> and only 1 volt V<sub>CE</sub> is 4.4 (typical). The 2N3261 also offers 9 nsec turn-on time and 11 nsec turn-off time at 100 ma I<sub>C</sub>.

**BROAD CURRENT CAPABILITY PERMITS BROAD APPLICATION.** In addition to high-speed computer logic applications, the 2N3261 is ideally suited to digital circuit applications in telemetry, communications equipment, digital test equipment and direct digital process control equipment.

**READILY AVAILABLE AT LOW COST:** RCA 2N3261 is available at \$2.00 each in quantities of 1,000 and up. It can be used as a direct replacement for the popular 2N2369A—but offers better performance per dollar. For more information, fill out and mail the coupon at right.

AVAILABLE THROUGH YOUR RCA DISTRIBUTOR



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**The Most Trusted Name in Electronics**

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- Please send Technical Bulletin on RCA 2N3261.
- Please send Technical Paper No. ST-2667 on RCA 2N3261.
- Please have RCA Field Engineer telephone me at (No.) \_\_\_\_\_ (Ext.) \_\_\_\_\_

Name \_\_\_\_\_ Title \_\_\_\_\_

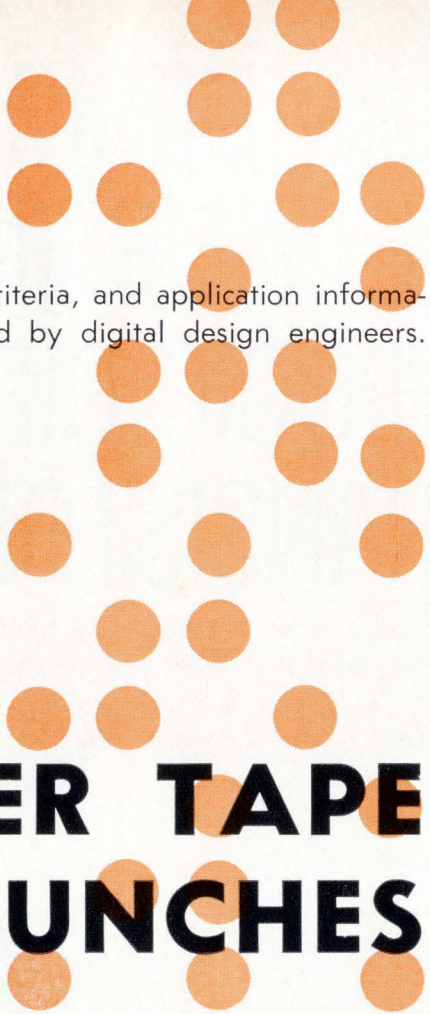
Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

## PRODUCT REFERENCE FILE

Background concepts, selection criteria, and application information on a class of products used by digital design engineers.

A vertical column of orange circles of varying sizes, arranged in a pattern that resembles a staircase or a series of steps, running down the center of the page.

# PAPER TAPE PUNCHES

The January 1965 issue of *COMPUTER DESIGN* featured a comprehensive survey of perforated tape readers. To complete the Product Reference File on the subject of perforated tape equipment, similar coverage of paper tape punches is presented here.

However, in contrast to the tape reader article, this report will not go into as much detail on the internal design of the equipment; the major emphasis here will be on the performance characteristics of commercially-available punch units.

WILLIAM A. GANNON,  
*Contributing Editor*

Regardless of the application, the selection of paper tape punches represents a key decision on the part of the digital systems designer. Fundamental operating characteristics, product specifications, application considerations, and price comparisons of 25 different models of tape punches are reviewed and summarized here for quick reference by digital systems designers. For best results, final selection of tape punches should be made only after consultation with the punch manufacturer. However, this survey report will assist the systems designer in narrowing down the selection of

punches to the most applicable few without undue deliberation and product research.

Although these punches are commonly referred to as "paper" tape punches, almost all commercially-available units are capable of punching other materials such as Mylar, paper-coated Mylar, etc.

Paper tape punches have been in use for many years as data recording devices. In the past few years, there has been a sustained increase in the number and variety of tape punch applications. This increase is due in part to design improvements and in part to demands imposed by new applications.

The application areas for tape readers were described in last January issue's survey article and they obviously apply to the punches. Broadly categorized, today's major applications include computer output, data logging and data acquisition, message and data communications systems, numerical control, and automatic testing operations.

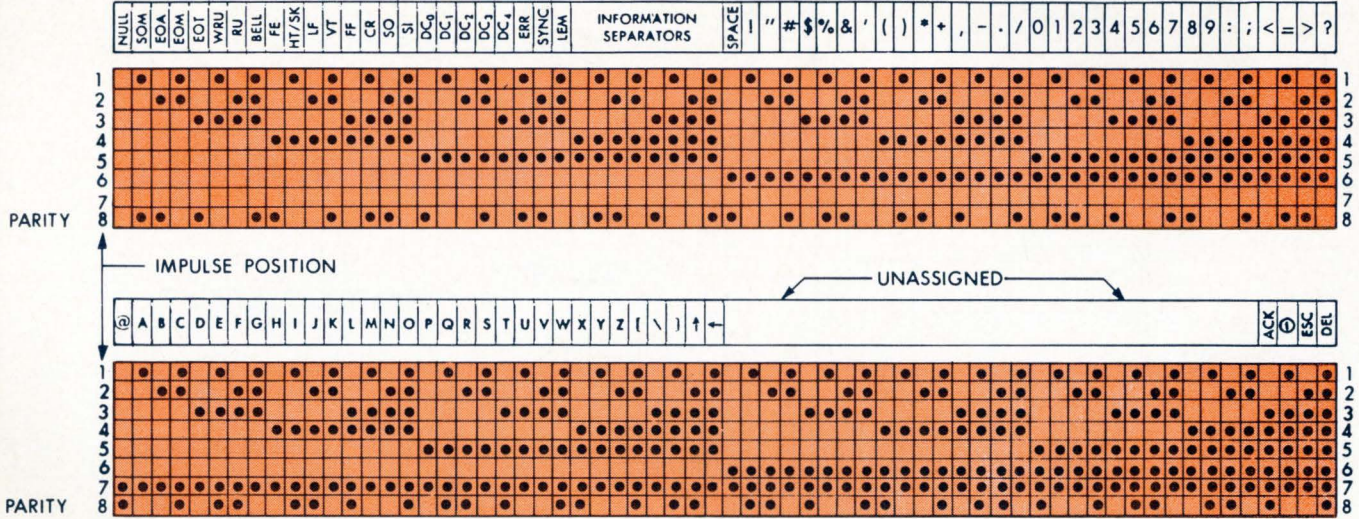
Punched tape has many advantages over other recording media. It is less expensive and less vulnerable to variations in moisture and temperature. In contrast to magnetic tape, punched data cannot be erased.

## TAPE STANDARDS

The January issue's tape reader article summarized the 8-channel hole code standards as proposed in

*A. W. Cannon*

**TABLE 1 ASCII 8-Level Code**



EIA Standard RS-244. However, as was pointed out by letters we received from many readers, we had neglected to include the American Standard Code for Information Interchange (ASCII). This 8-level code is shown here in Table 1. A proposed minor revision that includes completion of code assignments of the ASCII has been made by ASA.

**BASIC PUNCH DESIGNS**

There are many differences in the basic design of tape punches currently being marketed, while tape dimensions, hole codes, and channel capacities (5, 6, 7, or 8) remain standard. The basic function of the punch, of course, is to react to incoming pulses by activating punch pins which are forced through paper, Mylar, vulcanized fiber or aluminized tape. The particular punch pins to be energized correspond directly to the bit configuration of the character to be recorded.

The perforating action of tape punches dictates an electromechanical design approach requiring special consideration for the inherent problems of inertia, vibration,

noise, and mechanical wear. As punching speeds increase, punch design problems become more acute. For example, in a 300 char./sec. punch, shaft rotation rates up to 9,000 RPM are likely with feed shafts rotating up to 18,000 RPM. Also, at this speed, one cubic inch of chad (confetti) forms every 6 seconds when punching 8 channels. Removing the chad so that it does not clog the punch mechanism is a necessary precaution.

Frequently used devices for acti-

vating punch pins are solenoids, reciprocating cams, motor-driven clutches, tuned reeds, and electromagnets.

**Solenoids**

Solenoid-actuated punch mechanisms employ one solenoid for each channel and one for punching the sprocket hole. Also, the functions of bail and transport each require two solenoids. A maximum of 13 solenoids would then be required for an eight-channel punch. The

**LEGEND**

<b>NULL</b>	Null/Idle	<b>DC<sub>1</sub>-DC<sub>2</sub></b>	Device control
<b>SOM</b>	Start of message	<b>DC<sub>1</sub> (Stop)</b>	Device control (stop)
<b>EOA</b>	End of address	<b>ERR</b>	Error
<b>EOM</b>	End of message	<b>SYNC</b>	Synchronous idle
<b>EOT</b>	End of transmission	<b>LEM</b>	Logical end of media
<b>WRU</b>	"Who are you?"	<b>S<sub>0</sub>-S<sub>1</sub></b>	Separator (information)
<b>RU</b>	"Are you . . . ?"	<b>b</b>	Word separator (space, normally non-printing)
<b>BELL</b>	Audible signal	<b>∧</b>	Less than
<b>FE<sub>0</sub></b>	Format effector	<b>∨</b>	Greater than
<b>HT</b>	Horizontal tabulation	<b>↑</b>	Up arrow (Exponentiation)
<b>SK</b>	Skip (punched card)	<b>←</b>	Left arrow (Implies/ Replaced by)
<b>LF</b>	Line feed	<b>/</b>	Reverse slant
<b>V<sub>TAB</sub></b>	Vertical tabulation	<b>ACK</b>	Acknowledge
<b>FF</b>	Form feed	<b>⊖</b>	Unassigned control
<b>CR</b>	Carriage return	<b>ESC</b>	Escape
<b>SO</b>	Shift out	<b>DEL</b>	Delete/Idle
<b>SI</b>	Shift in		
<b>DC<sub>0</sub></b>	Device control reserved for data link escape		

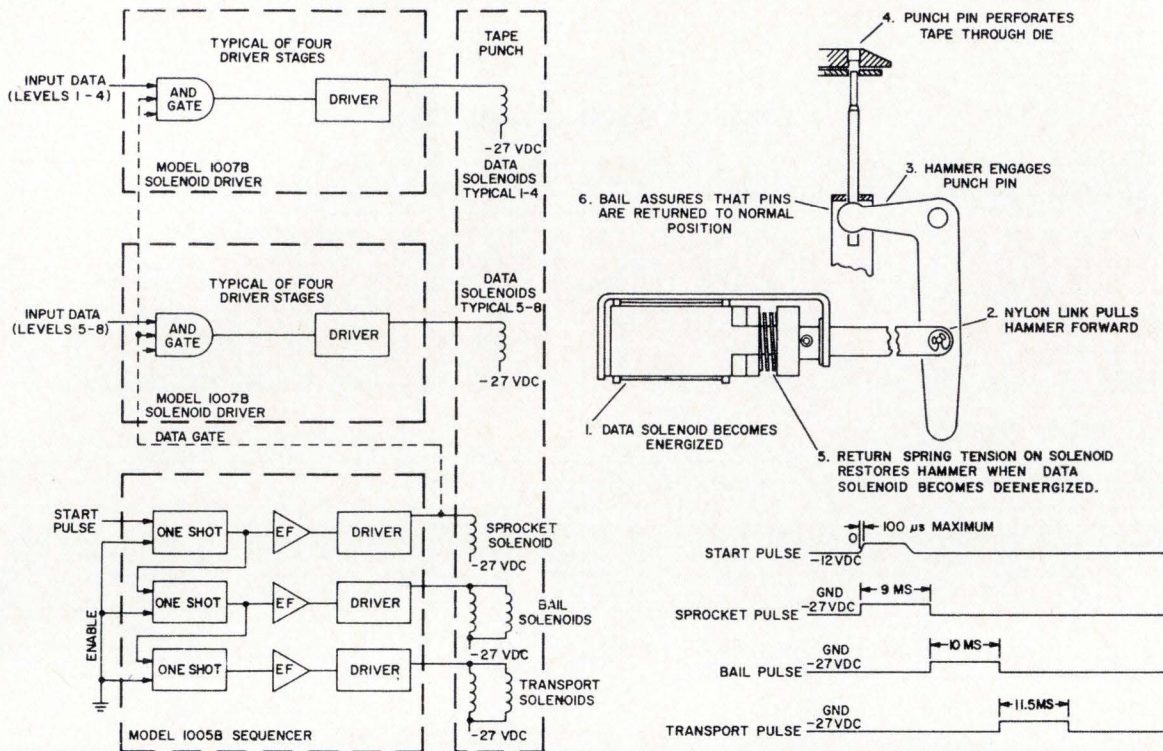


Fig. 1 Example of the mechanization and sequencing operation of a solenoid punch. This punch is manufactured by Invac Corp. Only one solenoid and punch pin is shown in upper right diagram. The schematic on the left depicts two accessory driver modules needed for a 5 through 8-level punch operation, a sequencer module supplied with each punch, and the punch itself.

mechanization and sequencing of a punching operation incorporating solenoids is shown in Fig. 1. The sprocket, bail, and transport solenoids are activated by output pulses from a sequencing device. The first of three pulses activates the sprocket solenoid which causes its associated punch pin to perforate the sprocket channel. Sprocket holes may be punched without data holes in order to produce a tape leader. When data holes are to be punched they are punched simultaneously with the sprocket holes. The second sequential pulse energizes the bail solenoid which causes the bail mechanism to return the punch pins to their normal positions. The third pulse energizes the tape transport solenoids which enables the transport mechanism to advance the tape. The sequencing of the punch, bail, and transport operations is also shown in Fig. 1.

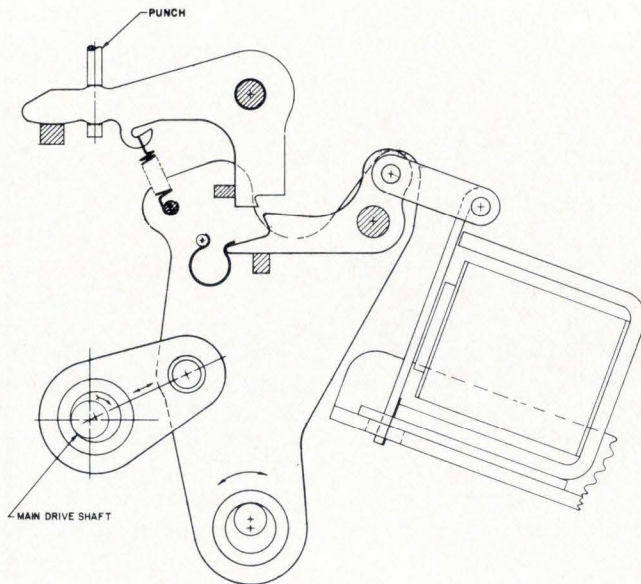


Fig. 2 Basic punch mechanism by Royal Typewriter uses the holding power of small efficient electro-magnets combined with off-center springs to activate the punch pins.

## "PERFORATED TAPE READERS"

### A 20-Page Reprint Now Available

The industry-wide survey of perforated tape readers that appeared as the Product Reference File feature in the January 1965 issue of COMPUTER DESIGN is now available as a 20-page reprint.

Providing a comprehensive analysis of the design and performance characteristics of commercially-available perforated tape reading equipment, this survey article serves as an excellent reference for evaluating and selecting a tape reader for a particular application.

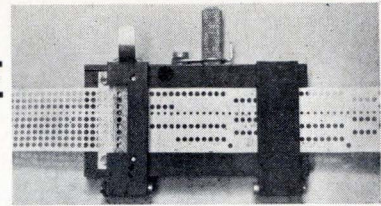
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### Reciprocating Cams

One approach to providing the reciprocating motion required for cycling the tape feed and punching operations is the use of triangular cams driven from a constant rotational power source. This type of mechanism is used in Soroban Engineering's Model GP-2 "Super-Speed" Perforator. The three lobe cam systems permit generation of reciprocating motions free of resonance effects which may occur with conventional spring load cam-followers operating at high speed.

In the Soroban design, positive following is maintained throughout the complete punch operation cycle. In addition, the dwell intervals produced by the three-lobe cams eliminate the impacts and adjustment instabilities which may be encountered when coupling and decoupling comparable feed and punching loads to more common sinusoidal drive

sources. A complete description of this type of punch mechanism is in Soroban's general catalog.

### Electro-Magnets

The Industrial Products Div. of Royal Typewriter has a patented scheme which uses the holding power of small, efficient, electro-magnets combined with off-center springs to activate the punch pins. The electro-magnets require less than 2 watts for up to 50% of duty cycle at up to 3000 RPM of main shaft. This basic mechanism is shown in Fig. 2. A tape punching mechanism used by National Cash Register is described in Fig. 3.

### Clutches

Punch mechanisms controlled by motor-driven clutches are offered by Tally. The clutches are activated

by a pulse which is simultaneously applied to electro-magnets. When the electro-magnets are energized, the clutch assembly rotates one-sixth of a turn causing the satellite gear on the clutch periphery to rotate and thereby force the corresponding punch pin through the paper. This mechanism is illustrated in Fig. 4.

### Tuned Reeds

A unique tape punch developed by Teletype Corp. does not require energy from a motor to punch the tape. Instead, this energy is stored in a tuned reed while it is attracted to a magnet. The reed (a steel bar) and its associated magnet and electronics are tuned to operate as a unit at a certain frequency. A reed is linked to a punch pin for each code level. When the reed is released by its respective magnet, the

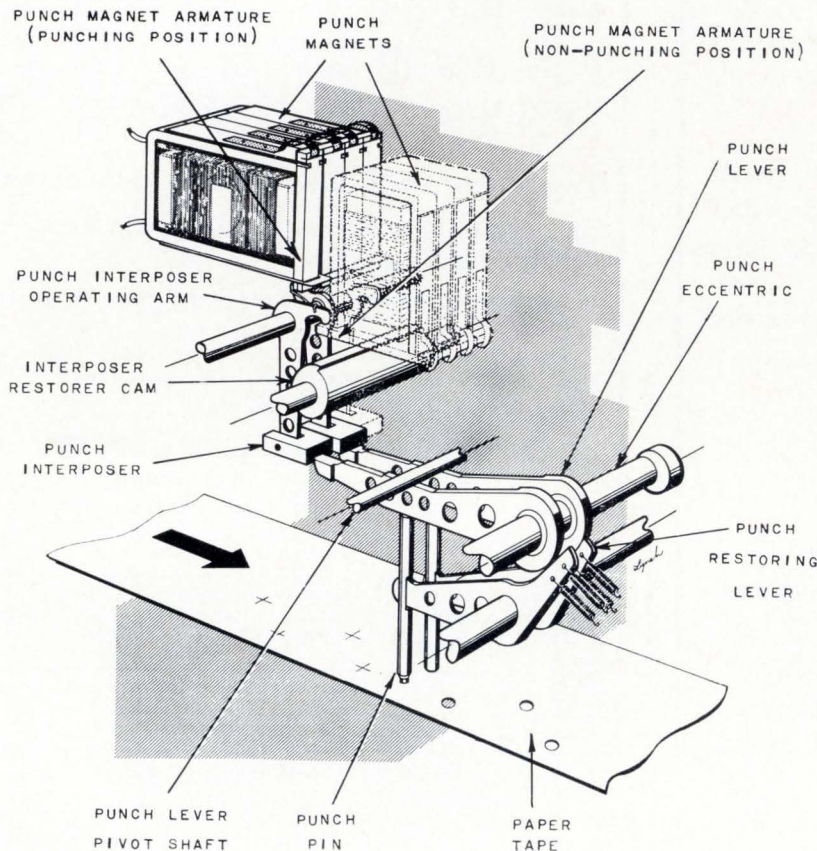


Fig. 3 The punch head manufactured by National Cash Register contains nine punch mechanisms; however, only two are shown here. Each tape punch mechanism punches a hole in paper tape when its associated punch magnet is energized by an external control at the proper time in the punch drive cycle. Eight of the punch mechanisms punch coded data in either 8, 7, or 5 channel codes. The ninth punch mechanism punches a feed sprocket hole every time a tape character is punched by the data punch mechanisms. The punch magnet associated with the punch mechanism in the foreground is shown de-energized to illustrate a non-punching operation. The punch magnet for the punch mechanism in the background is shown energized to illustrate a punching operation.

punch pin is driven through the tape. This mechanism is capable of operating at any speed up to 200 char./sec.

**Electrostatic Recorder**

As explained in the previous perforated tape reader survey, one company's photoelectric reader operates

on a reflected light principal. Thus, this company, Omnitronics, Inc., also offers an electrostatic recorder that fixes black powdered-ink spots on tape in the identical code configuration as that used on punched tape. A high-resistivity plastic-coated paper tape with a conductive backing is passed through the "writing" head which consists of two sets of closely-separated elec-

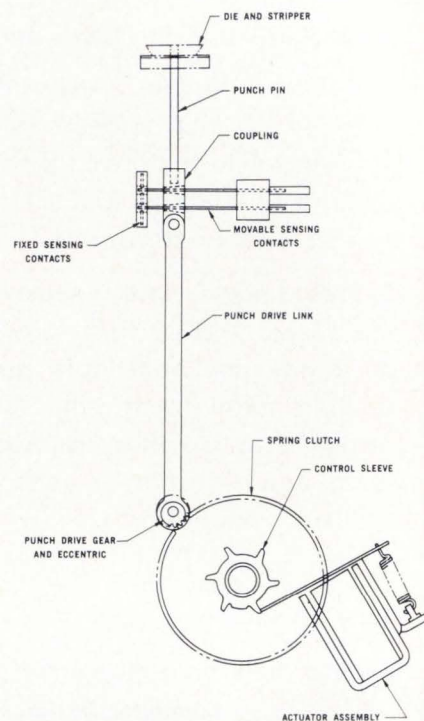


Fig. 4 New clutch assembly design used in Tally Corp.'s P-120 punch is said to work one-third as hard as previous designs. To record a character, an electric pulse is simultaneously applied to the electro-magnets of the escapement assemblies controlling the punches for a given character. When the electro-magnets are energized, the corresponding armatures are momentarily disengaged from the clutch control sleeves, permitting the clutch assemblies to rotate one-sixth turn. The gear on the periphery of the clutch assembly rotates the corresponding eccentric one full revolution, sending its punch pin through one up-and-down cycle to perforate the tape. Before the clutch completes the one-sixth revolution, the escapement armature has been released, engaging the clutch control sleeve and stopping the rotation of the clutch assembly.

trodes. Pulsing the electrodes leaves an electrostatic charge on the surface of the tape. The tape is then passed through dry powdered-ink which adheres to the charged areas in tiny capsule-shaped spots. These spots are then permanently fixed. The entire process — on-line, dry, and non-mechanical — is completed at the rate of 60 inches of tape per second.



## Selection Considerations

To satisfy varied user requirements, most manufacturers offer basic punch mechanisms with or without housing, feed and take-up reels, drive mechanism, and interface logic. This is advantageous for those users who intend to interface the punch with other equipment which is capable of providing mechanical drive and timing. This flexibility also satisfies the needs of the users who require a punch complete with timing, drive, logic, amplifiers, and mounting hardware.

Systems designers consider punching speed one of the most important functional characteristics when selecting a punch. The commercially-available punches discussed in this article operate at speeds ranging from 10 to 300 char./sec. (cps). The slow-speed (10 cps) units are generally interfaced with electric typewriters, page printers, and other keyboard devices which are used when an operator is preparing tapes. For recording bursts of output data from a computer, acquisition system, or logging device, medium or high-speed (60 to 300 cps) perforators are usually required. If a 10 cps punch is used to produce an object tape as a computer output, it is conceivable that the punching operation would take a few hours for a program of a few thousand instructions. The additional cost for a faster punch (in many applications) is certainly warranted when considering the attendant savings in computer output time.

Although some punches can be adjusted to punch either 5, 6, 7, or 8 channels, the 8-channel codes offer greater storage capacity as well as parity checking. Until recently, 5-level codes were used extensively in communications equipment. Now, however, 8-level ASCII code is an American standard. In the graphic arts industry, 6-level tapes with advanced feed holes are commonly used. In selecting the channel capacity, the system designer must consider code compatibility implications in order to avoid expensive buffering and code conversion equipment.

To maintain recording accuracy, punches are available which sense parity errors before punching and then inhibit punching when a parity

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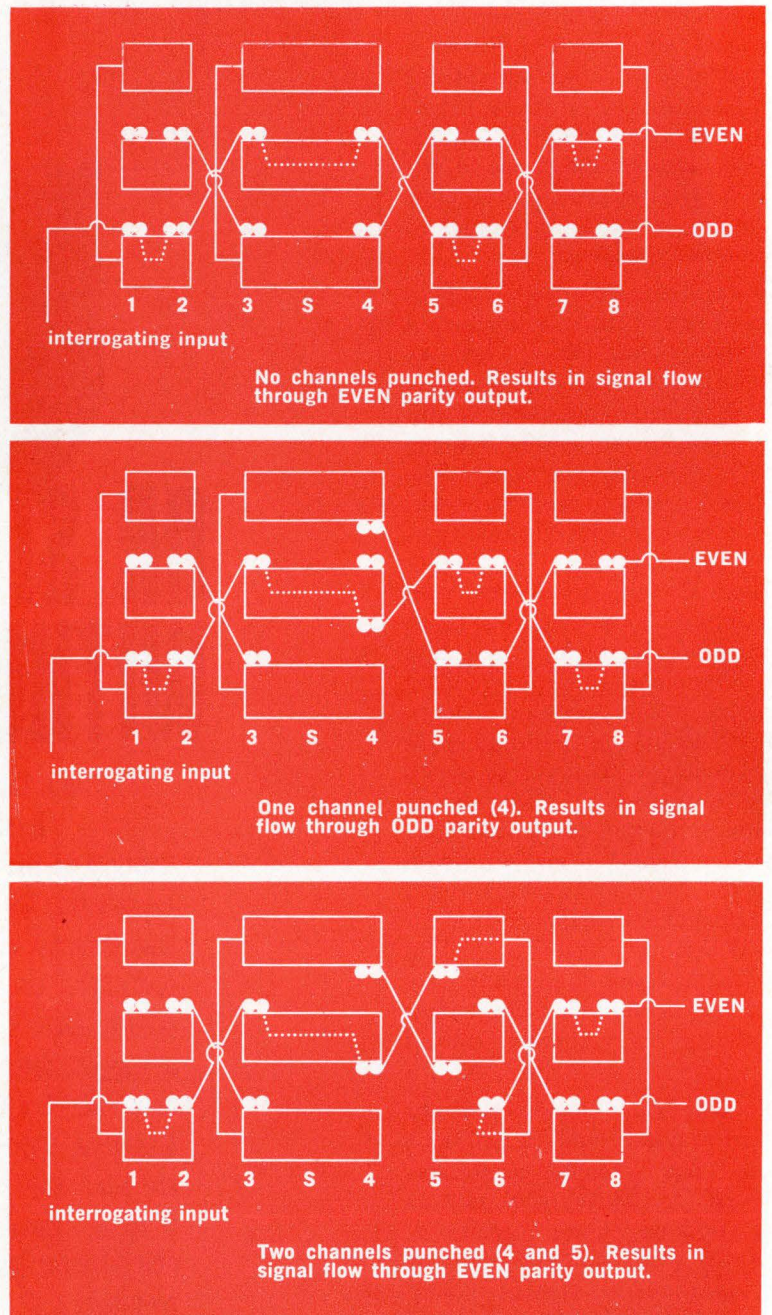
error is detected. Parity checking is generally offered as an option and is not usually included as a standard feature. The logic of parity checking is described in Fig. 5. Other error detecting features are broken tape sensing and out-of-tape sensing.

The ability to activate the punch automatically under program control (on-line) or manually (off-line) from a keyboard or other code selection device is a feature often required in computers and digital data recording systems. Some punches are ideally suited to this type of system integration, while other punches are primarily designed for off-line tape preparation.

Tape feed reels are generally included as standard items with the punch, however, take-up reels and spoolers are usually offered as options. Reversing the direction of the feed reel is possible in some punches to permit code deletion and tape editing, but punching is done in one direction only.

A wide variety of packaging schemes is offered by the punch manufacturers in order to satisfy diversified systems and OEM requirements. The user can usually specify whether the basic punch mechanism is to be rack-mounted, or supplied in a desk-top package, or console housing. Before selecting the packaging scheme, the system designer must consider the problems of chad disposal and air in-take locations for proper cooling.

Fanfold tape, as opposed to rolled tape, can impair cooling. According to Soroban Engineering, fanfold tape has three inherent disadvantages. First, as generally manufactured, fanfold tape produces an abnormal amount of lint. The common method for producing such tape is for the manufacturer to nick his slitting saws periodically. Thus a full width of paper is first partially slit and then folded at full paper width. The fanfold packs are finally broken away from the main folded stack with a device resembling a butcher's knife. The tufts, which are barely visible along the tape edge, spew an abnormal amount of dirt.



**Fig. 5** These diagrams illustrate the logic of parity checking as used in Tally Corp.'s P-120 punch. As the punches are forced through the paper, the corresponding punch linkages force the movable contacts from their "rest" positions, gating the delayed interrogation pulse to provide a continuous path through an odd or even output, depending on how many channels are punched. This action takes place in time for the user to exercise his option to inhibit tape advance in the event of a parity error.

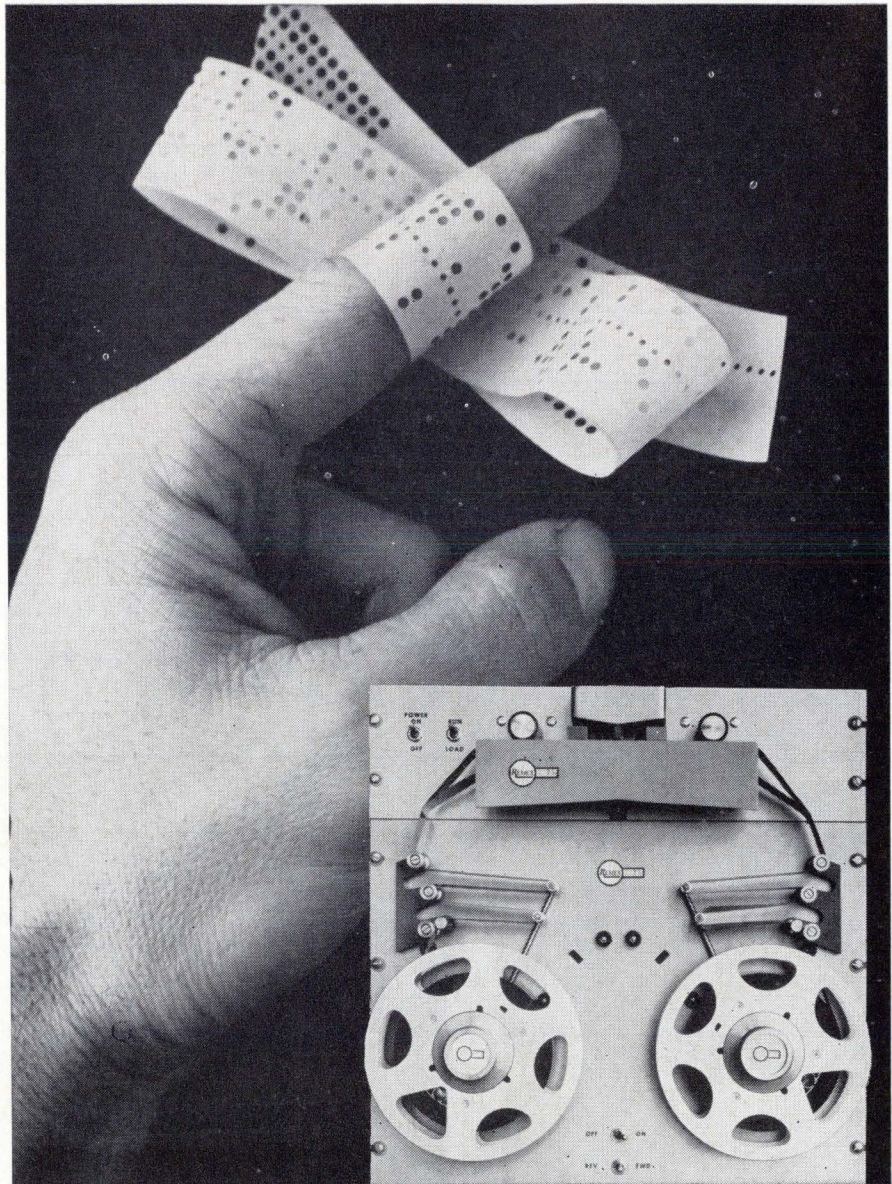
This dirt can block the cooling ducts depending upon the location of the air in-take. The second problem with fanfold tape results from the frequent occurrence of nicks at the folds. The nicks frequently bend back to produce a double tape thickness which will occasionally jam in the punch die block. The final complaint, according to Soroban, is price — fanfold tape is often quoted as high as three times the price of an equivalent length of rolled tape.

The advantages of fan-fold tape are that no reels are required, it's easier to handle, and the tape can be dropped into a file as is.

Noise, vibration, and mechanical wear of metal parts can be minimized through adequate preventive maintenance. Periodic lubrication and removal of chad and dirt are preventive maintenance procedures recommended by all manufacturers. Some manufacturers minimize the punching noise by housing the punch mechanism in an oil-filled housing.

Three types of Mylar tape are commonly used. Metalized Mylar tape of 0.0025" or 0.003" thickness is generally used in high-speed applications — program tapes for computer inputs or for some machine tool control applications. A three-ply, 0.004", paper-Mylar-paper laminate, often referred to as a "rope tape", is generally used as a program tape in business office systems. The third type, a 0.0038" thick Mylar-aluminum foil-Mylar laminate, is generally used in machine tool control applications because its toughness can withstand the "dirty" environment of a machine shop.

Before specifying a punch, the designer should question the punch manufacturer as to what materials the unit is capable of punching *without* modifying or making any adjustments in the punch mechanism. And if modifications have to be made, the designer should find out if such modifications affect the manufacturer's basic performance guarantee.



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MANUFACTURER	MODEL	APPROX. PRICE (\$)	PUNCHING SPEED (CHAR/SEC)	AVAILABLE CHANNELS	TAPE MOVEMENT	TAPE FEED METHOD	PARITY ERROR SENSING	END OF T SENSING
Facit Electronics	PE-1500	1930	0-150 Asyn.	5, 6, 7, 8	Uni-Dir.	Pinch	No	Optional
Invac Corp.	P-135	640	35 Asyn.	5, 6, 7, 8	Uni-Dir.	Sprocket	No	Yes
Kleinschmidt Div. of SCM	122	—	20 Syn.	5	Bi-Dir.	Sprocket	No	Yes
National Cash Register	EM-B1	795	120 Syn.	5, 7, 8	Uni-Dir.	Sprocket	No	Yes
	EM-B2	—	120 Syn.	5, 7, 8	Uni-Dir.	Sprocket	No	Yes
Navigation Computer Corp.	1010	1500	12 Asyn.	5, 6, 7, 8	Bi-Dir.	Sprocket	Optional	Yes
Ohr-Tronics, Inc.	110	650	30 Asyn.	5, 6, 7, 8	Bi-Dir.	Sprocket	Yes	Yes
Omnitronics, Inc.	ETR-7	7000	150 Asyn. 600 Syn.	5, 6, 7, 8	Uni-Dir.	Pinch Roller	Yes	Yes
Royal Typewriter Co.	Series 500	325	50 Syn.	5, 6, 7, 8	Bi-Dir.	Sprocket	Optional	Optional
	Series 700	425	75 Syn.	5, 6, 7, 8	Bi-Dir.	Sprocket	Optional	Optional
	Series 200	325	20 Asyn.	5, 6, 7, 8	Uni-Dir.	Sprocket	Optional	Optional
Soroban Engineering Inc.	LP-2	3200	150 Syn.	5, 6, 7, 8	Uni-Dir.	Sprocket	Optional	Yes
	GP-2	7900	300 Syn.	5, 6, 7, 8	Uni-Dir.	Sprocket	Optional	Yes
	PT-2	14000	100 Syn.	5, 6, 7, 8	Uni-Dir.	Sprocket	Optional	Yes
Tally Corp.	420PR	1165	60 Asyn.	5, 6, 7, 8	Bi-Dir.	Sprocket	No	Yes
	1477	1815	60 Asyn.	5, 6, 7, 8	Bi-Dir.	Sprocket	No	Yes
	430	1395	7 Asyn.	5, 6, 7, 8	Bi-Dir.	Sprocket	No	No
	P-150	1800	150 Asyn.	5, 6, 7, 8	Bi-Dir.	Sprocket	Yes	Yes
	P-120	1300	120 Asyn.	5, 6, 7, 8	Uni-Dir.	Sprocket	Optional	No
	820	3410	40 Asyn.	16	Bi-Dir.	Dual Sprocket	No	No
Teletype Corp.	DRPE	850	200 Asyn.	5, 6, 7, 8	—	—	No	No
	BRPE	725	110 Syn.	5, 6, 7, 8	Uni-Dir.	Sprocket	No	No
	35 ROTR	900	10 Asyn.	8	Uni-Dir.	Sprocket	No	No
	28 LPR	935	10 Asyn.	5	Uni-Dir.	Sprocket	No	No
	28 LARP	500	20 Asyn.	5, 6, 7, 8	Uni-Dir.	Sprocket	No	No

## PUNCH CHARACTERISTICS

TAPE SUPPLY LEVEL SENSING	PACKAGING STYLES	OVERALL DIMENSIONS (INCHES)	POWER REQUIREMENTS	COMMENTS
Optional	Desk-top, rack	20.3L x 8.3D x 8.6H	115 or 220 VAC 50-60 cps	Separate electronic unit and power supplies are available to simplify interfacing. Automatic motor shut-off prevents undue wear. Can punch Mylar tape at maximum speed.
Yes	Desk-top, console, rack	7 <sup>3</sup> / <sub>4</sub> L x 6 <sup>1</sup> / <sub>4</sub> D x 6 <sup>3</sup> / <sub>4</sub> H	- 27 VDC	Price includes arc suppression network and circuitry for controlling operation of sprocket, transport, and bail solenoids.
Yes	Rack, desk-top, console	—	115 VAC, 60 cps or 48 VDC	Controls include an on-off toggle switch for motor control, low tape alarm at supply reel, and torn tape alarm switch.
No	Rack, console	10L x 11 <sup>3</sup> / <sub>8</sub> D x 11H	117 VAC ± 10V 50-60 cps	EM-B2 contains the punching mechanism, EM-B1, plus tape transport mechanism. Accurate registration is achieved by having at least a dozen pins in contact with sprocket holes at all times. Tape is held tightly against feed wheel virtually eliminating the possibility of elongation of sprocket holes.
Yes	Rack, console	19L x 11 <sup>3</sup> / <sub>8</sub> D x 26 <sup>5</sup> / <sub>32</sub> H	117 VAC ± 10V 50-60 cps	
Visual	Desk-top	20L x 22D x 8 <sup>1</sup> / <sub>2</sub> H	110 VAC, 60 cps 50-75 watts	Characters printed on edge of tape while punching; alpha-numeric keyboard included; code change by plug-in module.
Optional	Rack, console	19L x 11H	115 VAC, 60 cps	Senses parity before punching and can inhibit punching. Price includes supply and take-up spooler; 2 cam contacts available.
No	Rack, console	19L x 3D x 12 <sup>1</sup> / <sub>2</sub> H	115 VAC, 60 cps 300 watts	Electrostatic recorder (not a perforator — see accompanying text).
Optional	Rack, desk-top, console	5 <sup>1</sup> / <sub>2</sub> L x 3 <sup>3</sup> / <sub>16</sub> D x 4 <sup>1</sup> / <sub>2</sub> H	24 or 48 VDC	Out of tape switch, parity check, manual tape feed control and rear chad eject available as optional extras. Mechanical drive and timing not included in price quoted here but models with complete drive and logic circuitry are available.
Optional	Rack, desk-top, console	5 <sup>1</sup> / <sub>2</sub> L x 3 <sup>3</sup> / <sub>16</sub> D x 4 <sup>1</sup> / <sub>2</sub> H	24 or 48 VDC	
Optional	Rack, desk-top, console	5 <sup>1</sup> / <sub>2</sub> L x 3 <sup>3</sup> / <sub>16</sub> D x 4 <sup>1</sup> / <sub>2</sub> H	24 or 48 VDC	
Optional	Rack, desk-top, console	5 <sup>1</sup> / <sub>2</sub> L x 3 <sup>3</sup> / <sub>16</sub> D x 4 <sup>1</sup> / <sub>2</sub> H	24 or 48 VDC	
Yes	Rack, desk-top, console	Variable	110 or 220 VAC 50-60 cps	The LP-2 and GP-2 are available as punch heads only and also as complete consoles with power supplies and drive and logic circuitry.
Yes	Rack, desk-top, console	Variable	110 or 220 VAC 50-60 cps	
Yes	Console	—	110 or 220 VAC 50-60 cps	Printing-perforator console with power supplies, drive and logic circuitry, and tape handling facilities.
Optional	Rack	19L x 13D x 10 <sup>1</sup> / <sub>2</sub> H	115/230 VAC 50-60 cps	Includes feed reel and take-up reel on panel mount.
Optional	Rack	19L x 13D x 10 <sup>1</sup> / <sub>2</sub> H	115/230 VAC 50-60 cps	Model 1477 is a compact reader-perforator combination.
No	Desk-top, console	17L x 16D x 7 <sup>3</sup> / <sub>4</sub> H	115/230 VAC 50-60 cps	Prints on tape while punching; integral keyboard included.
Optional	Rack	19L x 8 <sup>3</sup> / <sub>4</sub> D x 14H	115/230 VAC 50-60 cps	Feed and take-up reels available as options.
Optional	Rack	19L x 9D x 14H	115/230 VAC 50-60 cps	Take-up reel and feed reel included as standard items. Bi-directional unit available optionally.
Optional	Rack	19L x 13D x 10 <sup>1</sup> / <sub>2</sub> H	115/230 VAC 50-60 cps	Includes feed reel and take-up reel.
Yes	Rack, desk-top	9L x 9 <sup>1</sup> / <sub>4</sub> D x 7 <sup>3</sup> / <sub>8</sub> H	115 VAC, 60 cps 150 watts	Feed reel included in basic price. Features tuned reel punching mechanism.
Yes	Rack, desk-top	8L x 16 <sup>1</sup> / <sub>2</sub> D x 12H	115 VAC, 60 cps 65 watts	Feed reel included in basic price.
Yes	Rack, desk-top, console	13L x 14D x 9 <sup>1</sup> / <sub>4</sub> H	115 VAC, 60 cps 65 watts	Accepts serial inputs only and prints on tape while punching. Backspace feature is optional.
Yes	Desk-top, rack	9 <sup>3</sup> / <sub>4</sub> L x 12D x 9H	115 VAC, 60 cps 72 watts	
Yes	Desk-top	15 <sup>1</sup> / <sub>2</sub> L x 10 <sup>7</sup> / <sub>8</sub> D x 9 <sup>3</sup> / <sub>4</sub> H	115 VAC, 60 cps 75 watts	Parallel input only.

## MANUFACTURERS' UNITS

Accompanying this survey article is a chart entitled "Paper Tape Punch Characteristics" which summarizes the major performance characteristics of typical commercially-available punch equipment. This chart is

not intended as a basis on which to make a final selection for a particular application but rather as a good starting point for further investigation.

To supplement this chart, brief descriptions of each manufacturer's punch equipment line are given in this concluding section.

Facit Electronics, Stockholm, Sweden — The Facit PE 1500 tape punch is a high-speed (150 char./sec.) unit which finds its major application as a computer output device or in terminal equipment on fast data transmission links. The basic punch section can be combined

with a separate electronic control unit which contains all the circuitry for synchronization, paper feed and punch drive. The punch is motor-actuated and the punch selection is accomplished through solenoid action. The motor continues to

operate without feeding tape for approximately 5 seconds after the last character is punched and then shuts off automatically. Convertible for use with 5, 6, 7, or 8-track tape, the unit can also punch Mylar, metallized Mylar, and other materials.

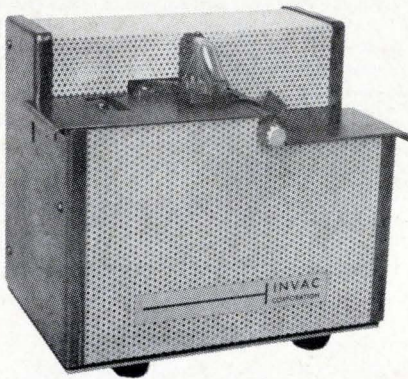


Fig. 6 Invac Corp.'s Model P-135 punch.

Invac Corp., Waltham, Mass. — The tape punch, Model P-135, made by Invac is a solenoid-actuated unit that punches 5, 6, 7, or 8-channel tape at rates from 0-35 char./sec. The punch can be battery operated since there are no ac power requirements. A sequencer printed circuit module, supplied with each punch, controls the operation of the sprocket, bail, and transport functions of the punch. Accessory driver modules are also available for a five through eight-level punch operation. This unit is shown in Fig. 6.

Invac recently developed a new tape punch package, the Model THPP-100. This package measures 15 $\frac{3}{4}$ "H x 19"W and may be mounted in a standard 19" relay rack. It contains a motorized take-up reel, supply reel, chad drawer, and tape tensioning arms in addition to a tape punch, power supply, sequencer printed circuit board, and two solenoid driver printed circuit boards. All that is needed to operate the Model THPP-100 is -12 volts to 0 logic levels for each data line and start pulse from 0 to 35 cps. Input is parallel by bit, serial by character.

Kleinschmidt Division of SCM, Inc., Deerfield, Ill. — This company's Model 122 is a 5-unit code punch that operates up to 20 char./sec. Unit is furnished with a tape supply

reel and powered take-up reel. Controls include an on-off toggle switch for motor control, low tape alarm at supply reel, and torn tape alarm switch.

National Cash Register Co., Dayton, Ohio — The EM-B2 paper tape punch manufactured by NCR is a high-speed unit that punches at a rate of 120 char./sec. The EM-B2 is capable of punching 5, 7, or 8-channel tape in any code. Extremely accurate registration of the punched tape is achieved by having at least a dozen pins in contact with the sprocket holes at all times, and, in addition, the tape is held tightly against the sprocket feed wheel by the tape guide shoe (the tape wraps almost halfway around the sprocket feed wheel). This type of design virtually eliminates the possibility of elongation of the sprocket holes. Also, this design configuration makes the punch "slot loading" which greatly simplifies the loading of the tape. The tape transport section contains tape supply, tape take-up punch mechanisms, and tape control arm buffers. The tape control arms form a loop of tape between the supply reel, take-up reel and the punch head to isolate the inertia of the reels from the punching head. The supply reel alternately drives and brakes to maintain a near constant tape loop. The take-up reel

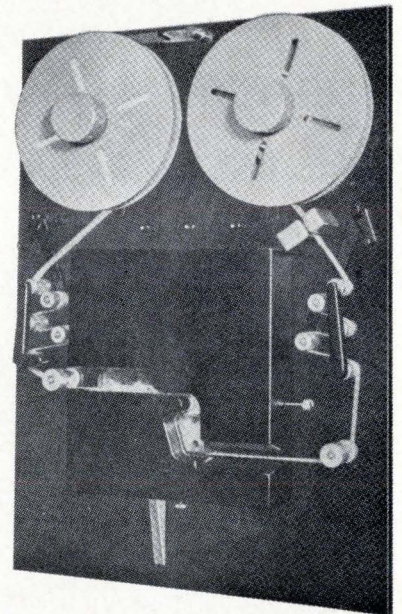
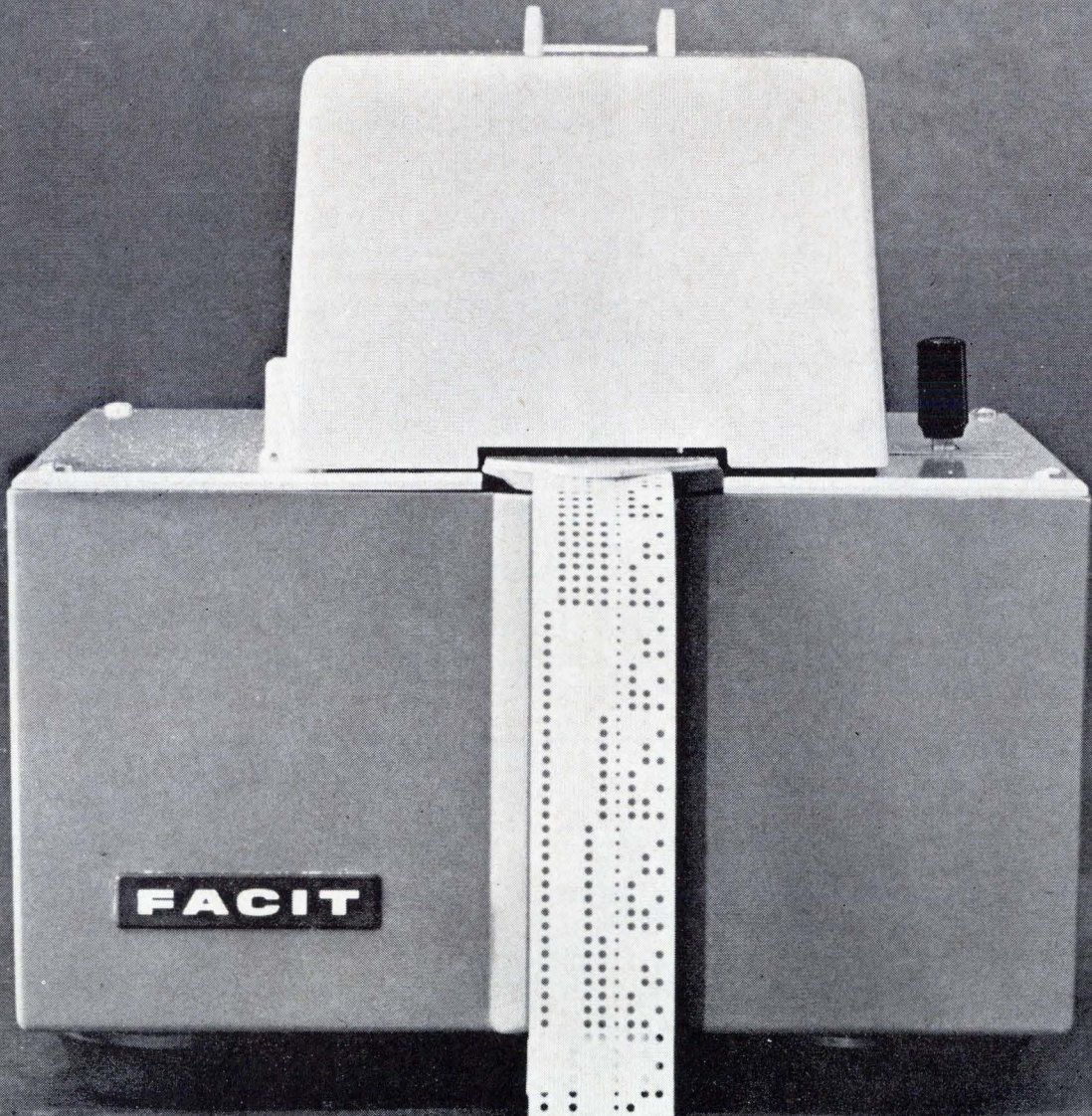


Fig. 7 National Cash Register's EM-B2 punch.

is driven by a stall motor. The paper tape transport section and the paper tape punching section are two independent units. As an option, the punching mechanism by itself is available as Model EM-B1. The EM-B2 is shown in Fig. 7.



**PE 1500**



# **COMPUTERS DATA TRANSMISSION DATA LOGGING**

**punched  
tape output**

**up to 150 characters per second**

** including tapes for TTS**

Navigation Computer Corp., Norristown, Pa. — The Model 1010 punch available from Navcor is a low-speed (12 char./sec.) desk-top unit. It is furnished with a numeric or full alphanumeric keyboard. Code changes are made simply by inserting a plug-in module. The punch also prints the characters on the edge of the tape.

Ohr-Tronics, Inc., Montvale, N.J. — This company's Model 110 punch operates at 30 char./sec. It senses parity errors before punching and can also inhibit punching. Two cam switches are available for interlocking with connected equipment. Memory and verification switches are included in each punch solenoid.

Omnitronics, Inc., Philadelphia, Pa. — As described in the January issue's tape reader survey, this company manufactures a tape reader that operates on a reflected light principle such that the unit can read both punched and printed tape. Thus, the company manufactures an electrostatic recorder that essentially fulfills the function of a mechanical tape punch but instead of punching it fixes black powdered-ink spots on the tape in the identical code configuration as that of punched holes. Operation of the recorder was discussed earlier in this article. The unit, shown in Fig. 8, operates at 150 char./sec. asynchronously and up to 600 char./sec. synchronously. The recorder accepts standard data pulses for from 5 to 8 channels plus sprocket channel. Edge-printed alphanumeric characters are available as an option.

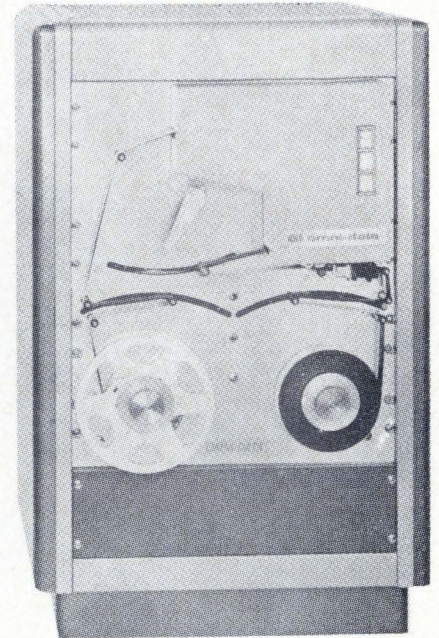


Fig. 8 Omnitronics' electrostatic paper tape recorder.

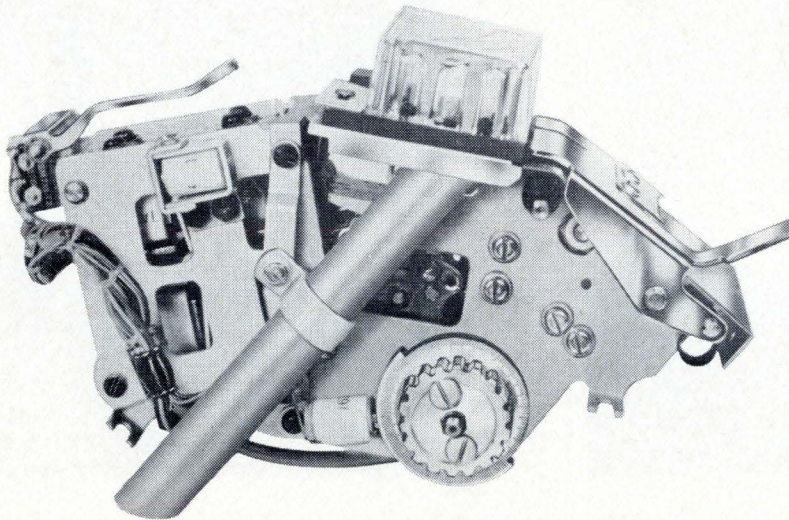


Fig. 9 Royal Typewriter Co.'s basic tape punch mechanism.

Royal Typewriter Co., Inc., Hartford, Conn. — This company makes a wide range of tape punch models in two basic series. Series 500 models are designed for synchronous operation at 50 char./sec. and Series 700 models operate synchronously at 75 char./sec. With all models, a user can specify a basic punch mechanism only (shown in Fig. 9), or a package containing the punch plus housing and motor drive, or a pack-

age complete with all logic and amplifier circuitry. Both series are available in three configurations: rack mounted with integral spoolers; integrated desk-top stations with complete tape handling facilities; or combination reader/punch units. Royal has recently developed a Series 200 punch that operates at 20 char./sec. asynchronously. The company has also announced a system that produces verified duplicate

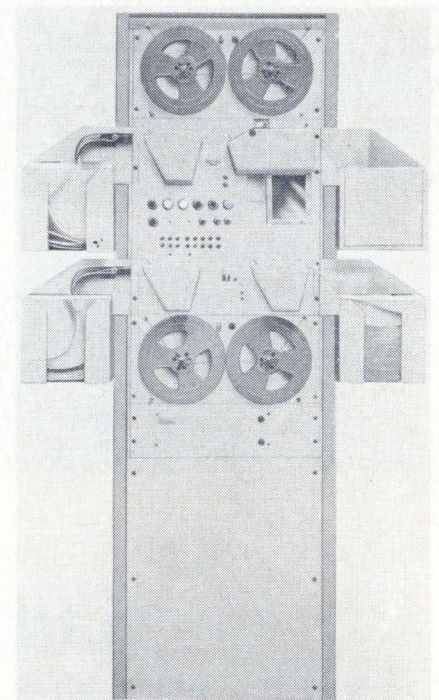


Fig. 10 Royal Typewriter Co.'s punched tape verify-duplicate system.

punched paper or Mylar tape in "one pass". The system, shown in Fig. 10, contains three tape readers and one punch that performs in one continuous cycle at an operating speed of 50 char./sec.



# DATA COMMUNICATIONS

equipment for on-line,  
real-time processing

## words for whachamacallits

What is a bit? What does ASCII stand for? What is real-time? These are typical of the jargon of data communications that has become so much a part of data processing.

Listed below are working definitions for terms related to Teletype equipment—the kind made for the Bell System and others who must have the most reliable communications at the lowest possible cost. Additional information on Teletype equipment and its uses is available by writing: Teletype Corporation, Dept. 71G, 5555 Touhy Avenue, Skokie, Illinois 60078.

### DATA HANDLING TERMS

**Alphanumerics**—Characters including letters of the alphabet, numbers, punctuation, and mathematical symbols.

**ASCII**—American Standard Code for Information Interchange. A 7-level coded character set and recording format approved by the American Standards Association for handling data within processing and communications systems. Teletype Models 33 and 35 equipment use the ASCII code, but add an 8th level for even parity check.

**Baudot Code**—A 5-level permutation code in which all code elements are of same length. This code is used on Teletype Models 28 and 32 equipment.

**Data Communications**—The preparation, transmission, and reception of data.

**Off-Line**—Not connected to a communications network. Paper tapes frequently are punched off-line on a Teletype ASR (automatic send-receive) set and later transmitted on-line using a paper tape reader.

**On-Line**—Connected to a communications network.

**Real-Time**—Communications while a process transpires, in order that results be useful in guiding the process.

**Total System Concept**—Refers to an equipment system providing pertinent information, at the right time and place, and in the right form, so that knowledgeable decisions can be made.

### TRANSMISSION TERMS

**Baud**—Unit of signalling speed. The speed in bauds is the number of code elements per second.

**Bit**—One impulse, or unit of information represented by a mark or space.

**Full-Duplex**—A circuit for simultaneous two-way communication.

**Half-Duplex**—A two-wire circuit for two-way communications, but not simultaneously.

**Line Switching**—Connecting two terminals through a switching center prior to exchanging information.

**Mark**—An impulse in a neutral circuit, which causes the loop to be closed; or in a polar circuit, which causes the loop current to flow in a direction opposite to that for a space impulse.

**Message Switching**—Receiving and storing messages, and retransmitting them on appropriate outgoing circuits.

**Parallel**—Refers to a system in which the elements defining a character occur simultaneously.

**Serial**—Refers to a system in which the elements defining a character occurs sequentially.

**Space**—An impulse, which in a neutral circuit, causes the loop to open; or in a polar circuit causes the loop current to flow in a direction opposite to that for a mark impulse.

**Start-Stop**—A system of operation whereby the start impulse precedes the first impulse of each character and is always a spacing impulse. The stop impulse follows the last impulse of each character and is always a marking impulse.

*machines that make data move*



CIRCLE NO. 16 ON INQUIRY CARD

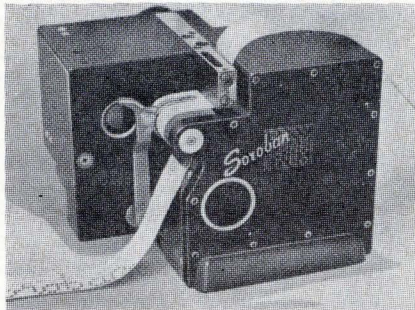


Fig. 11 Soroban Engineering's GP-2 punch.

Soroban Engineering, Inc., Melbourne, Fla. — Soroban's line of available punch equipment includes the punch-head mechanism itself, panel units containing the head plus drive motors and tape handlers, and complete consoles with associated circuitry and power supplies. Soroban's models include the Model LP-2 which is a 150 char./sec. unit and the Model GP-2, shown in Fig. 11, which is a high-speed 300 char./sec. unit. Design of these punches is such that severe environmental requirements can be met. Particular emphasis has been placed on adherence to MIL-E-16400 and MIL-I-26600. Soroban also makes a detachable print head that fits on their LP-2.

Tally Corp., Seattle, Wash. — Tally offers three basic punch models — the 60 char./sec. 420, the 150 char./sec. P-150, and a recently-developed 120 char./sec. P-120 unit. The 420 and P-150 are panel-mounted and they punch all Mylar, foil, and paper materials in varying widths up to 8 channels. The units are bi-directional for error correction routines. Tape handlers and drive modules are available for both models. The standard P-150 punch pin mechanism includes precious metal parity contacts that can be interrogated during a punching cycle and before the tape is advanced to the next character. If an incorrect parity code is sensed, the tape advance can be inhibited, the code in error can be overpunched with an all-hole delete code, and the tape can be advanced and the same character can be punched again. Tally's Model P-120 contains a new mechanism (described earlier in this article) in which most of the parts are working one-third as hard as they did in previous designs. The P-120, shown in Fig. 12, is a uni-directional unit, panel mounted with an integral tape supply and take-up reeling. Bi-

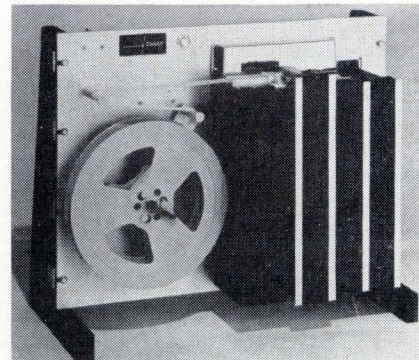


Fig. 12 Tally Corp.'s P-120 punch.



Fig. 13 Tally Corp.'s Model 430 printing perforator.

directional operation and error-checking are optional with the P-120. Tally also makes a printing perforator, Model 430, which is shown in Fig. 13.

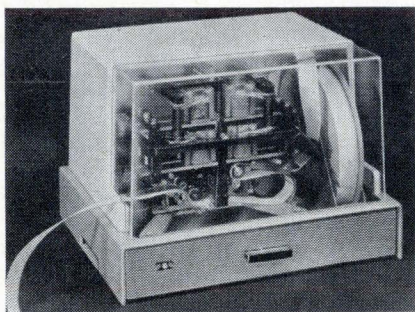


Fig. 14 Teletype Corp.'s DRPE punch.

Teletype Corp., Skokie, Ill. — For obvious reasons, Teletype's line of perforator equipment is particularly suited for message and data communications systems. Their Model DRPE, shown in Fig. 14, is a high-speed (200 char./sec.) unit that operates on a tuned-reed principle described earlier in this article. In message and data communications systems, the DRPE operates at any speed up to 2000 words per minute and functions in response to incom-

ing parallel-wire signals. The unit is asynchronous and needs no adjustments or modifications when transmission speed is changed. Shown in Fig. 15, Teletype's Model BRPE operates at 110 char./sec. and can be used for high-speed communications over conventional telephone channels. It gathers information from various sources and places it on one master tape for further transmission. Teletype's Model 28 typing tape punch is a receiving-only, 5-level reperforator actuated by incoming serial line signals. This unit simultaneously punches and prints information at a speed of 10 char./sec. asynchronously. Teletype also offers a Model 35 receive-only typing reperforator similar to the Model 28 except that the 35 records 8-level ASCII code. Another unit made by Teletype is a multi-magnet tape punch set, Model 28 LARP, designed to serve as a "slave" unit

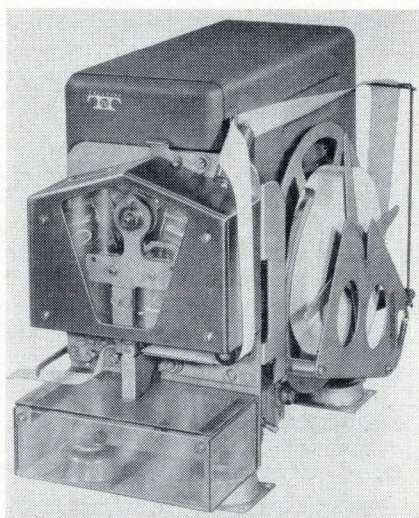


Fig. 15 Teletype Corp.'s BRPE punch.

in a variety of data systems. Operating at 20 char./sec., the unit provides logic programmed storage in fully perforated or chadless communications tape.

# DATA COMMUNICATIONS

equipment for on-line,  
real-time processing

## how modular can you get?

Teletype machines are modular by design, as are all the special purpose control and operating functions. As a result, Teletype equipment provides many more opportunities for you to improve on your capability to communicate data. This is also why Teletype sets are the best equipped to prepare data for transmission, as well as transmitting and receiving it.

### FRICION OR SPROCKET FEED?

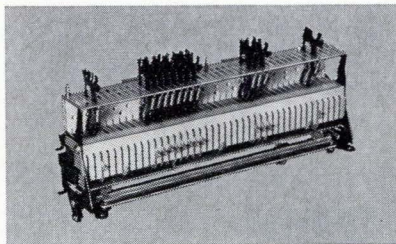
Teletype sets can be equipped with either a friction feed platen that prints on single or multiple copy paper, or a sprocket feed platen that positions multi-copy business forms for printing. Projecting pins engage perforations in the business form to provide for continuous, accurate multi-copy alignment.

Also, horizontal and vertical tabulators can be provided on Teletype Model 35 equipment to speed typing and improve efficiency. Teletype sets can be equipped with a form-out feature that with one key stroke will advance a business form, bringing the next one to the starting position.

**machines that make data move**

### NON-PRINTING FUNCTIONS

The stunt box can control many non-printing functions that add to the versatility of Teletype sets. Among these functions are carriage return and line feed, plus the ability to activate other apparatus including paper tape punches, paper tape readers, and business machines.



STUNT BOX

### OTHER CONTROL FUNCTIONS

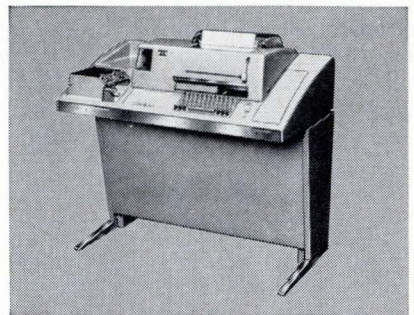
Control circuits for operating auxiliary input and output devices can be utilized, such as on the Teletype Model 35 ACS (Automated Communications Set). This is basically an automatic send-receive set with an additional tape reader for internal programming capabilities.

The auxiliary devices include: push button addresser that automatically calls in a preselected remote receiver, a push button generator that automatically types in repetitive stored data to further simplify the filling-out of business forms, and an auxiliary page printer and tape punch.

### ADDITIONAL TIMESAVERS

To further aid the operator in preparing business forms, Teletype machines are equipped with a copyholder to hold papers for easy, convenient reading and handling. Also, there is a form supply box for storing unused and completed business forms.

We have indicated only a few of the features that are or can be incorporated into Teletype sets. This versatility is one of the reasons why they are made for the Bell System and others who require dependable communications at the lowest possible cost. The new Model 35 ACS is described in an 8-page brochure, which you can obtain by writing: Teletype Corporation, Dept. 71G, 5555 Touhy Avenue, Skokie, Illinois 60078.



MODEL 35 AUTOMATED COMMUNICATIONS SET



This tape perforator is slow.

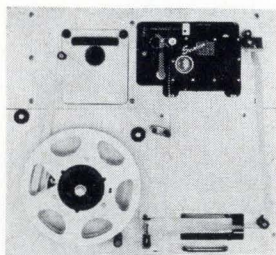


**Soroban's Model LP-2 perforates 5 to 8 level mylar or paper tape at 150 characters per second. At Soroban, this is slow.**

The LP-2 Perforator shares many design features and working components with its famous relative—the 300 character per second GP-2. But by limiting the maximum speed to 150 characters per second, Soroban produces a tape perforator with a remarkable operating life and reliability... and a speed which only the GP-2 can surpass.

All moving parts are in a sealed crankcase-like enclosure with integral oil bath and pressure lubrication systems. RFI is minimized because the electromagnets are also enclosed.

The LP-2 plugs into Soroban's 150 P1K Panel, which contains the drive motor and shock mounting, vacuum chad collection, 1000 ft. tape supply and takeup, and tape path monitoring switches. Operation is convenient, maintenance very simple.



Soroban's products also include high-speed Card Punches and Readers, Serial Printers, Tape Readers, and Keyboards. Information on these reliable high-performance equipments can be obtained from Soroban Engineering, Inc.

POST OFFICE BOX 1690  
MELBOURNE, FLA. 32902  
AREA CODE 305 723-7221

CIRCLE NO. 18 ON INQUIRY CARD

**TABLE 2 • MFRS.' LITERATURE**

For your product reference file, a complete set of manufacturers' literature can be obtained by circling the reader inquiry numbers listed below.

COMPANY	INQUIRY CARD NO.
Facit Electronics, Stockholm, Sweden . . . . .	80
Friden, Inc., San Leandro, Cal. . . . .	81
Invac Corp., Waltham, Mass. . . . .	82
Kleinschmidt Div. of SCM Corp., Deerfield, Ill. . .	83
National Cash Register, Dayton, Ohio . . . . .	84
Navigation Computer Corp., Norristown, Pa. . . .	85
Ohr-Tronics, Inc., S. Montvale, N.J. . . . .	86
Omnitronics, Inc., Philadelphia, Pa. . . . .	87
Royal Typewriter Co., Hartford, Conn. . . . .	88
Soroban Engineering, Inc., Melbourne, Fla. . . . .	89
Tally Corp., Seattle, Wash. . . . .	90
Teletype Corp., Skokie, Ill. . . . .	91

**SUMMARY**

We conclude this industry survey with a brief reminder that the manufacturers' units mentioned were just examples of each company's capability; most produce a complete line and some offer more than one type. For a complete reference file, we recommend that the reader supplement this survey article with a set of company brochures and technical data sheets. The list of manufacturers in Table 2 is keyed with reader service card numbers for your convenience in requesting this material.

# DATA COMMUNICATIONS

equipment for on-line,  
real-time processing

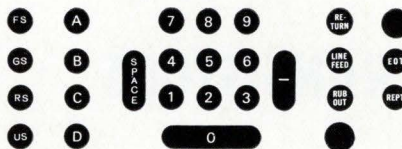
## there are keyboards...and there are keyboards

Data communications vary, requiring a variety of different keys and even different keyboards. This is why there are Teletype sets available with 3-row keyboards, 4-row keyboards, and numeric keyboards, having a variety of special purpose keys.

The 3-row keyboard operates on the 5-level Baudot code. The new 4-row keyboard is similar to the standard office typewriter, and operates on an 8-level code that's compatible with the American Standard Code for Information Interchange. It can communicate directly with computers and other business machines in data processing systems. The numeric keyboard consists of 25 keys that are used primarily to speed transmission of coded numeric data such as used to control inventory and delivery in warehouses, supermarkets, etc. Though this Teletype set can send only numeric data, it is capable of receiving and printing all alphanumeric characters.

### WHAT ARE THE "KEY" DIFFERENCES?

There are many different special purpose keys on Teletype keyboards. The most commonly used are the function or non-printing keys. On the 3-row keyboard, depressing the LTRS key transmits the letter characters shown on the lower keytops while depressing the FIGS key transmits the figure characters on the upper keytops.



NUMERIC KEYBOARD

On the 4-row keyboard, both the letters and figures are shown on the lower part of the keytops. Thus, the SHIFT key enables the code combinations to be generated for the printing characters shown on the upper keytops, such as "&" and "%". A CONTROL key is used to generate the code combination for the function characters shown on the upper keytops, such as "WRU" (who are you?) and "EOT" (end of transmission).

### ERROR DETECTION AID

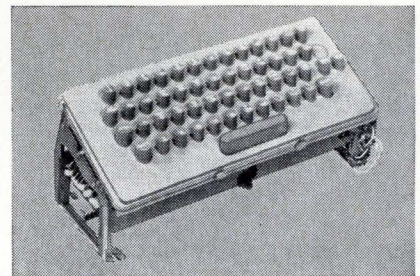
The 4-row keyboard can generate an "even parity" which is used to aid in error detection. Even parity provides for adding a marking pulse whenever the number of marking pulses in a code combination is odd. Thus, if a code having an odd number of marking pulses is received, it indicates an error. The eighth level is used for providing even parity.

*machines that make data move*

On friction feed typing units, depressing the LINE FEED key causes the paper to advance one line. Sprocket-feed typing units are equipped with both LINE FEED and FORM-OUT keys that cause the platen to advance a printed business form either one line or a sufficient distance to bring the next form to the starting position.

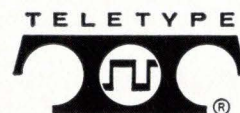
### SELF-CONTAINED KEYBOARDS

Self-contained 4-row keyboards are available to provide direct parallel-wire entry of variable data into computers and business machines.



ALPHANUMERIC KEYBOARD

The versatility of Teletype keyboards is another reason why they are made for the Bell System and others who demand reliable communications at the lowest possible cost. If you wish further information on Teletype equipment write: Teletype Corporation, Dept. 71G, 5555 Touhy Avenue, Skokie, Illinois 60078.





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Input Signal	Switching Speed
+ 16 v	4 ns
+ 4 v	2 ns
+ 1 v	1 ns

The ratio of switching speed to input voltage is  $S=V^{1/2}$ . This relationship was not noted until the input voltage was accidentally reduced below the reference ground level. In this case, an input of  $-1$  volt resulted in a switching speed of "3". Certain logical difficulties encountered at that point ruled out any practical application of imaginary switching speeds.

The Research Group was re-established, however, and soon discovered that further reduction of input voltage levels produced usable results. Switching speed again became a real value, but a negative value. With a  $-16$

volt signal, for example, the transistor under test switched four nanoseconds before the signal was applied.

The possibilities inherent in this effect were obvious, and once the Group was again operational, further investigations were conducted on a crash-priority footing. Much of the data resulting from these investigations remain proprietary, but the following general results can be published at this time.

A conventional ADD operation, using a 12-stage network of these special transistors, can be performed in minus 8 nanoseconds. Furthermore, a simple feedback loop places the Sum in the Accumulator before the Operand, thereby obviating the necessity of accessing this operand in the first place, thus saving even more time. However, it is in the case of Multiply, Divide, and similar more complex operations that speeds become truly remarkable. In at least one case, the result appeared on the output device before the problem had been coded. In fact, with computer logic operating in minus time and memory storing future data, it is foreseen that the major efforts of programmers will be devoted to constructing questions to go with the answers.

Production of these hyper-speed computers will doubtless have a profound effect on marketing techniques and philosophy. If answers to customer problems are produced before the computer is installed, special sales and rental agreements will certainly be necessary.

However, efforts are now under way to increase operational speeds to the point at which all results will be presented before the computer exists. With no need to design, construct, or debug the machines, the manufacture of computers can be expected to achieve new heights of economy, simplicity, and reliability. **END**

The PDP-8 is a powerful,  
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and exceptional  
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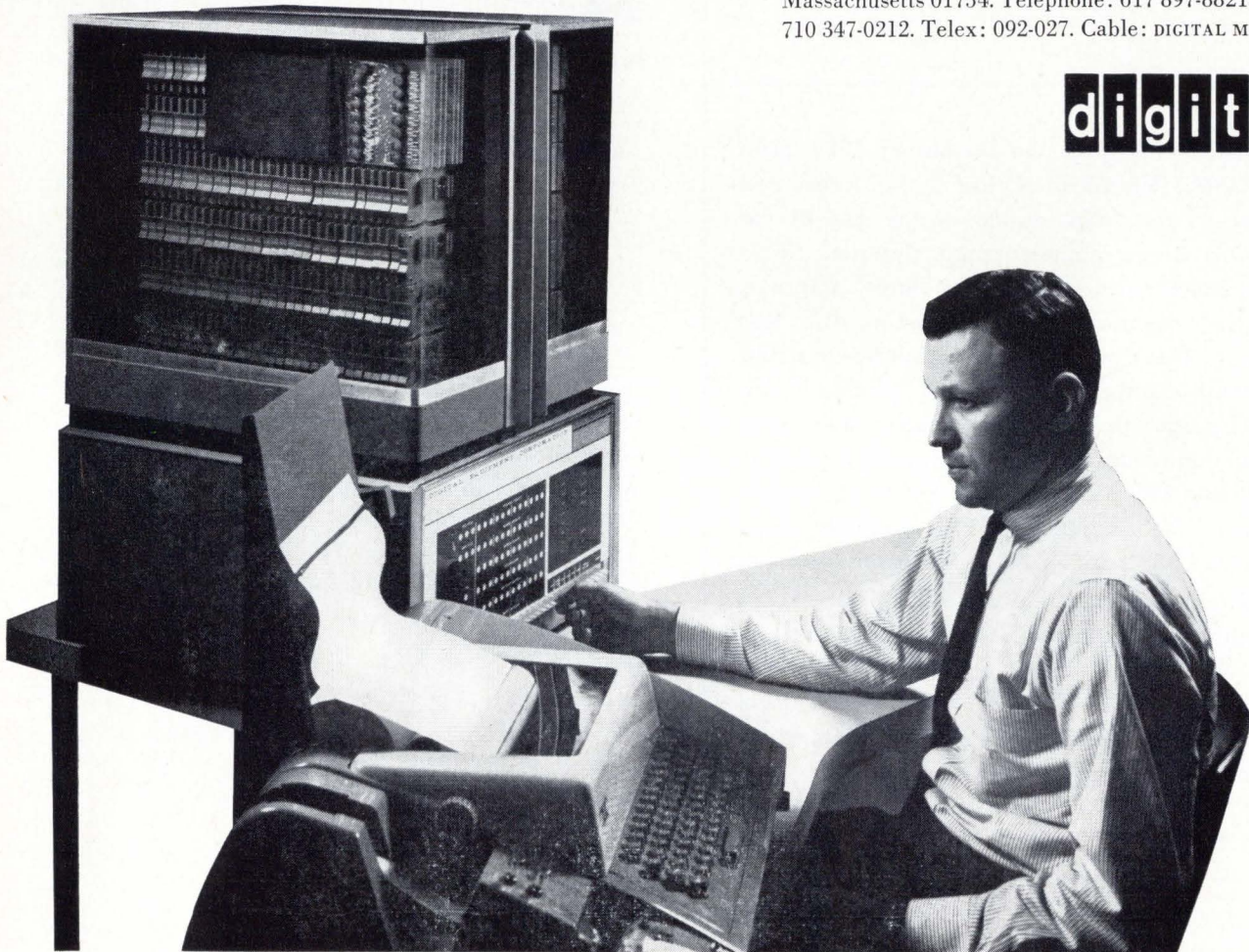
Besides FORTRAN, the software package includes an on-line debugging program which gives the user dynamic printed program status information and an on-line editing program which lets him add, delete, change or insert single lines or sections of his symbolic program. The system also contains a macro assembler, floating-point software, elementary function subroutines in single- and double-precision arithmetic, and utility, diagnostic, and maintenance routines.

An input/output bus system permits simple connection of numerous standard and custom devices without changes in the central processor. Standard options include analog/digital and digital/analog converters, analog multiplexers, magnetic tape, paper tape, and drum memory systems, cathode tube displays, card punch and readers and other devices.

For information about the PDP line of computers (including the new medium-sized PDP-7 and the large-scale PDP-6), ask any computer expert. For user handbooks and technical specifications, call any Digital Equipment office or the main office:

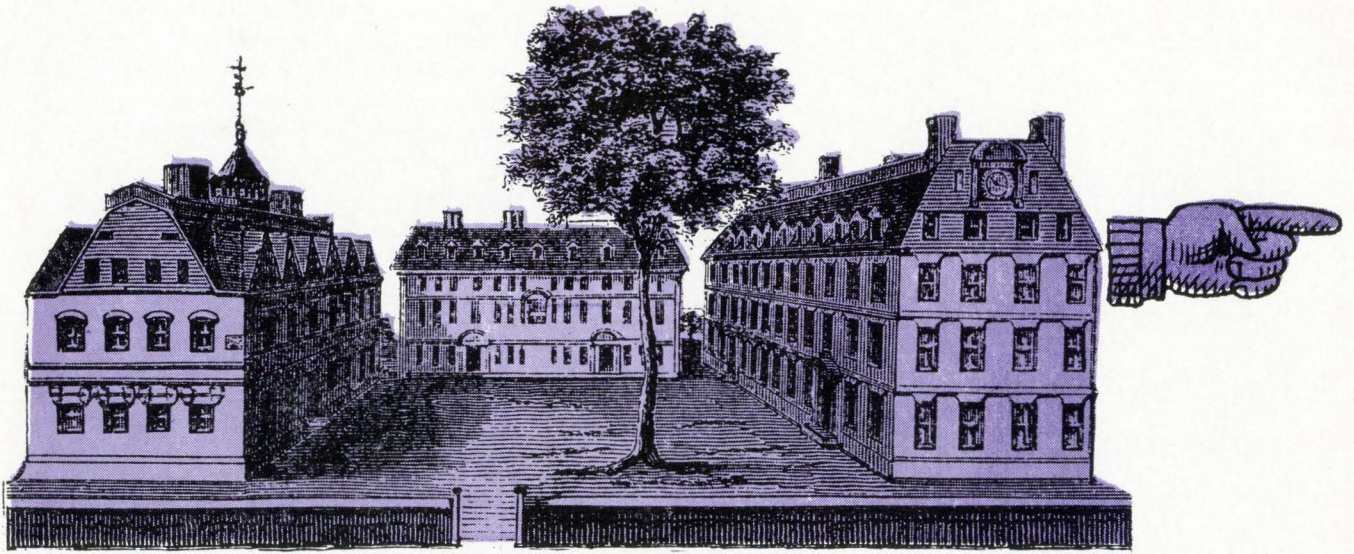
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CIRCLE NO. 20 ON INQUIRY CARD



# A Modified Harvard Chart

K. D. Smith, Senior Instr. Engr.,

*Phillips Petroleum Co., Atomic Energy Div.,  
Instrument Development and Technical Services Branch, Idaho Falls, Idaho*

**EDITOR'S NOTE:** In the December 1964 issue of *COMPUTER DESIGN*, the author presented a step-by-step explanation of the use of the Harvard Chart minimization technique. Since that presentation, the author came across a modified approach that is simpler and less tedious. This approach is described here using the same example from the first article. If you do refer back to that article, please make note of the following corrections: the reference in the text to Fig. 1 should have been referring to Table 3; the reference to Fig. 2 should have been to Fig. 1; in Table 3, the fourth term in the Prime Implicant column should be  $\bar{S} \bar{2} \bar{1}$  instead of  $S \bar{2} \bar{1}$ ; in the  $S84$  column of Table 1, all 3 and 7 terms should be slashed instead of barred, and in the 842 and 841 columns, the 6 and 7 terms should be slashed instead of barred.

#### Reference

1. E. P. Epley, "New Techniques in Switching Circuit Synthesis," Part 3, pp. 25-38, Ph.D. Thesis, University of Illinois, 1960.

A previous article in the December 1964 issue of *COMPUTER DESIGN* detailed the use of the Harvard Chart method of minimization of an N-variable switching function. This method as described in that article has some disadvantages. The elimination of the entries in the chart is tedious and can lead to errors. Also, the construction of the separate and long Prime Implicant Chart adds an additional step to the method.

These disadvantages of the Harvard Chart can be partially overcome by use of a Modified Harvard Chart.<sup>1</sup> Such a chart for five variables is shown in Table 1.

The chart is constructed as follows:

1. Rows and columns of the Harvard Chart are interchanged and the single variable columns are removed. Horizontal lines are drawn between each row.
2. The decimal integers of the chart are considered as points on the horizontal lines drawn in Step 1.
3. Room is left at the bottom of the chart for construction of a Prime Implicant Chart.

#### Example of Chart Use

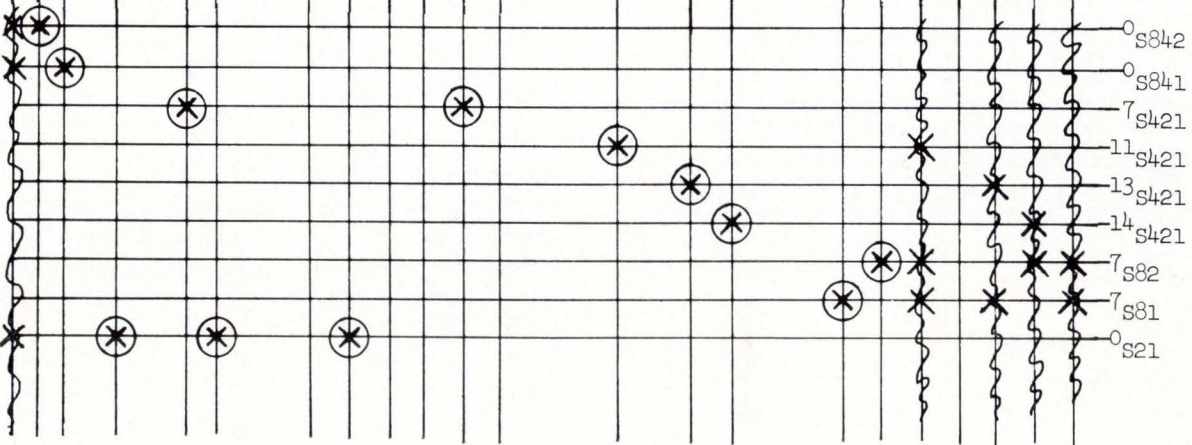
The practical application of this chart will be explained by the same example used in the previous article. It will be recalled that the example involved the minimization of a bipolar BCD even parity bit. The bipolar BCD output and the required parity bit P are shown in Table 2 where S = sign bit and 8, 4, 2, 1 = information bits. The switching function P can now be written using the decimal equivalents of the binary combinations where  $P = 1$ . Using the weight of  $S = 16$ , gives:

$$P = \sum (1, 2, 4, 7, 8, 19, 21, 22, 25, 26) + \sum \phi (0, 11, \dots, 16, 27, \dots, 31) \quad (1)$$

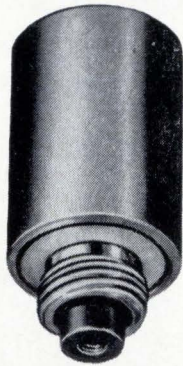


Table 1 — Modified Harvard Chart for N=5

d	d	d	d	d	d	d	d	d	d	d	
0	1	2	3	4	5	6	7	8	9	10	s8421
0	0	1	1	2	2	3	3	4	4	5	s842
0	1	0	1	2	3	2	3	4	5	4	s841
0	1	2	3	0	1	2	3	4	5	6	s821
0	1	2	3	4	5	6	7	8	9	10	s421
0	1	2	3	4	5	6	7	8	9	10	8421
0	0	0	0	1	1	1	1	2	2	2	s84
0	0	1	1	0	0	1	1	2	2	3	s82
0	1	0	1	0	1	0	1	2	3	2	s81
0	0	1	1	2	2	3	3	0	0	1	s42
0	1	0	1	2	3	2	3	4	5	4	s41
0	1	2	3	0	1	2	3	4	5	6	s21
0	0	1	1	2	2	3	3	4	4	5	842
0	1	0	1	2	3	2	3	4	5	4	841
0	1	2	3	0	1	2	3	0	1	2	821
0	1	2	3	4	5	6	7	0	1	2	421
0	0	0	0	0	0	1	1	1	1	1	s8
0	0	0	0	1	1	1	1	1	1	2	s4
0	0	1	1	0	0	1	1	2	2	3	s2
0	1	0	1	0	1	0	1	0	1	2	s1
0	0	0	0	1	1	1	1	2	2	2	84
0	0	1	1	0	0	1	1	0	0	1	82
0	1	0	1	0	1	0	1	0	1	2	81
0	0	1	1	2	2	3	3	0	0	1	42
0	1	0	1	2	3	2	3	0	1	0	41
0	1	2	3	0	1	2	3	0	1	2	21



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- Georgetown, Tex.:** Hillman Enterprises, Inc., UN 3-3780
- Los Altos, Calif.:** Richard Strassner Co., 948-334
- Portland:** Shaffer & Nelson, Inc., 234-7437
- Salt Lake City:** Oscar Salme & Assoc., Inc., AM 2-2349
- Seattle:** Shaffer & Nelson, Inc., MU 2-0186
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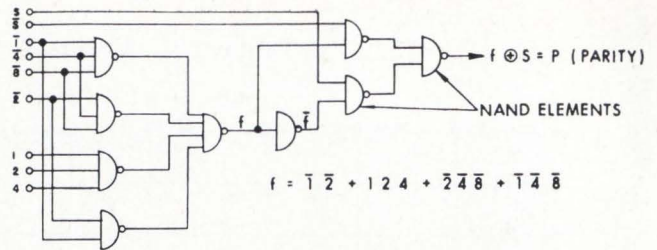


Fig. 1 Realization of parity function P.

Minimization of this function by use of the Modified Harvard Chart is illustrated by use of the chart shown in Table 1 and the following rules:

1. Points are marked on the N-variable combination line where the switching function equals one. For the above example, points are marked on the S8421 line for P = 1, 2, 4, 7, 8, 19, 21, 22, 25, and 26.
2. "Don't Care" points are marked on the N-variable combination line by use of the symbol *d*. For the above example this corresponds to the points 0, 11, . . . , 16, 27, . . . , 31.
3. Vertical lines are drawn from the points marked in Steps 1 and 2 through the chart and beyond to the bottom of the page.

The chart is now completed by starting at the bottom of the chart and inspecting the numbers crossed by the vertical lines drawn in Step 3. We use the following steps:

4. If all integers,  $N_i$ , on a horizontal line are crossed by vertical lines then the points corresponding to these integers are marked by dots with these exceptions:
  - (a) If the integers lie entirely on the *d* vertical lines, their points are not marked. For example, the 3's of line 84 of Table 1 are not marked since they all lie on the *d* vertical lines.
  - (b) If the integers are found on an *ijk* line then the *ij*, *ik*, and *jk* lines must be inspected. If the integer is marked on one of these lines then it is not marked on the *ijk* line. Similarly sub-lines for an *ijkl* integer must be inspected. For example, the 0's of the S421 line of Table 1 are not marked since they are marked on the S21 line.

Step 4 ends when all vertical lines contain at least one dot and we have inspected all rows except the N-variable combination line. Note, however, that the *d* lines may or may not have dots on them.

### Prime Implicant Chart

At the conclusion of Step 4, a Prime Implicant Chart is constructed at the bottom of the chart as follows:

1. Prime implicants are listed on the right-hand side of the chart. The prime implicants correspond to the integer  $N_i$  (with a subscript equal to the line notation) whose points are dotted on the Modified Harvard Chart. For example, the first prime implicant of Table 1 is  $0_{S21}$ , corresponding to the dotted 0's of the S21 line.
2. A cross is now placed on the prime implicant row where the number is dotted on the  $N_i$  row of the Modified Harvard Chart.

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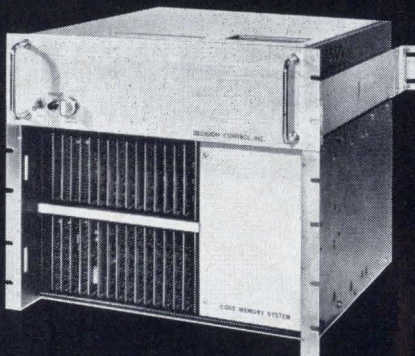
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Table 2 — Parity Bit Table

Dec. No.	BCD Output					Decimal Equivalent	P
	S	8	4	2	1		
+0	1	1	0	1	0	26	1
+1	1	0	0	0	1	17	0
+2	1	0	0	1	0	18	0
+3	1	0	0	1	1	19	1
+4	1	0	1	0	0	20	0
+5	1	0	1	0	1	21	1
+6	1	0	1	1	0	22	1
+7	1	0	1	1	1	23	0
+8	1	1	0	0	0	24	0
+9	1	1	0	0	1	25	1
-0	0	1	0	1	0	10	0
-1	0	0	0	0	1	1	1
-2	0	0	0	1	0	2	1
-3	0	0	0	1	1	3	0
-4	0	0	1	0	0	4	1
-5	0	0	1	0	1	5	0
-6	0	0	1	1	0	6	0
-7	0	0	1	1	1	7	1
-8	0	1	0	0	0	8	1
-9	0	1	0	0	1	9	0

Once the Prime Implicant Chart has been constructed, the minimum function is determined by choosing subsets of prime implicants. This procedure was outlined in the previous article and so will not be repeated. However, it should be noted that the wavy lines which appear in the Prime Implicant Chart are the result of the application of Rule 1 of the previous article. There it was stated that one should "...rule a line through all the crosses in each row that contains a circled cross. . .".

Application of the rules for the Prime Implicant Chart yields the switching function:

$$P = \Sigma (0_{S841}, 0_{S21}, 7_{S81}, 7_{S82}, 7_{S421}, 11_{S421}, 13_{S421}, 14_{S421}, 0_{S842}) \quad (2)$$

Transforming this equation into the S8421 terminology gives

$$P = S(82 + 81 + \bar{4}21 + 4\bar{2}1 + 4\bar{2}\bar{1}) + \bar{S}(2\bar{1} + 84\bar{2} + 84\bar{1} + 421) \quad (3)$$

This may be reduced to the function

$$P = S\bar{f} + \bar{S}f$$

where

$$f = \bar{1}\bar{2} + 124 + \bar{1}\bar{4}\bar{8} + \bar{2}\bar{4}\bar{8} \quad (5)$$

The reduction of equation (3) to equation (4) is not true in the general case but only for this particular example.

Synthesis of the parity function P may now be accomplished. The network realization is shown in Fig. 1. This completes the minimization by use of the Modified Harvard Chart. **END**

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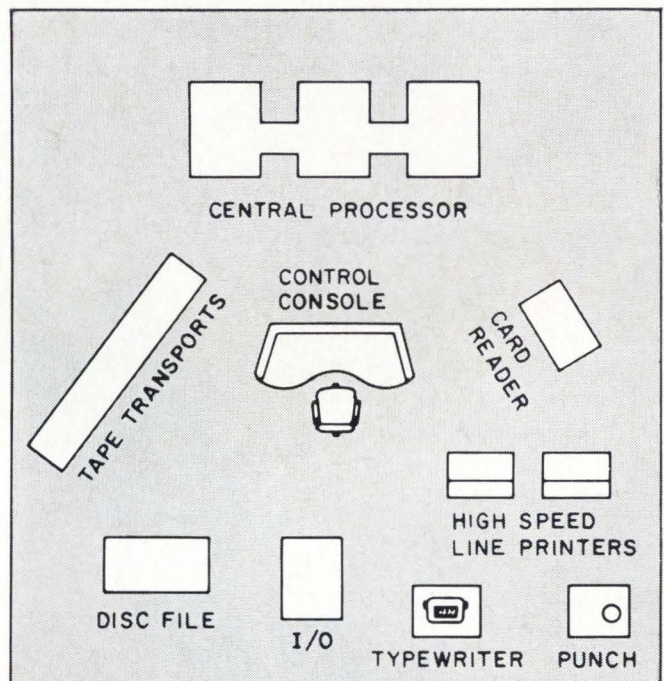
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# microelectronic magnetic encoders

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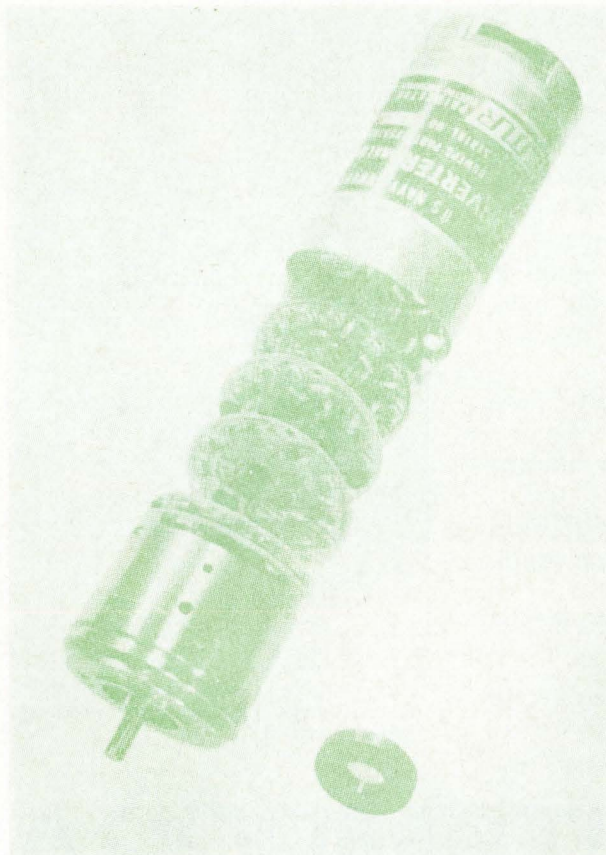


Fig. 1 Exploded view of EMR's Model 645 Series encoder showing the encoder itself in foreground adjacent to a typical code disc. Immediately to the rear of the encoder are the circuit wafers arranged to illustrate their relation to the housing in the upper right.

Up until now encoder users have recognized the value of magnetic encoders over optical and brush types, such as not having a built-in failure mode of a light bulb or rubbing contacts. However, magnetic encoders have not realized their full potential because of the lack of understanding on the part of system users for the electrical interface conditions required. Satisfactory basic magnetic encoder application requires (1) well-controlled interrogation signals, (2) careful line shielding or decoupling to prevent cross-talk of various bit outputs or system noise, and (3) stabilized threshold detection of the outputs. Recognizing these needs, Electro-Mechanical Research, Inc. of Princeton, N.J., has developed the 645 series which employs discrete component-microelectronic circuits with the raw magnetic encoder (Fig. 1) to provide electrical interface outputs for each bit equivalent to an open or closed transistor switch action with a resistor in series.

To prove the feasibility of the concept, EMR undertook the design of the 645A encoder which is a direct, one-to-one, replacement for a 13-bit, 64 turn, self-selecting brush encoder used in the MK-84, Polaris Digital Geo-Ballistic Computer. The 645A encoder has been built in the

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*Encoder Development, Princeton Div.,*  
*Electro-Mechanical Research, Inc.*

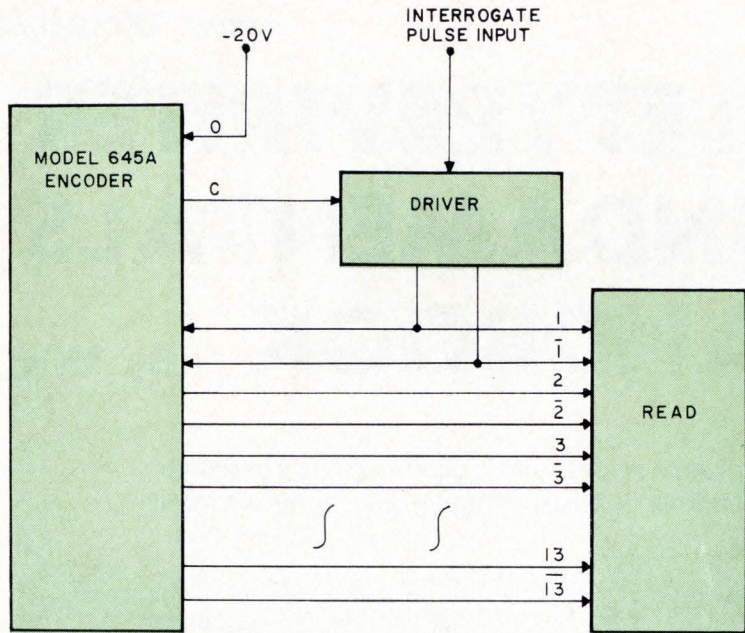


Fig. 2 Model 645A operation with external driver.

desired physical size and has lower power requirements than originally specified. No wiring changes are required in the computer and a brush encoder can be replaced by merely taking it out of the servo, inserting the 645A, and plugging it in. Because the task was to provide a direct retrofit, the design was considerably more difficult than it would have been to prepare a general design for system users to build around. EMR felt that if the task could be accomplished under these conditions, the less stringent encoder design conditions would be shown to be practical. Some of the more prominent design features that were accomplished on the Model A of the 645 Series that would not particularly be required by other users were:

- No ground connection was provided and no spare pins were available in the connector to pick it up. The problem was solved by designing the entire encoder to work with an average dc input power of 750 milliwatts and using a diode OR input ground return from two transistor logic switches in the computer, one or the other of which was in saturation to ground all the time.
- Error checking is accomplished in the MK-84 system by comparing bit-by-bit, the TRUE and COM-

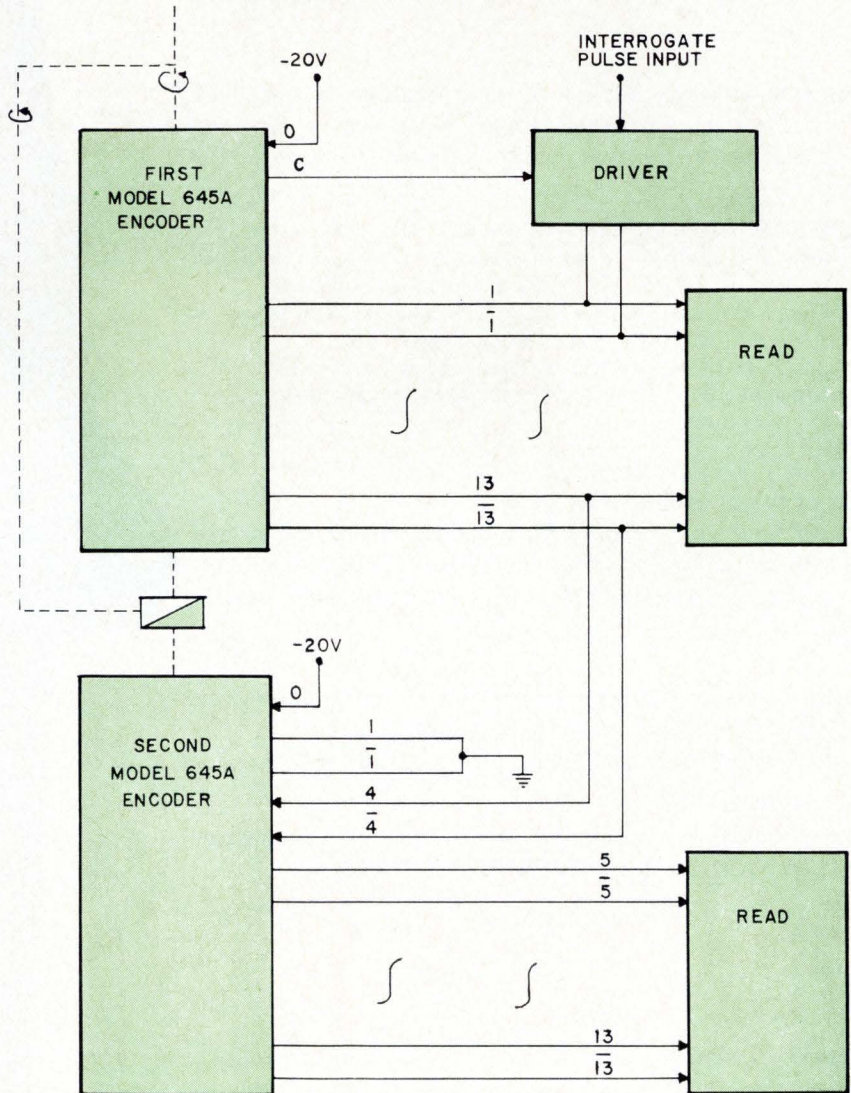


Fig. 3 Ganged encoder operation (22-bit capability).

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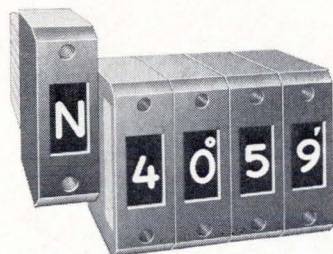
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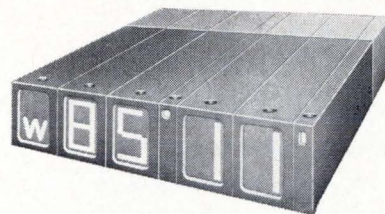
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PLEMENT outputs of each encoder word to make sure they are opposite. For the encoder to provide a valid check of error, it must have a built-in redundancy down to and including the sensors. The 645A, using "V" scan, has four sensors on each track, with one pair reading the TRUE code and the other pair reading the COMPLEMENT. Artificially providing a COMPLEMENT to the TRUE code output by using opposite halves of flip-flops is not acceptable, since it really tells nothing of what is going on in the encoder proper.

- External logic for count change inhibit is used in the MK-84 system (Fig. 2). The external logic requires a continuous output from the L.S.D., designated as the commutator output, for its operation. In self-selecting brush encoder applications, the logic is used to prevent the L.S.D. from changing due to rotation of the input shaft during the encoder interrogation. Provided

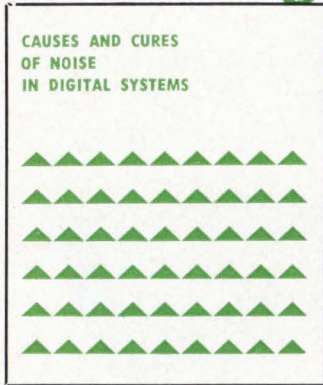
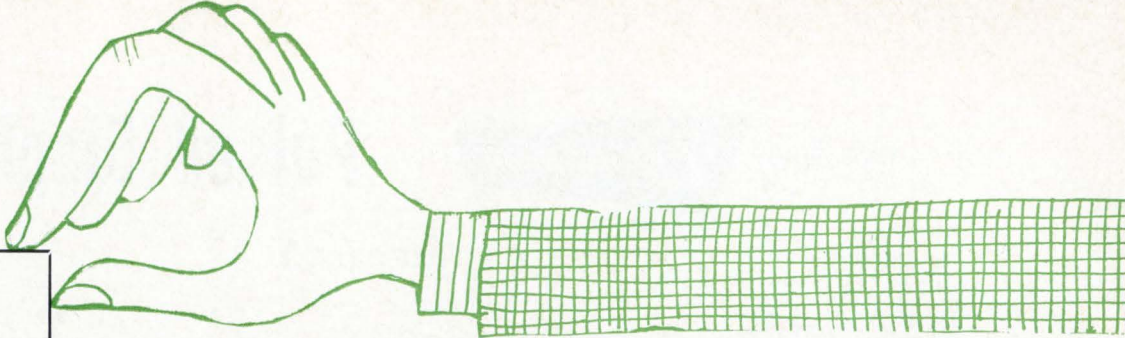
the shaft is not rotating too fast, the distance the disc will travel during interrogation is less than the tolerance of the "V" scan sensors, which means that even though the L.S.D. track has really sensed a change from zero to one, the output reading will remain a correct representation of the shaft position that prevailed when the L.S.D. output was frozen. The 645A includes internal free running circuits to provide continuously a commutator output. This, together with the inhibited logic level for "V" scan selection on track 2, limits the speed of rotation permissible during interrogation to 250 rpm.

- Ganged encoder operation is used to extend the encoder from 13 bits to 19 bits in the MK-84 by gearing two encoders together and electrically using the output of the most significant bit of the first encoder to provide the "V" scan logic input to the second encoder as shown in Fig. 3. For the 645A, this required

that inputs on terminal 4 and 4 be able to trigger the internal interrogation as well as to provide proper logic selection for the sensors on track 5.

- "Self-selecting" describes the ability of the encoder to provide internally its own "V" scan logic selection so that the output is a resolved natural binary count, thus eliminating the need for external lead-lag selection circuits. Efficient use of circuits in the 645A accomplished this with fewer components than would have been required to provide separate lead and lag outputs. The 645A performs the "V" scan logic and sets all 13 TRUE and COMPLEMENT outputs in less than 10 microseconds from the time it is interrogated.

One of the binary output circuits for the 645A encoder is shown in Fig. 4. The resistor R-2 in series with the output is for current limiting and prevents burn out if the



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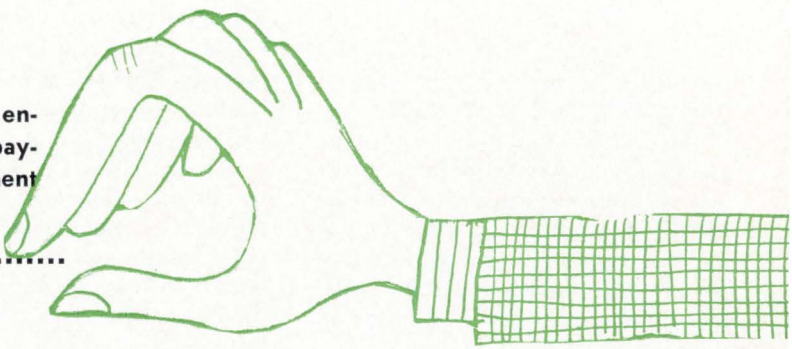
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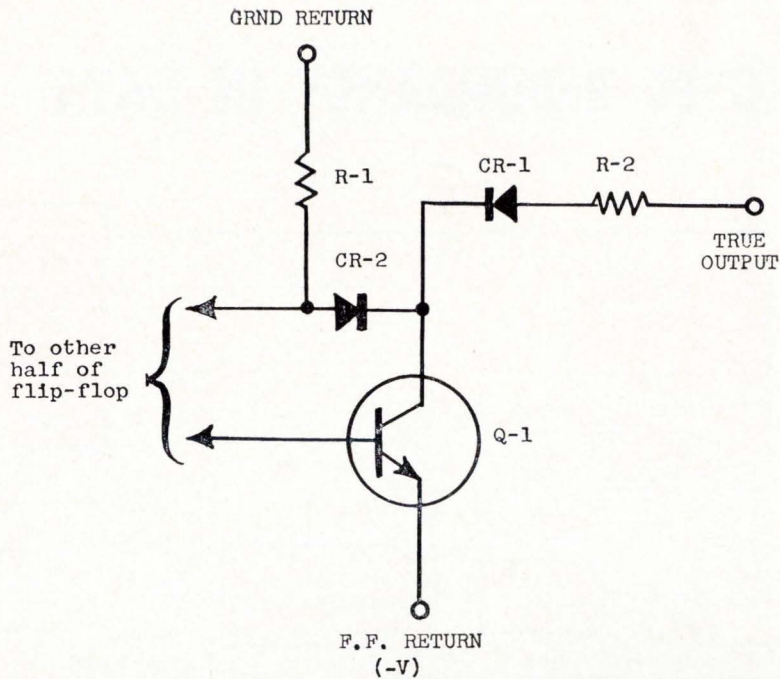


Fig. 4 One of the binary output circuits for the 645A encoder.

output is accidentally shorted. The logical ZERO and ONE voltage levels out of the encoder with a 4.7 K load are 0 and -13 volts respectively.

The high density packaging of the encoder circuits was accomplished by using TO 46 silicon transistors, TI Micro "G" silicon diodes, 1/10 watt Allen-Bradley resistors, microminiature capacitors, and 1/32" thick printed circuit boards. All the parts were chosen for high reliability on the basis of their past performance, and well over 90% of them are being used below 1/10 their rated power.

The 645A encoder was designed and is intended as a direct replacement for a brush encoder. For new encoder applications, EMR has designed a modified version, design-

ated the 645B, which exhibits these significant advantages: (1) elimination of external logic circuits; (2) reduction of encoder power by 30%; (3) encoder interrogation possible during higher shaft speeds of rotation. The 645B still retains the self-selecting and error checking feature of the 645A.

The next model in the series is a 645C which will have only TRUE outputs and while still being self-selecting will not have the error checking capability. This unit is intended to fill the needs of users who don't require all the features of the A and B and at the same time offer wider variation of inputs voltage levels and choice of either voltage polarity.

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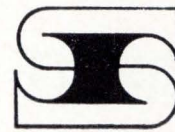
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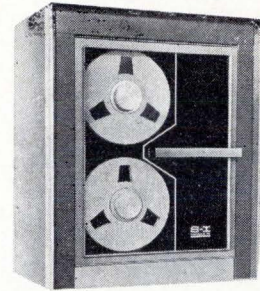
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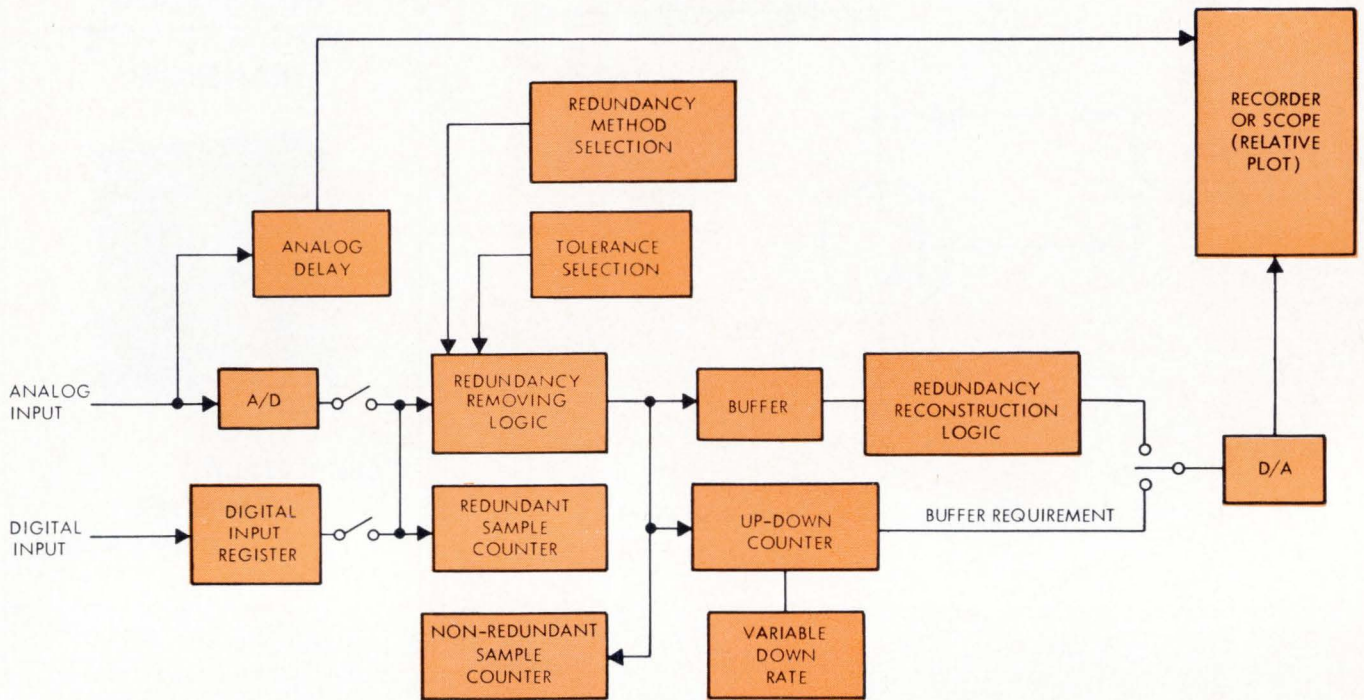


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# NOVEL DEVICE DIAGNOSES REDUNDANCY IN DATA



Block diagram of high-speed analyzer that diagnoses the amount of data redundancy.

A high-speed analyzer, recently developed by Radiation, Inc. of Melbourne, Florida, automatically diagnoses the amount of redundancy in data. The instrument, called a Data Management Analyzer (DMA), performs the functions of two high-speed digital computers, analyzing single-channel analog or digital data at word rates up to 10,000 cycles per second. It is housed in three desk-high racks.

Lawrence W. Gardenhire, noted scientist at Radiation, described the equipment as "an adaptive data system which we plan to use to analyze the data management problems of our customers during the system synthesis phase. With this device we can determine the amount of redundancy, the order of the data, the amplitude of noise present on the data, and the interpolation error due to the original sampling".

Functionally (see block diagram) the DMA accepts analog inputs of

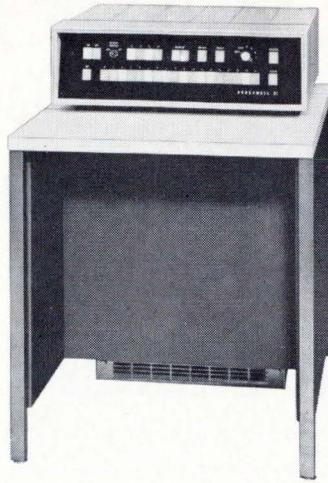
various types, including transducer outputs, voice and TV. The inputs feed into an analog-to-digital converter, are digitized, and enter the Redundancy Reduction Logic. Programmed to remove redundant samples by either a zero (step) order method or first (fan) order method, the Redundancy Reduction Logic identifies non-redundant samples within preselected tolerances. These samples feed through a variable bandwidth filter to represent a limited bandwidth transmission circuit. At this point, noise is added to depict the effects of digital transmission.

A count of the total number of input samples coming to the Redundancy Reduction Logic, when compared to the number of non-redundant samples, enables the user to determine the amount of reduction possible for a particular waveform at different selection tolerances and sampling rates.

The non-redundant samples enter and remain in the memory of the buffer while the Reconstruction Logic supplies the original number of redundant samples. These samples feed into a D/A converter which supplies an analog voltage to record or display on an oscilloscope. The original waveform, which has been delayed for the time required for removal and reconstruction, is now available for comparison with the reconstructed waveform.

Standard epoxy-potted digital logic modules are used throughout the instrument. The Redundancy Removal Logic is comprised of about 2,000 of the plug-in rectangular components. Reconstruction Logic requires about 1000 modules. Additional modules can be added to provide multi-channel capability.

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**Some other features are:**

**Word Length:** 18 bits plus parity and memory guard bits. Single word instructions provide 8192 directly addressable core locations.

**Priority Interrupts:** Up to 16 hardware levels.

**Memory:** Magnetic core, random access; 2,048 to 16,384 words capacity; prewired for field expansion; non-volatile on power failure.

**Memory Guard:** Gives "padlocked" protection against accidental modification of guarded core locations.

**Direct Memory Access:** Independent path to memory for external I/O operations on a fully buffered, cycle-steal basis.

**Silicon Hybrid Circuits** with low active component count insure reliable system operation from 32 to 120° F.

**Indexing** may be combined with indirect addressing.

**Three-Address Register Commands** allow three-address arithmetic and/or logical operations with single word, one cycle instructions.

**Double Length Accumulator** facilitates 36-bit arithmetic.

**Parallel I/O Channels** — designed to provide efficient and convenient interface with user's system equipment.

**Typical Operating Speeds** (in microseconds, including accessing and indexing): register arithmetic/logical operations, 6.0; load/store, 12.0; multiply, 54.0.

**Options:** Auxiliary drum memory, magnetic tape unit, high speed paper tape punch and tape reader, priority interrupts, DMA.

**Software**—An extensive software package includes CONTRAN, the new compiler-level programming system for real-time control; FORTRAN IV with linkage capability to executive programs; and CAP assembly system plus arithmetic, utility, and diagnostic programs.

The H22 central processor with a cycle time of 1.75 microseconds is available at a slightly higher price.

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\*Basic price of \$21,000 includes H21 central processor with 2K core and input/output typewriter with integral tape punch and reader.

**Honeywell**



# SOME OBSERVATIONS ON DECIMAL-TO-BINARY CONVERSION OF FRACTIONS

N. J. Abbod

In this article, the relationships between decimal fractions and their binary equivalents are examined, and observations are made with regard to the existence of a terminating binary equivalent, and the rationality of repeating, non-terminating fractions.

## Terminating Fractions

All terminating decimal fractions may be represented in the form:

$$\frac{N}{10^P}$$

To convert we set:

$$\frac{N}{10^P} = \frac{B}{2^Z}$$

where N = Decimal Number; B = Binary Number; P = Decimal Exponent (number of places to the right of the decimal point); and Z = Binary Exponent (number of places to the right of the binary point).  
But:

$$\frac{N}{10^P} = \frac{N}{2^P \times 5^P} = \frac{B}{2^Z}$$

therefore:

$$B = \frac{N \times 2^Z}{5^P \times 2^P}$$

From this expression, the observation may be made that B will be a terminating binary number if, and only if, N is divisible by  $5^P$ ; further, the binary exponent Z will then equal the decimal exponent P.

The following algorithm may therefore be postulated for finding terminating binary equivalents for decimal fractions.

Express the fraction in the form:

$$\frac{N}{10^P}$$

If N is not divisible by  $5^P$ , no terminating binary equivalent exists. If N is divisible by  $5^P$ , the binary exponent

Z equals the decimal exponent P, and the quotient, expressed in binary form, is the binary number B.  
Some illustrative examples:

Example 1. Convert  $(0.4375)_{10}$  to  $(0.X)_2$ .

$$0.4375 = \frac{4375}{10,000} = \frac{4375}{5^4 \times 2^4} = \frac{4375}{625} \left( \frac{1}{2^4} \right) = \frac{7}{2^4}$$

$$(7)_{10} = (111)_2$$

Therefore, the equivalent binary number is 0.0111.

Example 2. Convert  $(0.9375)_{10}$  to  $(0.Y)_2$ .

$$0.9375 = \frac{9375}{10,000} = \frac{9375}{10^4} = \frac{9375}{5^4 \times 2^4} = \frac{625}{9375} \left( \frac{1}{2^4} \right) = \frac{15}{2^4}$$

$$(15)_{10} = (1111)_2$$

Therefore, the equivalent binary number is 0.1111.

## Repeating Non-Terminating Fractions

For repeating non-terminating binary fractions, the observation is made that each represents a rational number. For example, in a decimal repeating fraction:

If  $n = 0.132132132 \dots$  then  $1000n = 132.132132132 \dots$

$$1000n = 132.132132132 \dots$$

$$-n = 0.132132132 \dots$$

$$\hline 999n = 132$$

$$n = \frac{132}{999} = \frac{44}{333}, \text{ a rational number.}$$

Similarly, in binary repeating fractions:

If  $b = 0.01001100110011 \dots$  then  $10000b = 100.110011001100 \dots$

$$10000b = 100.110011001100 \dots$$

$$-b = 0.010011001100 \dots$$

$$\hline 1111b = 100.1$$

$$b = \frac{100.1}{1111} = \frac{100.1(10)}{1111(10)} = \frac{1001}{11110}, \text{ a rational number.}$$

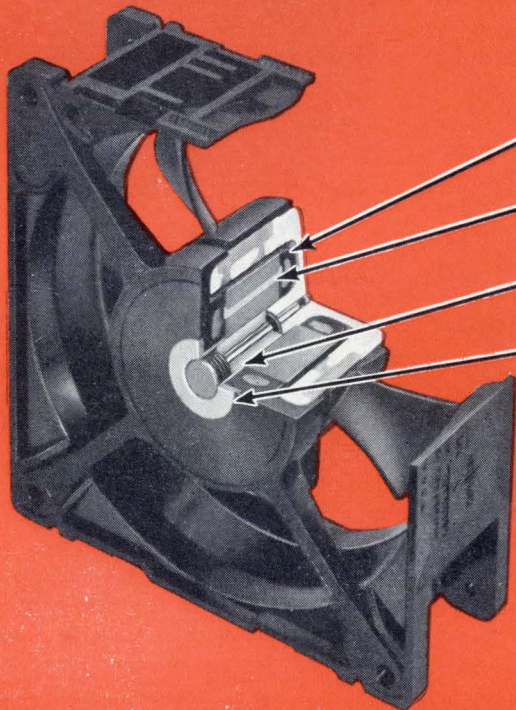
The author wishes to acknowledge the encouragement of Dr. R. P. Loomba, Associate Professor of Electrical Engineering, San Jose State College, in the preparation of these observations. **END**

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## NEW PRODUCTS

### DIGITAL-TO-VIDEO DISPLAY

New system permits display of computer-generated data at a series of locations remote from the data processing center. Designated the S-C 1200, the system translates digital data from a computer into a visual format for display on the screen of one or more television consoles. In the system, the computer feeds data to the data distributor. From the distributor, data are sent to the selected buffer which consists of a core memory, display generator selection circuitry, load and unload circuitry. The buffer continuously repeats the information to a display generator to supply sufficient repetitions to permit flicker-free viewing of the data. Each buffer can drive four generators. The display generator presents the data on the face of a special cathode ray tube in the form of letters, numbers, symbols and lines of any kind. It can produce complex figures or curves by joining line segments (vectors) together. A film projector is provided within the generator so fixed background data such as graph lines, business forms, maps, etc., may be superimposed under program control thereby not requiring extensive computer time to generate. Direct view displays may also be utilized instead of TV monitors, or may be used in parallel with microfilm/hardcopy systems. The digital-to-video system is said to be extremely economical because it is far less expensive to display data on a series of TV monitors than on a series of direct view displays. Also the technique makes it possible to present many channels of information to each monitor. Stromberg-Carlson, San Diego, Cal.

Circle No. 194 on Inquiry Card

### IC TESTING SYSTEM

An integrated circuit testing system, called Scat (Sequential Component Automatic Test), can test discrete circuits on printed-circuit cards and/or ICs in micrologic packages. It can perform differential dc and/or ac voltage measurements from 100v to 1mv and differential dc and/or ac current measurements (floating from ground) from 100 ma to 10 pa. Scat can also make high frequency ac and pulse measurements up to 10 giga-cycles in the same test socket as is used for dc tests. This system can be programmed by tape, magnetic disc or a computer and completely self-checks itself prior to each measurement. Continental Device Corp., Hawthorne, Cal.

Circle No. 130 on Inquiry Card

### PULSE VOLTAGE GENERATOR

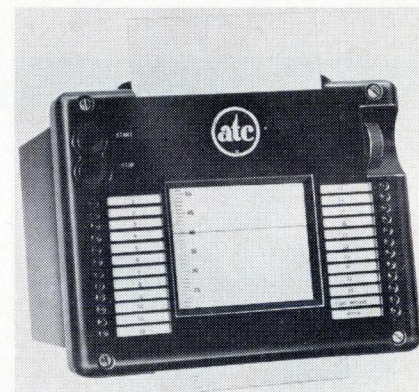
Pulse voltage generator converts programmed sync pulses from digital program generators into stable, variable parameter pulses for investigation and test. Positive and negative pulse voltage generators feature variable rise/fall times from 8 to 200 nanoseconds (at 50 volts) and pulse amplitudes from 0 volt to 50 volts. Completely self-contained, the generators provide variable trigger, delay, sync, width, rise time/fall time, and output amplitude controls. They also incorporate internal triggering and sync output provisions, allowing one or more instruments to operate without program source. Computer Control Co., Framingham, Mass.

Circle No. 138 on Inquiry Card

### MINIATURE COOLING BLOWER

Less than 3 inches in diameter, 2½ inches long, and weighing only 7.35 ounces, a new vane-axial blower unit is operable from sea level to 7500 feet altitude and from 40F to 110F ambient temperature. The dc unit delivers an air flow of 33 cfm at a static pressure of 0.5 inches of water (standard density), at which point it draws 6.16 watts at 7.7 volts dc. The Torrington Mfg. Co., Torrington, Conn.

Circle No. 133 on Inquiry Card

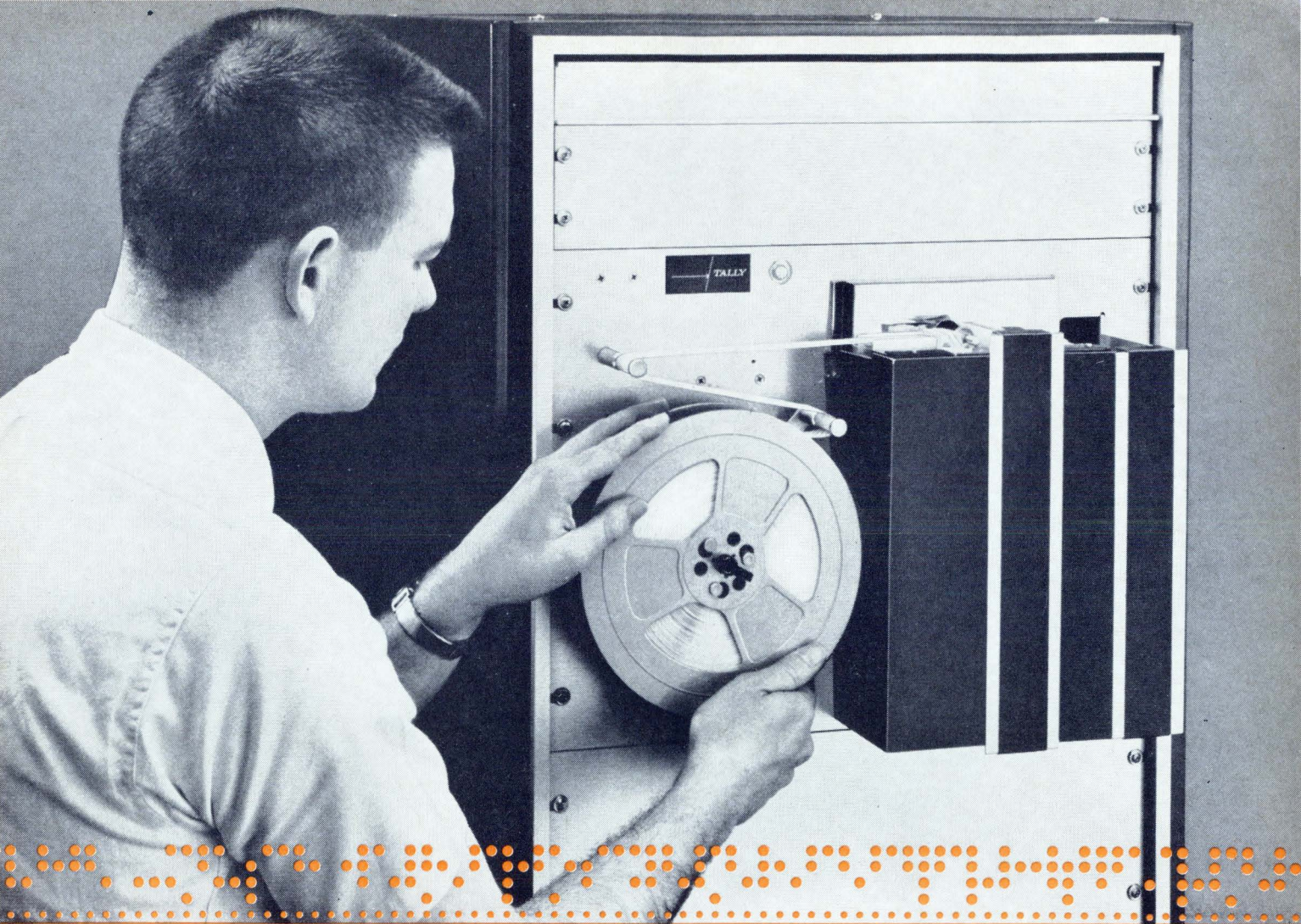


### CARD PROGRAMMER

New program card controller automatically programs 12, 24, or 48 control circuits according to an exactly synchronized time or step schedule which is pre-cut on a durable plastic card. Once cut, the cards can be used indefinitely to repeat the desired program within an accuracy of  $\pm 1/4\%$ . Different programs require only a different card. The unit can be ordered as a time or step programmer. In the timer version, it is driven by a synchronous motor and is available in 11 standard ranges of 37.5 seconds to 25 hours. The stepper version is available in 60 or 150 step option which automatically sequences the control circuits in response to step impulses, at speeds of up to 6 steps per second. Pilot lights indicate the condition of each control circuit during all parts of the program. Each control output is a SPDT snap-action switch with a non-inductive rating of 10 amps at 115 volts ac. Automatic Timing & Controls, Inc., King of Prussia, Pa.

Circle No. 123 on Inquiry Card





# NEW P-120 PERFORATOR...

... puts down data at 120 char/sec,  
catches errors,  
and prices out at \$975 in quantity

Once in a while, a new product comes along which fits the functional needs of a market to a "T". Tally's new P-120 Perforator is just such a device. The P-120 embodies more useful features and better performance specifications than any perforator ever offered at this price (or even several times the price).

This compact, panel-mounted perforator features integral tape supply and take-up reeling.

The P-120 is designed for quick, easy, front tape loading. Using a limited number of moving parts in a highly accessible frame gives exceptional reliability and speeds maintenance. Operation is asynchronous. Error control and remote tape backup options are offered at modest extra cost. Error checking is accomplished by contacts which

sense the mechanical motion of each punch pin. If an error is sensed, a delete code can be punched **before** the tape advances.

A new bulletin, yours for the asking, tells all. Write our Mr. Ken Crawford, Tally Corporation, 1310 Mercer Street, Seattle, Washington 98109. In the U.K. and Europe, address our man in London, H. Ulijohn, Tally Europe Ltd., Radnor House, 1272 London Road, Norbury, S.W. 16, Surrey, England.



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CIRCLE NO. 29 ON INQUIRY CARD

## NEW PRODUCTS

### PULSE GENERATOR

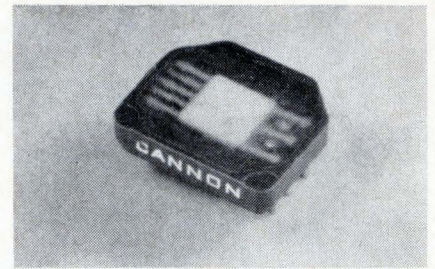
New programmable pulse generator, Model 171, combines the versatility of a general-purpose instrument with the added feature of digital control capability, either manually or remotely-programmed. The 171's pulse period and width are digitally programmable to within 0.01%. Rise and fall times are independently variable from 6 ns to 100  $\mu$ sec. Price is \$2,875. E-H Research Labs, Oakland, Cal.

Circle No. 145 on Inquiry Card

### LOW NOISE CABLES

Line of low noise cables utilizes a unique method of manufacture to achieve noise levels consistently improved by a magnitude of five times to one over those of existing designs, according to the manufacturer. In the new low noise line, carbon thread is added over the dielectric, producing a conductive layer between dielectric and shield. This is said to result in a consistently low level of noise. Other advantages cited for the new cable include easier termination to connectors and substantially lower prices. Microdot Inc., So. Pasadena, Cal.

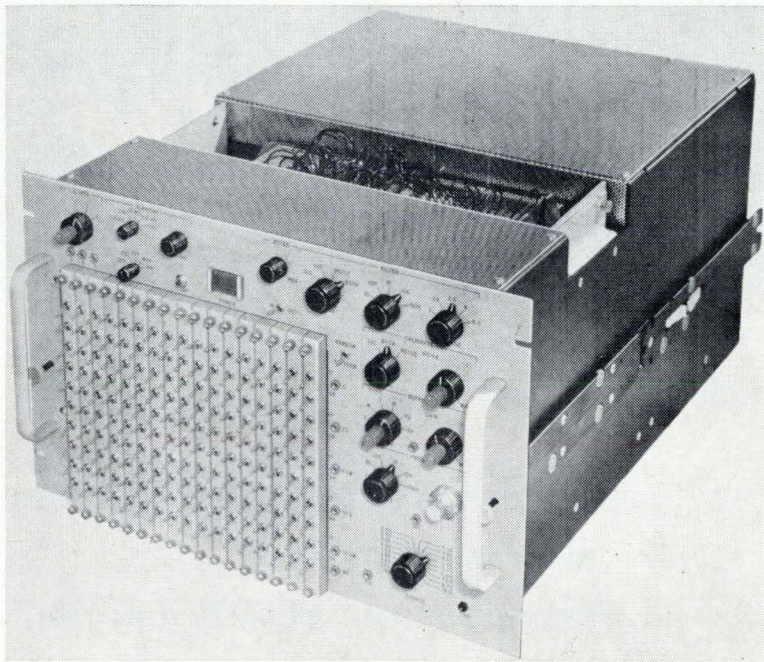
Circle No. 142 on Inquiry Card



### MICROMODULE CONNECTORS

Called "Bug Plug" micromodules, new units are designed to permit flat-pack modules with integrated circuits to be plugged into printed circuit boards. Repair difficulties are thereby greatly reduced since a defective unit can be simply unplugged and replaced. Leads from integrated circuits are attached to the contacts of a "Bug Plug" module by percussive/arc or resistance welding. After the leads are secured, the unit is encapsulated for protection. The new modules are capable of withstanding shock up to 50 g's and vibration up to 2,000 cps without resonance or a measurable loss of continuity. ITT Cannon Electric, Los Angeles, Cal.

Circle No. 127 on Inquiry Card



### PCM SIGNAL SIMULATOR

Pulse-code-modulation signal simulator designed for ground station monitoring of telemetered signals is only 12 $\frac{1}{4}$ " high including power supply. The unit is a complete PCM test lab including a built-in bit-by-bit comparator with panel-controlled signal delay. It generates all commonly used PCM codes (RZ, NRZ-C, NRZ-S, NRZ-M, Split Phase) in either polarity at rates from 1 to 1,000,000 bits per second. Signals can be generated in bi-polar

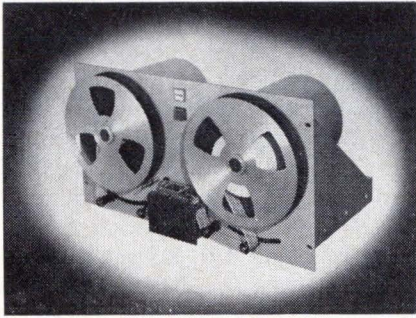
form also. The Model 200 Signal Simulator can be programmed to provide up to six words ranging in length from 2 to 34 bits with data content controlled by easily accessible front panel toggle switches. Frame length may vary from 1 to 2048 words, and subframe length from 1 to 256 frames. Frame sync may be fixed or alternating, and subframe sync may be fixed, advancing ID or a complement of frame sync. The Roback Corp., Huntingdon Valley, Pa.

Circle No. 136 on Inquiry Card

### CIRCUIT CARD DRAWERS

A new horizontal drawer unit is capable of holding up to 75 circuit cards, and is available in either a patented "Tilt-File" design or standard fixed drawer concept. The units are available in three models, two of which are hinged to allow complete access to circuit cards, connectors, and wiring during servicing. One hinged model is available with interchangeable extruded flanges framing the front panel allowing the option of either rack-mounted or desk-top approach to instrument design. All "Tilt-File" drawers have latches that lock the frame at the vertical and closed positions. The third model is of fixed drawer design and provides sturdy packaging that will meet many standard requirements. Quick disconnect slides and perforated covers are available for all drawers. SCANBE Mfg. Corp., Monterey Park, Cal.

Circle No. 137 on Inquiry Card



### PAPER TAPE READERS

Panel-mounted paper tape reader system offers asynchronous operation at any rate up to 30 cps, together with completely automatic tape spooling and respooling. The system generates no electrical noise to interfere with external logic, and can itself be driven by standard logic levels. The spooling mechanism is a self-contained, bi-directional servo system which operates directly from 115-volt ac power, and incorporates a special magnetic braking arrangement for smooth, noiseless stops. Optional control, timing and gating signal outputs make the system readily adaptable to a variety of computer applications. All sub-assemblies are designed for minimum routine maintenance requirements. Price: \$520.00. Navigation Computer Corp., Norristown, Pa.

Circle No. 129 on Inquiry Card

### TRIMMING POTENTIOMETER

Miniature adjustment potentiometer is said to feature exceptional resolution in a smaller-than-standard package. Measuring one inch long, the new Model 3070 has a seven-inch resistance element incorporating the same helical principle used in precision potentiometers. As a result, it has, according to the company, as great as nine times better resolution than comparable sized adjustment units. This unique design is said to also enable the use of resistance wire having about double the normal cross-section area for any given resistance value. This greatly increases element life and overall reliability. Bourns, Inc., Riverside, Cal.

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# SLASH HIGH-SPEED DATA HANDLING COSTS!



## ELIMINATE PAPER TAPE PROBLEMS WITH DIGI-STORE® DS-2 MAGNETIC TAPE UNITS

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## NEW PRODUCTS

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### MONOLITHIC MEMORY

A high-speed memory unit is described as an industry "first" and potentially one of the simplest and most economical approaches to producing complex memory systems. This monolithic ferrite device is now in pilot production for tests and evaluation. New unit is said to offer not only the advantage of a full-cycle time as low as 200 billionths of a second, but adds to this small size, production economies, and the capability of withstanding shocks and vibrations encountered in air and space applications. The monolithic unit is a "batch processed" ferrite memory which eliminates the tedious task of core-stringing and handwriting, prime cost factors in memory systems. The device also incorporates an integrated diode selection matrix or "indexing circuitry" which also reduces the number of peripheral components. New production process employs tissue-thin layers of conventional ferrite material fired into a solid monolithic ferrite wafer one-inch square and five one-thousandths of an inch thick. Each wafer contains 4096 theoretical cores, with each core having an effective diameter of only 5 mils — or about the diameter of a human hair. If individual cores of this size could be made, wires smaller than the strands of a spider web would be needed in the core-stringing operations. Full-cycle time (read, delay, write) is as low as 0.2 microseconds for a 64 word by 64 bit unit. Drive current requirements are said to be less than those of present small-core, coincident-current memories. However, voltages are equal to those of conventional core arrays. In the new device, two wafers are interconnected with an integrated silicon diode selection matrix of 128 diodes. This 4.5-inch by 3.75-inch module has a memory capacity of 4096 bits in two-"core"-per-bit linear-select operation. Commercial Engineering, RCA Electronic Components and Devices, Harrison, N. J.

Circle No. 134 on Inquiry Card

### CARD READERS

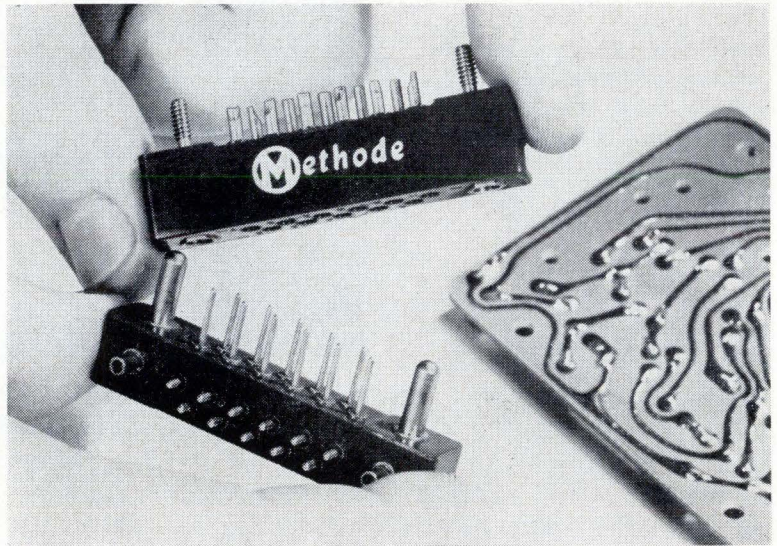
Versatility is said to be a prime feature of a new card reader which operates off-line to complement, or on-line to implement, existing systems. Reading speed is 10-12 columns per second. All alpha-numeric or special symbols, in Hollerith or other coding systems, are accepted. Other unique capabilities include unattended operation and remote transmission via Dataphone. The Model 600 becomes the focal point of a punch card system when interfaced with other punch card devices, printers, listers, and calculators. This interface allows gradual assimilation of a complete low volume terminal station, at nominal cost, according to the company. Data Trends, Inc., Parsippany, N.J.

Circle No. 143 on Inquiry Card

### MINIATURE 95-OHM LINE

A manufacturer of wire and cable has announced the availability of several miniaturized signal transmission lines. One such line, a shielded twin lead, or twinax, has a characteristic impedance of 95 ohms  $\pm$  3% yet is only 0.050" in diameter. Two Awg 33 wires are held in precise position within a slim rod of Teflon around which are wrapped two layers of conductive foil overlapped 50% to provide almost complete electrostatic shielding. The construction is then jacketed with a polyester laminate insulation to provide protection from cut-through and abrasion. Attenuation of the cable is 23db per 100 feet at 100 megacycles. W. L. Gore & Associates, Inc., Newark, Del.

Circle No. 147 on Inquiry Card



### PC BOARD CONNECTORS

Printed circuit board connectors contain 11 staggered socket and pin contacts on 0.100" centers. Approximately two inches long and 0.400 inches wide, the connectors meet all of the environmental and electrical requirements of MIL-C-8384 for rack and panel connectors. Originally developed for military use, the female connector features remov-

able/replaceable solder pot contacts. Male unit features stainless steel guide pins and brass nickel plated rollover rivet type p/c board mounting studs. The plug or male type connector ranges in price from \$2.85 to \$5.75 each and the female receptacle connector is priced from \$2.45 to \$5.10 per unit. Methode Electronics, Inc., Chicago, Ill.

Circle No. 128 on Inquiry Card

## DIGITAL TAPE TRANSPORT

A new digital tape transport has a tape speed of 75 inches per second and packing density of up to 800 characters per inch, and can be used by computer and systems manufacturers as a tape transport or, with additional solid-state electronics, as a complete tape memory system. The transport offers high data reliability because of a servo-driven single-capstan drive mechanism which provides gentler tape handling than conventional methods, according to the company. The maximum number of tape passes which can be made of a single-given tape on the unit without dropout errors is from three to 10 times greater than with pinch-roller tape systems, the company reports. The new transport is offered in cabinet consoles four feet high or in vertical mountings of less than three feet in height. Price range is \$6,000 to \$13,000, dependent upon accompanying electronics required. Ampex Corp., Redwood City, Cal.

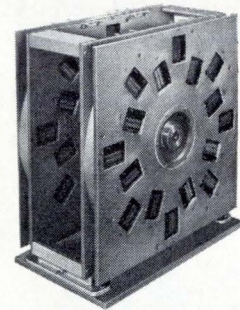
Circle No. 132 on Inquiry Card

## HIGH PERFORMANCE TRANSISTORS

A breakthrough in high-frequency silicon transistor voltage breakdown characteristics, attributed to the use of "annular" construction methods, has made possible the introduction of new 30-mc PNP and NPN devices with collector-emitter voltages in excess of 300 volts. This high-voltage performance is said to represent almost a threefold increase in voltage capability over that previously attainable. According to the company, these new annular transistors put the designer in command of a whole new set of design values in applications such as video amplifiers, core driving, voltage regulation, and applications using line voltage sources. In many designs it is now possible to entirely eliminate the need for power transformers previously used in equipment operated from 120-volt sources. Motorola Semiconductor Products, Inc., Phoenix, Ariz.

Circle No. 146 on Inquiry Card

# How do you design memory systems to be both strong and lightweight?



## Very simple.

The answer to the question is **simple** and so is the **advanced design** of the new L-400 Magnetic-Disc Memory Systems developed by Librascope Group of General Precision, Inc. This simplified design provides strength, light weight, and dependability at low cost where rapid-access memory is required in data storage and transfer for computer systems and peripheral equipment. An important saving of capital expenditure is made possible with the L-400 series memory files because you can install only the memory capacity presently needed, allowing for later expansion or "add on" memory capability as required. Librascope's series L-400 consists of two models: the L-414, a 14-inch disc memory file with a storage capacity of up to 8,388,608 bits, and the 24-inch disc L-424 with a capacity of up to 27,033,600 bits. Field expansion of a 14-inch or 24-inch memory is accomplished by adding "head bars" of 16 read-write heads to the

basic single disc system. Further expansion is possible by adding the 16-head modules to the opposite side of the disc. For maximum capacity, a second disc is added with head bars on both sides. These memories provide outstanding magnetic performance under all operating conditions. They can be used as the main storage, buffer storage, or to supplement other memories. Reliable and inexpensive, they are available now. If necessary, they can be tailored by Librascope to fill your need. For complete technical details, write for Bulletin L-400.

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CIRCLE NO. 32 ON INQUIRY CARD

## NEW PRODUCTS

### COMPUTER ACTUATOR

High-speed solenoid is designed for mechanical actuation in all types of computer and data processing equipment. In addition to speeds of less than 10 milliseconds, the unit offers a compact configuration for applications where size and weight are critical factors. Speeds as low as 3-4 milliseconds can be readily attained in the same package. The overall package weight is 20 grams. The body size is 0.500" dia. x 0.875" long. The Model L-2795 was designed to operate on a 24 vdc system requiring 36 watts of power. Force-stroke combinations up to 2 lbs. at 0.050" are attainable from this unit. G. W. Lisk Co., Clifton Springs, N.Y.

Circle No. 151 on Inquiry Card

### DATA SERIALIZER

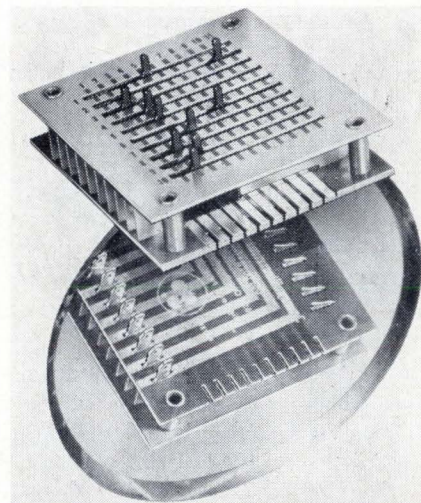
A new highly-flexible device converts outputs of digital voltmeters, analog-to-digital converters, or voltohmmeters into serial data form. Called the Series 6010 Serializer, this solid-state unit may be programmed to select eleven input characters, plus up to three internally-generated characters, and convert these signals into a form for electric typewriters, paper tape units, card punches, and similar print-out devices. The unit accepts the following parallel inputs: up to five 4-line BCD groups, a 4-line range group, and a 4-line mode and sign group. An optional expansion permits the addition of up to four 6-line alphanumeric binary input groups. Features include variations in output sequence or word format, and an optional device that provides a column counter which can be used to generate a carriage return after a predetermined number of words. Electronic Associates, Inc., West Long Branch, N.J.

Circle No. 180 on Inquiry Card

### DIGITAL-TO-SYNCHRO CONVERTERS

Digital-To-Synchro converters featuring single speed resolution and accuracy to 5 seconds of ARC finds a major application in digital computer-controlled servo positioning or indicating systems. The units accept computer input angles in parallel binary or BCD form and convert these inputs to three or four wire analog outputs capable of driving synchros and/or resolvers. Maximum updating rate is 500 words per second. A wide range of low power logic levels can be accommodated including both negative and positive logic. The synchro or resolver output angle can be changed a full 180° in less than two milliseconds. Astrosystems, Mt. Vernon, N.Y.

Circle No. 148 on Inquiry Card



### PATCHBOARD SELECTOR SWITCH

Compact size crossbar-type selector switch with inter-connections to provide the same circuit capabilities as a 100 jack patchboard fits easily in a space 4" x 4" x 2". The miniature patchboard module measures 3 1/2" x 3 3/8" x 1-9/16". Interconnectability between all "x" and "y" circuits, with OFF positions, is provided by means of added printed circuitry on back side of the baseboard. This package, in a 10 x 11 arrangement, provides 100 switching positions plus an OFF position for each circuit. Cherry Electrical Products, Highland Park, Ill.

Circle No. 161 on Inquiry Card

## COLOR CRT

New cathode ray tube system was designed to withstand military environments remaining completely operational without color degradation caused by changing magnetic fields. Thus, for the first time, according to the company, full-range color can be utilized in the display of sensor and computer information in aircraft, ships, submarines, and tanks. Additional features of the dynamic color display, called Chromascope, include image storage, true three-dimensional capability in full color or monochrome, and the capacity for the simultaneous presentation of data from different sources on a single viewing surface. The method of simultaneously displaying data is said to be considerably less complex than conventional scan conversion, making it possible for each data to be identified by an assigned color. Litton Industries, Guidance and Control Systems, Woodland Hills, Cal.

Circle No. 152 on Inquiry Card

## TAPE TRANSPORTS

New family of instrumentation magnetic tape loop transports is said to possess unique capabilities as test beds for tape system design work ranging from studies and/or development of heads, tapes, read/write circuits to sophisticated memory systems. The equipment's unusual operating characteristics are said to make feasible for the first time, the economical development of multi-channel wideband delay lines, transient spectrum analyzers, band-width compressor/expanders, transient recorders and related memory/data analysis devices. The first standard unit offered has simple controls that permit routine adjustment of all important tape, head, and drive parameters. Tape speed is continuously variable to 250 inches/second, tape tension is adjustable to 16 ounces, and the machine will handle 1/4", 1/2" or 1" wide paper, plastic or metal base tapes 1/4 mil to 10 mils thick. S. Himmelstein & Co., Chicago, Ill.

Circle No. 158 on Inquiry Card

## What has 21 cards, is stacked by an expert and leaves nothing to chance?

It must be the SEMS-4R . . . the low-cost, general-purpose memory system designed and built by Electronic Memories. The SEMS-4R meets military, industrial and commercial requirements where speed, reliability and mobility are essential.

The 21 card memory system provides extremely high reliability in severe environments. Any trouble shooting is quick and sure with the easily removed and replaced printed circuit cards.

And "stacked by an expert" is no exaggeration. Among the hundreds of designs in the Electronic Memories library are many units presently used in space probes, satellites, aircraft, shipboard and ground based systems. Extensive experience in supplying memory systems stands behind the SEMS-4R.

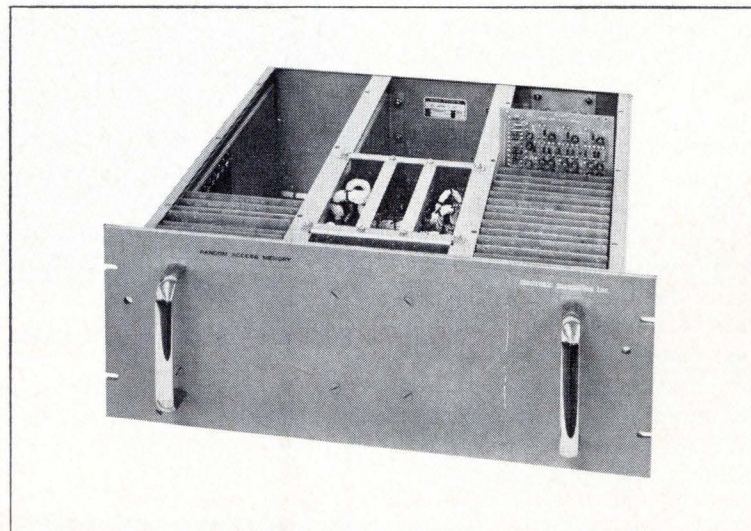
If you'd like to find out more about this severe environment, random access core memory that has 21 cards, is stacked by an expert and leaves nothing to chance, ask us.

### SEMS-4R Core Memory System

Capacity:	256 to 8192 words of 6 to 40 bits
Speed:	4 $\mu$ sec cycle time, 1 $\mu$ sec access time
Operating Temperature Ranges:	-40°C to +85°C -20°C to +65°C 0°C to +50°C
Size:	17" x 17" x 7" (19" rack mounting)
Volume:	2023 cubic inches
Environments:	MIL-Q-9858, MIL-E-16400E, MIL-E-4158B, MIL-STD-810 for GSE

## electronic memories inc.

12621 Chadron Avenue, Hawthorne, California



CIRCLE NO. 33 ON INQUIRY CARD

## NEW PRODUCTS

### INTERCHANGEABLE LOGIC MODULES

New NAND and NOR elements can be used interchangeably in the same logic system whether it is positive or negative. The use of this line of 1 mc welded digital logic modules will result, for most cases, in a 10 to 50% reduction of system component requirements, according to the manufacturer. The module line includes some 19 logic functions, all of which are compatible for NAND-NOR operation. Magnetic Systems Corp., Clearwater, Fla.

Circle No. 177 on Inquiry Card

### MAGNETIC LATCHING RELAY

New magnetic latching relay, claimed to be virtually free of mechanical failures, uses a magnet instead of interlocking metal levers. Such levers are said to be the cause of 90% of old style latching relay failures. The company feels that by using a magnet for both trip and release, a major cause of failure is eliminated. In this new relay, a one-piece armature on the magnet rocks up and down with a seesaw movement. In normal operation the armature is attracted to the coil side energized. It also operates in the opposed mode at about  $\frac{1}{2}$  the voltage or  $\frac{1}{4}$  the power. Several times the line voltage can be applied without affecting magnet strength even though coils are connected simultaneously and opposed to the magnet. The direction of flux produced by the coil in normal operation aids the magnet and has no tendency to demagnetize. Bi-stable polarized feature of the latching relay allows use of one coil where it is more economical to provide reverse switching to the relay. Milwaukee Relays, Inc., Cedarburg, Wisc.

Circle No. 174 on Inquiry Card

### SHAFT-ANGLE ENCODER

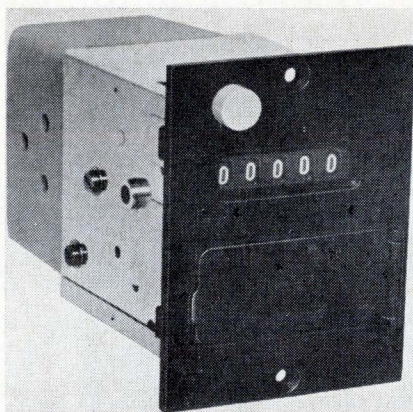
A duty-cycle "Vernisyn" encoding system was developed for continuous updated high precision read-out of shaft position. Resolution and accuracy of up to better than 1 sec. of arc may be achieved in any unit format as may be required. Visual display, as well as any coded electronic outputs, may be accommodated in standard  $5\frac{1}{4} \times 19$ " rack-mountable packages. The multiple advantages described above are made possible as a result of a duty-cycle detection of the electrical phase difference between multi-cycle (250 cycles per diametral inch) signals generated in input and stator members. High-fidelity signals are generated by means of a full perimeter variable-reluctance sensing means. By duty-cycling alternate cross-over points of both signals, the analog of the phase difference is generated for direct comparison with the D/A conversion of the digitized output. If any difference exists, the digital output is stepped up or down accordingly until the analogs correspond. As a result, the shaft indication may be made to track at a rate in excess of one megacycle. Data Technology, Inc., Watertown, Mass.

Circle No. 144 on Inquiry Card

### MULTIPLEXERS

Solid-state switching unit is especially suited to connecting test points to an analog-to-digital converter. This multiplexer features low leakage currents, and variable channel "ON" time. The low leakage currents permit use of large test point source resistances (with negligible error introduced as a result of leakage currents flowing through the test point source resistance). Leakage currents are low even when operating at high temperatures (+75C). The channel "ON" time can be made as long as one millisecond to allow sufficient time to charge circuit capacitances through large test point source resistances prior to measurement. The analog switching elements are designed for and yield very low offset voltage over the full temperature range; drive circuit isolation is assured by using transformer coupling between the analog and logic circuits. A single multiplexer unit contains a maximum of 128 channels. The number of channels may be any integral multiple of 8; two multiplexer units may be connected in parallel to provide a 256-channel multiplexer. General Dynamics/Electronics, Rochester, N. Y.

Circle No. 156 on Inquiry Card



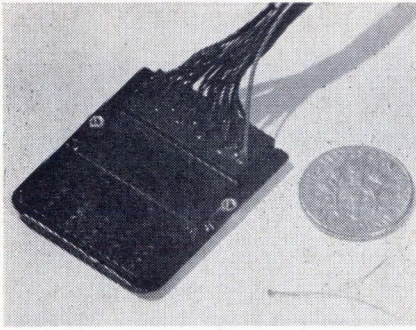
### PREDETERMINING COUNTER

New unit is an adding predetermining counter with combined pushbutton and electrical reset. The de-

sired count is preset into the counter by opening the hinged cover under the wheels for setting in the count desired. The visual register shows the progress count. Upon reaching the predetermined number an SPDT switch is thrown and stays in that position until reset by electrical impulse to the solenoid or pushbutton command. The cycle is thus automatically repeated until the presetting is changed. The connections are made from the back by a plug connector. Total capacity is 99999; resetting time is 250 miliseconds; and counting rate is 25 ips. Presin Co., Inc., Bridgeport, Conn.

Circle No. 165 on Inquiry Card





### GALLIUM PHOSPHIDE LAMPS

New subminiature, gallium phosphide junction device emits red light when passing current in the forward direction. The new type of light source, based on radiative recombination at the PN junction, is suitable for a variety of instrument and indicator applications where small size and low operating current are important. These lamps are approximately 0.030" in diameter and provide electroluminescent radiation at 7000 Å. Switch-on time of the lamp is, typically, 15 nanoseconds and the operating temperature range is from -20C to +70C. The small 0.030" x 0.050" diode has many potential applications in industry and research. These applications range from simple ON/OFF indicators to arrays for film marking and for display of digital computer outputs. They can also be used with photoconductor elements to construct a variety of switches and isolators. Ferranti Electric, Inc., Plainview, N. Y.

Circle No. 121 on Inquiry Card

### PLOTTER/BUFFER

New unit provides efficient, high-speed on-line plotting with the IBM/360 computer family in any of its configurations. Designated the Model 110, it is compatible with company's digital incremental plotters, and can be operated as a control unit attached either to a multiplexor or a selector channel. The core buffer unit stores up to 2048, 6-bit plotter command characters and accepts data at rates up to 500,000 bytes-per-second. California Computer Products, Anaheim, Cal.

Circle No. 178 on Inquiry Card

# This new 10ns current driver generates perfect waveforms for fast rise time switching

**Linear Rise & Fall: ±5% at 10ns, worst case**

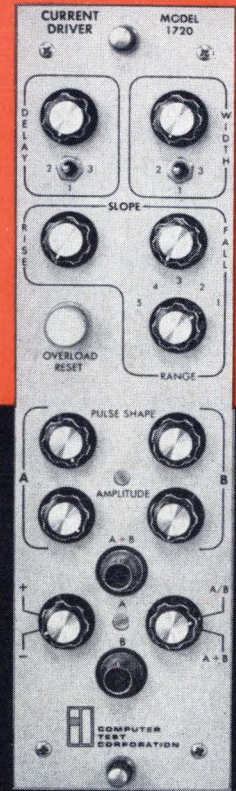
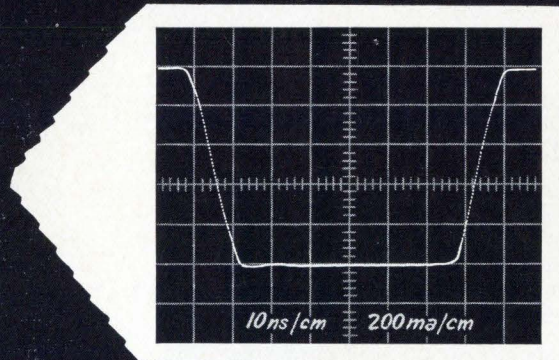
**Two outputs: 600ma each, 1 amp bussed together**

**Low Output Capacitance: 50pf worst case, 30pf typical**

**Bi-Polar Output: either positive or negative output pulses**

**High Voltage Output: 60V in direction of drive; 60V back emf**

**Square Corners: 5% max deviation all waveform corners**



## square-cornered current pulses

Many of the newer and faster memory devices actually switch states on the rise time of the driving pulse at or near the top corner of the waveform. Any ambiguity in specifying or developing the pulse shape about the 90% amplitude point, therefore, can result in significant errors in load response making perfect correlation and repeatability of test data impossible. This new and critical requirement in current driver design has raised to a new level of importance the degree of squareness of the pulse corner.

**In corner squareness, in low output capacitance and in linearity, the Model 1720 Current Driver is way out in front in the memory test field.**

COMPUTER TEST CORPORATION  
CHERRY HILL, NEW JERSEY



CIRCLE NO. 34 ON INQUIRY CARD

## NEW PRODUCTS

### INDUSTRIAL DIGITAL CIRCUITS

Ready-to-use encapsulated digital circuit modules, designed for heavy duty industrial and commercial applications, can be supplied separately or premounted on any of twenty standard circuit boards according to customer requirements. A wide variety of flip-flops, gates, multivibrators, followers, drivers, and other digital circuits are available. Typically, an all-silicon counter register flip-flop in volume costs only \$4.97. Skilled assistance in system design application of the new standard encapsulated digital circuits and complete breadboarding kits are said to be available from the manufacturer. The Roback Corp., Huntingdon Valley, Pa.

Circle No. 170 on Inquiry Card

### 100 MC PULSE GENERATOR

New Pulse Generator delivers continuous pulses or internally regulated pulse bursts with rise time under  $2\frac{1}{2}$  nanoseconds, at repetition rates up to 100 mc. It is expected that this instrument will be especially useful in the design and testing of high clock-rate computer systems. With rapid rise time and ability to deliver 10 volts into 50 ohms, the Model 216A also exhibits nearly ideal pulse shape. The output circuit constitutes a true 50 ohm source, even during the generation of the pulse. Reflections which would otherwise interfere with accurate measurements are thus eliminated. The instrument may be set up to generate pulse bursts, either on external trigger command or at selected successive intervals, each burst consisting of any desired number of internally-generated pulses. This pulse train feature will facilitate logic circuit testing. Hewlett-Packard Co. Palo Alto, Cal.

Circle No. 150 on Inquiry Card

### DELAY LINE MEMORY

Packaged magnetostrictive delay line memory systems are all-solid-state, self-contained units which provide delays from 50 to 4200 microseconds per pass-through. In addition to fully-contained delay line memory systems, the same delay lines are offered without circuitry. Several systems can be cascaded with the delay-per-pass greatly increased and the number of passes diminished. The memory systems are all "non-return-to-zero" types which accept an input logic signal of  $6 \pm 2$  vdc and  $0 \pm \frac{1}{2}$  vdc to provide an output of 10 milliamps at the same voltage levels as the input logic. Control Electronics Co., Inc., Farmingdale, N. Y.

Circle No. 169 on Inquiry Card

### ELECTRONIC CALCULATORS

The first two models in a new line of noiseless fully-automatic electronic calculators are said to be the first compact truly-versatile solid-state calculators with a completely automatic floating decimal system. The capacity of these calculators, called Cogito 240 and 240SR, enables them to handle computations involving two twelve digit numbers, calculating the 24 most significant digits for the answer. This feature, coupled with the completely automatic decimal, gives a total capacity in the product register of 52 decimal places. All computations are displayed as on a TV screen. The three visible working registers are shown on the screen enabling the operator to obtain proof of all entries and answers simultaneously. The Cogito machines contain three memory registers which can store three separate numeric entries, any one of which may be recalled for use in any computation. The ability to transfer factors and answers between all registers and memories is another advantage of the machine. Each model weighs 35 pounds, is 10 inches high, and requires a 14 inch x 19 inch space on a desk top. Model 240 will sell for \$2195 and Model 240SR for \$2395. SCM Corp., New York, N. Y.

Circle No. 159 on Inquiry Card

## *preliminary design engineer*

A new position carrying a high degree of responsibility in analysis of computer requirements in an interesting range of avionics systems (including inertial navigation, gravity measurement and target locator) has been created in the expansion now underway at Bell Aerosystems Co.

Areas of responsibility will include determination of computer requirements, preparation of computer specifications, preliminary design of systems, and computer selection.

Requirements include a BS or advanced degree in EE with minimum 5 years experience in design application and programming of on-line computers for military use.

This opening provides an opportunity to join a company with achievements and a broad range of interests not only in Avionics, but also in rocket motors (AGENA), air cushion vehicles (SKMR-1 Hydroskimmer), and V/STOL (X-22A). To arrange a convenient interview, send background details and indicate salary desired to Mr. T. C. Fritschi, Dept. C-2.



**BELL AEROSYSTEMS CO.**

DIVISION OF BELL AEROSPACE CORPORATION - A **Textron** COMPANY

P.O. BOX #1, BUFFALO 5, NEW YORK

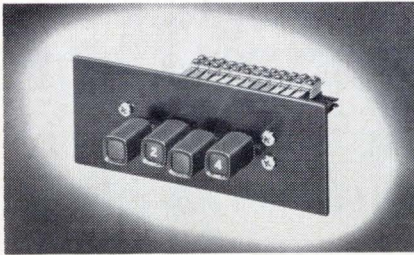
(a few miles from Niagara Falls)

An Equal Opportunity Employer

## MINIATURE DISPLAY

New display unit offers a 10-line input and in-plane display in a miniature 1" package. It plugs into a standard 14-pin tube socket. Available in several voltage ranges from 3 to 28 volts, the unit features a miniature diode matrix and encapsulated circuitry. It is available in single units or multiple units on common panels with and without bezels. United Computer Co., Phoenix, Ariz.

Circle No. 179 on Inquiry Card



## NO-BULB PUSHBUTTON SWITCHES

New illuminated pushbutton switch requires no bulb or electrical power. Called the Glo-Button, X Series, it combines the economy of non-illuminated switching with the advantages and efficiency of the illuminated type. The button has a translucent front screen upon which a desired legend is marked in an opaque color. The opaque color provides the background for the legend, while the legend itself remains clear. An internal fluorescent illuminator is carried on a pusher which has two legs extending out from the rear. When the station is actuated the rear legs of the pusher bring the orange-red fluorescent illuminator flush with the screen. The legend then lights up due to reflected ambient light and projects a clearly visible legend or symbol that signals the switch control status. When the illuminator is recessed, in the unactuated position, ambient light is not reflected and no illuminator color is presented to the legend. Glo-Buttons mount on standard  $0.050 \times 0.187$  plungers in either of two mounting planes so that the button shell can be oriented to match horizontal or vertical layouts. Switchcraft Inc., Chicago, Ill.

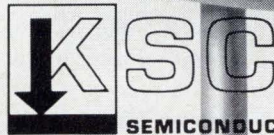
Circle No. 120 on Inquiry Card

## Germanium Power TO-5s

### Best Way to Optimize Switching Power vs. Size

And optimize cost • And optimize gain •  
And optimize gain holdup • And optimize  
leakage (closest thing to silicon in  
germanium power) • Write for specs.

In full and continuing production of 2N1038 through  
2N1045 in TO-5 and TO-11 packages, plus special KSC  
numbers for unique applications.



SEMICONDUCTOR CORPORATION

437 CHERRY ST., W. NEWTON, MASS., TEL. 617-969-9026, TWX 617-332-8479

CIRCLE NO. 35 ON INQUIRY CARD

# REMEMBER

# RESE

for magnetic  
core memories

**RESE** ENGINEERING INC.

A and Courtland Streets, Philadelphia, Pa. 19120. (215) GL5-9000

CIRCLE NO. 36 ON INQUIRY CARD

## DATA TRANSMISSION SYSTEM

High-speed data transmission system is said to be smaller and more reliable and economical than existing systems which operate at equivalent speeds. Called the Lenkurt 26C Duobinary-Datatel data set, the system was developed using integrated circuitry making possible a unit design  $3\frac{1}{2}$  inches high and 10 inches deep. Weighing only 20 pounds, the unit can be cabinet-mounted or installed in a standard 19-inch communications rack. The 26C data set transmits digital signals over conventional voice channels by wire, land or submarine cable, or microwave radio at fixed speeds of 2400 and 1200 bits per second. The 2400-bit rate is the equivalent of approximately 3200 words per minute. The 26C is a second-generation which is one-sixth the size of the 26B, its predecessor. Both of the systems achieve extremely high rates of speed and accuracy through a technique called duobinary coding. Lenkurt Electric Co., Sub. of GT & E, New York, N. Y.

Circle No. 160 on Inquiry Card



## PHOTOELECTRIC TAPE READER

New photoelectric tape reader operates at speeds up to 60 characters per second using standard 1 inch 8 channel tape. The reader is said to require minimum service since the only moving part is the tape drive sprocket. Silicon components are used to minimize temperature drift. The light source has a life expectancy of 2 years. Several optional features can be added to the basic reader. Carlton Controls Corp., Worcester, Mass.

Circle No. 164 on Inquiry Card

## NEW IC DIGITAL COMPUTER

Marking their entry into the computer field, Systems Engineering Labs has introduced a series of general purpose digital computers which are said to offer the fastest throughput rate and highest data storage and instruction handling capacities of any machines in their size or price range. Called the "SEL 800 Series", these highly versatile, stored program computers are designed for real-time processing and control operations or for scientific and general off-line computation. All SEL computers are supplied with a complete software package that includes one-pass FORTRAN IV compiler, the MNEMBLER assembly language, diagnostics, utilities, and a complete library. According to the company, the most advanced design techniques available to computer science have been incorporated in the 800 Series. One major innovation is the use of all silicon monolithic integrated digital circuits in place of discrete component circuits. The smallest machine in the series is the SEL 810, a 16-bit binary unit capable of executing up to 60 instructions. Price of the 810 is \$29,500. In the medium scale is the SEL 840, which has a 24-bit capacity and the capability of executing 91 instructions. Price of the 840 is \$80,000. Both the 810 and 840 have 4096 word basic storage capacity and hardware multiply and divide capability. Systems Engineering Labs, Inc., Ft. Lauderdale, Fla.

Circle No. 153 on Inquiry Card

## COMPUTER TAPE REELS

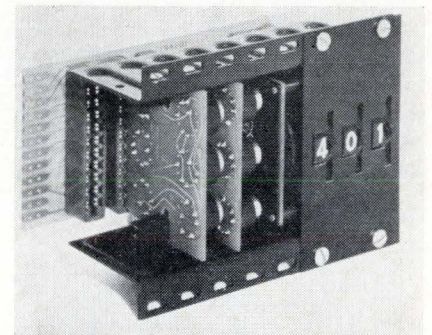
Developed to assure perfect alignment of reel and tape under all winding conditions, new aluminum-hubbed reels are available in  $10\frac{1}{2}$ -inch and  $8\frac{1}{2}$ -inch sizes with all of the firm's computer tapes. Use of the reels is said to provide greater flange stability, eliminate cracked hubs, and significantly reduce tape operating interruptions. Reeves Soundcraft Div., Reeves Industries, Inc., Danbury, Conn.

Circle No. 171 on Inquiry Card

## CERMET MODULES

Compact passive circuit network module combines the stability and reliability of cermet resistors and capacitors with the heat dissipation characteristics of a thick alumina substrate. Resistors, capacitors and interconnections are permanently fused to the substrate by firing at temperatures exceeding 600C. Standardized form factors combined with rugged package design are said to make the modules easy to handle during assembly operations. Tinned copper pins are swaged into alumina substrate and connected to circuit by solder and cermet conductors. The entire module is insulated and sealed by a cover coat. Prices range from 20c upward in production quantities depending upon the circuit and number of passive elements. CTS Corp., Elkhart, Ind.

Circle No. 155 on Inquiry Card



## BINARY THUMBWHEEL SWITCH

A binary output switch is said to be the first decimal-to-binary converter packaged into a thumbwheel switch for simplified manual setting of binary numbers with decimal switches. Positive positioning, easy decimal number readout and long service life, are features of the device. Unique switching design and the use of integrated circuits is said to keep costs and size down. No conversion time is required, since all integrated circuits act as parallel dc. The binary number is, therefore, instantly available at the switch output terminals. ECCoSWITCH, Div. of Engineered Electronics Co., Santa Ana, Cal.

Circle No. 172 on Inquiry Card

## ETCHED CIRCUIT LAMINATE

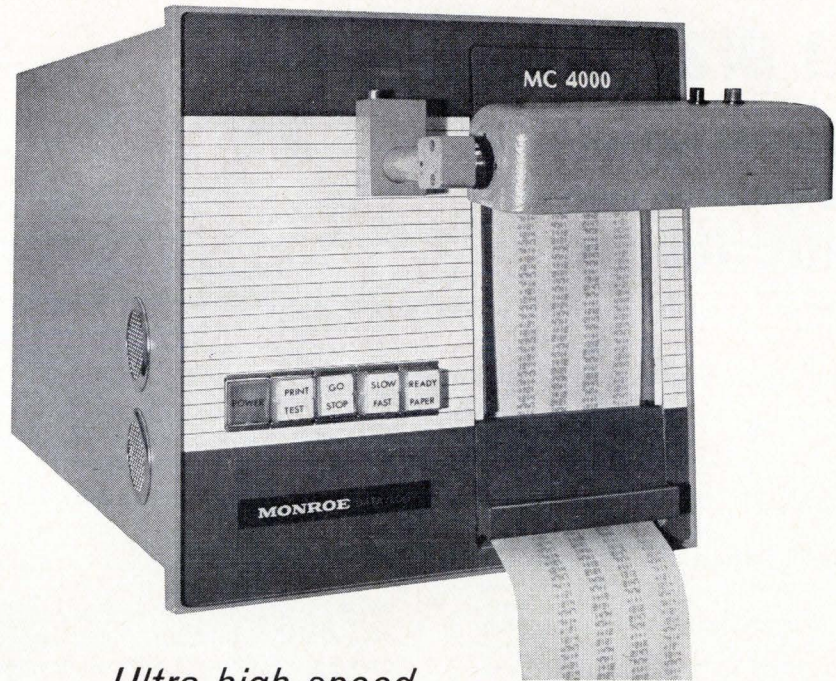
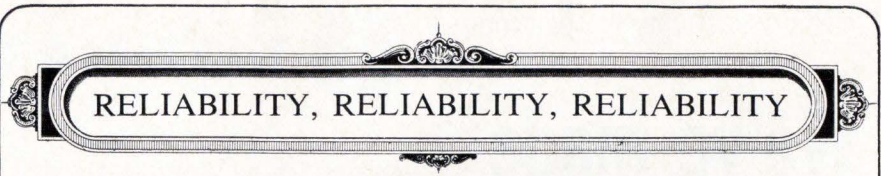
A flexible epoxy, copper clad, laminate material is said to offer a new versatility of design for flexible, stacked and continuous etched circuitry. Known as MX6500 flexible epoxy "CuClad", it is described as a truly flexible, copper clad, fiber reinforced epoxy dielectric system, capable of withstanding Class B (130C) operation. The laminate can be plated, etched, soldered, and otherwise processed in accordance with standard printed circuit processing techniques. The base material is a cured epoxy material, which bonds directly to the copper without the use of helper adhesives, with a bond strength of 18 pounds per inch. The low modulus of the epoxy allows it to accommodate stresses usually applied to copper, thus giving added ductility to the metal foil and added tolerance to severe creasing and flexing. A unique feature of the epoxy is that it possesses an affinity to itself and to plastics, metals, and other materials, under heat and pressure. Possible applications for the material include all flexible printed circuitry, flexible coils, static grounds, and stacked circuits. 3M Company, St. Paul, Minn.

Circle No. 141 on Inquiry Card

## POWER SUPPLY MODULES

Two new series of compact plug-in power supply modules feature output voltages up to fifty volts and output currents to one amp as selected from over twenty-five stock models. The all-silicon construction and self-contained heat sink permit operation at ambient temperatures of up to 71C without external heat sinking or cooling. Regulation is 0.05% for the R Series supplies, and 0.5% for the SR Series. Both types are completely short-circuit proof with automatic reset after the short is removed. The modules are  $3\frac{1}{4} \times 3\frac{1}{4} \times 5$  inches, with an octal plug-in connector and 6-32 mounting studs. Power/Mate Corp., Pearl River, N. Y.

Circle No. 124 on Inquiry Card



## *Ultra high speed* *Monroe DATA/LOG®* *MC 4000 Printer delivers* **6000 lines per minute!**

That's 100 lines per second, synchronous or *any* speed less than 100 lines per second that your application might require. The MC 4000 is truly synchronous or asynchronous.

A non-impact printer. Completely silent. Absolute reliability.

It's available in a numeric model (15 characters in each column) or in an alphanumeric model (43 to 64 characters in each column). Both models are 32 columns wide and have the same 6000 lines per minute printing speed.

Look at these MC 4000 features: Character serial input, bit parallel. Data transfer time of 50 microseconds (no buffers required). Only two moving parts—the paper feed stepping motor and the fan. Compact:  $10\frac{1}{2}$ " high,  $10\frac{3}{4}$ " wide. Rack mount available. All solid state with cathode ray tube through fiber optics.

Any 4 line code for the numeric model; any 6 line code for the alphanumeric model. Any logic level.

Price, just \$5650 for the numeric, \$5850 for the alphanumeric model.

Reliable. Silent. Ultra high speed. Synchronous or asynchronous.

And, like all Monroe DATA/LOG printers, the MC 4000 is covered by a full year's warranty with on site maintenance.

*For additional information, specification sheets or a demonstration, write or call Monroe DATA/LOG Division of Litton Industries, 343 Sansome, San Francisco. (415) 397-2813.*

**MONROE**  
**DATA/LOG**  
DIVISION OF LITTON INDUSTRIES 

CIRCLE NO. 37 ON INQUIRY CARD

# We've made a practice of good ideas.

Our staff has had plenty of them. That's how we've stacked up all the "firsts" behind our name. (First magnetic element used in computers, first commercial magnetic core memory, fastest ferrite memory system to date, first magnetic thin film memory in use, delivery of first time-limited partial switching core memory.)

If your thinking is as good, you can make it count. At UNIVAC-St. Paul, laboratory research constantly nourishes design and development efforts. It produces not only "hows," but "whys." A recent example is in multi-aperture core behavior.

Look what is being done right now in memory development using multi-aperture core techniques. We came up with an analog magnetic storage device—a practical application of time-limited, partial-switching representing significant technical progress in the field of simplified analog recording through the use of discrete magnetic elements. Transient effects are received as analog data and stored for later read-out.

There are several other advanced development programs which show the same pioneering spirit. Our minimum employment requirements are a BS in Engineering or Physics and 2 or more years experience in memory development including traditional ferrite core configurations, multi-aperture cores (Biax, Transfluxor) and/or thin films. A concentration on advanced development and advanced manufacturing is particularly desired. Send a resume at once to Mr. R. K. Patterson, Employment Manager, Dept. G-9, UNIVAC Division of Sperry Rand Corp., Univac Park, St. Paul, Minn. 55116. An Equal Opportunity Employer.

**UNIVAC**  
DIVISION OF SPERRY RAND CORPORATION



## LITERATURE

### Film Circuits

A 12 page technical bulletin called "The Story of Cermetology" presents the case for cermet film hybrid circuits and discusses techniques and applications of cermetology. Typical circuitry is shown with outline drawings, schematics, and reliability data. Columbia Technical Corp., Woodside, N. Y.

Circle No. 200 on Inquiry Card

### Power Supplies

Regular company technical bulletin concerned with the many aspects and applications of electronic power supplies is intended as an aid to applications engineers and anyone concerned with understanding the capabilities of power supplies. The current issue contains six pages, four of which are devoted to an engineering presentation entitled, "Electrical Versatility of 'PAX' Modules Broadens Their Application Capabilities". Kepco, Inc., Flushing, N. Y.

Circle No. 208 on Inquiry Card

### Scientific Computer

A 12-page brochure describes a new scientific computing system, the EAI 8400. A medium-scale, general purpose digital computer, it incorporates advanced design for real-time on-line scientific applications as well as general-purpose scientific computation. The brochure describes the hardware and operational characteristics in terms of the system's autonomous processor, exchange, and memory modules. It also includes a list of the complete instruction repertoire. Electronic Associates Inc., West Long Branch, N.J.

Circle No. 206 on Inquiry Card

### Welded Logic Modules

A 32 page technical booklet, entitled, "Short Cuts to Successful Logic Systems", contains much of the basic information necessary for successful application of welded logic modules. The contents include a discussion of NAND/NOR logic concepts; a glossary of logic systems terminology; basic equations, circuits and module operating parameters; mechanical specifications for modules; and accepted test procedures. Also included is a module selector chart designed to speed and simplify system specification. Magnetic Systems Corp., Clearwater, Fla.

Circle No. 204 on Inquiry Card

### Magnetic Core Tester Design

A two-page bulletin tells how to design a simple magnetic core tester for laboratory or quality control applications using company's modules and current drivers. Characteristics and specifications of the drivers are discussed, and the modules needed to perform a write-read-burst-read test sequence are listed on the block diagram. Digital Equipment Corp., Maynard, Mass.

Circle No. 207 on Inquiry Card

### Datalogger

A complete high-speed datalogger multiplexes analog signals, digitizes the data, and records on magnetic tape. The high-speed multiplexing and high information density on the tape are ideal for long term data logging requirements. Data bulletin gives complete details. A. D. Data Systems, Inc., East Rochester, N. Y.

Circle No. 202 on Inquiry Card

## Tape Preventive Maintenance

The second in a series of five papers covering the wide area of computer tape management is entitled "Why Is Tape Preventive Maintenance Needed?". The paper considers the various tape problems that can be avoided by an adequate system of preventive maintenance. Thorough examination is given to the primary cause of tape trouble: the dirt which collects on tape during normal computer use. Among other sources of tape problems explored is improper winding, which results in tape skew and edge damage. The remainder of the paper testifies to the economic soundness of a tape preventive maintenance program and the effectiveness of tape rehabilitation. General Kinetics Inc., Arlington, Va.

Circle No. 205 on Inquiry Card

## Magnetic Tape Production

A new 12-page monograph titled, "Magnetic Tape Production and Coating Techniques", was written, according to the authors, to dispel the cloak of secrecy surrounding the manufacture of high-quality magnetic recording tape, and to provide interested users with a reasonably detailed description of the various steps employed in its production. Memorex Corp., Santa Clara, Cal.

Circle No. 211 on Inquiry Card

## Universal Time Code Reader

A 2-page bulletin describes a universal time code reader for translating time code formats recorded on magnetic tape. The unit accepts a serial, amplitude modulated carrier time code input in any of the major code formats, displays the time, and provides a parallel BCD logic level output of the time reading. Slow code outputs, pulse rate outputs, and other optional features are available. The reader utilizes six unique passive matrix plug-in cards to select the time code format to be translated. Chrono-Log Corp., Broomall, Pa.

Circle No. 201 on Inquiry Card



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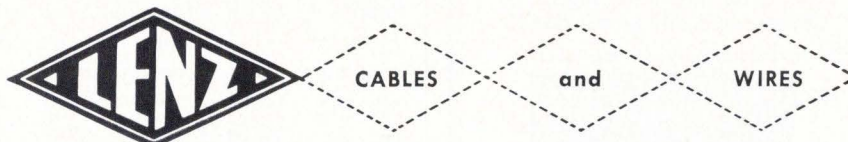


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## LITERATURE

### Bus Bar Assemblies

Laminar bus assemblies, "the engineered component approach to complex power distribution requirements", are described in a new four-page folder. Bus bars are said to offer reliability, compactness, and economy over conventional wire assemblies. Of prime importance, the bus bar can be engineered to give the desired electrical characteristics for specific requirements. Representative characteristics for voltage and current ratings, insulation resistance, dissipation factor, and capacitance are presented. Rogers Corp., Rogers, Conn.

Circle No. 212 on Inquiry Card

### Semiconductor Reliability

A 32-page brochure details steps taken in the manufacture of silicon semiconductor devices to assure their reliability. Five major sections deal with reliability in operation, maintaining reliability by tight process control, assuring reliability by comprehensive testing, designing reliability into the product, and other factors affecting product reliability. Unusual views of the inner workings of transistors and integrated circuits are given. Fairchild Semiconductor, Mountain View, Cal.

Circle No. 213 on Inquiry Card

### IC Logic Modules

A 22-page handbook contains technical and application information on a line of integrated circuit logic modules. The integrated circuits, mounted on a 44-pin connector circuit card, are emitter-coupled logic circuits. A variety of standard and special configurations are available. Digital Products, San Pedro, Cal.

Circle No. 210 on Inquiry Card

### Paper Tape Reader

A 4-page product information bulletin describes a paper tape reader. An isometric drawing discloses the mechanical functioning of the star wheel sensing system and the tape feeding mechanism. Mechanical and electrical specifications, and a description of the different tape reader models available are included. Ohr-Tronics, Inc., Montvale, N. J.

Circle No. 203 on Inquiry Card

### Potentiometer Handbooks

A 64-page "Handbook of High Precision Potentiometers" was written to help the designer solve difficult circuit problems. The handbook shows many applications of basic designs to special requirements. Subjects covered include potentiometer computing circuits; trig, log and exponential functions; loading effects and tracking; and mil specs for shock and vibration. Also discussed are quadrature, noise measurement, and potentiometer definitions. Potentiometer Div., Litton Industries, Mount Vernon, N. Y.

Circle No. 217 on Inquiry Card

### Crystal Oscillators

The basic design approach and application and performance data on temperature-compensated crystal oscillators are described in a new bulletin. It describes the relative advantages over conventional techniques of stable frequency control. The description includes the method utilized to obtain crystal compensation, and a short discussion of the computer program that is used. Design examples show performance parameters, specific applications, and the current state-of-the-art. According to the bulletin, the technique is gaining wide acceptance in the field of communications and time and frequency control. Bendix Pioneer-Central Div., Davenport, Iowa.

Circle No. 214 on Inquiry Card



## Differential Equation Solver

Two brochures describe a new approach to the real time solution of simulation problems involving differential equations. A 44-page brochure with illustrations and block diagrams details the operation and theory of the DES-1 system and an 8-page brochure presents a description of DES-1 characteristics. The DES-1 solves systems of differential equations in real time, using general purpose digital computer techniques, a special language, and a special console, resulting in operating procedures similar to those of an analog computer. Scientific Data Systems, Santa Monica, Cal.

Circle No. 219 on Inquiry Card

## Digital Instrumentation

In a new 4-page condensed catalog, the major specs, general descriptions, and prices are given for 25 standard pulse generators, digital data generators, and plug-in output units. Datapulse, Inglewood, Cal.

Circle No. 220 on Inquiry Card

## Tape Tester

Literature on a new computer tape tester provides a file-sized guide to the tester which has the ability to test nine-track as well as seven-track and full-width tape. This capability, according to the company, will make the Model 97 invaluable in the movement into the next generation of computers. The brochure explains how manufacturers will use the Model 97 to certify new tape for sale as error-free, and how computer facilities will use it to test tapes to insure that the error count is held within the limits that can be tolerated by their applications. General Kinetics, Arlington, Va.

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## LITERATURE

### Automatic Voltage Regulators

A 24-page bulletin contains complete features, specifications, and outline drawings on a line of automatic voltage regulators used to maintain a constant output voltage regardless of line or load changes. The bulletin covers electromechanical types in ratings to 275 kva and instantaneous electronic types to 15 kva. Data is also provided on standard 400 cycle and militarized types. A section is devoted to a full range regulator controller that supplies full range regulated ac voltage, ac current or dc voltage when used with motor-driven variable transformers. Superior Electric Co., Bristol, Conn.

Circle No. 215 on Inquiry Card

### DC Power Supply

Catalog describes 201 models of dc power supplies including a new line of silicon modules. Complete specifications, illustrations, dimensions and description are listed. Also described in detail is a new over-voltage load protector designed to protect a load from excessive voltage originating at a power source. Dressen-Barnes Electronics Corp., Pasadena, Cal.

Circle No. 218 on Inquiry Card

### Magnetic Tape Storage

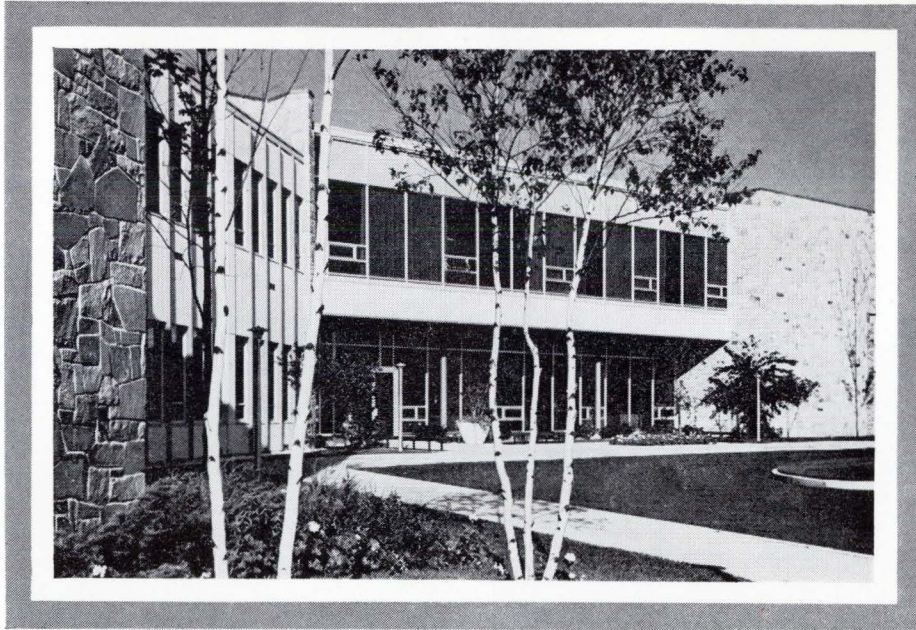
Data sheet pictures and describes a new design "Netic" magnetic tape storage container which is said to make possible, for the first time, an integrated rack mounted recording facility consisting of tape deck, associated amplifiers, power supplies, and tape storage. Magnetic Shield, Perfection Mica Co., Chicago, Ill.

Circle No. 216 on Inquiry Card

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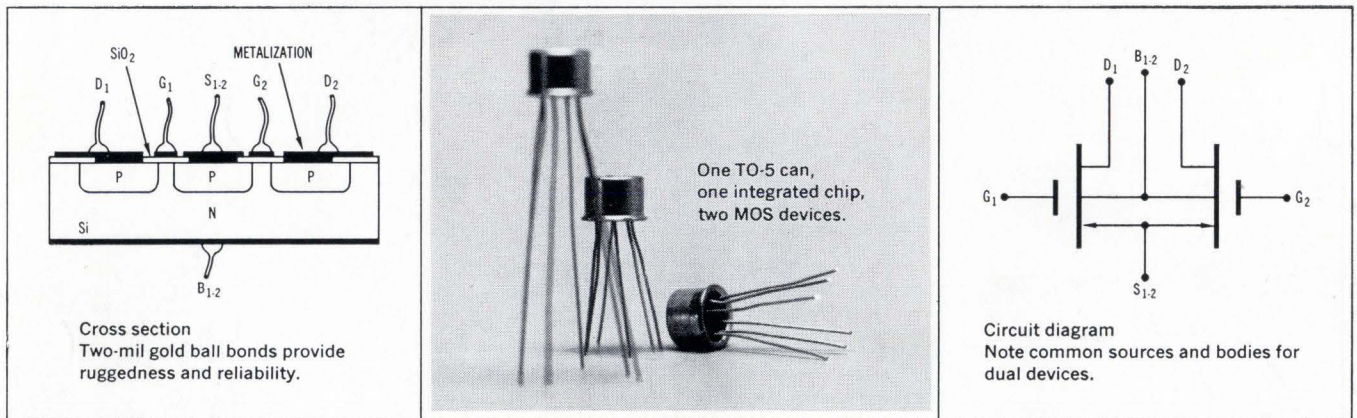
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- low OFF leakage ■ less than 1.0 nA ■ ( $V_{DS} = -15\text{V}$ )
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- $BV_{DSS}$ ,  $BV_{SDS}$  ■  $-30\text{V min}$  ■ ( $I_D$  or  $I_S = 1\ \mu\text{A}$ )
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