COMPUTER DESIGN

THE DESIGN AND APPLICATION OF DIGITAL CIRCUITS, EQUIPMENT & SYSTEMS

APRIL 1966

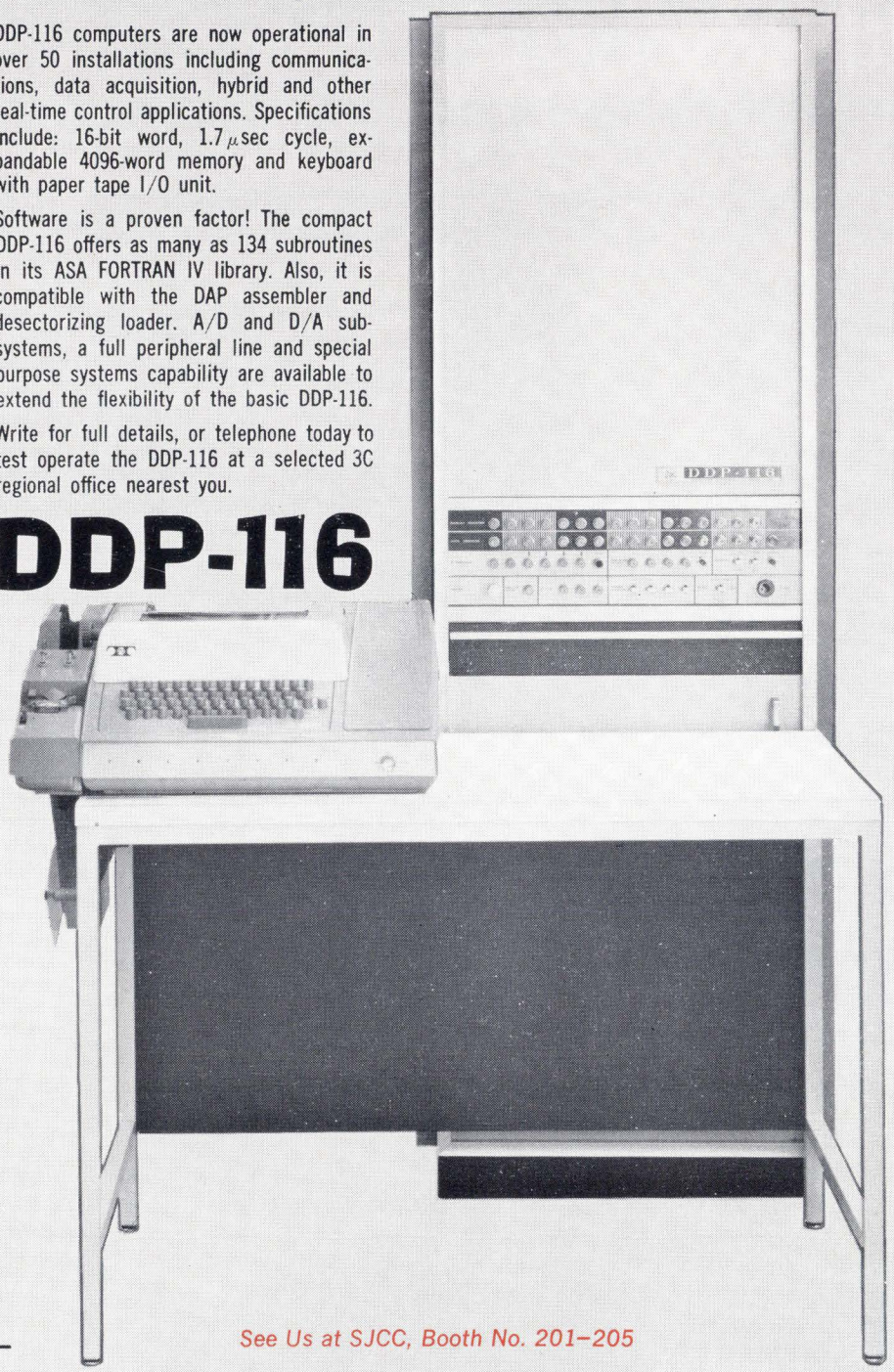
ONLY 3C OFFERS
30 DAY DELIVERY
ON THE HOTTEST COMPUTER IN THE $28,500 PRICE RANGE

DDP-116 computers are now operational in over 50 installations including communications, data acquisition, hybrid and other real-time control applications. Specifications include: 16-bit word, 1.7 μsec cycle, expandable 4096-word memory and keyboard with paper tape I/O unit.

Software is a proven factor! The compact DDP-116 offers as many as 134 subroutines in its ASA FORTRAN IV library. Also, it is compatible with the DAP assembler and desectorizing loader. A/D and D/A subsystems, a full peripheral line and special purpose systems capability are available to extend the flexibility of the basic DDP-116.

Write for full details, or telephone today to test operate the DDP-116 at a selected 3C regional office nearest you.

DDP-116



See Us at SJCC, Booth No. 201–205

COMPUTER CONTROL COMPANY, INC.
OLD CONNECTICUT PATH, FRAMINGHAM, MASSACHUSETTS, U.S.A.
LONDON PARIS FRANKFURT

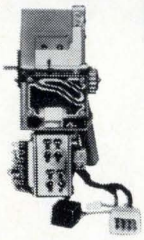
3C SALES OFFICES: NEEDHAM, MASS.; FOREST HILLS, N.Y.; LEVITTOWN, PA.; SYRACUSE, N.Y.; SILVER SPRING, MD.; HOUSTON, TEXAS; HUNTSVILLE, ALA.; COCOA BEACH, FLA.; DES PLAINES, ILL.; DETROIT, MICH.; WEST CARROLLTON, OHIO; LOS ANGELES, CALIF.; KENT, WASH.; ALBUQUERQUE, N.M.

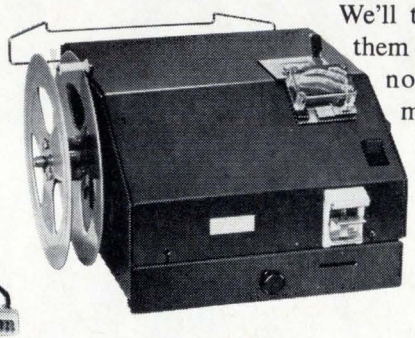
CIRCLE NO. 1 ON INQUIRY CARD

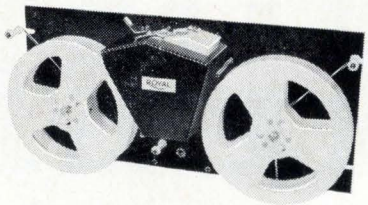
Chances are one of Roytron's 52 paper tape punch or reader models will meet your requirements.

If not, we can make one that will.

Roytron offers one of the widest ranges of paper tape punch and reader models in the industry. At last count there were 52. You can get them separate or combined, or integrated into our Verify-Duplicate System. With or without electronic logic and circuitry. In 20, 50 or 75 cps speeds. Desk-mounted, rack-mounted or specially designed. And with a meaningful warranty backed by a nationwide system of service centers. Just write for complete specifications, and pick the Roytron paper tape punch, reader, or combination that comes closest to meeting your requirements. We'll tailor it to fit them exactly. And if none of our 52 models fills the bill, we can build the 53rd just for you.







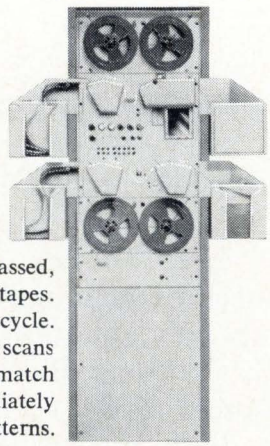
Roytron paper tape punch mechanism: Punch control solenoids, 320 ohms @ 24 VDC.

Roytron paper tape reader mechanism: Reader contacts make and/or break 50 volts @ 50 ma (resistive); continuous current 500 ma (resistive).

Prices:

Basic punch mechanism: 20 cps, $350.00; 50 cps, $325.00; 75 cps, $450.00.

Basic reader mechanism: 20 cps, $310.00; 50 cps, $285.00; 75 cps, $405.00.



The Roytron 8001 Verify-Duplicate System. An unsurpassed, low cost, one-pass system for producing *verified* duplicate punched tapes. Three readers and one punch duplicate and verify in one continuous cycle. The master tape is read by two readers. The third reader scans the duplicate tape after punching. If the tapes do not match in any detail, an error light comes on, and the system will immediately stop and display the two non-matching code patterns.

A DIVISION OF LITTON INDUSTRIES **ROYTRON™**

ROYAL TYPEWRITER COMPANY, INC.
150 New Park Avenue, Hartford, Conn. 06106 TWX: 710-425-0062 Phone: (203) 233-2621.

Visit us at the Spring Joint Computer Conference, Boston, Mass., April 26-28. Booths 1106-1107-1108.

CIRCLE NO. 3 ON INQUIRY CARD

APRIL 1966 • VOLUME 5 • NUMBER 4

COMPUTER DESIGN

FOR ENGINEERING PERSONNEL RESPONSIBLE FOR THE DESIGN & APPLICATION OF DIGITAL CIRCUITS, EQUIPMENT, AND SYSTEMS IN COMPUTING, DATA PROCESSING, CONTROL AND COMMUNICATIONS.

Editorial & Executive Offices
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Tel. 369-6660

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BPA

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FEATURES

DEPARTMENTS

George Washington couldn't sleep here.

There's too much going on.

"Here" is IBM's Federal Systems Center in Bethesda, Maryland.

What's going on? Plenty!

Our principal mission is to develop and build special information processing equipment to solve individual and unique problems for command/intelligence, marine, tactical and communications systems.

As a member of our creative Federal Systems Center team, you'll work on some of the most advanced, sophisticated systems development problems we believe you've ever seen.

If your discipline is listed below, we may have an immediate opening for you. Look and see if your talent and training are needed.

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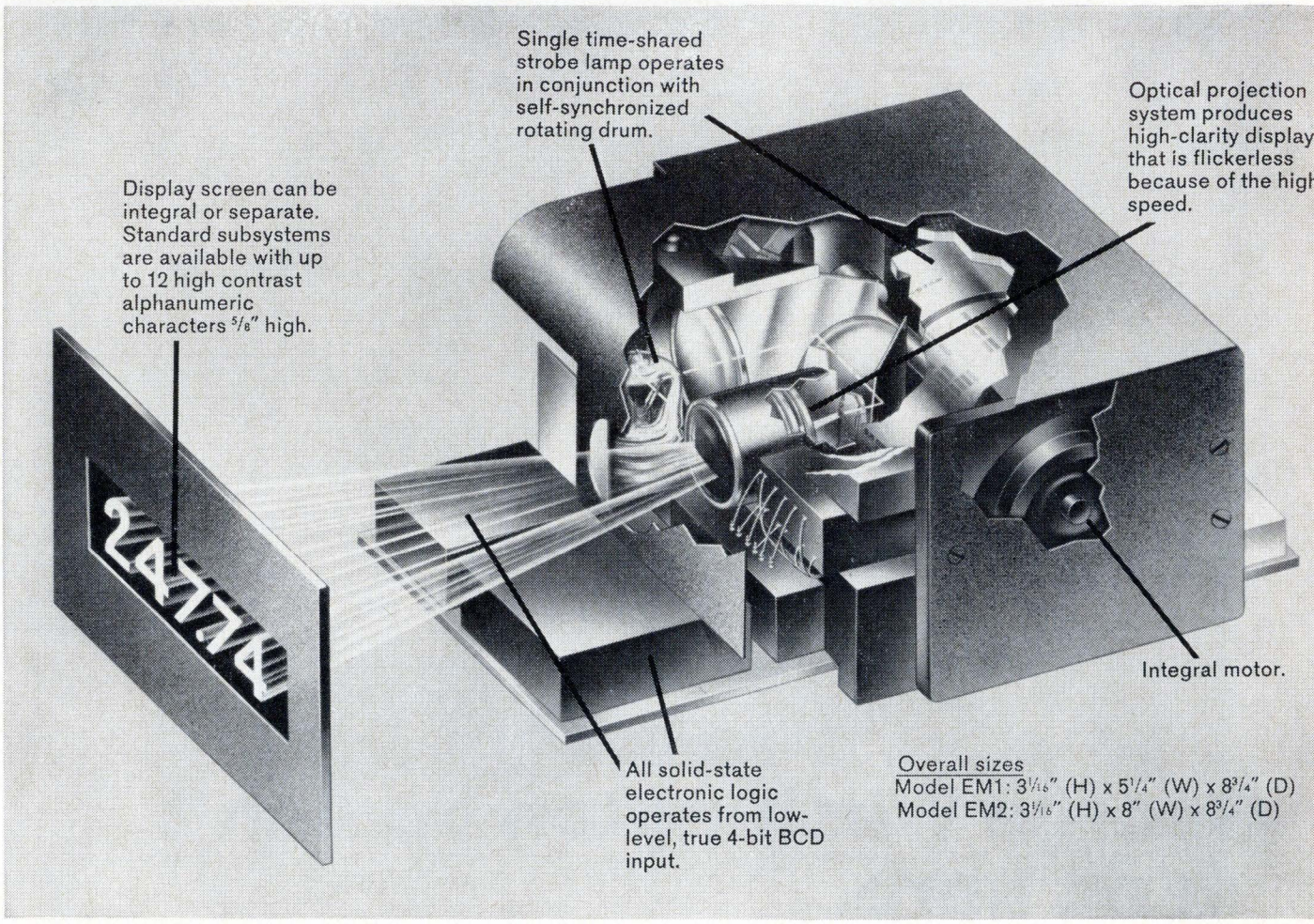
Data Display Devices from Raytheon



New Raytheon Datastrobe* subsystem offers you reliable readouts at very low cost

The Datastrobe subsystem employs a new concept of data display that offers you precisely registered, reliable readouts and simple, flexible installations—at very low cost.

To produce high-clarity displays of precise registration, the Datastrobe subsystem utilizes (1) a single rotating, self-synchronized drum operating in conjunction with a single time-shared, high-speed strobe lamp, (2) time-shared, all solid-state circuits, and (3) an optical projection system to produce multi-digit, in-line, single-plane displays.

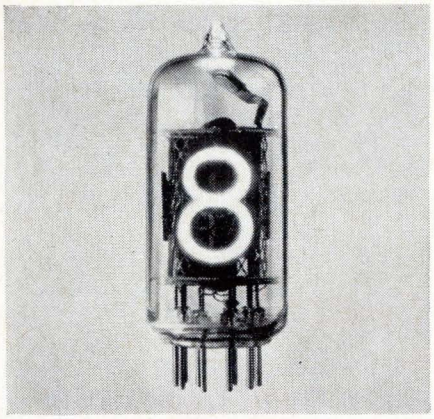
Reduced number of components increases reliability. The time-sharing feature reduces the number of components. Self-contained Datastrobe subsystem wires directly to logic without buffers or drivers. There are no signal amplifiers, mechanical switches or relays. One 6-digit Datastrobe subsystem can replace as many as 66 incandescent bulbs or 6 electromechanical readouts! No compiementary input or 8-line to 4-line converter is required.

Self-decoding eliminates wrong readouts. A self-decoding feature incorporated into the Datastrobe subsystem uses direct logic comparison to eliminate erroneous or ambiguous readouts. The conventional white-on-black displays are bright, steady, and provide high contrast and easy recognition.

Wide range of design options. Datastrobe subsystem display screens can be integral or separate. Standard models are available with up to 12 digits; floating decimal point is optional. Models with more digits and combinations of alphanumeric characters or symbols are available. Additional readout locations are accommodated with simplified wiring. Codes other than BCD, such as 2-out-of-5 code, are available as options.

For a Datastrobe demonstration, contact your Raytheon regional sales office.

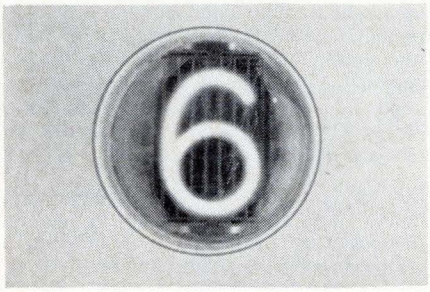
CIRCLE NO. 5 ON INQUIRY CARD



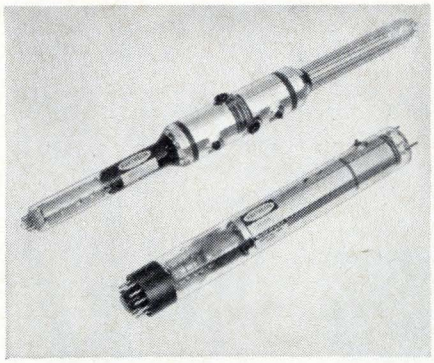
Datavue* Numerical Indicator Tubes in side-view configurations. These side-view in-line visual readout tubes display singly numerals 0 through 9 or preselected symbols such as + and − signs. Gas-filled cold-cathode tubes, they employ the principle of the neon-glow lamp. And their life expectancies range upward of 200,000 hours in dynamic operation.

The 5/8" high characters are easily read from a distance of thirty feet. They're also easily read in high ambient light—where other displays tend to wash out. Erroneous readouts due to segment failure do **not** occur because the characters are fully formed.

Side-view Datavue tubes cost less because their engineering design provides manufacturing economies. They're also economical to install because the bezel and filter assembly can be eliminated, and their mating 11-pin sockets are less expensive than for end-view types.

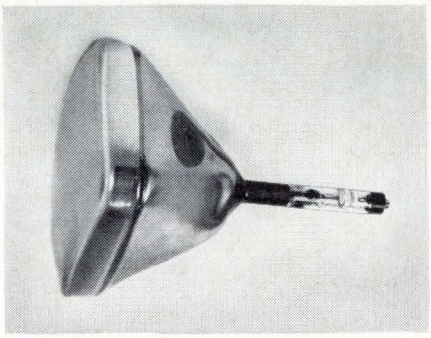


Datavue* End-View Tubes. Raytheon end-view Datavue tubes have essentially the same characteristics as side-view types. They fit into standard-size receptacles and conform to EIA ratings. Models include round (CK8421) and rectangular (CK8422). Both models are designed for ultra-long life, with an expectancy of 200,000 hours or more in dynamic operation.

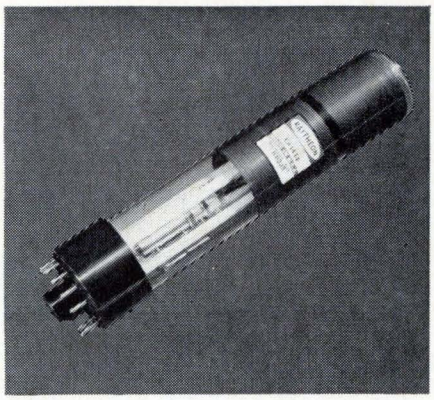


Recording Storage Tubes. Raytheon recording storage tubes are electronic input/output cathode ray storage devices. Applications include radar scan-conversion, slow-down video, signal processing, signal enhancement, time delay, and stop motion. Types include single gun and dual gun—standard and miniature sizes. Shown above are miniature single-gun (CK1516) and dual-gun (CK1519) storage tubes, which provide high resolution and erase capability of 1.2 seconds.

Recording storage tubes feature fast writing, long storage, fast erase and immediate readout capabilities. Information can be written and stored by sequential techniques or by random writing. Complete, partial, or selective erasure is possible. Many other types of recording storage tubes are available, covering a wide range of requirements and applications.



Dataray* Cathode Ray Tubes. Raytheon makes a wide range of industrial CRTs —including special types—in screen sizes from 7" to 24". Electrostatic, magnetic, and combination deflection types are available for writing alphanumeric characters while raster scanning. All standard phosphors are available and specific design requirements can be met. Combination deflection or "diddle plate" types include CK1395P (24" rectangular tube), CK1400P (21" rectangular), and CK1406P (17" rectangular).



Symbolray* CRT Tube. The new Raytheon CK1414 Symbolray tube provides alphanumeric inputs for computer readout devices. The tube's 2" target can be scanned electronically to select symbols, characters, and punctuation marks in sequence to form the readout on a display tube. This type has applications with data processing equipment as an economical method for generating characters for hard copy print-out or for cathode ray display. Design with 64 and 100 characters are available.

Send the Reader Service Card for Literature Kit containing these data sheets and catalogs—

Datastrobe Data Sheet
Datavue Numerical Indicator Tube Catalog
Cathode Ray Tubes Data Sheets
Recording Storage Tube Brochure

Or call your nearest Raytheon regional sales office, or write to *Raytheon Company, Components Division, 141 Spring Street, Lexington, Mass. 02173.*

*Trademark of Raytheon Company

RAYTHEON

Raytheon Components Division—A single source for Transistors/Diodes/Integrated Circuits/Industrial Tubes/Control Knobs/Panel Hardware/Circuit Modules/Display Devices

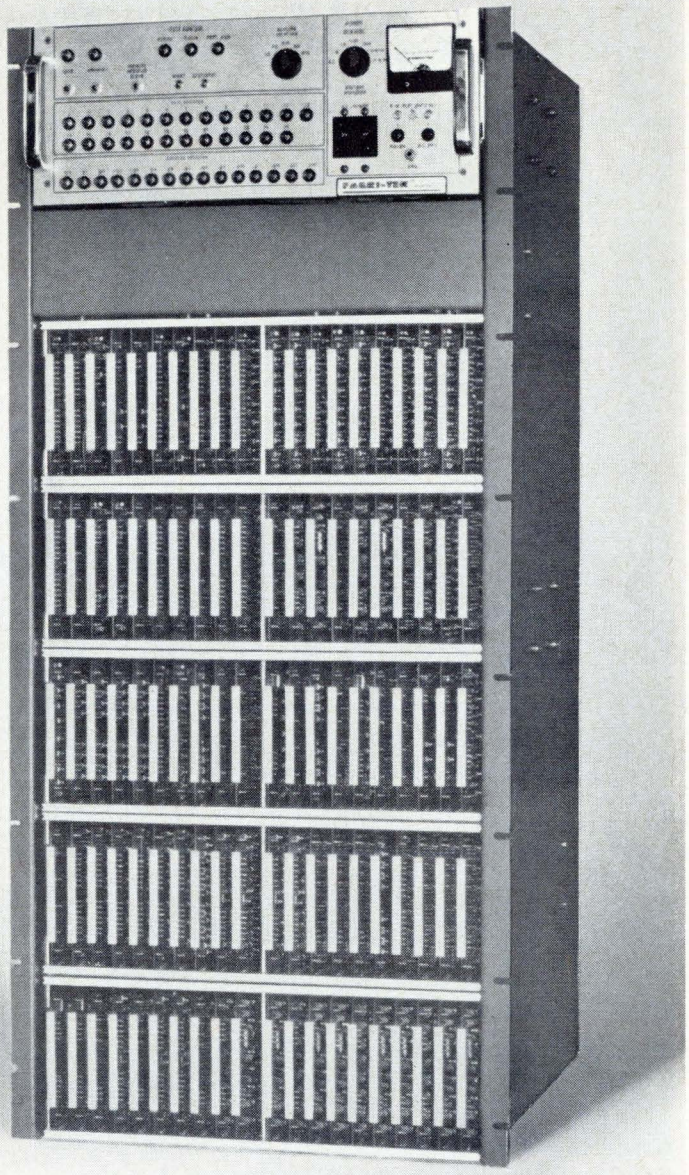
CIRCLE NO. 5 ON INQUIRY CARD

1-microsecond full-cycle

600-nanosecond half-cycle

380-nanosecond access

FABRI-TEK reliability



The Fabri-Tek Series MFA1 one-microsecond coincident-current core memory system offers you unsurpassed reliability, versatility, maintainability, and lowest ultimate cost.

All-silicon semiconductor construction assures maximum reliability and longer life in the operating temperature range. Word capacities are available from 32 to 32,768 in any desired bit length. Full-cycle, half-cycle, full-and-half-cycle, and split-cycle operation and all types of access modes are possible. Any combination of address register, data register, power supply, and self-test features can be ordered.

If you have a requirement for 1-microsecond memories and won't be satisfied with anything but field-proven quality, then the Fabri-Tek Series MFA1 system is your answer. Ask for Bulletin 6534A. Write, call, or wire: Fabri-Tek, Incorporated, Amery, Wisconsin; phone: 715-268-7155; TWX 510-376-1710.

FABRI-TEK LEADS IN MEMORY TECHNOLOGY

Check with Fabri-Tek for rewarding engineering opportunities!

CIRCLE NO. 7 ON INQUIRY CARD

Editorial Notes

CD REFRESHER SERIES

This month **COMPUTER DESIGN** inaugurates a new department which will provide a continuing series of review tutorials on basic analytical techniques used, at one time or another, by all professionals in the field of computer design.

The first series of articles under this new department has been named Mathematics Revisited: Selected Topics in Probability and Statistics. This series has a two-fold purpose: first, to serve as a review for those readers whose skills in the area of interest have become dulled through disuse; second, to provide a primer for those readers who may never have been formally exposed to the subject material.

To these ends, the articles are result-and-application oriented. Rigorous mathematical development of equations, proof of theorems, and mathematician's jargon are left to the textbooks. Prolific footnoted references and bibliographies are not provided; the reader who wishes to pursue the subject matter in greater depth will find detailed treatment of nearly all of the topics discussed in these articles, in any of a number of excellent texts.

Mathematical background material is briefly presented, in tabular form, whenever a review is required for understanding of the manipulations used in the text. No mathematics beyond undergraduate level will be encountered.

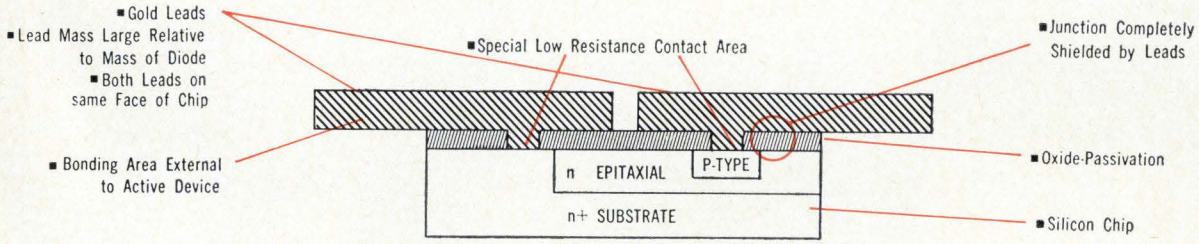
Each article will contain a complete topic, and will therefore stand as nearly independently of the others as is possible. This month's subject covers basic probability concepts, the next issue will explore the principal rules for manipulating probabilities.

DAN M. BOWERS,
Contributing Editor

Now Available from General Instrument...

HERCULEADS™

The ULTIMATE DIODE



General Instrument's HERCULEADS beam-lead diode is a self-contained diode package with total environmental immunity—the smallest discrete diode available —and it is virtually indestructible.

Ultimate in cost savings

The irreducible minimum in processing achieved via complete batch fabrication and self packaging offers minimum possible cost.

Ultimate in size

The **HERCULEADS** diode is the smallest available. Together with the leads which are uniquely integrated with the diode body, it measures less than 15x30 mils.

Ultimate in reliability

Most potential failure modes commonly associated with diodes, both electrical and mechanical, are eliminated. All bonding leads external to the active device permit simple, economic, high rel connections without the use of eutectics, aluminum or thermal wire bonding. And total surface passivation is assured because of **HERCULEADS'** unique design and metal-over-oxide construction.

Ultimate in versatility

Besides its use as a single, twin lead self-packaged device, the **HERCULEADS** diode is highly adaptable for use in module or stick arrays. Its design and construction make it ideal for automatic handling and positioning, and its pure gold cantilevered leads permit high reliability bonding. Electrical parameters available are comparable to those achieved in the most advanced single-plane devices presently in use.

Electrical Specifications for H100 Series at 25°C

PRV	90 V @ 10 μA
I_F	40 mA @ 1 V
I_R	2 nA @ −40 V
C_D	2.4 pf @ 0 V
t_{rr}	4 ns @ I_F = 10 mA to V_R = −40 V

HERCULEADS diodes in 10-PAKS are now in stock at your authorized General Instrument Distributor.

Write for full data and specifications.

GENERAL INSTRUMENT CORPORATION
SEMICONDUCTOR PRODUCTS GROUP
600 West John Street, Hicksville, New York

GENERAL INSTRUMENT

Booths 2B12-2B14 • IEEE SHOW

CIRCLE NO. 9 ON INQUIRY CARD

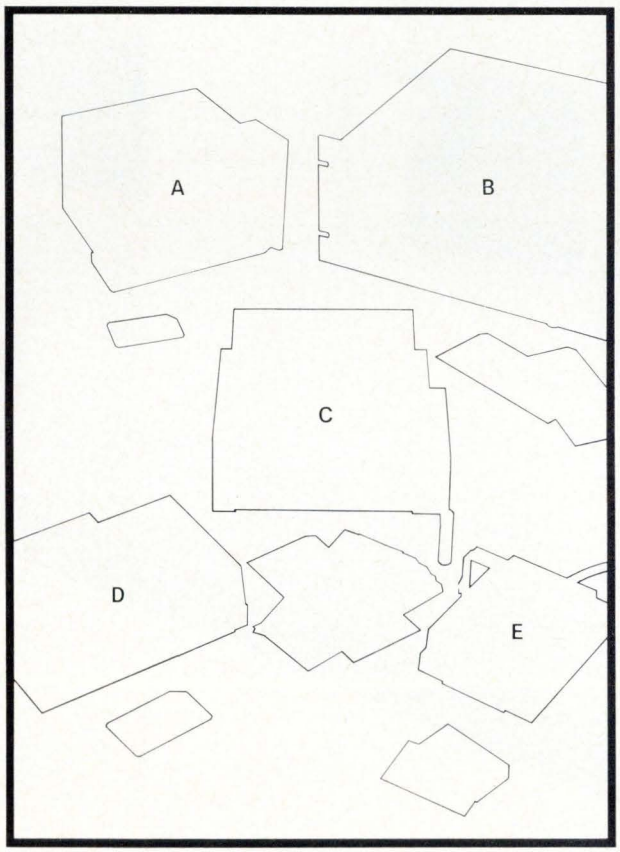

TO OPERATE
1. LIFT DOOR
2. INSERT ALL CARDS-CUT CORNER FIRST & TO LEFT.
3. CLOSE DOOR
4. PUMPS UNLOCK WHEN LIGHT GOES ON
AFTER PUMPING
1. PUSH THIS BUTTON.
2. WHEN LIGHT GOES OUT-LIFT DOOR UNTIL CARDS SNAP OUT.
IMPORTANT
AMP
AMP
AMP

Have you tried out your card tricks on this family?

Here's a modern family of card readers that fits right in with the current and future needs of industry. No matter what kind of cards a system may use, one of these compact, handsomely styled A-MP★ SYSCOM★ card readers can handle them.

The unlimited number of programs that can be handled and the convenience of punched tabulating or credit cards make these units practical for many varied applications. In production control and reporting, where data must be randomly gathered from many sources into a central computer, the A-MP Card Reader functions as data input equipment. Location and status of production parts can be determined in seconds instead of hours or days; production machinery breakdowns and schedule changes can be ascertained before they seriously affect production.

In batch mixing or blending operations, a card reader can program changes in formula, mixing times, sequence, quantity measurements, and the like. It reduces the operator's work to inserting the appropriate tabulating card and checking on proper functioning of the equipment. It also reduces the chance of human error and ensures consistent product quality.



A. All Weather Credit Card Reader. **B.** Rack Mounted Standard Size Card Reader. **C.** Desk Top Standard Size Card Reader. **D.** Motorized Credit Card Reader. **E.** Credit Card Reader.

Warehouse inventory and supply procedures have been vastly speeded up by the use of tabulating card systems. By inserting a punched card into an A-MP Card Reader, a dispatcher could select a quantity of a product for an order. This quantity is deducted from the inventory and a new total is derived from the card. The same card can also be used to initiate the billing process to the customer.

Bulk plant dispensing can be accomplished with the All-Weather Card Reader. The driver simply inserts a wallet-size card, which unlocks the pumps. When the driver finishes loading his truck, he depresses a button on the card reader front panel. This automatically locks the pumps, records the transaction, unlocks the reader and partially ejects the card(s). Training devices can employ a card reader to simulate anything from control servo inputs on an aircraft trainer to missile guidance system outputs. Card programming is an economical approach to unlimited program flexibility.

From design to material selection, utmost care has been exercised to assure the engineering soundness and practicality of these card readers. This is evidenced by their reliability, efficient operation, and attractive appearance. Examine their outstanding features and you'll see why these card readers are exceptional:

- Cast metal housing
- Exclusive double wiping action pre-cleans contacts
- Interlocks ensure accurate positioning and sensing of cards
- Indicator lights to show when the card is in "read" position (on B & C only)
- Various matrix arrangements available—240-bit capacity for credit cards; 960-bit for tab cards
- Redundant contacts—two contacts sense each hole (on A, D & E only)
- Long operating life—1,000,000 cycles, minimum (on A, D & E only)
- Desk top, rack, or outdoor models available
- Automatic or semi-automatic reading and card ejection available

If you want to automate your operation, check on AMP's family of Card Readers. Write today for more information.

★Trademark of AMP Incorporated

AMP
INCORPORATED
Harrisburg, Pennsylvania

A-MP★ products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan • Mexico • Spain • West Germany

CIRCLE NO. 10 ON INQUIRY CARD

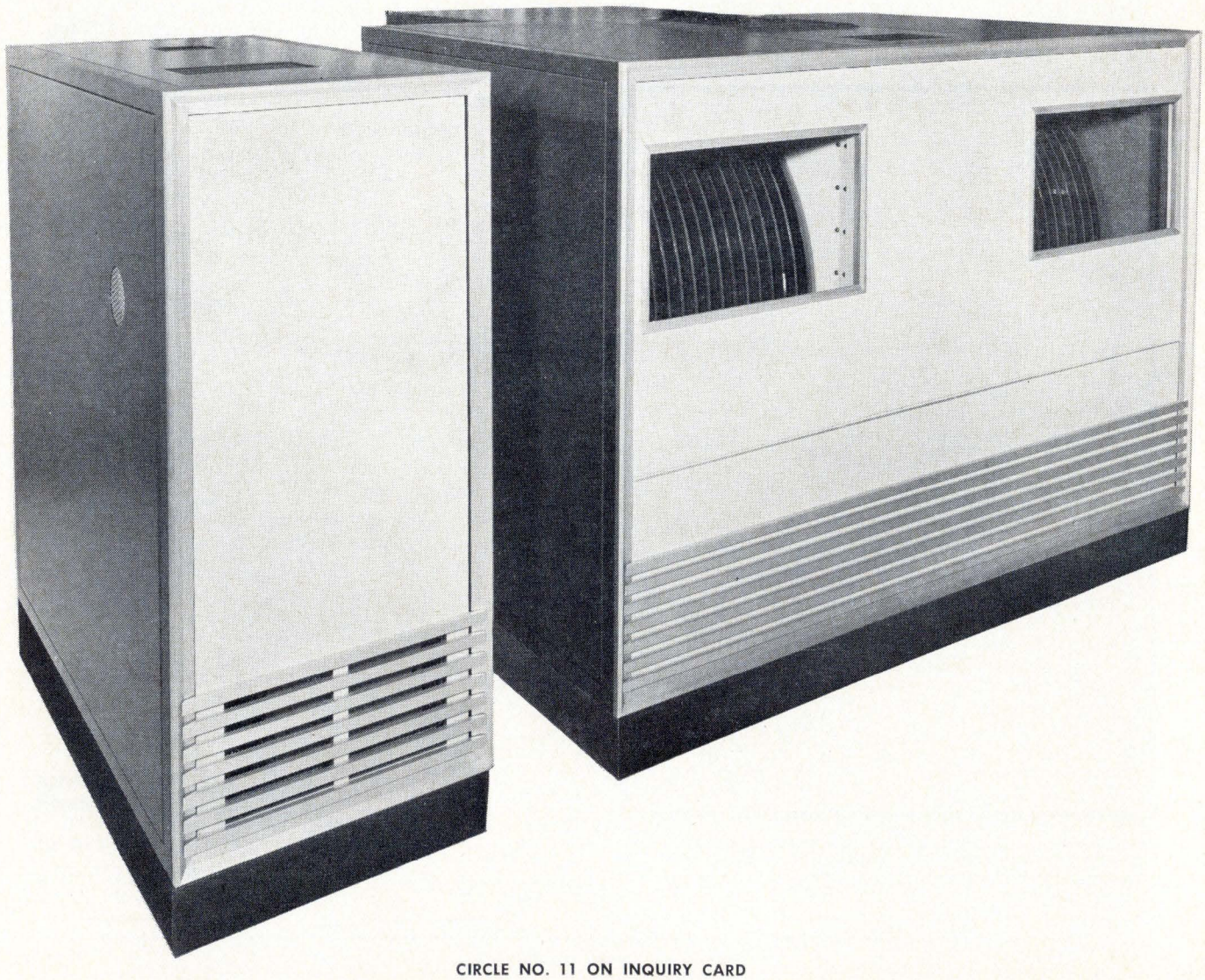
Now Cheaper by the Billion.

Introducing the Bryant Series 4000-2A real time mass memory system. It can store 3.8 billion bits. The largest single unit disc file capacity in the world. And by far the lowest costing random access system available today. All data is on-line, available within an average of 100 milliseconds. A basic cabinet offers modular growth to capacity. Environmental control reduces maintenance to a minimum. Dual access option offers increased throughput. The 2A joins 190 Series 4000 files operating all over the world. Deliveries begin in November, 1966. But don't wait till then. Call your nearby Bryant Application Engineer now or write: 850 Ladd Road, Walled Lake, Michigan 48088.

BRYANT
COMPUTER PRODUCTS

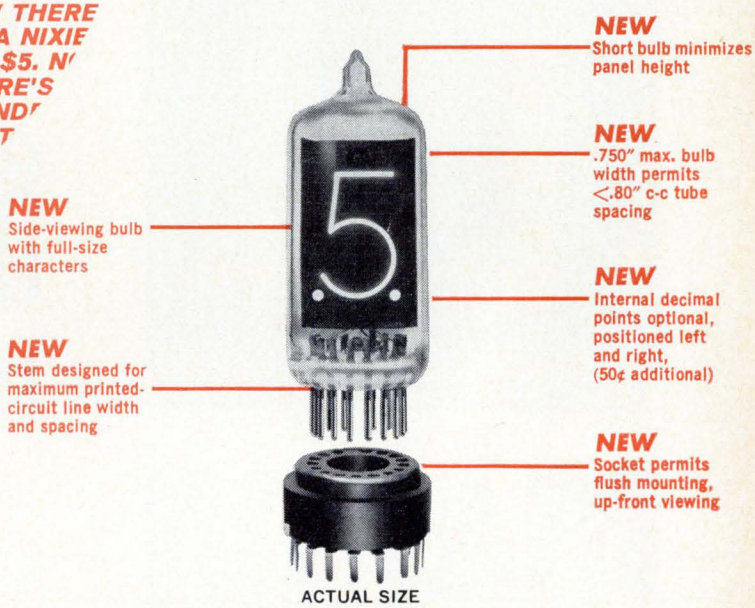
XLO

EX-CELL-O CORPORATION



CIRCLE NO. 11 ON INQUIRY CARD

NOW THERE'S A NIXIE® TUBE FOR UNDER $5



Here it is! Our all-new NIXIE tube—the industry's lowest-cost electronic readout*, and one sure to usher in a whole new generation of low-cost digital instrumentation.

But—*don't be misled by its low, low cost.* It's *all* NIXIE tube—in name, in design, in construction, in performance, in quality, in long, trouble-free life.

Important new design and manufacturing techniques have made its low price possible. Now check the important new features shown—they make the new NIXIE tube more functional and easier to use.

The new NIXIE tube Type B-5440 is available now—from stock—both from the factory and from Burroughs Stocking Dealers across the country.

Before you freeze a new design, before you commit your company to a costly and irreversibly uneconomical position, *call, wire* or *write* for samples or prototype quantities.

Remember—the low cost of the new NIXIE tube Type B-5440 precludes consideration of other types of numerical readouts such as electro-luminescent and projection types where cost is a major factor. Get a *real* NIXIE tube with *real* NIXIE-tube performance and acceptability.

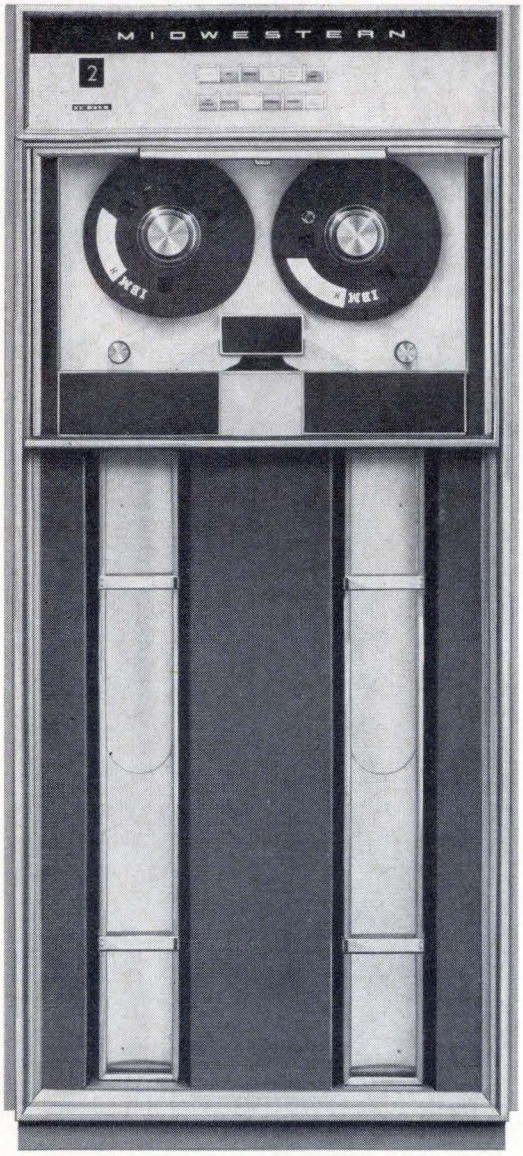
Use the reply card for full information on the new NIXIE tube and complete readout-application assistance.

**$4.95 in quantities of 1000.*

Only Burroughs manufactures NIXIE Tubes

Burroughs Corporation / ELECTRONIC COMPONENTS DIVISION
PLAINFIELD, NEW JERSEY 07061

CIRCLE NO. 12 ON INQUIRY CARD



How does Midwestern guarantee data reliability?

M4000
DIGITAL TAPE TRANSPORT

COMBINING UNPARALLELED OPERATING DEPENDABILITY WITH THIRD GENERATION COMPUTER SYSTEM PERFORMANCE FOR ADVANCED DATA PROCESSING SYSTEMS

The M4000 pneumatic tape transport system is guaranteed to read tapes recorded to IBM compatability specifications with less than one transient error per 10^9 data bits; at densities to 800 bpi, and at transfer rates to 120 KC. Every production tape transport is factory tested for a minimum of 100 full reel passes; reading and error checking random record length, variable pattern data tapes under full program control. Actual statistical results of these tests, over a number of transports and many thousand full passes, have shown an average data reliability rate of one transient error in 27.1×10^9 characters read. This safety margin, developed from actual test data, makes Midwestern's guarantee of one error in 10^9 a realistic promise, not just another empty claim.

For more information on the M4000, write or call Ralph P. Bohn, Digital Tape Products Division, P. O. Box 1526, Tulsa, Oklahoma 74101. Our phone number is 918-627-1116.

MIDWESTERN INSTRUMENTS
SUBSIDIARY OF THE TELEX CORPORATION

CIRCLE NO. 13 ON INQUIRY CARD

Now Litton's All-Solid State Optical Encoders Eliminate Tungsten Bulbs And Increase MTBF Six Times!

Under operational conditions, MTBF for a typical 2^{13} full word Litton encoder is 30,000 hours (very conservatively rated) compared with 5,000 hours experienced under equivalent conditions for an encoder using tungsten bulbs.

Rugged, durable gallium arsenide light sources are responsible for the sixfold increase in reliability. Gallium arsenide not only eliminates the instabilities and failures of tungsten bulbs but also uses far less power and generates far less heat. Periodic preventive maintenance required with tungsten bulbs is reduced. Ultimate cost of ownership is naturally substantially less.

Litton all-solid state optical encoders offer proven temperature stability from −55°C to +85°C. They operate dependably and accurately during 70g shocks and recover from 105g shocks. Other environmental characteristics meet or exceed military specifications. These encoders have been built and shipped and are now in service.

This new technique can be applied to incremental positioning devices as well as absolute position encoders, and in any code pattern—natural binary, BCD, gray code and sine/cosine of shaft angle. Please call us direct with your requirements or contact your nearest Litton regional engineering office. Encoder Division, 7942 Woodley Ave., Van Nuys, Calif. (213) 781-2111. New York: (212) 524-4727. Chicago: (312) 775-6697. Washington: (202) 462-8833.

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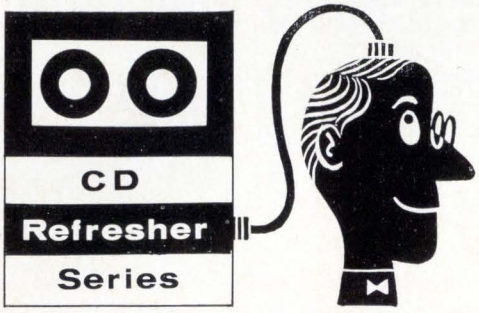
CIRCLE NO. 14 ON INQUIRY CARD



MATHEMATICS REVISITED:

Selected Topics In Probability and Statistics

PART 1 – BASIC PROBABILITY

Dan M. Bowers, Contributing Editor

An understanding of Probability is most easily and thoroughly acquired if one first develops a feel for three fundamental concepts: "randomness," "independent trials," and "in the long run."

"Randomness" is a property which describes the unpredictability, haphazardness, "chance," or uncertainty in the result of a particular operation. If a balanced die is repeatedly (and honestly) rolled, "randomness" describes the sequence in which the six possible numbers appear. If a balanced coin is repeatedly flipped, "randomness" describes the sequence in which heads and tails appear. If 5000 ticket stubs are placed into a drum and stirred, and five stubs are drawn to award door prizes, "randomness" describes the sequence of the numbers drawn, and their relation to the original set of 5000 numbers. If 99 black balls and one white ball are placed into a tub, shaken, and are drawn out (without peeking), "randomness" describes the fact that, in any given draw, the ball may be either black or white, even though we intuitively expect that this operation will nearly always result in the drawing of a black ball.

"Independent trials" is a concept which is expressed by James Bond as "the wheel has no memory." If the property of randomness is assumed, then the roll of a die or the toss of a coin is completely unaffected by the result of the preceding roll or toss, or, for that matter, by the result of the subsequent or any other roll or toss. Each roll or toss is an "independent trial." Provided the five ticket stubs are returned to the drum and the contents stirred (to assure randomness), a second draw of five stubs is unaffected by the first draw. Provided the ball drawn is returned to the tub, the tub shaken, and another ball drawn, its color is unaffected by the color of the first ball. In James Bond's example, each spin of a roulette wheel is an "independent trial."

"In the long run" relates to the familiar "law of large numbers"; through Probability theory we can predict that out of a large number (strictly speaking, an infinite number) of independent trials of a given random operation, a certain result will occur a certain percentage of the time. Thus we can say that "in the long run," one-sixth of the rolls of a die will result in a four, half the coin tosses will result in a head, a given ticket will be drawn once every 1000 5-stub draws, and a white ball will result one percent of the time.

Applying these concepts, we can see that if nine consecutive coin tosses have all resulted in heads (an unlikely sequence of events), the outcome of the tenth toss is still equally likely to be a head as a tail, since it is an independent random trial, and heads and tails are equally likely in the long run. The weatherman's statement that the probability of snow on a given day is 70% means that in the long run — i.e., out of a large number of days (independent trials) which exhibit certain meteorological characteristics, as evaluated by the forecasting techniques used in this case — snow will result on 70% of the days; further, the 70% snowy days are randomly selected from those showing the meteorological characteristics of interest. (Note that the forecaster seemingly cannot be wrong, since the occurrence of snow on a particular day has the property of randomness; if, however, it remains clear on 90 out of 100 days on which the forecaster predicts 70% for snow, he may — quietly — re-examine his forecasting techniques. We shall see in a later article of this series how one may determine whether the 10% occurrence of snow in the face of 70% prediction for snow may reasonably be attributed to chance; we shall, for example, be able to state that we are more than 99% certain that the 70% prediction was wrong, based on the 10% snow in 100 observations.) If 99 draws have resulted in a black

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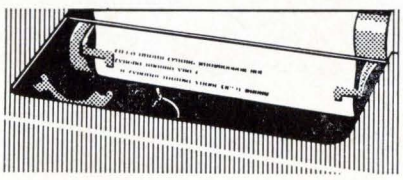
features you can take-for-granted

There are many features on Teletype sets that assure you of the most reliable, efficient, and least costly terminal equipment for your data communications systems. Take these features for granted . . . since they are standard on new model Teletype machines.

COPY VIEWING AREA

All Teletype RO (receive-only), KSR (keyboard send-receive), and ASR (automatic send-receive) sets have a convenient window that provides the typist with a clear view of the copy as it is being typed. The rear edge of this window has a tearing surface to facilitate removal of the printed copy.

The upper cover of these sets is hinged, allowing easy access to the equipment for changing the paper supply and typing ribbon. On ASR sets, the paper tape chad from the punch head is conveniently collected in a chad container.

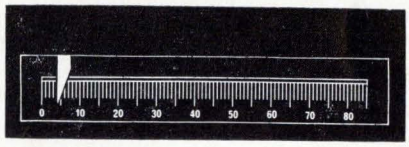


WINDOW FOR VIEWING COPY

CHARACTER COUNTER

The standard Teletype Model 35 ASR set has many additional versatile features, such as: a character counter that enables the typist to see at a glance how many spaces have been typed from the left margin of the page; a utility tray to conveniently hold papers or forms; a clear plastic bubble on top of the upper cover for viewing the paper supply and observing the operation of the typing unit; and an end-of-line indicator that glows red as the type box nears the end of the line.

Other features of the Model 35 ASR include: a window for viewing the paper tape and the punching operation; a low paper alarm that operates when the paper supply is nearly exhausted;



CHARACTER COUNTER

a copyholder and line guide to hold short messages the typist is sending; as well as illuminating lamps for the typing unit and reperforator areas.

BREAK BUTTON

When the paper supply is running low, you merely depress an illuminating "BREAK" button on the Teletype machines to "break off" communication in the middle of transmission. After the paper has been changed, the line is easily restored by depressing the BREAK-RELEASE key—without losing any portion of the text.

These standard features are another reason why this equipment is made for the Bell System and others who require reliable communications at the lowest possible cost. For more information on Teletype machines, write for our new brochure "ALL ABOUT TELETYPE EQUIPMENT." Teletype Corporation, Dept. 71D, 5555 Touhy Avenue, Skokie, Illinois 60076.

machines that make data move

TELETYPE

CIRCLE NO. 15 ON INQUIRY CARD

ball, the 100th ball is still very likely to be black, even though in the long run (which might be 3000 draws in this case), an average of one out of every hundred draws will result in a white ball.

PROBABILITY

In the long run, a given result of a random operation will occur with a frequency equal to the product of its Probability and the number of times the operation is performed. Conversely put, we are defining Probability as the ratio, "in the long run," between the frequency of occurrence of a particular result, and the number of times the operation is performed. Mathematically stated, if $\alpha_1, \alpha_2 \ldots \alpha_n$ are the possible results of an operation, $f(\alpha_i)$ is the number of occurrences of the i^{th} result, and k is the number of times the operation is performed, then $P(\alpha_i)$, the Probability of the i^{th} result, is

$$P(\alpha_i) = \lim_{k \to \infty} \frac{f(\alpha_i)}{k}$$

We see that "in the long run" is implemented by defining the Probability, as k becomes very large.

Since one can never perform any operation an infinite number of times, a Probability can be only approximated by experimental means. For example, one actual coin toss experiment (performed during a quiet midwatch) of 1000 tosses resulted in 490 heads and 510 tails; we could therefrom calculate P(heads) of 0.49 compared to the well-known P(heads) of 0.50. Fortunately, Probabilities of many events of interest can be calculated without recourse to experimental trials, and the Probabilities of other events can in general be estimated — to within a predictable amount of error — on the basis of relatively few trials. These techniques will be discussed.

Examining the definition of Probability, we can

TABLE 1

PERMUTATION AND COMBINATION RULES

RULE 1: If X and Y are two independent operations (i.e., the result of X has no relation to the result of Y and vice versa), and if there are x different results of operation X, and y different results of operation Y, then there are xy different results of the operation of performing X and Y together. (Example: a roll of die 1 has 6 possible results, and a roll of die 2 has 6 possible results, therefore, the roll of die 1 and die 2 together has 36 possible results, as shown in the text.)

RULE 2: Permutations within a set: A set of n different objects can be arranged in n! different ways, where $n! = n(n\text{-}1)(n\text{-}2) \ldots (3)(2)(1)$. (Example: four persons at a bridge table can be seated in $4! = 24$ different ways; let the persons be numbered 1, 2, 3, 4, and the places a, b, c, d; then if person 1 is at place a, person 2 can be at b, c, or d, with persons 3 and 4 at c and d or d and c, b and d or d and b, b and c, or c and b, respectively, giving 6 possible arrangements for person 1 at seat a; the 18 other arrangements result from person 1 being at seats b, c, and d.)

RULE 3: Permutations of groups from a set: if a group of p objects is taken from a set of n $(n > p)$, the number of different arrangements of the group is:

$$n(n\text{-}1)(n\text{-}2) \ldots (n\text{-}p+1)$$

(Example: If a 3-desk office is available to seat three of the 5 men assigned to a project, there are 60 different arrangements possible; if the men are designated a, b, c, d, and e, and the desks 1, 2, and 3, then any of the five men can be assigned to desk 1, combined with any of the remaining four at desk 2, combined with any of the remaining three at desk 3.)

This can also be written $\frac{n!}{(n-p)!}$, where n! is the number of arrangements of the set of n, and $(n-p)!$ is the number of arrangements of the "leftover" items.

RULE 4: Combinations: (*permutations* describe the number of different arrangements of objects within a set; *combinations* refer only to the number of different objects in the set, regardless of their arrangement. Example: there is only one *combination* of cards in an ace-high straight heart flush, but there are, by Rule 2, $5! = 120$ *permutations,* or arrangements of the cards.) The number of combinations of p objects taken from a set of n $(n > p)$ is

$$\frac{n(n\text{-}1)(n\text{-}2) \ldots (n\text{-}p+1)}{p!}$$

This is seen to be the number of permutations of p objects taken from a set of n (from Rule 3), divided by the number of permutations within the set of p (from Rule 2). Using the second notation shown in Rule 3, this can be written as:

$$\frac{n!}{p!\ (n\text{-}p)!}$$

which is usually written $\binom{n}{p}$.

To re-emphasize: the number of combinations of n objects taken p at a time is:

$$\binom{n}{p} = \frac{n!}{p!\ (n\text{-}p)!}$$

DATA COMMUNICATIONS

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...versatility we've got!

If your data communications system requires a Teletype set with vertical or horizontal tabulation, we've got it. If you need a Teletype machine that prints on multiple copy business forms with form-out and line-feed features, we've got it.

Teletype research and development engineers have created these optional features and the ones described below to provide the versatility you need in your data communications systems.

AUTOMATIC CONTROL

Teletype Model 33 and 35 ASR (automatic send-receive) sets can be equipped for automatic unattended operation with the following controls:

Automatic Reader Control allows taped data to be transmitted automatically by the reader of an unattended ASR set when called in by a remote Teletype machine.

Automatic Punch Control allows data to be transmitted to the reperforator of an unattended set when called in by a remote Teletype machine.

Automatic Printer Control allows printed data to be transmitted to the printer of an unattended set when called in by a remote Teletype machine.

When these three features are used on the same set, you can separate the tape punch, tape reader, and printer operations, enabling you to tape data without printing page copy, or print the copy without punching a duplicate tape.

PUSH BUTTON DATA GENERATOR

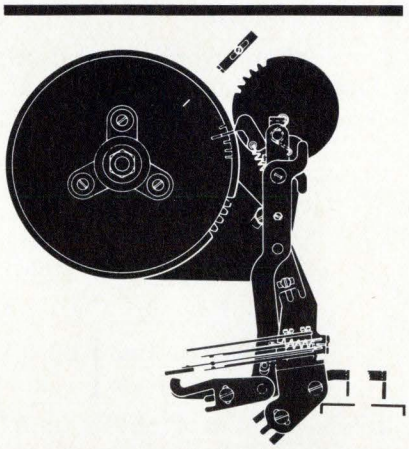
AUTOMATIC DATA PREPARATION

Teletype R&D engineers have developed a Push Button Data Generator to simplify and speed the flow of fixed data. By preprograming fixed data (such as addresses and identification numbers) into the PBDG, you can automatically print as many as 24 alphanumeric characters and other symbols by depressing a single button.

Operating on either a 5 or 8-level code, the basic Teletype PBDG unit consists of 12 pushbuttons that are capable of generating a total of 288 characters. The PBDG can be used as a self-contained unit or combined with Teletype KSR (keyboard send-receive) or ASR sets.

The PBDG has wide application wherever there is a need for automatic handling of repetitive data or information. For instance, in a computer time-sharing system, the intricate instructions needed to activate the computer for a particular user can be programed into the PBDG, and transmitted automatically to the computer merely by pressing the appropriate buttons.

machines that make data move



VERTICAL TABULATOR

AND MORE FEATURES

There are many additional features that are available on Teletype machines, such as a variety of different width platens, and automatic carriage return-line feed. That's why this equipment is made for the Bell System and others who require reliable communications at the lowest possible cost.

Additional information on the Push Button Data Generator and our other features can be obtained by writing: Teletype Corporation, Dept. 71D, 5555 Touhy Avenue, Skokie, Illinois 60076.

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CIRCLE NO. 16 ON INQUIRY CARD

deduce five important properties.

1. $0 \leq P(a_i) \leq 1$; $P(a_i)$ is non-negative, and can assume any value between zero and one.

2. The Probability of a **certain** result (e.g., the Probabilities of death and taxes) is unity, since every performance of the operation results in the specified result a_i, therefore $f(a_i) = k$. Note, however, that the reverse is not necessarily true, i.e., a Probability of unity does not necessarily describe a **certain** result. For example, if there are a million balls in a tub, and all are black except one which is white, the Probability of drawing a black ball is 1.00000, yet we still might draw a non-black ball.

3. The Probability of an impossible result is zero, but a Probability of zero does not necessarily describe an impossible result; both of these statements follow from reasoning similar to that above. It is fair to state, with respect to Probabilities of zero and one, that they represent results which are "for all practical purposes"* impossible or certain, respectively.

4. The Probability of a result other than a_i, i.e., the Probability that a_i will not occur (defined as $P(\bar{a}_i)$ is

$$P(\bar{a}_i) = 1 - P(a_i).$$

(Since all results of the k trials which are not a_i must be $\bar{a}_i$, then

$$f(\bar{a}_i) = k - f(a_i),$$

and

$$P(\bar{a}_i) = \lim_{n\to\infty} \frac{f(\bar{a}_i)}{k} = \lim_{n\to\infty} \left[\frac{k - f(a_i)}{k}\right] = 1 - P(a_i).)$$

5. It follows from 4 above, that the sum of the Probabilities of the results of an operation must be unity. That is, if a_1, a_2, a_3, and a_4 are the only possible results of a given operation, then

$$P(a_1) + P(a_2) + P(a_3) + P(a_4) = 1$$

This property is known as exhaustiveness. Note that it holds only if the results a_1, a_2, a_3, and a_4 are **disjoint,** that is, no two of them may occur simultaneously.

EQUIPROBABLE RESULTS

An important class of operations (significantly including most gambling problems) can be described by the following characteristics:

1. There are n possible results: a_1, a_2, a_3, ... a_n, and one of them must occur.

2. The results are mutually exclusive **(disjoint),** i.e., only one of them may occur for any trial.

3. The results are equiprobable of occurrence, i.e.,:

$$P(a_1) = P(a_2) = P(a_3) = \ldots = P(a_n).$$

Under these conditions, the Probability of a particular condition is the simple ratio of the number of possible results which satisfy the condition (known as "successes") to the total number of possible results, n. For example, in the standard 52-card deck of playing cards, there are 52 possible and equiprobable results of the operation of drawing one card. If a "success" is defined as drawing a heart, there are 13 results which can cause a "success," and 52 possible results, so that:

$$P(\text{heart}) = \frac{13}{52} = \frac{1}{4}.$$

In the roll of a pair of dice, there are 36 possible results:

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

From the rule described above, we can easily calculate the Probability of each total throw value:

$$P(1) = \frac{0}{36} = 0.000 \qquad P(7) = \frac{6}{36} = 0.167$$

$$P(2) = \frac{1}{36} = 0.028 \qquad P(8) = \frac{5}{36} = 0.139$$

$$P(3) = \frac{2}{36} = 0.056 \qquad P(9) = \frac{4}{36} = 0.111$$

$$P(4) = \frac{3}{36} = 0.083 \qquad P(10) = \frac{3}{36} = 0.083$$

$$P(5) = \frac{4}{36} = 0.111 \qquad P(11) = \frac{2}{36} = 0.056$$

$$P(6) = \frac{5}{36} = 0.139 \qquad P(12) = \frac{1}{36} = 0.028$$

Using only the definition of Probability for equiprobable results, we can calculate the Probabilities of a number of interesting operations. In the examples used in the beginning of this article, it is easily seen that:
for the balanced die,

$$P(1) = P(2) = P(3) = P(4) = P(5) = P(6) = 1/6.$$

for the balanced coin,

$$P(\text{heads}) = P(\text{tails}) = 1/2$$

for the 99-black-and-one-white ball,

***One definition of "for all practical purposes" is illustrated by an engineering undergraduate (male) and a coed, who take initial positions at opposite ends of a football field; each, in turn, walks half the distance toward the other. Theoretically they will never meet at an intermediate point, but they can get close enough "for all practical purposes."**

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look ma...no hands!

Teletype page printers can be equipped to be turned on, transmitted to, and turned off by remote stations—without an operator present. This, in part, is accomplished by an automatic answer-back mechanism installed in the set's receiver.

STORES UP TO 20 CHARACTERS

Capable of storing up to 20 characters, the answer-back mechanism of an unattended set can be triggered by a distant Teletype machine to automatically return its identification call letters. This notifies the transmitting station that it is connected and ready to receive data.

A station's call letters are easily coded on a rotating drum within the answer-back mechanism. You can change your identification call letters at any time by merely replacing the existing drum with a newly coded one.

THREE DIFFERENT METHODS

The answer-back mechanism can be triggered in three different ways. (1) A converter within the called Teletype set automatically turns on the set's motor and energizes a magnet, which in turn actuates the answer-back mechanism. (2) A "WHO ARE YOU" character can be transmitted by the sending station. This triggers the answer-back drum in the remote receiver to return its identification call letters to the sending station. (3) Local identification is initiated by depressing the "HERE IS" key. The answer-back drum will then print the receiving station's call letters at both terminals.

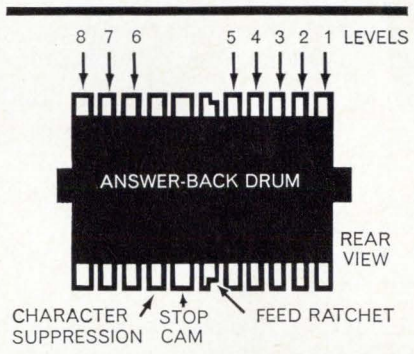
DISCRETE CODE

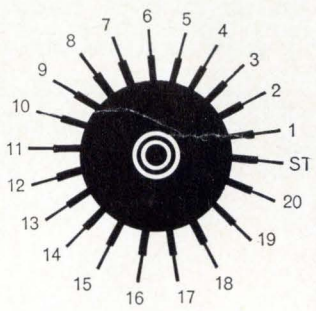
Telespeed sending sets can be equipped for automatic unattended transmission to a receiving unit. However, in order to assure that only your own receivers are capable of turning on your sending unit, both sets have a discretely coded signal. This special 14-bit code prevents any other receiver from accidentally calling in your sending set.

Here's how it works with Telespeed 750 equipment. A previously punched paper tape is placed in the tape reader of the sending unit, and the AUTO key pressed to make the set ready for unattended operation.

Incoming calls to the sending set will be answered with a tone signal. On hearing the tone, the receiving set operator presses an AUTO RDR START key which transmits the discrete code. The sending unit recognizes the correct code, turns on its tape reader, and transmits the information prepared in tape form.

The versatility of this Teletype equipment is another reason why it's made for the Bell System and others who require reliable communications at the lowest possible cost. For additional information on the discrete code, write for our new "TELESPEED 750" brochure. Teletype Corporation, Dept. 71D, 5555 Touhy Avenue, Skokie, Illinois 60076.





LEFT SIDE VIEW

ANSWER-BACK MECHANISM

machines that make data move

TELETYPE

CIRCLE NO. 17 ON INQUIRY CARD

P(black) = 0.99; P(white) = 0.01.

For the 5000-ticket-stub problems, the calculations are less obvious. Intuitively, since there are 5000 stubs and 5 to be drawn, we expect the probability of success to be 1/1000. The total number of possible results of drawing five stubs out of 5000 is the number of combinations of 5000 things, taken 5 at a time (see Rule 4 in Table 1), which is:

$$\binom{5000}{5} = \frac{5000!}{5!\ (5000-5)!} = 25{,}997{,}949{,}781{,}251{,}000.$$

A success in this operation consists of a draw of the one "winning" stub, plus any other four of the 4999 non-winning stubs. This, by Rule 4, can happen in $\binom{4999}{4}$ ways. The Probability of success, therefore, is the ratio of the number of ways a success can occur to the number of possible results,

$$\frac{\binom{4999}{4}}{\binom{5000}{5}} = \frac{1}{1000}$$

Similarly, we can calculate the Probabilities of desired results in card games. The probability of a perfect hand (all of one suit) in bridge, is the ratio of the number of such perfect hands possible (4) to the total number of hands possible, $\binom{52}{13}$, which is 635,013,559,600; therefore, we can expect to have one of the four perfect hands — in the long run — for each 157 billion hands of bridge that we play.

More within the realm of possibiliy is the Probability of a good poker hand, for example, p aces in a deal of five-card stud. There are $\binom{52}{5}$ possible poker hands. A success is defined as having p aces and 5 - p other cards. The aces can occur in $\binom{4}{p}$ ways, and the other cards can occur in $\binom{48}{5-p}$ ways, since there are 4 aces and 48 other cards to choose from. By Rule 1 in Table 1, there are, therefore, $\binom{4}{p}\binom{48}{5-p}$ successful combinations, and the desired probability is

$$\frac{\binom{4}{p}\binom{48}{5-p}}{\binom{52}{5}}$$

It is left as an exercise for the serious gambler to complete the problem for the desired number of aces. (Note — before betting — that this expression gives only the probability of getting **exactly** p aces. In the next article we shall see how one determines such things as the probability of getting **at least** p aces.)

Once certain Probabilities have been calculated, it is useful to operate with them to obtain the probabilities of more complex events. In this way, we avoid having to return to the basic (and frequently, as seen above, quite messy) combinatorial representations for further calculations. Also, of course, there are many problems which cannot be solved with this basic approach. The next article in this series will develop and illustrate the manipulation rules for Probabilities. **END**

GOVERNMENT REPORTS ★ ★

STUDIES IN INTER-SENTENCE CONNECTION

Studies conducted by the Rand Corp. working with a Russian physics text, find a recurrence of significant words between sentences. This recurrence, Rand concludes, is frequent, machine recognizable to a very large degree, and of potential use for researchers in automatic information processing. It has been suggested that only words high on a dependency tree of a sentence be selected for purposes of automatic indexing and abstracting, and Rand finds that most of the recurring words in sentence pairs would be preserved if such syntactic pruning were employed. There is a strong tendency for recurring words to appear at the same clause level in the two sentences. Although the generation of paragraphs remains a distant goal of automatic abstracting, Rand predicts recurrence will be a necessary condition for joining sentences together.

Order from Clearinghouse, U. S. Dept. of Commerce, Springfield, Va., 22151. Order No. AD-626-572. Price: $1.00.

MICROELECTRONICS IN SPACE RESEARCH

A review of the contributions made by NASA research programs to this field, which appear to be useful for general industrial application, places emphasis on silicon integrated device technology because of its relatively large importance. Microelectronics is defined by the review as those technologies by which circuit functions are realized in inseparable solid structures which duplicate the behavior of collections of conventional lumped parameter components. This eliminates from consideration microminiaturization aimed solely at size reduction of components and circuits. The publication begins with a review of microelectronics and discusses thick films, thin films, silicon integrated devices, and general device considerations. It then moves into technology and techniques, device design and development, and reliability, and concludes with a variety of applications in space systems. NASA says that much of the application information being generated can be of value to other users of microelectronic devices.

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COMPUTER EFFECTIVENESS EVALUATION

Guidelines that can lead to better managerial decisions regarding automation use and planning have been worked out in an Air Force-sponsored project conducted by the Auerbach Corp. The Auerbach process for computer installation performance effectiveness evaluation operates on a set of specifications and characteristics regarding the principal problem tasks of an installation, its computer complex, and administrative and financial performance. The process provides objective measures of performance efficiency based on both quantitative and qualitative data, and provides standards for measuring installation effectiveness. Specifications and characteristics are collected via questionnaires in four categories: computer hardware, extended machine (hardware/software interaction), software evaluation, and problem specification. Algorithms are used to summarize the raw data elements and a computer program selects data elements, makes simple arithmetic combinations of these elements into composites, and prepares the data for entry into a statistical analysis. Stepwise multiple regression analysis is used to determine the relative significance of various data elements and to calculate their relative weights.

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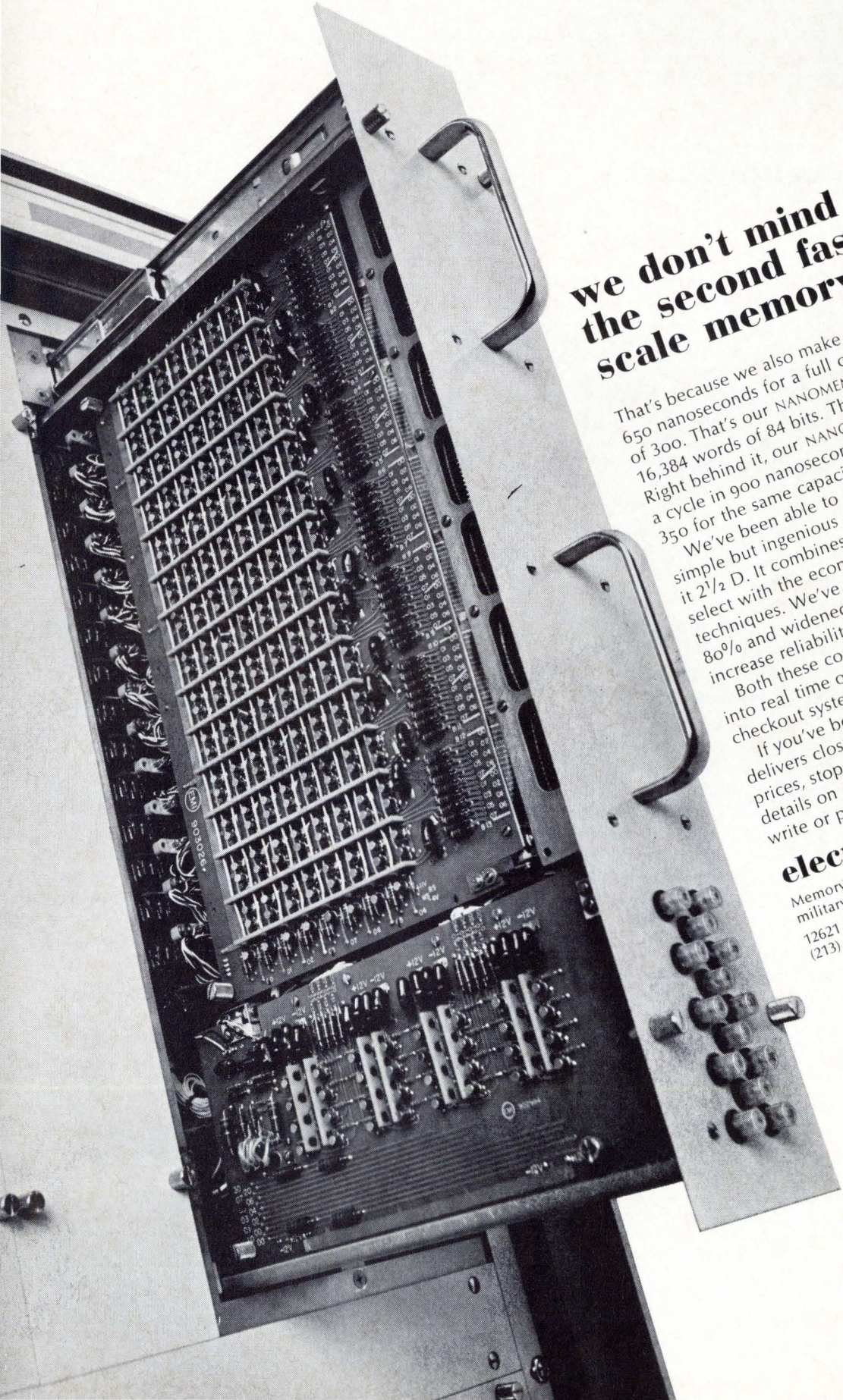

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We've been able to reach these speeds by using a simple but ingenious magnetic organization. We call it 2½ D. It combines the speed potential of linear select with the economy of coincident current techniques. We've also reduced stack connections by 80% and widened operating margins to increase reliability.

Both these compact memory systems fit perfectly into real time or high speed computers and checkout systems.

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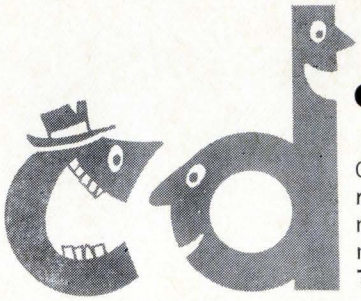

commentary

Comments and opinions on topics of current interest to digital design engineering personnel. A monthly column organized and prepared under the direction of **T. PAUL BOTHWELL, Contributing Editor.**

Programming Languages

E. E. GRIFFITH

One of the most common questions asked by the hardware-oriented professional trying to learn more about programming is: What's the difference between FORTRAN and COBOL? Many times the programmer accepts this question at face value and barges head-on into a discussion which attempts to define "the differences." Words such as verb, jargon, syntax, dialect, idiom, punctuation, etc., are used until the listener has the confused feeling he is getting a course in linguistics instead of programming. If he had been forewarned, perhaps he wouldn't be so confused.

Whenever discussing programming languages, it is usually interesting and sometimes informative to draw a parallel with the social languages.

If we say that the difference between FORTRAN and COBOL is really one of jargon it would not be too misleading. COBOL is simply designed for a different purpose than FORTRAN. The former is used by accountants, payroll personnel, etc., in which transactions, entries, opening and closing of files are terms in daily use and are, therefore, part of the jargon of those particular areas. On the other hand, terms such as functions, arrays, equivalence, relational operators, etc., are found in use by the mathematician/scientist. FORTRAN has been designed for use by these disciplines.

It is interesting to note that there are dialect problems in programming languages just as there are in the social languages. The word ACCEPT in one dialect of FORTRAN may have to be replaced with READ in another dialect to accomplish the same thing. The traveler is certainly aware of this type of problem by expecting to get the same thing in Boston when he orders the "milk shake" that he ordered in Los Angeles.

Sometimes, these differences are more severe, and therefore, cause rather serious communication problems. ALGOL, for example, is similar in some ways to FORTRAN, but is sufficiently different in grammar so that a programmer who understands FORTRAN will not necessarily be able to understand ALGOL. Perhaps the magnitude of this type of problem can be recognized by the analogy of the differences in Italian and Spanish. They are similar in many respects, but are quite different.

A practical suggestion might be for everyone to get together and decide on a standard programming language. The mathematicians could choose from FORTRAN, ALGOL, ALTAC, AUTOCODE, etc.; the business community could select from COBOL, GECOM, TABSOL, FACT, etc.; the control area could decide from APT, AUTOPROMPT, PROCOM, PIGEON, etc. This is still being attempted with some, but disappointingly little, success. Unfortunately, emotion is not the least of the problems. Who can really explain why ALGOL is more popular in Europe and FORTRAN is the defacto standard in the U.S.?

No one will deny the need for standards, but the selection of a standard is something else. But is this really too different from the problems confronting the various disciplines when communicating in social languages? It would appear worthwhile for the medical profession to standardize on a language for their journals. It is not inconceivable that there would be factions in favor of German as being more precise than English or a proposition that Latin is more universally understood.

We have heard criticisms of the programming profession that suggest the reasons for so many different languages are due to a lack of discipline; that if there were some semblance of strong leadership there wouldn't be so many languages. However, if we apply our analogy, we can see that these criticisms might be unfair. Human nature seems to have more of an impact than might be expected, even in the stark technical world.

There is considerable pressure within the programming profession to develop a universal programming language; a language that is all things to all people. The interest in NPL (i.e., PL/I) is the result of such pressure. This new language seems quite good and appears to place the goal of

The author of this month's CD Commentary, Edward E. Griffith, is Manager of the Programming Department at Computer Control Co. He directs the specification and generation of software for all computer product lines. In computer design activity, he coordinates program requirements with design engineering.

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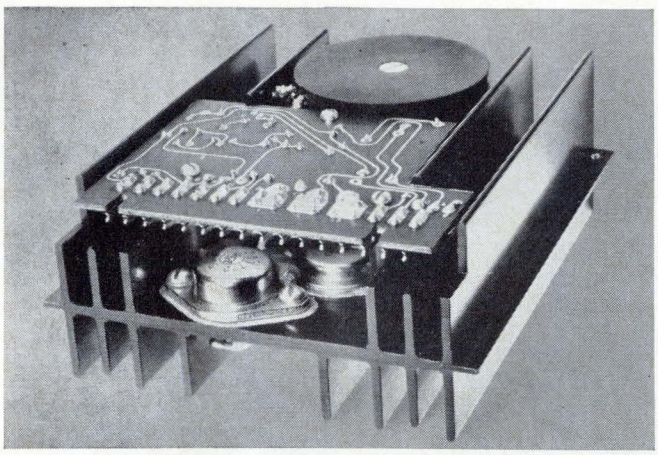
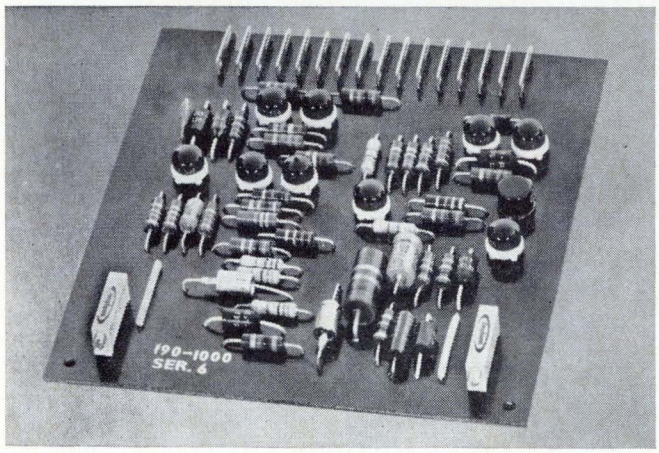


Omnimod power control module.



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standardization within reach (this is controversial, but certainly we are closer than we were a few years ago). The programming profession, you see, has not ignored the problem, but does in fact have a direction and even a plausible solution in mind. The challenge is now out to the social scientist. A universal social language would certainly solve many problems that confront societies. Is all hope lost for Esperanto? It certainly doesn't appear realistic in the foreseeable future, but it would be nice if societies had a standard language in which to communicate. If Esperanto were chosen as the universal social language and NPL were selected as the universal programming language, the final step would be to tie the two together and define NPL in Esperanto!

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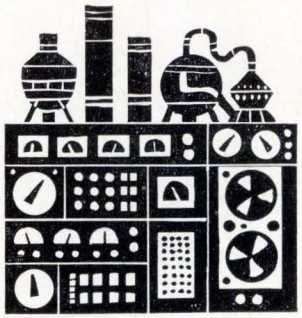


INDUSTRY NEWS

RECENT ANNOUNCEMENTS FROM COMPUTER MANUFACTURERS:

FROM SDS — Boeing orders an SDS 9300; Jet Propulsion Labs orders 13 SDS 920 computers; Tymshare Associates orders an SDS 940; and SDS 92 working in tandem with an SDS 930 will control a nation-wide network of 60 communications terminals for Sandia Corp.

FROM CDC — Curtis Publishing Co. orders two CDC 8090 computer systems and a CDC 915 page reader; CDC's 6600 passes acceptance test at Berkeley's Lawrence Radiation Lab facility; Navy's Underwater Ordnance Station now using a CDC 3200 for testing of underwater weapons; San Francisco bank installs CDC 915 optical page reader system; Duncan Electric of Lafayette, Ind. installs a CDC 160 for calibrating watt-hour meters; a CDC 3100 will be used by Itek Corp. in their digital mapping system and another CDC 3100 was installed at the U. S. Navy's Pacific Missile Range; the Interstate Power Company at Dubuque, Iowa has placed an order for a CDC 636 industrial computer system to be used for monitoring and data logging of power plant operation.

FROM HONEYWELL — U. S. Navy will lease one Series 200 computer for their Public Works Center at San Diego to be followed by similar installation at 8 other Public Works Centers around the world; a Series 400 computer system was recently installed at a London insurance brokerage firm; a British textile firm orders a Honeywell 120 smallest of the Series 200 line.

FROM DEC — The Australian Atomic Energy Commission orders a PDP Multianalyzer; a geodetic survey ship called the Whiting will use a PDP 8 to plot data; the Argonne National Lab in Chicago is using a PDP 7 for film-scanning development program for low-energy physics studies.

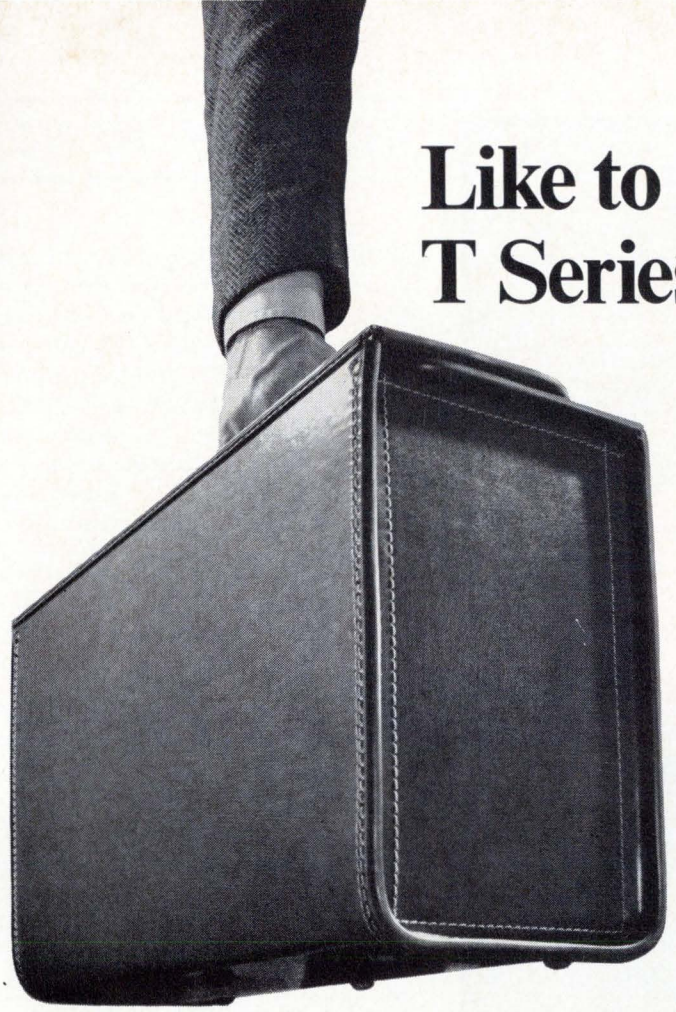
FROM IBM — Three IBM 360/30 computers are reported in successful operation at C-E-I-R, Inc's service bureaus; Computer Sciences Corp. will expand its remote services with an IBM 360/65 and a 360/75; an IBM 360/50 is now undergoing testing at Rensselaer Polytechnic Institute.

FROM UNIVAC — Sperry Rand announced the receipt of a multi-million dollar contract from Bell Telephone Labs for continuation of the design, development, and delivery of data processors and thin-film memory modules for use in the Nike-X system; a Univac 418 computer became the operating hub of a real-time stock market computer answering network in London.

FROM 3C — Computer Control is furnishing two DDP 116 systems to Tridea Corp. to be used for on-line machine tool programming in conjunction with a Tridea-developed automatic line tracer.

1966 FJCC CALL FOR PAPERS

The Technical Program Committee for the 1966 Fall Joint Computer Conference, November 8-10 at San Francisco Civic Center, has issued a call for papers dealing with significant trends, achievements, concepts and techniques covering the entire information processing field. Survey and tutorial papers are welcome. Sessions are planned on on-line hardware, software and applications in commerce, business, and industry. Session topics at present include: Analog and Hybrid Computers, Communication Devices and Systems, Components and Circuits, Impact of Computers on Education, Impact of Computers on Management, Machine Organization, Management of Data Processing Centers, New Areas of Application, Numerical Analysis, On-Line Systems, Peripheral Equipment, Programming Languages, and Storage Devices. An AFIPS $500 award has been established for the best paper presented at the conference. Submissions are due by May 2. Only new papers not exceeding 10,000 words will be considered. Five copies of drafts, including 100/500-word abstracts, should be sent to: Dr. William H. Davidow, Technical Program Committee Chairman, 1966 FJCC, P.O. Box 2208, Menlo Park, Cal. 94025.



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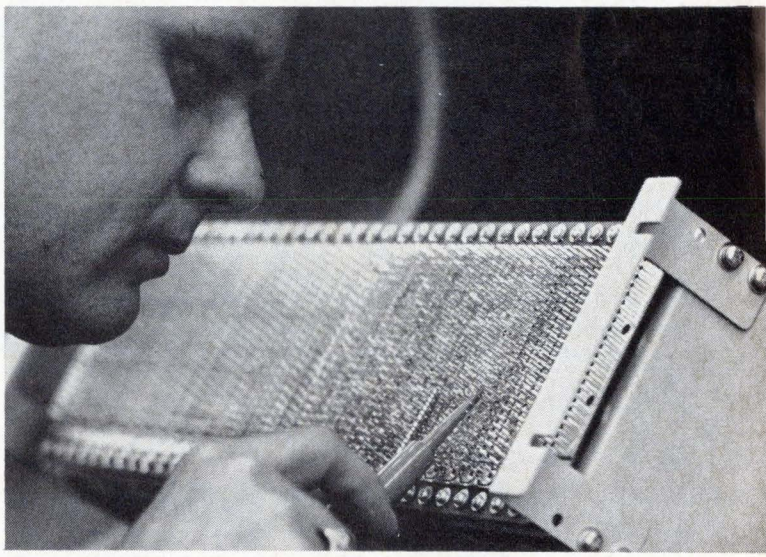
Our new T Series integrated circuit logic modules are so fast and flexible that we can hardly blame you if you doubt the



amazing specs: Fan out of 14. Noise rejection up to 1.8v. 18 nanosecond gates. 40 nanosecond flip-flops.

So we've given our men demonstration kits and you can see for yourself.

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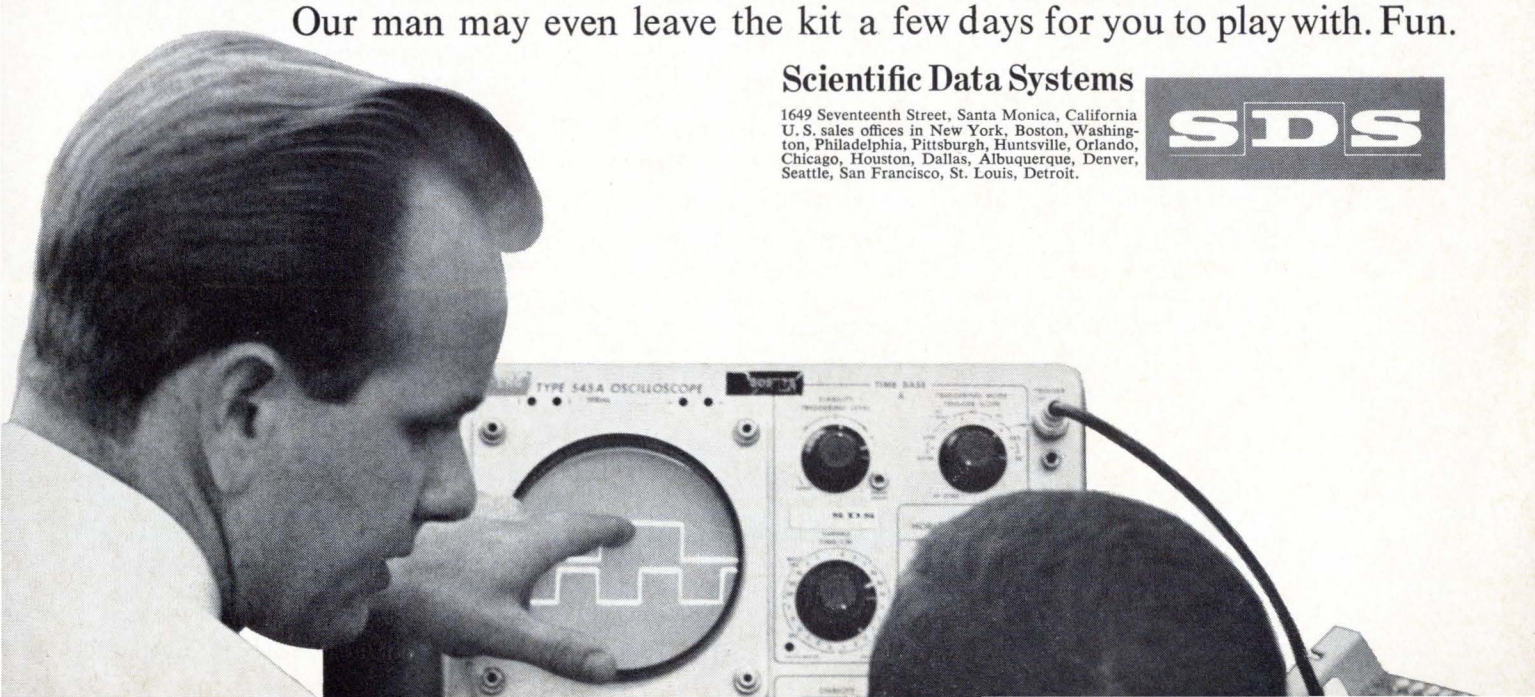


INDUSTRY NEWS

FROM ASI — A digital system for seismic data processing will be delivered to Central Exploration of Oklahoma City. The ASI system consists of an Advance Series 6040 computer, a special seismic communications system, and various input-output and peripheral gear.

FROM NCR — A German bank has installed an NCR 315 computer system and has placed an order for a second system.

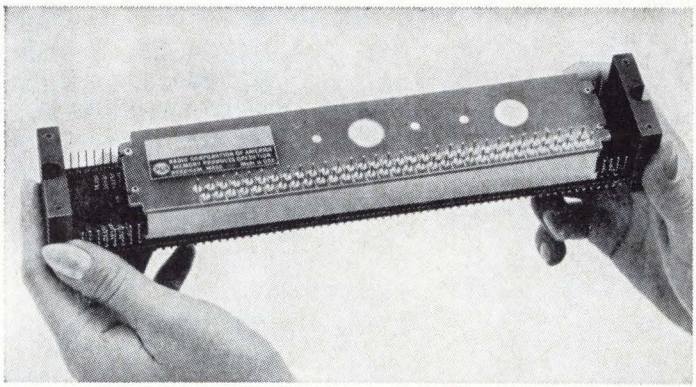
FROM FOXBORO — The Foxboro Co. has received a repeat order calling for additional instrumentation and expanded digital computer facilities for Allegheny Power System's generating plant.

GERMANIUM TRANSISTOR PRICES HAVE BEEN SHATTERED BY FAR-REACHING PRICE REDUCTIONS ACCORDING TO AN ANNOUNCEMENT FROM MOTOROLA SEMICONDUCTOR PRODUCTS INC., PHOENIX, ARIZ. The price reductions range from 91 to 14 percent, with an average reduction of 49 percent, and cover 29 device types. The price cuts affect devices now in general use as well as state-of-the-art types. Included in the general price roll-back are high-frequency devices ranging from high-current core and line-drivers to ultra-low-noise RF amplifiers. The price reductions are attributed to a new manufacturng technique, known as Selective Metal Etch, which provides a much higher yield to the desired transistor specifications than the conventional process that has been in general use for a number of years. In addition, the technique permits "batch processing" of larger quantities of devices, greatly reducing individual device manufacturing costs.

ASSIGNMENT: BUILD A 16,384-BIT MEMORY STACK FIT FOR OUTER SPACE, TO WITHSTAND:-

50 G SHOCK
10 G VIBRATION
△T of -55° to +105°C

Result: This RCA ferrite memory stack, designed to withstand the rigors of space flight, meets the toughest kind of environmental specs:



Vibration—10 g (0 to peak) 5 to 2000 to 5 cps at 1 minute/octave logarithmic sweeps, once along each of 3 mutually perpendicular axes.

Mechanical Shock—50 g, 11 ± 1 msec, half-sine wave, 2 shocks in both directions in each of 3 mutually perpendicular axes, a total of 12 shocks.

ΔT— 5 cycles per MIL-STD-202, Method 102A, within limits of —55° C to +105° C. Unit to operate at specs at 0° C, 25° C and 70° C (without use of heaters or other means of internal temperature control).

How did RCA meet these demanding requirements?

- **By double-testing** each RCA wide-temperature-range ferrite memory core for 100% quality assurance.
- **Precision stringing** an array of 16 planes, each 32 x 32 cores, with continuous wiring through all 16,384 cores; no splices or internal solder joints are permitted. Then 100% testing the entire array.
- **Folding** the 16 planes over to form a continuously wired memory stack—and 100% testing it again.
- **Encapsulating** the stack in silicone rubber and securing it to its support case—and 100% testing it again.
- **Shaking, shocking and temperature cycling** the stack and 100% testing it at three different temperature levels.

Here's one more example of what RCA can do to build memory-system components to meet *your* requirements, regardless of how difficult they may be. Whatever you need in ferrite memory components, call your local RCA Field Office or write, wire or phone: RCA Electronic Components & Devices, Memory Products Operation, Section FZB4, 64 "A" Street, Needham Heights, 94, Mass. Phone: (617) HI 4-7200.

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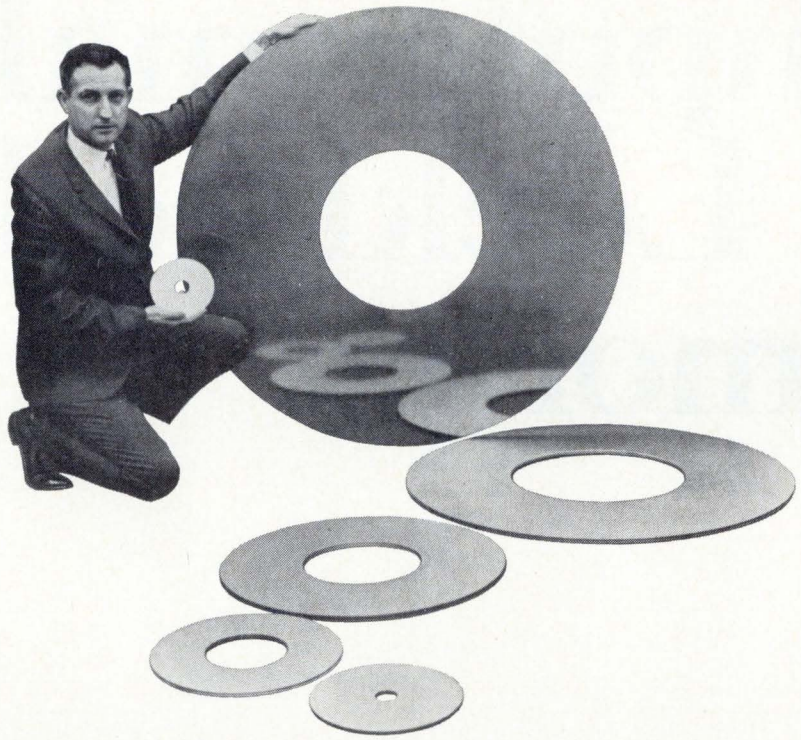
INDUSTRY NEWS

HONEYWELL'S EDP DIVISION WILL MARKET THE BUNKER-RAMO CORP'S NEW SERIES 200 AND 400 INFORMATION DISPLAY AND INQUIRY DEVICES IN COMMERCIAL AND GOVERNMENT DATA PROCESSING MARKETS here and abroad. Bunker-Ramo will continue to manufacture and market these input/output display devices. The worldwide service to organizations of both firms will coordinate field servicing of the devices. The arrangement also provides Honeywell with rights for future manufacture of display units in the United Kingdom, Germany, and Canada as well as in other selected countries. The agreement excludes Japan, where Bunker-Ramo display devices are marketed by the Nippon Electric Company. Nippon Electric also manufactures and markets Series 200 computer systems under a Honeywell license.

THE THIRD CONSECUTIVE YEAR OF RECORD SALES AND EARNINGS WAS REPORTED BY SCIENTIFIC DATA SYSTEMS for the year ended December 31, 1965. Total revenues more than doubled 1964 results, increasing to $43,999,924 from $20,486,789 for the previous year. Substantial growth was also shown in net income which rose to $3,371,628 for 1965 as compared to $2,179,-399 in 1964. According to SDS President Max Palevsky, "New orders during the fourth quarter and in the first eight weeks of 1966 continue to be received at a satisfactory rate." More than 200 SDS computers were shipped last year bringing the total of installations at year end to over 400 computers in 20 countries. The number of employees at SDS also rose substantially to 2,373 at the end of 1965 from 1,357 in 1964.

No one has a larger line of disc memories.



See the largest line of disc memories available at the Spring Joint Computer Conference, Booth 913-916

Whether your information storage requirements are small or require data stored in millions of bits, Librascope Group of General Precision, Inc., has a disc memory system for every application. These systems have a proven history of reliable performance in computing systems designed for military, business, engineering, and educational applications.

LIBRAFILE mass memories: Large-capacity, high-speed, random-access information storage systems. Two disc sizes available. 48″ discs capable of storing up to 400 million bits. 38″ discs with a capacity of 200 million bits. LIBRAFILE mass memory information retrieval is either fixed-address search or search-by-record content. Access time less than 20 ms. Data transfer rates in the megacycles.

Militarized disc-memory systems: High-speed, random-access, information-storage systems. Consists of disc memory for data storage and an electronic subsystem that provides complete interface, control, and read/write electronics. These systems can be used as a data base for shelter, van, or shipboard applications. Storage capacity of 25 million bits on 24″ discs. Customized capacity up to 80 million bits.

L-400 magnetic-disc memory systems: Provide data storage and transfer in computer systems, peripheral equipment, and other systems where rapid-access memory is a requirement. 24″ disc storage capacity up to 36 million bits.

Airborne disc file: Small, compact file designed for airborne (MIL-E-5400 class 2) applications, as well as for shipboard and mobile field operations. 6¼″ disc with capacity of 1 million bits. Customized airborne memories available with capacity up to 50 million bits.

L-300 disc memory: For use in computer systems and peripheral equipment as main storage, buffer storage, or as a supplemental memory. 10″ disc with a capacity of 275,000 bits.

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Economical custom design. With Lockheed's exclusive "plug in" memory stacks, and other unique modules, we can assemble special memories to fit your need quickly and at low cost.

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Tell us your memory application, so we can give you the most useful information. Address: 6201 E. Randolph St., Los Angeles, California 90022.

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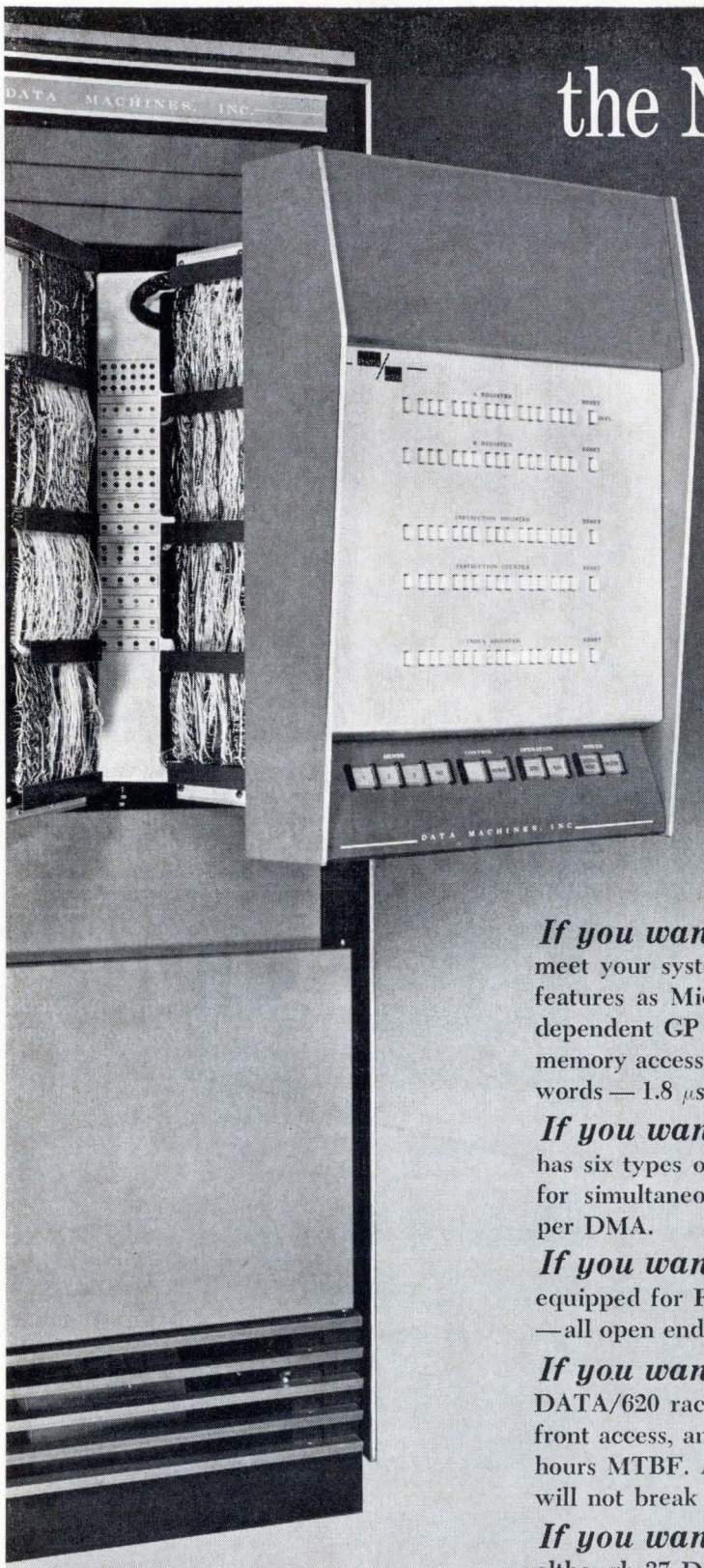

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If you want... a computer specifically designed to meet your system requirements — with such useful system features as MicroExec for sub μsec processing rates — independent GP memories for simultaneous operation — two memory access channels, 555 KC and 200 KC — 16 or 18 bit words — 1.8 μsec core memories, and 0 to 12 v. logic levels.

If you want... Input/Output flexibility, DATA/620 has six types of I/O facilities and up to sixty-four devices for simultaneous I/O rates of more than 500,000 words per DMA.

If you want... complete software, DATA/620 is equipped for FORTRAN in 4 K, Assembler, Aid, Maintain —all open ended—and more than 100 machine commands.

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If you want... 90 day delivery you can still have it — although 37 DATA/620s have been sold and 10 delivered.

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See the DATA/620 at booth 1113 at the Spring Joint Computer Conference.

CIRCLE NO. 31 ON INQUIRY CARD

from our man in Washington

Increased emphasis abroad on EDP equipment for accounting, inventory control, and production planning is expected to contribute to a strong growth in exports of computer machines in 1966, according to the Commerce Department's Bureau of International Trade. This increase will continue the long-standing upward trend in these sales, as foreign governments and industries follow the U.S. lead in EDP routines.

.....

The EDP system of the Internal Revenue Service produced over $35 million in additional revenue during 1965, and offset $33.6 million in potential refunds of 178,000 business and individual taxpayers against unpaid tax balance of the same taxpayers. A total of $70 million in additional revenues is credited to the EDP system since it became operational in 1962. Business returns were processed on a nationwide basis for the first time in 1965, and processing of individual returns under EDP was introduced into a second IRS region. In addition, the IRS Data Center in Detroit handled centrally such Revenue Service programs and activities as payroll preparation, taxpayer compliance measurement, statistics of income, tax forms distribution, and management information programs.

.....

We can expect requirements for qualified well-trained scientists and engineers to be as great as, or greater than, the numbers we will train, according to Dr. Bowen C. Dees, associate director for planning at the National Science Foundation. He further predicted, in congressional testimony, that this country will face large requirements for scientists and engineers. The anticipated supply of university graduates in science and engineering becoming available, he believes, over the decade will not meet all our requirements. It is likely, he added, that scientific manpower deficits will be clearly observable in large numbers of unfilled jobs late in the decade.

.....

The Joint Committee on the Organization of the Congress is exploring the possibilities of using EDP equipment as an aid to Congress. Members of the Joint Committee are intensely interested in the possible use of EDP equipment and information storage and retrieval systems as a means of assisting the Congress, its committees, and its Members in more rapid and complete access to information as a basis for legislative decisions.

.....

President Johnson in his budget message to Congress called attention to the great benefits the Federal Government has obtained from the use of electronic computers. With the direct annual cost of accruing and operating this equipment now in the range of $2 billion, the President said he intended to make sure that this huge investment is managed efficiently — through such means as research, equipment sharing, careful purchasing, and coordinated government-wide utilization policies.

Efforts will be made to achieve greater standardization in the field of EDP by approving additional funds in the budget for the new Center for Computer Sciences and Technology at the Bureau of Standards.

Recent Defense Department Contracts .....

THE GARRETT CORP., Los Angeles, Cal., an order in the amount of $1,365,438 for spare parts to support the central air data computer on F-4 series aircraft. Work will be done in Los Angeles. The Middletown Air Materiel Area, Olmstead AFB, Pa., is the contracting agency.

GENERAL PRECISION, INC., Little Falls, N.J., a $5,200,000 initial increment to a fixed-price contract for components for navigational computer sets and aerospace ground equipment for C-141 aircraft. Estimated final amount of this contract is $13,000,000. Work will be done in San Marcos, Cal.

BENDIX CORP., Teterboro, N.J., for the Aeronautical Systems Division a $1,500,000 initial increment to a $5-760,625 fixed-price contract for production of aircraft navigational computer equipment.

LEAR SIEGLER, INC., Grand Rapids, Mich., a $1,418,282 fixed-price contract for components for bomb computer systems. U.S. Navy Purchasing Office, Washington, D.C., is the contracting agency.

1890 ONCE UPON A TIME THERE WAS A COMPANY 1966

. . . It made all sorts of useful things  like d/c battery chargers . . .  air cooled engine-generators . . .  emergency standby electric power supply units . . . electric plants on wheels  and other fascinating equipment. In fact, this company  still does. Many of you know the company we're talking about—UNITED STATES MOTORS CORPORATION. Giants of industry and those responsible for our defense posture did business with it you know when—AND NOW! It continues to build quality products—more sophisticated of course—but then what isn't today! It has highly sensitive "No-Break" MICRO POWER Electrical Plants  . . . Standby Emergency Power Equipment  on wheels . . . without wheels  . . . and in capacities ranging from only 500 watts to 750 KW. Its plant is modern  inside and outside  . Its equipment is used in communications systems  . . . computer systems  . . . in hospitals and  schools, and by industrials to protect special processes from losses due to power outages. Applications are virtually unlimited. Let's get together. Our sales and service centers are—

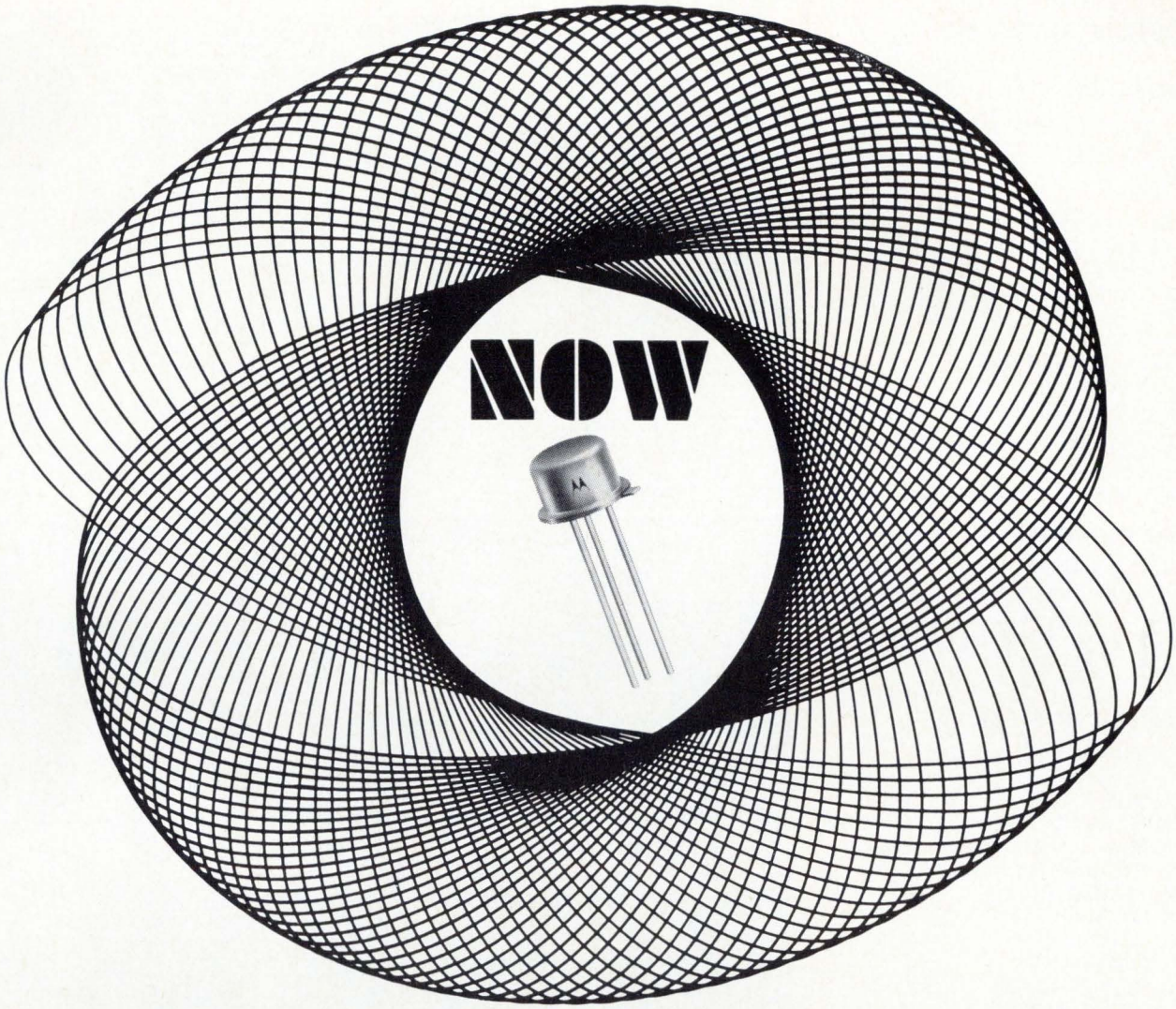
NEW YORK AREA
855 Riffle Street
Phone 382-1631 (201)
Rahway, New Jersey 07065

SAN FRANCISCO AREA
8 Echo Lane
Phone 388-1992 (415)
Mill Valley, California 94943

MIDWEST AREA
339 West 20th Street
Phone 231-4560 (414)
Oshkosh, Wisconsin 54901

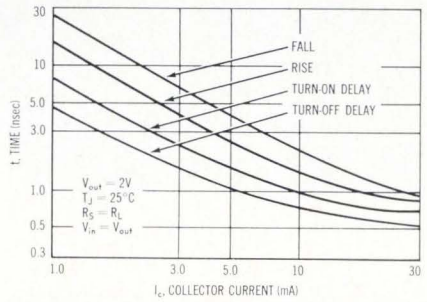
UNITED STATES MOTORS CORPORATION
OSHKOSH, WISCONSIN

CIRCLE NO. 32 ON INQUIRY CARD



a new era for current-mode switching . . . with Motorola's 1800 MHz 2N3960 NPN Silicon Annular* Transistor

TYPICAL SWITCHING TIMES



LIMIT CURVES AVAILABLE IN DESIGNERS* DATA SHEET

You'll find a full complement of limit curves on each device in a special Motorola Designers Data Sheet. Thus, you can readily explore their use in your circuits using "worst case" design techniques. Both devices are in stock in TO-18 packages. TO GET STARTED, send for your copy of the Data Sheet. Simply write Technical Information Center, Motorola Semiconductor Products Inc., Box 955, Phoenix, Arizona 85001.

A new magnitude of switching speed for non-saturated, digital systems applications is here — ready for your immediate prototype designs . . . with typical f_T performance of 1800 MHz!

Previously, frequency response has been limited to a range of about 1200 MHz before encountering a self-limiting tradeoff with breakdown voltage. Now, Motorola's newly developed "narrow-base profile" process technique makes possible a micro-thin base thickness (on the order of 0.1 micron) and a new high level of frequency response (f_T).

And, because the 2N3960 uses Motorola's patented annular device structure, this frequency response is offered to you at no sacrifice in breakdown voltages. You've come to expect this with all annular built devices.

As a result, both 2N3960 and its sister device, 2N3959, are able to satisfy, as never before, the three key requirements for highest speed in current-mode designs — high f_T, low capacitances, and low base-spreading resistance.

Guaranteed **minimum** f_T values are 1300 MHz for 2N3959 and 1600 MHz for 2N3960 at 10 mA. Both are also specified at 5 and 30 mA collector currents.

Other high-performance characteristics . . .	
Output Capacitance (C_{obo}) (V_{CB} = 4 Vdc, I_E = 0, f = 100 Kc)	2.5 pf max.
Input Capacitance ($-C_{ibo}$) (V_{EB} = 0.5 Vdc, I_C = 0, f = 100 Kc)	2.5 pf max.
Collector-Base Time Constant ($r_b' C_c$) (I_C = 10 mA, V_{CE} = 10 V)	
2N3959	25 psec max.
2N3960	40 psec max.
Collector-Base Breakdown Voltage (BV_{CBO}) (I_C = 10 μAdc, I_E = 0)	20 Vdc min.
Collector Emitter Breakdown Voltage (BV_{CEO}) (I_C = 10 mAdc, I_B = 0)	12 Vdc min.

*Annular semiconductors patented by Motorola Inc.

MOTOROLA
Semiconductors

CIRCLE NO. 33 ON INQUIRY CARD

BOSTON REVEALED

CONVENTION SITE:

1. War Memorial Auditorium
2. Parking

HOTELS:

3. Sheraton-Boston
4. Sherry-Biltmore
5. Lenox
6. Copley Square
7. Sheraton-Plaza
8. Ritz-Carlton
9. Statler-Hilton
10. Bradford
11. Touraine
12. Parker House
13. Madison
14. Vendome
15. Cambridge Charterhouse

TRANSPORTATION:

16. Logan Airport
17. South Station
18. North Station
19. Callahan & Sumner Tunnels
20. Back Bay Station
21. Bus Terminal

POINTS OF INTEREST:

22. Bunker Hill Monument
23. Navy Yard
24. "Old Ironsides"
25. Museum of Science
26. Mass. Institute of Technology
27. New Government Center
28. State Capitol
29. Old North Church
30. Custom House
31. Faneuil Hall
32. Boston Common
33. Public Gardens
34. John Hancock Tower
35. Copley Square
36. Boston Public Library
37. Prudential Tower

STREETS:

38. Boylston St.
39. Commonwealth Ave.
40. Beacon St.
41. Storrow Drive
42. Memorial Drive
43. Mass. Ave.
44. Huntington Ave.
45. Mass. Turnpike
46. Southeast Expressway
47. Mystic River Bridge

MISCELLANEOUS:

48. Boston Harbor
49. Charles River
50. Mystic River

1966 SPRING JOINT COMPUTER CONFERENCE

WAR MEMORIAL AUDITORIUM, BOSTON, MASS.

APRIL 26, 27, 28, 1966

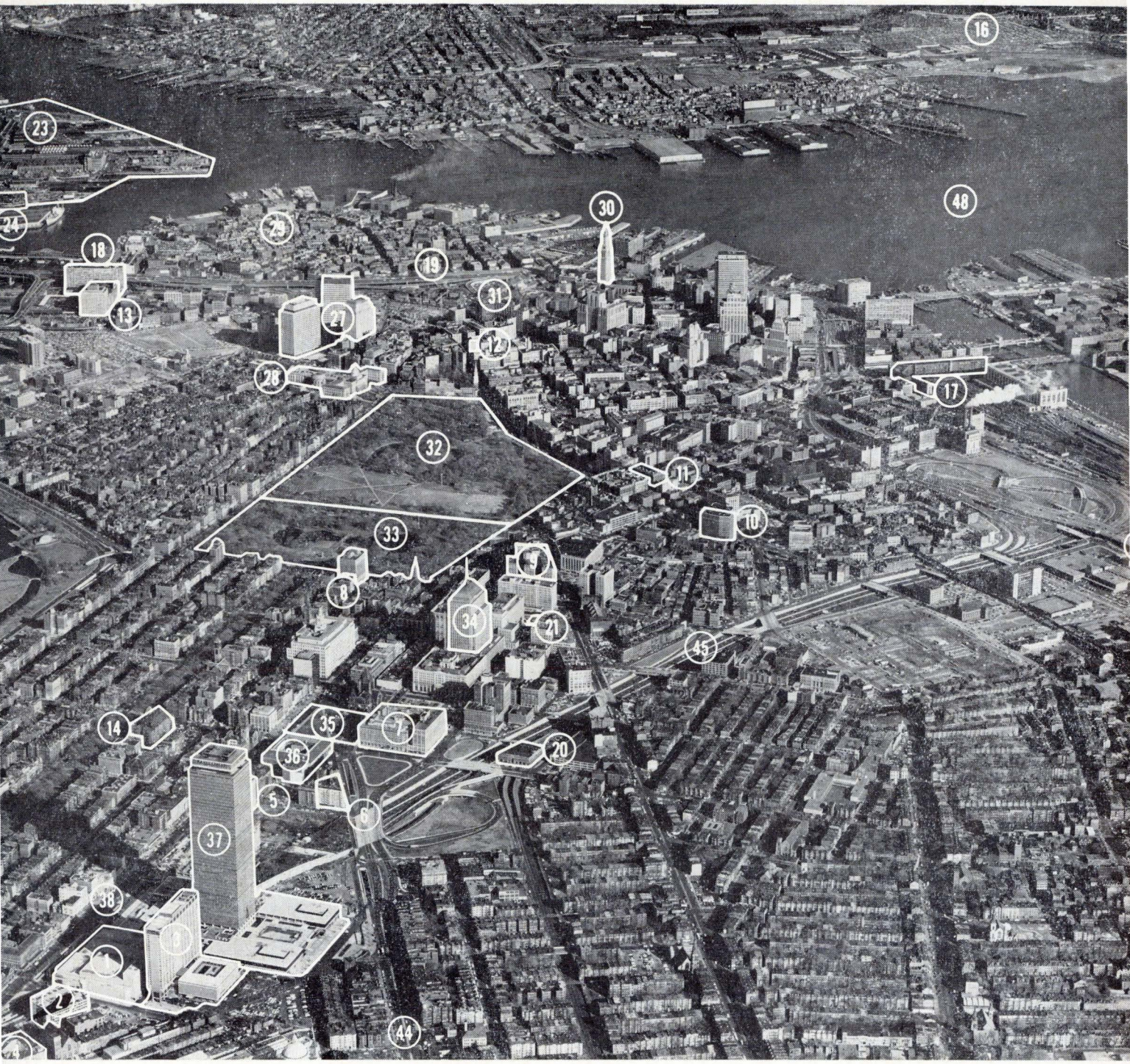


Photo Courtesy of AERIAL PHOTOS OF NEW ENGLAND

The 1966 SJCC is being held in Boston's new Prudential Center, a multi-million dollar complex consisting of offices, shops, restaurants, the Sheraton-Boston Hotel, and the War Memorial Auditorium. This new center is located along Boylston Street near Copley Square.

All of the SJCC activities will be carried on in the Sheraton-Boston Hotel and the War Memorial Auditorium which are adjoining buildings with direct interior connection. Registration booths, exhibits, the Science Theater, and most technical sessions will take place in the Auditorium. Some technical sessions and all other SJCC activities will take place in the hotel.

TECHNICAL PROGRAM SUMMARY

TUESDAY, APRIL 26

SESSION 1 . . . . . 1:00 P.M. GRAND BALLROOM

DISPLAY APPLICATIONS RESEARCH

ON-LINE GRAPHICAL SPECIFICATION of PROCEDURES, W. R. Sutherland; DISPLAY CONSOLE USAGE, W. H. Ninke; THE GRAIL PROJECT, T. O. Ellis and W. L. Sibley; COMPUTER CONSTRUCTION AND DISPLAY OF MOLECULAR MODELS, C. Levinthal; THE COMPUTER-AIDED LECTURER, G. J. Culler; COMPUTER AIDS FOR COMPOSING, MODIFYING AND STUDYING TEXT, D. C. Engelbart.

SESSION 2 . . . . . 1:00 P.M. BABBAGE ROOM

COHERENT OPTICAL INFORMATION PROCESSING

COMPUTER APPLICATION OF ELECTRO-OPTICS, W. J. Poppelbaum; MATHEMATICAL REVIEW OF COHERENT OPTICAL SYSTEMS, G. B. Parrent, Jr.; THE ROLE OF COHERENT OPTICAL SYSTEMS IN DATA PROCESSING, L. J. Cutrona; REQUIREMENTS FOR HOLOGRAM CONSTRUCTION, E. N. Leith and J. Upatnieks; APPLICATIONS OF COHERENT OPTICAL TRANSDUCERS TO OPTICAL REAL-TIME INFORMATION PROCESSING, D. B. Anderson.

SESSION 3 . . . . . 3:30 P.M. AUDITORIUM

TIME-SHARING

TIME-SHARING IN THE IBM SYSTEM/360: MODEL 67, C. T. Gibson; A TIME-SHARED DATA MANAGEMENT SYSTEM USING A CROSS-INDEX FILE AND SELF-DEFINING ENTRIES, E. W. Franks; AN ANALYSIS OF TIME-SHARING COMPUTER SYSTEMS USING MARKOV MODELS, J. L. Smith; AN OPTIMIZATION MODEL FOR TIME-SHARING, D. W. Fife.

WEDNESDAY, APRIL 27

SESSION 4 . . . . . 9:00 A.M. AUDITORIUM

PANEL DISCUSSION: THE MEANING OF COMPUTER TIME-SHARING

PANELISTS: J. D. Babcock, L. R. Hague, T. E. Kurtz, K. F. Powell, I. E. Sutherland, J. R. Ziegler.

SESSION 5 . . . . . 9:00 A.M. BABBAGE ROOM

SIMULATION AND MODEL-BUILDING

DSL/90 — A DIGITAL SIMULATION PROGRAM FOR CONTINUOUS SYSTEM MODELING — PART 1 AND PART 2, R. N. Linebarger and W. M. Syn; A DIGITAL SYSTEM FOR ON-LINE STUDIES OF DYNAMICAL SYSTEMS, T. C. Bartee and J. B. Lewis; SIMULATION OF LOGICAL DECISION NETWORKS OF TIME-DELAY ELEMENTS BY MEANS OF A GENERAL-PURPOSE DIGITAL COMPUTER, Y. N. Chang and O. M. George; SIMULATION OF A MULTIPROCESSOR COMPUTER SYSTEM, J. H. Katz; MARKOVIAN MODELS AND NUMERICAL ANALYSIS OF COMPUTER SYSTEM BEHAVIOR, V. L. Wallace and R. S. Rosenberg; SMPS — A TOOL BOX FOR MILITARY COMMUNICATIONS STAFFS, K. Jacoby, D. Fackenthal, and A. Cassel; DIGITAL SIMULATION OF LARGE SCALE SYSTEMS, R. V. Jacobson.

CONFERENCE TIMETABLE

Monday, April 25

6:00 p.m.	Message Center Opens
6:30 p.m.	Registration Center Opens
10:30 p.m.	Registration Center Closes
11:00 p.m.	Message Center Closes

Tuesday, April 26

8:30 a.m.	Registration and Message Centers Open
10:00 a.m.	Keynote Address
11:30 a.m.	Exhibits and Computer Sciences Theater Open
1:00 p.m.	Technical Sessions 1 and 2
3:30 p.m.	Technical Session 3
5:00 p.m.	Exhibits Close
5:30 p.m.	Registration Center Closes
6:00 p.m.	Cocktail Party
11:00 p.m.	Message Center Closes

Wednesday, April 27

9:00 a.m.	Registration and Message Centers Open
9:00 a.m.	Technical Sessions 4 and 5
10:00 a.m.	Exhibits Open
10:30 a.m.	Computer Sciences Theater Opens
12:00 noon	Conference Luncheon
1:30 p.m.	Technical Sessions 6 and 7
3:45 p.m.	Technical Sessions 8 and 9
5:30 p.m.	Registration Center Closes
8:00 p.m.	Exhibits Close
11:00 p.m.	Message Center Closes

Thursday, April 28

9:00 a.m.	Registration and Message Centers Open
9:00 a.m.	Technical Sessions 10, 11, and 12
10:00 a.m.	Exhibits Open
10:30 a.m.	Computer Sciences Theater Opens
12:00 noon	Registration Center Closes
1:00 p.m.	Technical Sessions 13 and 14
3:30 p.m.	Technical Sessions 15 and 16
5:00 p.m.	Exhibits Close
8:30 p.m.	Boston Pops Concert
11:00 p.m.	Message Center Closes

SESSION 6 . . . . . 1:30 P.M. AUDITORIUM

PROCESSING LARGE FILES

TECHNIQUES FOR REPLACING CHARACTERS THAT ARE GARBLED ON INPUT, G. Carlson; ADAM — A GENERALIZED DATA MANAGEMENT SYSTEM, T. L. Connors; THE ENGINEER-SCIENTIST AND AN INFORMATION RETRIEVAL SYSTEM, C. A. Merritt and P. J. Nelson.

SESSION 7 . . . . . 1:30 P.M. BABBAGE ROOM

WAVEFORM PROCESSING

EFFECTS OF QUANTIZATION NOISE IN DIGITAL FILTERS, B. Gold and C. Rader; A REAL-TIME COMPUTING SYSTEM FOR LASA, H. W. Briscoe and P. L. Fleck; HIGH-SPEED CONVOLUTION AND CORRELATION, T. G. Stockham, Jr.

SJCC TOURS

There will be a number of local technical tours arranged during the three days of the conference. A list of tours and a description of each will be posted at a desk near the registration center. PLEASE SIGN UP EARLY FOR TOURS YOU WISH TO TAKE. This is necessary due to security requirements at several facilities and maximum group size limits imposed by others.

MITRE CORPORATION

Tour of the Systems Design Laboratory and demonstration of the AESOP system.

M.I.T., LINCOLN LABORATORY

Demonstration of TX2 graphics system.

AIR FORCE CAMBRIDGE RESEARCH LABORATORY
HANSCOM FIELD

Demonstration of DX1 — Digigraphics plus color scope routines now being developed.

HONEYWELL, INC.

1. Demonstration at Programming and Research Center in Newton.
2. Demonstration at Engineering and Research Center in Waltham.

CONTROL DATA CORPORATION

Inspection of Digigraphic Laboratory with demonstration of Model 270 Digigraphic System and Model 278 Jumping Spot Film Scanner.

HARVARD UNIVERSITY

Cambridge Electron Accelerator on-line with Harvard Computation Center. Communication will be by two display scopes located at the Accelerator.

KEYDATA

Tour of 491 Computer facility and demonstration of a Keydata billing or invoicing application.

COMPUTER CONTROL CORPORATION

Inspection of computer design and manufacturing facility with question and answer period by company officers.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Demonstration showing the ability to write a program through a time-shared system from a remote terminal.

SESSION 8 . . . . . 3:45 P.M. AUDITORIUM

PROGRAMMING LANGUAGES

A COMPUTER PROGRAM TO TRANSLATE MACHINE LANGUAGE INTO FORTRAN, W. A. Sassaman; TECHNIQUES AND ADVANTAGES OF USING THE FORMAL COMPILER WRITING SYSTEMS FSL TO IMPLEMENT A FORMULA ALGOL COMPILER, R. Iturriaga, T. A. Standish, R. A. Krutar, J. C. Earley; A PROPOSAL FOR A COMPUTER COMPILER, G. Metze and S. Seshu.

SESSION 9 . . . . . 3:45 P.M. BABBAGE ROOM

BUSINESS APPLICATIONS

A BUSINESS ORIENTED TIME-SHARING SYSTEM, G. F. Duffy and W. D. Timberlake; "NEVER-FAIL" AUDIO RESPONSE SYSTEM, B. C. Dale; APPLICATION OF COMPUTER-BASED RETRIEVAL CONCEPTS TO A MARKETING INFORMATION DISSEMINATION SYSTEM, J. J. Gatto.

THURSDAY, APRIL 28

SESSION 10 . . . . . 9:00 A.M. AUDITORIUM

THE EVOLVING LIBRARY

LIBRARIES AND MACHINES — A REVIEW, B. W. Adkinson; COORDINATED INFORMATION PROCESSING IN THREE MEDICAL LIBRARIES, F. G. Kilgour; PLANS FOR INFORMATION TRANSFER EXPERIMENTS AT M.I.T., C. F. J. Overhage; ON-LINE INFORMATION NETWORKS, J. C. R. Licklider.

SESSION 11 . . . . . 9:00 A.M. BABBAGE ROOM

CURRENT DEVELOPMENTS IN PERIPHERAL HARDWARE

A NEW LOOK IN PERIPHERAL EQUIPMENT DESIGN APPROACH, E. Masterson; A SERIAL READER PUNCH WITH NOVEL CONCEPTS, D. W. Bernard, R. F. Borelli, F. A. Digilio and F. V. Thiemann; THE IBM 2560 MULTI-FUNCTION CARD MACHINE, C. E. Spurrier; A NEW DEVELOPMENT IN THE TRANSMISSION, STORAGE AND CONVERSION OF DIGITAL DATA, R. P. Burr, J. J. Rheinhold and R. K. Andres; IBM 2321 DATA CELL DRIVE, A. F. Shugart and Y. Tang.

SESSION 12 . . . . . 9:00 A.M. GRAND BALLROOM

ANALOG/HYBRID TECHNIQUES

HYBRID SIMULATION OF A HELICOPTER, W. J. Kenneally, E. E. L. Mitchell, I. Hay and G. Bolton; A TIME-SHARED HYBRID SIMULATION FACILITY, R. Belluardo, R. Gocht, and G. Paquette; HYBRID SIMULATION OF A FREE PISTON ENGINE, R. E. Gagne and E. J. Wright; HYBRID ANALOG/DIGITAL TECHNIQUES FOR SIGNAL PROCESSING APPLICATIONS, T. G. Hagan and R. Treiber; HYBRID SIMULATION OF A REACTING DISTILLATION COLUMN, R. Ruszky and E. E. L. Mitchell; TRANSIENT NEUTRON FLUX DISTRIBUTION STUDIES BY COMPRESSED AND REAL-TIME COMPUTER COMPLEXES, J. E. Godts and A. S. Weinstein.

SESSION 13 . . . . . 1:00 P.M. AUDITORIUM

PANEL DISCUSSION: RESOURCE ALLOCATION

PANELISTS: C. R. Blair, E. L. Glaser, T. Kallner, V. A. Vyssotsky, S. MacD. Warshall.

SESSION 14 . . . . . 1:00 P.M. BABBAGE ROOM

COMPUTER TECHNIQUES IN PATTERN RECOGNITION

PATTERN RECOGNITION STUDIES IN THE BIOMEDICAL SCIENCES, R. S. Ledley, J. Jacobsen, M. Belson, J. Wilson, L. Rotolo, and T. Golab; A CHESS MATING COMBINATIONS PROGRAM, G. W. Baylor and H. A. Simon; MULTIDIMENSIONAL CORRELATION LATTICES AS AN AID TO THREE-DIMENSIONAL PATTERN RECONSTRUCTION, S. J. Penny and J. H. Burkhard; A PATTERN RECOGNITION TECHNIQUE, AND ITS APPLICATION TO HIGH RESOLUTION IMAGERY, R. D. Joseph and S. S. Viglione; THE DEVIL'S ADVOCATE, M. L. Minsky.

SESSION 15 . . . . . 3:30 P.M. AUDITORIUM

PANEL DISCUSSION: DEVELOPMENT OF A "CHECKLESS-NO MONEY" ECONOMY

PANELISTS: Neal Dean, John McCleary, Richard Bez, Robert Whitby.

SESSION 16 . . . . . 3:30 P.M. BABBAGE ROOM

PANEL DISCUSSION: HYBRID COMPUTATION

PANELISTS: R. Belluardo, D. C. Augustin, G. Paquette, R. Gocht, M. F. Fineberg, J. J. Clancy, C. F. Hansen, and W. H. Pierce.

SJCC EXHIBITS

Approximately 85 exhibitors will occupy 150,000 sq. ft. of space on two floors in the War Memorial Auditorium. Exhibit hours are Tuesday, 11 A.M. to 5 P.M.; Wednesday, 10 A.M. to 8 P.M.; and Thursday, 10 A.M. to 5 P.M.

Below are brief descriptions of some of the equipment that will be on display.

ADAGE, INC., BOSTON, MASS.

Will demonstrate a hybrid computer, called Ambilog 200, which performs signal processing on either of two "fresh" inputs — the human voice or the human heartbeat sound. Operator will demonstrate full control of all computer operations by light pen and CRT communications. These processing operations will include power-spectrum-density analysis, auto-correlation, and cross-correlation. Also on display will be a computer linkage system and an A/D converter with 800 nanosecond conversion time.

AMPEX CORP., REDWOOD CITY, CAL.

Memory products and magnetic tape equipment.

ANELEX CORP., BOSTON, MASS.

Will demonstrate their new 4000 printer that produces up to 150 columns at 300 lines per minute. Also on display will be a disk file storage that has a total capacity of 60 million bits with a positioning time of 100 milliseconds. The exhibit will also show a high-speed print station and Franklin Electronics' digital printers.

APPLIED DYNAMICS, INC., ANN ARBOR, MICH.

Analog and hybrid computing equipment.

AUTO-TROL CORP., ARVADA, COLO.

Will demonstrate a "machine tool director" designed specifically for use with existing machine tools and positioning tables of various types. Input data can be from punch cards, paper tape, or magnetic tape; or the unit can be operated manually from switches on the front panel. This all-digital device will be on display attached to a coordinatograph for automatic drawing and scribing.

BELL SYSTEM, NEW YORK, N.Y.

Touch-tone telephone (12-button card dialer) and a tele-typewriter which operates at 150 words per minute with expanded ASCII code.

BECKMAN INSTRUMENTS, INC., FULLERTON, CAL.

General-purpose digital and hybrid computers.

BENSON-LEHNER CORP., VAN NUYS, CAL.

Will demonstrate their off-line CRT microfilm printer/plotter and magnetic tape plotting systems.

CALIFORNIA COMPUTER PRODUCTS, ANAHEIM, CAL.

Will display a new CRT microfilm plotting system in which input commands from a computer are used to produce discrete incremental steps relative to the X and Y axes. A number of other types of plotting equipment will also be on display.

COMPUTER ACCESSORIES CORP., SANTA BARBARA, CAL.

A magnetic card memory that provides an on-line random access storage capacity of 100 million bits will be demonstrated. The unit uses flexible magnetic cards contained in interchangeable cartridges as the storage medium.

COMPUTER CONTROL CO., FRAMINGHAM, MASS.

Exhibit will demonstrate wide product line including three general-purpose computers (DDP-124, DDP-116, and the DDP-224), new integrated circuit core memory, complete line of IC digital modules, new memory exerciser, and other digital products.

COMPUTRON, INC., WALTHAM, MASS.

Magnetic tape certification equipment and tape cleaning systems.

CONTROL DATA CORP., MINNEAPOLIS, MINN.

Exhibit will feature a computerized information system employing a visual display system with six entry/display stations. Four remote calculators will be linked to a computer in Los Angeles and one remote station will be linked to a computer in Minneapolis.

DARTEX, INC., SANTA ANA, CAL.

Will demonstrate digital magnetic tape data systems that serve as buffered links between high-speed computers and data source devices. Exhibit will also feature data logging incremental recorders, remote data collectors, and other magnetic tape equipment.

DATA PRODUCTS CORP., CULVER CITY, CAL.

High-speed page printers and disc file storage systems.

DATA MACHINES, INC., NEWPORT BEACH, CAL.

Will demonstrate their new Data/620 system computer designed for integrated information, processing, and control systems.

DECISION CONTROL, INC., NEWPORT BEACH, CAL.

Will introduce a complete new line of integrated circuit logic modules. Includes twenty types that operate to 5 mc with noise rejections of over 1 volt.

DI/AN CONTROLS, BOSTON, MASS.

Will introduce a new computer keyboard that is a self-contained system especially designed for automatic typesetting operations. Other equipment on display includes a high-speed printer, a field-programmable magnetic timer, core-transistor logic modules, and a two-microsecond memory.

DIGITAL ELECTRONIC MACHINES, INC., KANSAS CITY, MO.

A card reader unit that reads 80 to 51 column tab cards and converts their content to any desired 5 to 8 level output codes. Will also display a card-to-tape converter and a data collection unit.

DIGITAL EQUIPMENT CORP., MAYNARD, MASS.

New DEC system that will be introduced at the exhibit will either be a CRT display system built around a PDP-8 computer or a LINC-8 laboratory computer system. Standard products such as "Flip-chip" digital modules will also be dispayed. Handbooks on this module line will be given out.

DIGITRONICS CORP., ALBERTSON, N.Y.

Complete line of perforated tape reading and handling equipment.

ELCO CORP., WILLOW GROVE, PA.

Line of electrical connectors including microcircuit connecting components and systems.

ELECTRONIC ASSOCIATES, WEST LONG BRANCH, N.J.

Scientific digital computers and hybrid computing systems.

ELECTRONIC MEMORIES, INC., HAWTHORNE, CAL.

Large scale memory system operating at a cycle time of only 650 nanoseconds will be demonstrated. It has a capacity of 16,384 words of up to 84 bits and an access time of 300 nanoseconds.

FABRI-TEK, INC., AMERY, WISC.

Magnetic core memory systems.

FAIRCHILD SEMICONDUCTOR, MOUNTAIN VIEW, CAL.

Ferrite core stacks which use printed circuit planes and soldered connections of both the single mat and four-mat configurations. Also on display will be a mechanical model of a microcircuit memory. And — perhaps — a portion, or the whole, of a new 2½D memory system.

FERROXCUBE CORP. OF AMERICA, SAUGERTIES, N.Y.

Exhibit will feature magnetic recording head assemblies, memory cores, planes and stacks, and memory systems. A new glass-bonded ferrite recording head will be on display. Also a new line of low-cost 10-microsecond memory systems will be introduced.

GENERAL ELECTRIC COMPUTER DEPT., PHOENIX, ARIZ.

General-purpose computing systems.

GENERAL PRECISION/LIBRASCOPE, GLENDALE, CAL.

Memory drums and disc file storage systems.

HEWLETT-PACKARD, DATAMEC DIV., MOUNTAIN VIEW, CAL.

Magnetic tape transports and tape handling equipment.

HONEYWELL EDP DIV., WELLESLEY HILLS, MASS.

Will demonstrate on-line information processing from multiple display terminals to Honeywell 200 computers located at the company's plants in the greater Boston area. File updating, data readout, and a graphic "clue game" puzzle will be included in the demonstrations.

INDIANA GENERAL CORP., VALPARAISO, IND.

Memory cores, planes, and stacks.

IBM CORP., WHITE PLAINS, N.Y.

General-purpose computing systems.

ITT INDUSTRIAL PRODUCTS DIV., SAN FERNANDO, CAL.

Color display computer oscilloscopes and a character generator unit will be displayed.

KENNEDY CO., PASADENA, CAL.

Magnetic tape incremental recording equipment.

LOCKHEED ELECTRONICS CO., LOS ANGELES, CAL.

Will introduce two new magnetic core memory systems — a 2½D system and an integrated circuit system. The 2½D memory has a read-write cycle of 750 nanoseconds and an access time of 300 nanoseconds. The IC memory weighs less than 6 pounds; requires only 20 watts of power.

MAGNE-HEAD DIV. OF GENERAL INST., HAWTHORNE, CAL.

Will display memory drums, memory discs, and digital magnetic tape heads. A feature of the exhibit will be a complete line of economical commercial-grade disc storage units with prices ranging from $2500 for a 1 million-bit capacity to $9000 for 8 million-bit capacity.

MIDWESTERN INSTRUMENTS, TULSA, OKLA.

Will exhibit digital magnetic tape transports that provide a full range of compatibility with third generation computers.

MONROE DATALOG DIV., LITTON INDUSTRIES, SAN FRANCISCO, CAL.

Various models of digital printers.

NATIONAL CASH REGISTER, DAYTON, OHIO

Complete line of input/output and peripheral equipment.

NORTH ATLANTIC INDUSTRIES, PLAINVIEW, L.I., N.Y.

Thumbwheel switch assemblies and A/D conversion interfaces for computer systems.

OHR-TRONICS, INC., NEW YORK, N.Y.

Will exhibit tape readers, tape punches, encoding keyboards, tape duplication systems, edge-punched card readers, punched ticket readers, and ticket print punch machines.

POTTER INSTRUMENT CO., PLAINVIEW, L.I., N.Y.

Exhibit will feature their new chain printer, an offline print station, and a dual-cartridge random access magnetic tape memory system.

RAYTHEON COMPUTER, SANTA ANA, CAL.

General-purpose computers, logic modules and A/D converters/multiplexers.

RCA — EC & D DIV., HARRISON, N.J.

Ferrite memory cores, planes, and stacks.

REEVES INSTRUMENT CO., GARDEN CITY, N.Y.

Large-scale hybrid computing system.

SCIENTIFIC DATA SYSTEMS, SANTA MONICA, CAL.

General-purpose computers, logic modules, and other digital components and systems.

SOROBAN ENGINEERING, INC., MELBOURNE, FLA.

Complete line of input/output and peripheral devices and equipment.

TALLY CORP., SEATTLE, WASH.

Complete line of paper tape readers, punches, and handling equipment. Also will display new data communications systems.

TELETYPE CORP., SKOKIE, ILL.

Will feature page printer linked to a computer to demonstrate on-line real-time data processing. Also a high-speed tape-to-tape system designed for use with other Teletype equipment or for communications with various computer and business machines.

TEXAS INSTRUMENTS, IND. PROD. GROUP., HOUSTON, TEX.

Will display data acquisition instruments, pulse generators, digital tape transports, and a high-speed digital computer which was optimized for seismic data processing.

TRANSISTOR ELECTRONICS CORP., MINNEAPOLIS, MINN.

Information display panels, indicators, readouts, and switches.

VERMONT RESEARCH CORP., N. SPRINGFIELD, VT.

Drum memory system that is capable of storing 256,000 24-bit words with an average access time of 8.6 milliseconds and a bit transfer rate of 1.5 megacycles.

How can Potter offer a chain printer priced so low?

This new Potter printer provides the combined benefits of high reliability and lowest cost of any line printer now available. Potter made it all possible by taking a completely fresh approach to printer design and construction . . . producing a 600-line-per-minute unit with only a fraction of the parts used in a conventional drum printer.

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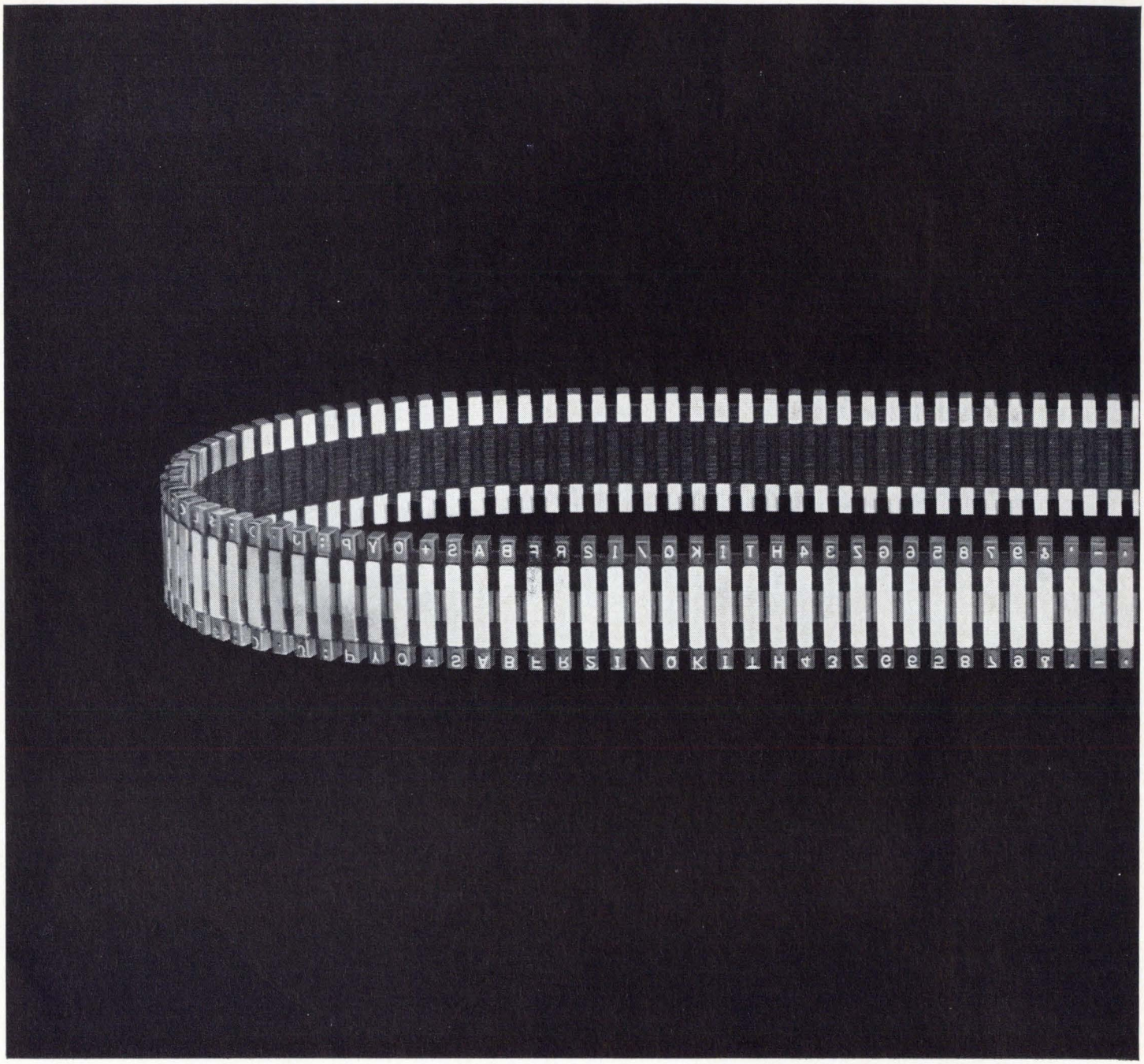

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Multi-Million-Bit 2½D

Unique driving and sensing circuits combined with a simplified core stack result in a large-scale memory system that offers 4-wire versatility with 2-wire cost.

The new Series MT Mass Memory system developed by Fabri-Tek uses a two-wire large-plane stack design and a novel sensing circuit to reduce "per bit" cost of a large system to a practical level. The typical four-wire core stack, which is the major cost factor for large 3D coincident-current core memories, has been replaced in this new system with a 2-wire, 2½-D stack. Normally, the lower-cost two-wire stack usually means slower, word-organized 2D selection and increased cost for additional address selection circuits. However, the 2½D selection retains the speed and most of the circuit economy of coincident-current systems.

Cost-Conscious Design

Core Costs

Core costs were kept down by using high-production low-cost 30-mil cores and relaxing core requirements as follows:

- Improving current margins by eliminating the inhibit function
- Relaxing delta noise requirements with new sensing system
- Allowing wider limits for peaking and switching times.

Plane Costs

Core plane costs were kept down by using larger planes which reduce stringing, terminating, testing, and rework cost on a per-bit basis as follows:

- Stringing only two wires through each core reduces cost over 50 percent from four-wire stacks of same size, since the first wires are the easiest to string
- Larger planes reduce the number of terminations; fewer terminations mean reduced cost and increased reliability
- Larger planes take only slightly more testing time, resulting in lower test cost per bit
- Larger planes would tend to indicate more rework, but the simpler stringing and relaxed core requirements actually reduced rework cost-per-bit.

Circuit Costs

Sensing circuit uses Y drive lines as sense lines and permits each sense amplifier to serve 262,144 bits. Complete system requires only 80 sense amplifiers.

Organization and Operation

A system containing 262,144 words of 80 bits represents the maximum module size. Actual arrangement consists of 64 separate planes in four substacks of 16 planes each. Each plane contains 327,680 cores arranged 256 x 1280. Substacks measure approximately 3 by 10 by 47 inches. There are 4096 X lines and 5120 Y lines, with Y lines arranged in 80 groups of 64 lines each. The complete stack operates as a single massive two-dimensional array totalling 20,971,520 bits. A block diagram of a complete MT system is shown in Fig. 1.

A read-restore cycle consists of the following:

- One Y line in each of the 80 groups is selected by the address register under control of the six low-order address bits
- A half-current enabling pulse is

R. J. Petschauer, Dir. of Engrg., G. A. Anderson, Mgr. of Memory Systems Group, and W. J. Neuman, Supervisory Engr., Fabri-Tek, Inc., Amery, Wisc.

Memory

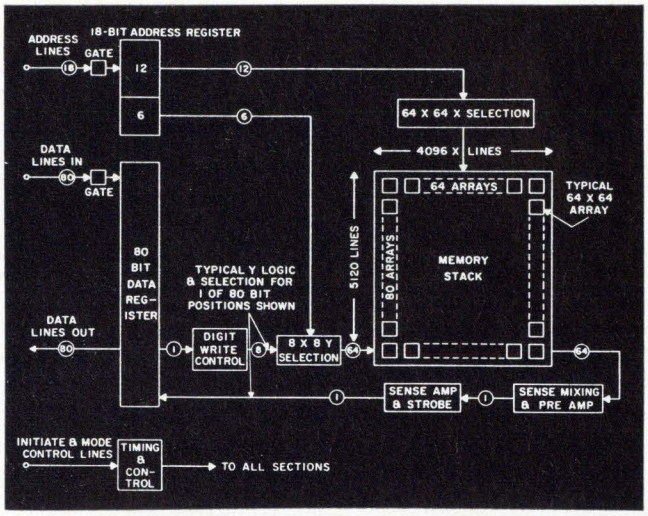


Fig. 1 Block diagram of Fabri-Tek's 2½D mass memory.

generated on the selected lines

- Noise on the Y lines is allowed to decay, since these lines are also used for sensing
- One of the 4096 X lines is selected by the 12 uppermost bits of the address
- The selected X line is pulsed with a half current to read out 80 cores, one in each of the 80 Y line groups
- The outputs are amplified, strobed, and transferred in parallel to the data register.

Restoration is accomplished by applying reverse half-current pulses on the selected X lines and on those Y lines where a "one" is to be written.

Figs. 2, 3, and 4 describe, respectively, the Y driving and sensing method, the X drive selection, and the Y selection matrix.

Sense Amplifiers

Fig. 5 is a schematic of a complete sense amplifier. Only 80 such amplifiers are required for all 5120 Y lines. Each of the 80 main sense amplifiers has available to it the output of any of eight preamplifiers, selected by the address register. Each of the preamplifiers is connected to eight Y lines by four transformers with series-connected secondaries.

Because only one preamplifier is selected at a time, each main amplifier "sees" no more than eight sense lines at a time. One of the eight sense lines carries the output from the selected core. The other seven each have half-current noise from only one core. Thus, the main sense amplifier receives the output from the selected core and the noise from only seven other cores. In contrast,

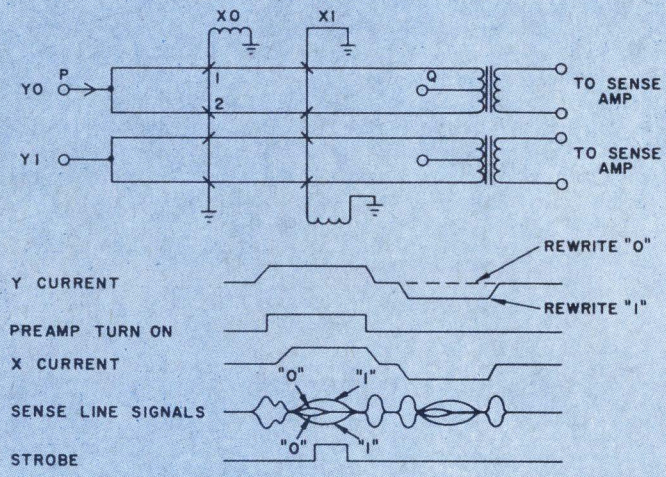


Fig. 2 Selection of an individual core operates as follows. The Y current from point P to point Q divides, linking two rows of cores. The X current from the X drive transformer to ground aids the Y current in core 1 and bucks the current in core 2. Core 1 will switch if it previously was storing a ONE. Core 2 is unaffected because the net current through it is zero. Other cores linked by the X or Y lines are not switched because they receive only half-current pulses. If it is desired to select core 2, the Y current is reversed, since Y current polarity is part of the selection scheme. The return path for the Y current from the two lines is from opposite ends to the center tap of a transformer winding. The initiation of the Y current would cause no net output on the transformer secondary if it were not for manufacturing tolerances on the transformer and impedance unbalance between the two Y lines. Noise resulting from these unbalances is allowed to decay by delaying the initiation of the X current pulse about a half to one microsecond. When the X current pulse is initiated, the selected cores receive full current and are read out. The switching of a selected core induces a differential voltage across the transformer primary, which appears in the secondary and is transmitted to the sense amplifier. The signal is strobed at the time of optimum signal-to-noise ratio.

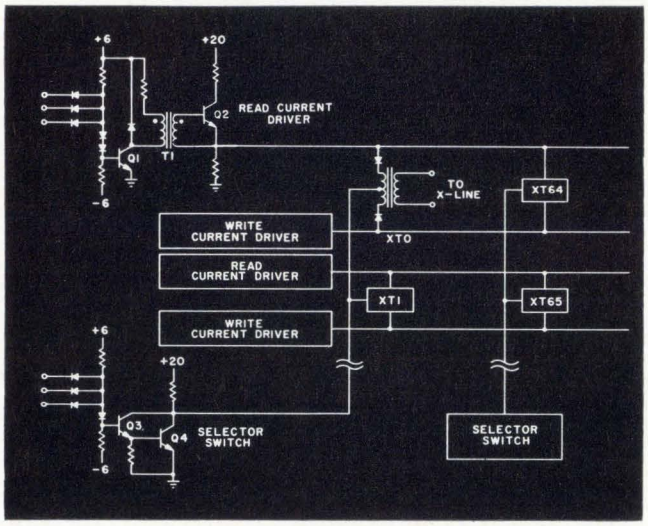


Fig. 3 The X drive line selection consists of the following. The X lines are selected by a 64 x 64 transformer-diode matrix. At the start of the cycle, a selector switch controlled by the upper six bits of the address grounds the center taps of 64 transformers. The next six bits of the address and a suitable timing pulse turn on a read current driver and selector switch, and a positive pulse is generated in the selected X line. After the read pulse is completed, the same six bits of the address turn on the write current driver, generating a negative current pulse in the selected X line. The first stage of the current driver performs the NAND function. Its output is transformer coupled to Q2, which amplifies the current. The backswing of transformer T1 is adjusted so the base of Q2 is driven with sufficient reverse current to obtain a fast turn-off at the termination of the input pulse. The selector switch is functionally a high-gain logic NAND circuit. The collector of Q4 must be able to handle the current generated by a current driver as well as the current in the pull-up resistor and current from shunt capacitance.

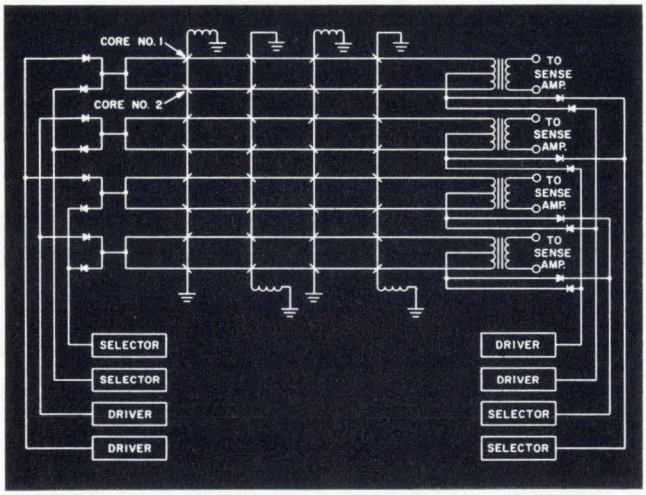


Fig. 4 The Y drive line selection is similar to that for the X lines except that the Y current drivers and the selector switches must handle twice the current, since they provide current for two lines. The Y selection matrix requires four diodes for each pair of lines because current must be driven in both directions. For the purpose of illustration, a 2 x 2 matrix is shown, but the same scheme is used for the 8 x 4 matrix of the actual system.

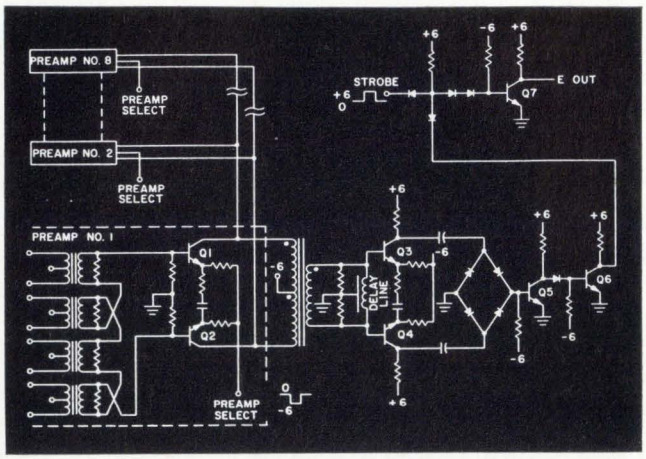
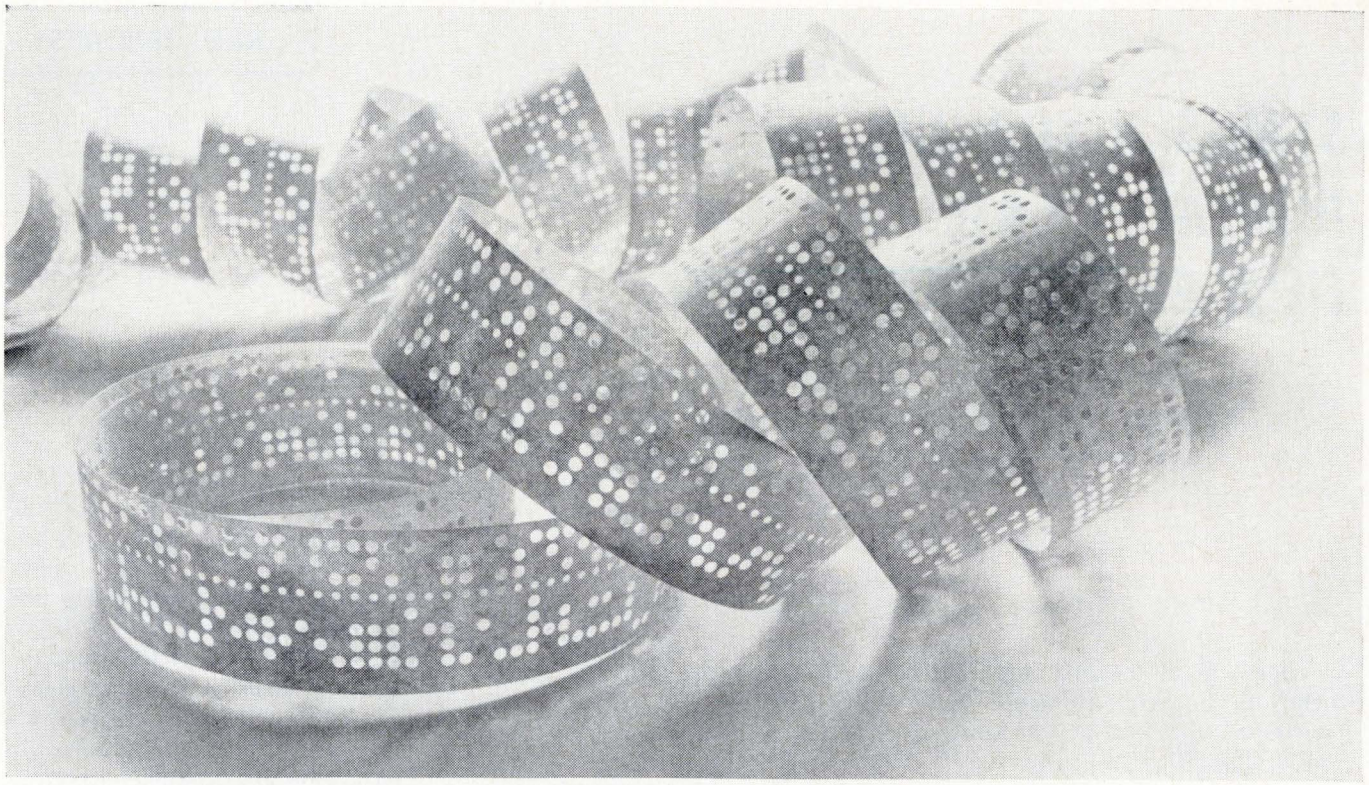


Fig. 5 Sense amplifier used in new memory system.

a typical four-wire coincident-current memory system of 4096 words has 126 cores which contribute half-current noise at read time.

The amplified signal from the preamplifier is transformer coupled to the main sense amplifier. Noise resulting from Y current generation or an unbalance in the preamplifier collector currents can cause a voltage level shift in the main sense amplifier. Such a level shift changes the threshold of the main amplifier, and it is desirable that the amplifier return to the quiescent level before the core signal is applied. This is accomplished by the delay line across the input to the main amplifier. A step voltage, such as might be caused by unequal currents in the two driven Y lines, appears at the input only during the down-and-back time of the delay line. No further voltage due to the unbalance appears across the delay line until the step voltage is removed. Thus, a signal superimposed on a dc level appears at the input as being referenced to ground and the threshold of the amplifier is not changed during strobe time.

The down-and-back time of the delay line is made long enough so the major portion of the signal is passed through the amplifier. The signal is rectified, amplified, inverted, and ultimately ANDed with the strobe pulse. The resulting output is used to set the data register flip-flop.



Clark Equipment Company gets data from 127 sales offices, 4 manufacturing plants, and a major warehouse as soon as it's recorded

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CIRCLE NO. 35 ON INQUIRY CARD

STABLE N-CHANNEL INSULATED GATE FIELD-EFFECT TRANSISTORS

New Development Seen as the Most Important Microelectronic Advance in the Last Five Years.

Development of the first n-channel metal nitride semiconductor insulated-gate field-effect transistors (MNS/IGFET) fabricated via a new silicon planar technology was reported at the IEEE's International Solid State Circuits Conference by scientists from the Sperry Rand Research Center, Sudbury, Mass. The development, which promises to cure the electrical instability of present n-channel IGFETs, was based on the substitution of silicon nitride for silicon oxide as a more effective insulating material in the devices.

P-channel, enhancement mode MNS/IGFETs built and tested at the Sperry Rand Research Center have demonstrated marked improvements in electrical stability, lower threshold voltage and greater voltage-handling capability over the newest metal oxide semiconductor (MOS) devices. Now under early tests, experimental n-channel enhancement mode devices using silicon nitride are expected to perform as well. Sperry is using the silicon nitride in these devices as a mask against diffusion, as a passivation layer over p-n and n-p junctions, and as an insulating dielectric.

Until the Research Center's recent development of a deposition process that made practical the switch from oxide to nitride, the microelectronics industry was largely stymied in its pursuit of electrically-stable IGFETs and microcircuits of the new and promising MOS-type. Use of this type of device in such applications as computer logic and memory array circuits is expected to effect a sharp cut in equipment size and cost. Engineers at the Sperry Semiconductor Division, Norwalk, Conn., said that up to ten times the number of MOS-type components can be packed on the same chip with no increase in the size of the circuit package or the number of electrical connections.

Sperry Rand researchers, led by Drs. Nigel C. Tombs, H. A. Richard Wegener, and Roger Newman, manager of solid state sciences, last month reported solution of the stability problem in the p-channel enhancement mode. Company officials said that the development could be the most important advance in the industry in the last five years. Sperry Semiconductor Division expects to have silicon nitride devices in its product line this year.

Complementary Pairs

The achievement of stable n-channel devices will open the way to production of complementary pairs of both p- and n-channel units on the same chip substrate, Dr. Wegener said. The enhancement mode of operation is especially attractive, he added, because the device is normally off until turned on by the application of a voltage to the gate. Its opposite number, a depletion mode device, is easier to construct, but is normally on, and draining full power until shut off by a bias voltage from a separate power supply. While p-channel IGFETs had been difficult to fabricate, the physicist explained, n-channel devices were a virtual impossibility. This was due to the inability of the oxide insulation to keep contaminants from moving toward the silicon. Nitride, on the other hand, has proved an effective barrier.

In their first tests, Sperry's n-channel MNS/IGFETs have shown source-to-drain leakage currents to be orders of magnitude less than the same currents in n-channel MOS devices. Dr. Wegener has observed leakage currents of less than one-tenth nanoampere across MNS/IGFETs in the "OFF" mode, an exceptionally low level which provides a well-defined threshold voltage.

Sperry has just begun temperature-bias stability tests on its n-channel enhancement mode MNS/IGFETs, and definitive results are not yet available. Dr. Wegener said, however, that they expect the n-channel devices to perform as well as p-channel MNS units under test. In this test both MOS and MNS devices intentionally contaminated with sodium ions were stored at 150 degrees C with +30 volts applied to their gates. Results showed that the operating point of the gates of the MOS devices had shifted by about 20 volts; the MNS characteristics by less than one volt.

The company will extend the use of silicon nitride to integrated circuits, diodes, and double-diffused transistors. The latter are expected to double their present voltage-handling capability. The new technology also may be applied to such materials as germanium, gallium arsenide, and indium arsenide, in addition to silicon. END

An Automatic Ferrite Core Tester

The ferrite core industry is an old and mature one and automatic core testing is very sophisticated; for example, cores can be production-tested currently at the rate of up to 1000 per minute. However, up to the present, automatic core testing is range testing. This means that certain limits are pre-established for the core output values and cores are tested to fall within these limits. Very little, if any, of the automatic testing is done to give *actual* core outputs. Testing to give actual core outputs seems to be laborious and time consuming for more than a few cores. Therefore, a core test setup that automatically measures the actual core output has been designed at Fairchild Semiconductor's memory products department. This core test setup is described in this article.

The basic parts of the test setup are:

- A programmed manual core tester
- A programmed sampling core
- A digital printer
- An X-Y recorder
- Calibration and reference standards equipment.

Typical core outputs that will be measured are:

- uV1 — undisturbed ONE output
- dV1 — read disturbed ONE output
- dVz — write disturbed ZERO output
- t_s — switching time of ONE output
- t_p — peaking time of ONE output.[1]

The purpose of this core test setup is three-fold. The actual core outputs are used for AQL testing, the generation of tag samples for correlation with customers, and statistical trend analysis. All of these test procedures, described in detail in Table 1, require that the individual core outputs be measured and recorded. In some cases, the actual cores are associated with their data outputs. Since the test results are printed out

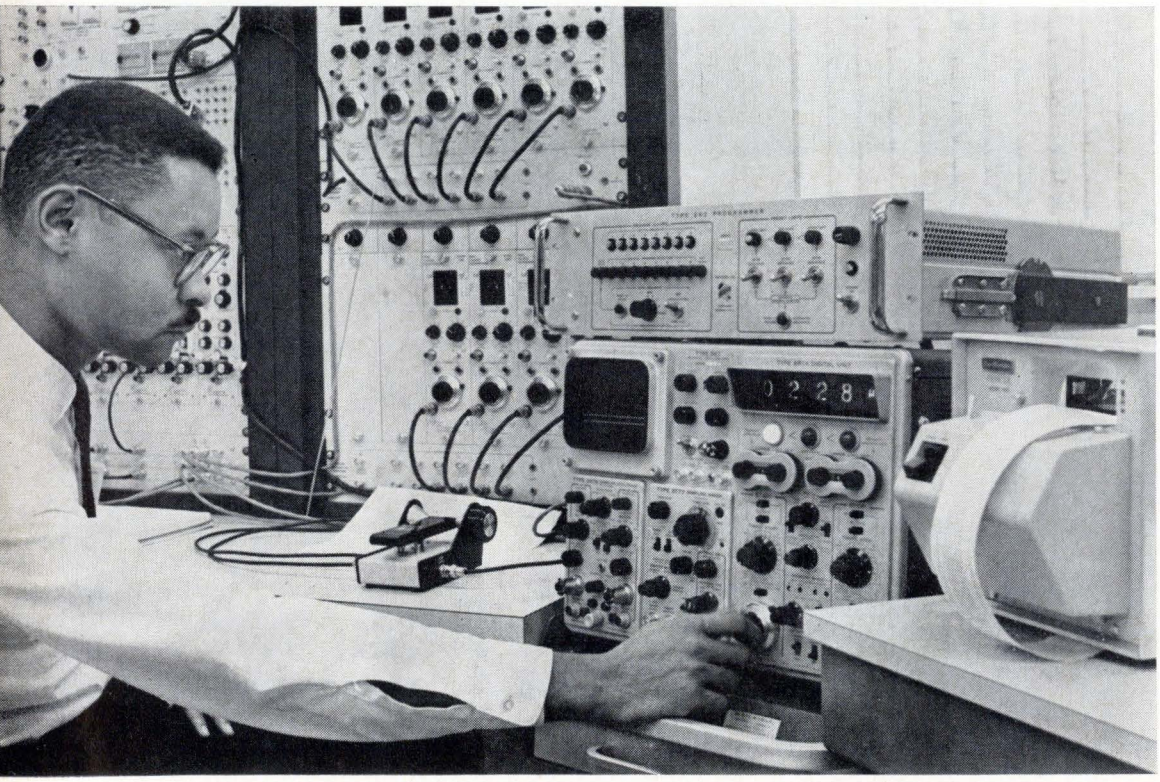

Fig. 1 Author Frank Greene operates the new automatic core test setup.

FRANK S. GREENE, JR., Senior Engineer,
Fairchild/Memory Products,
Mt. View, Cal.

In contrast to conventional range testing, this new core test setup automatically measures the actual core outputs for a more thorough analysis of core quality.

on paper tape, they are immediately available to an operator for interpretation. Also, this data is used to plot core output distributions or it is sent to customers in the case of tag samples. Cores are serialized such that they can be tagged with their individual results. The accuracy of the automatic test setup is within 1% of that obtained using standard calibrators for the same core measurements. A photograph and a block diagram of the core test setup are shown in Figs. 1 and 2 respectively.

Operation of the New Tester

The measuring technique with the new tester is as follows. If the cores are to be serialized, a prepunched adhesive tape is first placed on a manual core jig sticky side up. A core is then placed above the tape, the jig is closed and the measurements are automatically made. If the cores are not to be serialized, a manual core jig or an AQL handler is used. The core is pulsed using a program generated by the programmed pulse generator. A typical pulse program is shown in Fig. 3.

The numbers below the pulses in Fig. 3 indicate the program step at which the pulse occurs. If for example, a dV1 core output is to be measured, the scope is synchronized on program step 7. The sampling scope now measures the average of ten sweeps of the core output before a print-out is made. After a print-out the programmer sequences to the next program card, that could be, for example, a switching time measurement. If this is the switching time of a uV1 core output, the scope sync is changed to program step 2. Fig. 4 shows the relationship

TABLE 1

TEST PROCEDURES WITH ACTUAL CORE OUTPUTS

AQL TESTING

Although cores are 100% tested with an automatic core tester, AQL testing is still necessary to guarantee certain quality levels. Usually AQL testing is a manual process where each core is individually checked on a scope by a technician. This introduces an element of human error. With the automatic core test setup, the measurements are all made by a sampling scope with a much more repeatable error characteristic. One industry standard now is 0.015 AQL as defined by MIL-STD-105D, Inspection Level II. The table below gives sample sizes and acceptance levels for an 0.015 AQL:

Lot Size	Sample Size	No. of Rejects
10,000-35,000	315	0
35,000-150,000	500	0
150,000-500,000	800	0
over 500,000	1200	1

A 250,000 core lot indicates a sample size of 800 cores with no rejects allowed to pass the 0.015 AQL level. Typical core measurements are uVI, dVI, dVz, t_s, and t_p. In a typical AQL test procedure N samples are randomly selected from a shipment lot. The number N is obtained from the above table; for instance, for a 250,000 core lot, N would be 800 cores. Eight-hundred cores are then tested with an AQL test setup. AQL test data is generated in one of two ways.

1. The cores are loaded one at a time on a manual core jig, the actual core outputs printed out and each core serialized. This can be very time consuming and costly, because of the labor involved in handling the cores.
2. Alternately, an AQL core handler is used to select the cores. An AQL handler is a modified high-speed automatic core handler that selects cores singly under operator control. It contains both accept and reject bottles for the tested cores. Since the individual core outputs are available, the rejected cores can be removed from the reject bottle and tagged with their data. This AQL test technique is faster because the amount of manual core handling is greatly reduced.

TAG SAMPLES

The purpose of tag samples is to establish and maintain tester correlation with customers. It is vitally important that agreement be maintained on the level of quality of cores being received by customers. Tag samples are routinely furnished with each core shipment. A typical tag sample contains 10 cores with their associated data. Although tag samples may seem unnecessary once correlation has been established, tag samples are very useful in maintaining correlation and also in giving another check on the shipment of cores that is actually going to a customer.

STATISTICAL TREND ANALYSIS

A continuing problem of statistical analysis is obtaining enough samples to be representative of an entire lot. Not only are numbers of cores important, but accurate measurements have to be made; range testing is not sufficient. With the test setup described here, data on large numbers of cores is conveniently obtained for distribution plots. The data is printed out on paper tape and sent to a computer facility for reduction and distribution plotting. The data obtained during AQL'ing is used to generate the distribution plots. These plots are used both as feedback to core production and to marketing for price adjustments when special orders require only a part of the normal distribution. These distributions measured over a long period, for a particular core type, are a good measure of both the long and short term uniformity of the cores.

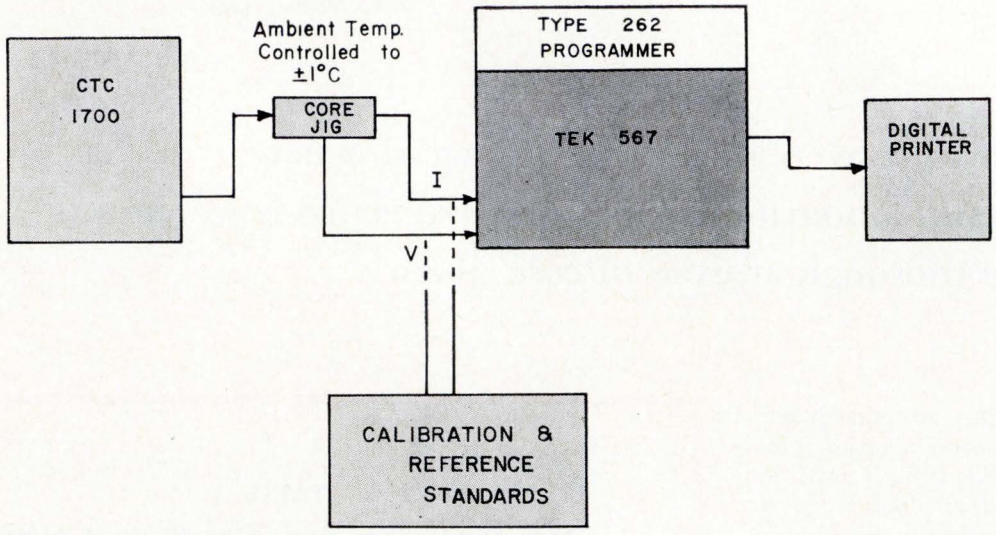

Fig. 2 Block diagram of automatic core tester. The basic parts are a Computer Test Corp. (CTC) Model 1700 programmed pulse generator, a Tektronix 567 oscilloscope with a Type 262 Programmer, a digital printer, and calibration and reference standard equipment that typically consists of a Computer Test Corp. Model 1085 Calibrator, a time mark generator, and a signal generator.

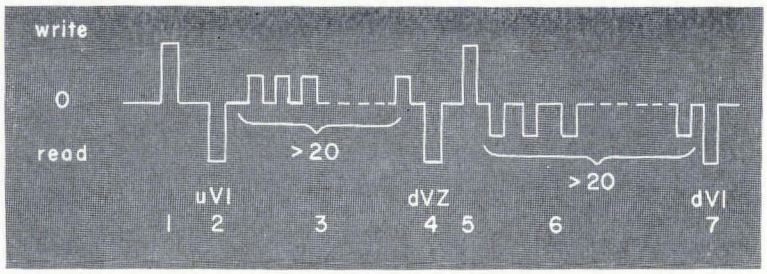

Fig. 3 Core test pulse pattern.

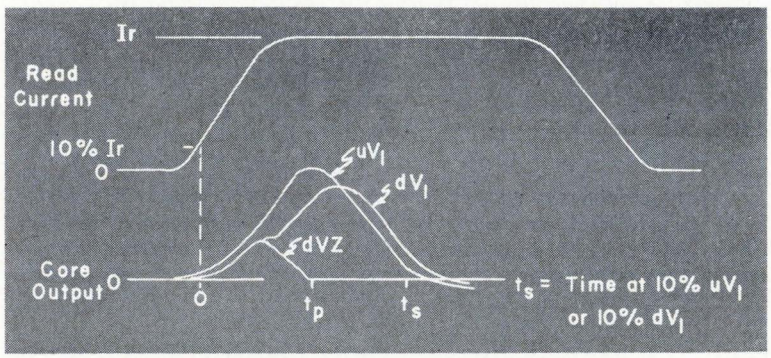

Fig. 4 Read current and core output.

of the core output to the read current pulse. As many as eight different preprogrammed measurements are available with the type of programmer used in this tester. The test time for seven core measurements including print-out is approximately one minute.

Basic to any core analysis is an accurate description of the test current pulses, especially the read current pulse. The linearity, overshoot and corner deviation must be accurately measured in addition to the amplitude. The Tektronix 567 operated in the manual scan mode is used to generate signals for an X-Y recorder to make 11″ x 16″ plots of the read current. From these plots, measurements of the overshoot, linearity, and corner deviation with a 2% to 3% accuracy can be made. This is impossible to do visually from the face of an oscilloscope. Fig. 5 shows the outputs of the automatic core test setup. They include a tag sample that is serialized, a print-out from the digital printer of the core outputs, and drive current waveforms as obtained from the X-Y recorder with typical measurements illustrated.

Other measurements that are made with the same test setup (more accurately than can be measured visually from the face of an oscilloscope) are the pulse program's rise time, fall time, and duration. This facilitates adjusting the core tester from one test program to another. This setup can also be used for the selection of matched calibrated cores

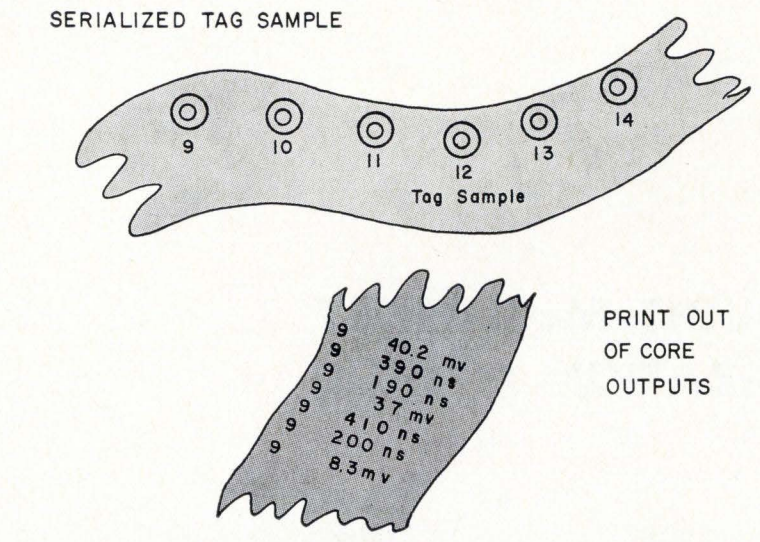

Fig. 5 Outputs of automatic core tester.

that are required in production automatic core testing. This is especially true when multiplexed core handlers are operating with an automatic core tester.

Summary

An automatic core test setup has been described that accurately measures and records the actual core output. The core data obtained is extremely valuable for AQL testing, tag samples, and parameter distributions. Since all of the core outputs are measured with a programmed sampling scope, the element of unpredictable human error is eliminated. **END**

ACKNOWLEDGMENTS

Many people have contributed in one way or another to this project and all cannot possibly be named. However, special thanks are due to Harley Perkins and Mel Phelps of Fairchild Memory Products for their ideas and encouragement. I am also indebted to Kerm Fleck of Tektronix, Inc. for help with equipment problems.

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1. "NONMETALLIC MAGNETIC CORES TO BE USED IN A COINCIDENT CURRENT MEMORY WITH A TWO-TO-TWO SELECTION RATIO OPERATING UNDER FULL SWITCHING CONDITIONS," ASTM designation: C526-63T, 1963.

THE QUINE-McCLUSKEY MINIMIZATION METHOD

EDITOR'S NOTE: **Based on an example that is real, relevant, and sufficiently simple, here is a clear, straightforward explanation of an important logic minimization technique.**

The minimization of Boolean functions of six or more variables is a unique and interesting problem because map methods, which are fast and reliable for problems involving functions of fewer variables, become cumbersome as the number of variables increases. Different and more systematic techniques must be considered for these problems.

The Quine-McCluskey method is an important technique for three reasons: (1) it is completely systematic, that is, all minimal representations of the functions can be found; (2) it is a practical hand method for solving problems involving six or more variables; and (3) it is the basis for many of the computer programs now available for logic minimization.

This article explains Quine's original method and then gives McCluskey's important improvements. Three notations are given (algebraic, binary, decimal) so that the reader can clearly see the similarities between and advantages of the various notations.

Quine's Method

The method developed by Quine is a two step process. First, all prime implicants are found by an exhaustive comparison of algebraic minterms of the function to be simplified. This comparison looks for pairs of minterms that differ in only one variable such as:

$$A\ \overline{B}C\ \overline{D},\ A\ BC\ \overline{D}$$

This pair can be immediately combined to form the term $AC\ \overline{D}$ because $AC\ \overline{D}\ (B+\overline{B}) = AC\ \overline{D}$.

After each minterm has been compared with every other minterm, the process is continued with the new group of terms just formed. Any term combined into a new term is checked off the list indicating that it is not a prime implicant.

When the comparison process is completed, all prime implicants have been formed, and the next step is to select a group of these to form the simplified expression. This selection is accomplished with a prime implicant table as shown below:

PRIME IMPLICANTS	$\overline{A}\,B\,\overline{C}\,\overline{D}$	$\overline{A}\,B\,\overline{C}\,D$	← MINTERMS
*$\overline{A}\,\overline{B}\,\overline{C}$	X	X	
$\overline{A}\,\overline{B}\,D$		X	

An X in the chart indicates that the corresponding minterm is included in the corresponding prime implicant.

After the chart is filled out, all columns are scanned to find those having only a single X. Such a condition means that the minterm is only included in one prime implicant, thus that prime implicant is essential and is so marked with an asterisk. It must be included in the final expression.

Next, all minterms that are included in the essential prime implicants should be indicated by circling *all* X's in their columns.

Any minterm not included in the essential prime implicants must be included in the simplified function by

DONALD E. REA, *Group Engineer*
General Dynamics/Pomona, Pomona, Cal.

As a Group Engineer at General Dynamics, Donald E. Rea is in charge of computer and simulation equipment development. He is responsible for the development of analog, digital, and hybrid data acquisition and computer systems. He also teaches courses in computing and logical design at the Extension Division of the University of Cal., Los Angeles. Mr. Rea graduated from Fresno State College with a B.S. in Physics in 1957 and from the University of California, Berkeley with an M.S. in Engineering Science in 1961.

including one or more non-essential prime implicants along with the essential ones.

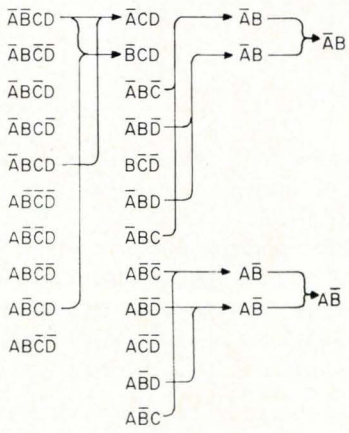
To illustrate Quine's method consider the following problem:

Design a switching network whose inputs are BCD digits in the excess-three code and whose single output is logical 1 if the input is a legitimate excess-three digit.

The standard-sum expression for this function is as follows:

$$F = \overline{A}\,\overline{B}\,C\,D + \overline{A}\,B\,\overline{C}\,\overline{D} + \overline{A}\,B\,\overline{C}\,D + \overline{A}\,B\,C\,\overline{D} + \overline{A}\,B\,C\,D + A\,\overline{B}\,\overline{C}\,\overline{D} + A\,\overline{B}\,\overline{C}\,D + A\,\overline{B}\,C\,\overline{D} + A\,\overline{B}\,C\,D + A\,B\,\overline{C}\,\overline{D}$$

Note that the terms are given high-order-first, that is, A is the 2^3 bit. The first step is to list the above terms in a column and systematically compare and check off combined terms:



Now continue with the new list as shown in the right-hand column of figure above. When the process can be carried no further, the unchecked terms are prime implicants: $\overline{A}$ CD, $\overline{B}$ C D, B $\overline{C}$ $\overline{D}$, A $\overline{C}$ $\overline{D}$, $\overline{A}$ B, A $\overline{B}$.

Now the prime implicant chart can be drawn:

	ĀB̄CD	ĀBC̄D̄	ĀBC̄D	ĀBCD̄	ĀBCD	AB̄C̄D̄	AB̄C̄D	AB̄CD̄	AB̄CD	ABC̄D̄
ĀCD	X				Ⓧ					
B̄CD	X								Ⓧ	
BC̄D̄		Ⓧ								X
AC̄D̄						Ⓧ				X
* ĀB		Ⓧ	Ⓧ	Ⓧ	Ⓧ					
* AB̄						Ⓧ	Ⓧ	Ⓧ	Ⓧ	

Note that $\overline{A}$ B and A $\overline{B}$ are essential, thus we circle all minterm entries included by these two prime implicants.

The only entries not circled by this process are those of the minterms $\overline{A}$ $\overline{B}$ C D and A B $\overline{C}$ $\overline{D}$. These can be included in the simplified expression by including $\overline{A}$ C D or $\overline{B}$ C D and B $\overline{C}$ $\overline{D}$ or A $\overline{C}$ $\overline{D}$.

Thus, four minimal solutions exist, each consisting of the essential prime implicants plus one of the four combinations of the needed non-essential prime implicants. These expressions are:

$$F = \overline{A}\,B + A\,\overline{B} + \overline{A}\,C\,D + B\,\overline{C}\,\overline{D}$$
$$F = \overline{A}\,B + A\,\overline{B} + \overline{A}\,C\,D + A\,\overline{C}\,\overline{D}$$
$$F = \overline{A}\,B + A\,\overline{B} + \overline{B}\,C\,D + B\,\overline{C}\,\overline{D}$$
$$F = \overline{A}\,B + A\,\overline{B} + \overline{B}\,C\,D + A\,\overline{C}\,\overline{D}$$

Except for the possibility of factoring, these four expressions are equally simple.

While this simple problem could easily be solved using map methods, the important point is that Quine's method is completely systematic and, by using it, all

equivalent sum-of-products expressions containing no redundant terms can be found. Also, the method is equally applicable regardless of the complexity of the problem.

McCluskey's Method

McCluskey noted that many of the comparisons made in Quine's method are unnecessary since for some of these comparisons, terms cannot possibly be combined. An example of such a case would be:

$$A\ \overline{B}\ C\ \overline{D},\ \overline{A}\ B\ C\ \overline{D}$$

Since two variables differ, these two minterms cannot combine to eliminate a variable.

In order to eliminate the need for making these needless comparisons, McCluskey introduced a binary notation for minterms as follows:

Form a binary number designator for each minterm replacing complemented literals with a 0 and non-complemented literals with a 1. Every minterm has a unique binary designation.

EXAMPLES: $\overline{A}\ B\ C\ D$ converts to 0111
$A\ \overline{B}\ \overline{C}\ D$ converts to 1001

McCluskey further noted that for a minterm with X numbers of binary 1's in its designator, that minterm need only be compared with minterms having $X \pm 1$ binary 1's in their designators since all other minterms must differ by more than one variable.

Therefore, the first step in McCluskey's method is to convert all minterms into their binary designators and list these in a column in groups according to the number of binary 1's in their designators. The logic behind this step is that when the terms are so ordered, the terms of one group need only be compared with the terms in the groups on either side.

As an example, consider the previous problem. The equivalent expression using binary designators is:

F = 0011 + 0100 + 0101 + 0110 + 0111 + 1000 + 1001 + 1010 + 1011 + 1100

Ordering these terms in accordance with McCluskey's rule yields:

0100
1000
0011
0101
0110
1001
1010
1100
0111
1011

The comparison process is quite easy with the binary designators, as we merely look for pairs of numbers differing by only one bit. When such a pair is found, the numbers involved are checked off as before and the combined term is written with a blank in the differing bit position to indicate that the variable has been eliminated by the combination process.

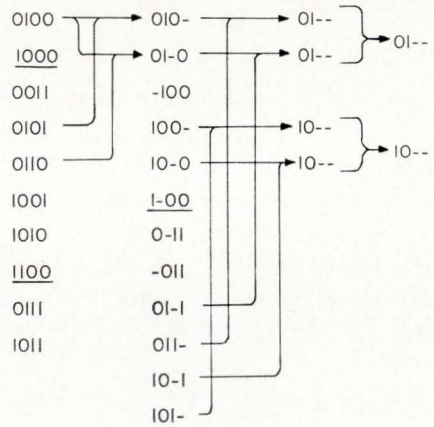
The comparison process starts by comparing the numbers in the first group with those in the second. When this step is completed a line is drawn under the newly formed combined terms, and the numbers in the second group are compared to those in the third, etc.

The same comparison process is applied to the newly formed groups. It is important to note that in order for two numbers having blanks to be combined, the blanks must be in the same bit positions and the numbers must differ in one bit position. For example: 01-1 and -111 cannot be combined while 01-1 and 00-1 can be combined to form the term 0 - - 1.

When the comparison process cannot be carried further, all prime implicants have been formed, and the next step is to build a prime implicant chart. The use of the chart is identical in Quine's and McCluskey's methods.

After the simplified expression has been found, it can be reconverted to algebraic notation.

The same example is fully worked out below using McCluskey's methods:



The prime implicants are then -100, 1-00, 0-11, -011, 01 - -, and 10 - -. The prime implicant table can now be formed:

	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100
-100		(X)								X
1-00						(X)				X
0-11	X				(X)					
-011	X								(X)	
*01--		(X)	(X)	(X)	(X)					
*10--						(X)	(X)	(X)	(X)	

Now the essential prime implicants are identified and all X's of minterms included in essential prime implicants are circled.

The simplified expressions are:

F = 01 - - + 10 - - + 0-11 + -100
F = 01 - - + 10 - - + -011 + -100
F = 01 - - + 10 - - + 0-11 + 1-00
F = 01 - - + 10 - - + -011 + 1-00

which are equivalent to the solutions obtained before.

McCluskey's Method with Decimal Notation

Even further improvement in the methods previously described can be achieved by adopting a decimal notation. In this notation, the decimal number equiva-

lents of the binary designators will be used. Thus the symbology $\overline{A}$ B $\overline{C}$ D, 0101 and 5 are all equivalent representations for the minterm $\overline{A}$ B $\overline{C}$ D. The function of the example problem could be written: F = 3+4+5+6+7+8+9+10+11+12 or, more compactly, F = Σ(3,4,5,6,7,8,9,10,11,12).

The ordering of minterms takes place as before, thus the example problem would be ordered:

4
8
3
5
6
9
10
12
7
11

As an aid in solving problems in decimal notation, the following chart gives all possible 6 variable minterms grouped according to the number of binary 1's in their equivalent binary designators. An extension of this chart (up to 7 variables) is contained in Appendix 2 of Reference 1.

Chart for ordering 6 variable problems.

Number of 1's	Minterms
0	0
1	1, 2, 4, 8, 16, 32
2	3, 5, 6, 9, 10, 12, 17, 18, 20, 24, 33, 34, 36, 40, 48
3	7, 11, 13, 14, 19, 21, 22, 25, 26, 28, 35, 37, 38, 41, 42, 44, 49, 50, 52, 56
4	15, 23, 27, 29, 30, 39, 43, 45, 46, 51, 53, 54, 57, 58, 60
5	31, 47, 55, 59, 61, 62
6	63

The comparison process initially looks for pairs of minterms that differ by an integral power of 2 such as 1, 2, 4, 8, 16, 32, etc. Note that this is exactly equivalent to looking for pairs of binary numbers which differ in only one bit position.

When such a pair of decimal numbers is found they are grouped together, the individual numbers are checked off, and the difference is placed in parentheses after the pair to indicate which variable had been eliminated. Thus the following combining operations are exactly equivalent:

$\frac{\overline{A}B\overline{C}D}{\overline{A}BCD} \rightarrow B\overline{C}D$ **QUINE'S METHOD**

$\frac{0101}{1101} \rightarrow -101$ **McCLUSKEY'S BINARY**

$\frac{5}{13} \rightarrow 5, 13\,(8)$ **McCLUSKEY'S DECIMAL**

While making comparisons in the minterm column, some additional needless comparisons can be eliminated. If a number, X, in one group is being compared to all numbers in the next group, there is no need to compare X with any numbers smaller than X. The reason why no such valid comparison can take place can be seen from the following argument:

Let X be a number in the group having 2 binary ones. All numbers in the next group have 3 binary ones. In comparing X with any number, Y, having 3 binary ones, the additional one in Y constitutes a differing variable. Consequently, in order for a comparison to take place, all other bits in X and Y would have to be identical. If this is the case, then it is clear that Y must be larger than X.

After all possible combinations of minterms have been formed, the process continues by comparing pairs of minterms. Only pairs having the same number(s) in parentheses can be combined, and for two pairs to combine to form a group of 4 minterms, the first numbers of each pair must differ by a power of two.

A further improvement which the decimal notation allows is the elimination of duplicated terms. This can be accomplished by only combining groups which result in an increasing series of numbers. For example, the term 4, 5, 6, 7, (1, 2) would be accepted while the redundant term 4, 6, 5, 7 (2, 1) would be thrown out by the above rule.

When the combining process is completed, all unchecked entries correspond to prime implicants. The next step is to draw the prime implicant chart, identify the essential prime implicants, and finally write down the simplified expression.

This last step requires decoding the decimal notation of prime implicants back to algebraic form. This can best be done by converting first to binary form then to algebraic form. An example will illustrate this process.

To convert the term 5, 13 (8) we note that the (8) means that the variable corresponding to decimal 8 is blank. Thus, if we simply write the term corresponding to either 5 or 13, and then throw out the 8 term we will have the correct term.

Term 5 = 0101 = $\overline{A}$ B $\overline{C}$ D
Term 5, 13 (8) = -101 = B $\overline{C}$ D

To clarify the decimal notation method, the example problem will again be worked out.

F = Σ (3, 4, 5, 6, 7, 8, 9, 10, 11, 12)

4	**4, 5 (1)**	**4, 5, 6, 7 (1, 2)**
8	**4, 6 (2)**	**8, 9, 10, 11 (1, 2)**
3	**4, 12 (8)**	
5	**8, 9 (1)**	
6	**8, 10 (2)**	
9	**8, 12 (4)**	
10	**3, 7 (4)**	
12	**3, 11 (8)**	
7	**5, 7 (2)**	
11	**6, 7 (1)**	
	9, 11 (2)	
	10, 11 (1)	

The prime implicants are 4, 12 (8); 8, 12 (4); 3, 7 (4); 3, 11 (8); 4, 5, 6, 7 (1, 2) and 8, 9, 10, 11, (1, 2). Again the prime implicant chart is formed:

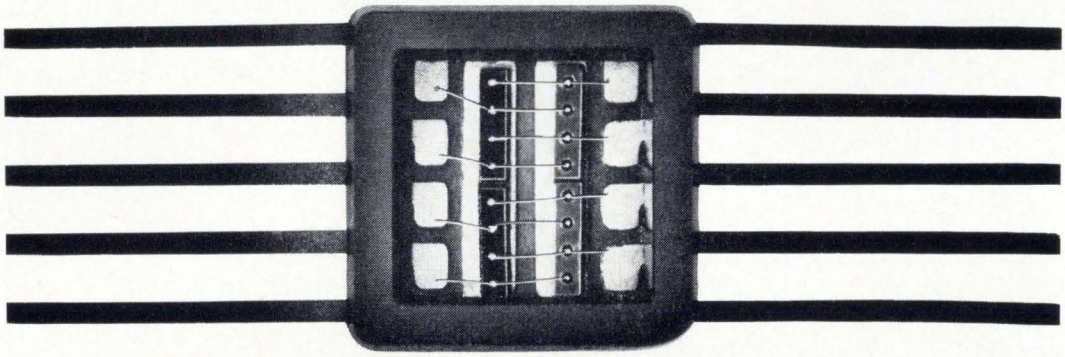
#4104-26

16-DIODE ARRAY

Ultra-fast, silicon Planar epitaxial core driver arrays

Fairchild 16-diode arrays offer performance characteristics unmatched by any other currently available. These arrays consist of 8 common anode and 8 common cathode diodes, interconnected in a single package. Other array configurations may be ordered with any number of diodes from 2 to 16. You can get Fairchild 16-diode arrays in TO-5 cans (FSA1412), ¼"x¼" Flatpaks (FSA2000), or in a configuration using discrete microdiodes. All three are hermetically sealed and offer excellent thermal conductivity, which permits operation to 400mW. Evaluation quantities are now available. Call your Fairchild Distributor or write for detailed specifications.

FAIRCHILD
SEMICONDUCTOR



DC forward current (I_F)	<330mA
Recurrent forward peak (i_f)	<800mA
Reverse current (I_{R1})	<100nA (V_R = −40V)
Reverse current (I_{R2}) (T_A = 150°C)	<100μA (V_R = −40V)
Capacitance (C)	<8.0pf
Reverse recovery time (T_{rr1})	<25nsec. (I_F = I_R = 10 to 200mA)
Reverse recovery time (T_{rr2})	<90nsec. (I_F = 300mA I_R = 60mA)
Operating Temperature (T)	−65°C to 175°C

Planar is a patented Fairchild process.

FAIRCHILD SEMICONDUCTOR/A Division of Fairchild Camera and Instrument Corporation ■ 313 Fairchild Drive, Mountain View, California (415) 962-5011 ■ TWX: 910-379-6435

CIRCLE NO. 39 ON INQUIRY CARD

	4	8	3	5	6	9	10	12	7	11
4, 12 (8)	⊗							X		
8, 12 (4)		⊗						X		
3, 7, (4)			X						⊗	
3, 11 (8)			X							⊗
*4,5, 6, 7 (1,2)	⊗			⊗	⊗				⊗	
*8, 9, 10, 11 (1,2)		⊗				⊗	⊗			⊗

F = 4, 5, 6, 7 (1, 2) + 8, 9, 10, 11 (1, 2) + 3, 7 (4) + 4, 12 (8)
F = 4, 5, 6, 7 (1, 2) + 8, 9, 10, 11 (1, 2) + 3, 7 (4) + 8, 12 (4)
F = 4, 5, 6, 7 (1, 2) + 8, 9, 10, 11 (1, 2) + 3, 11 (8) + 4, 12 (8)
F = 4, 5, 6, 7 (1, 2) + 8, 9, 10, 11 (1, 2) + 3, 11 (8) + 8, 12 (4)

Converting the prime implicants will result in the same four equations as before.

The Prime Implicant Chart

The selecting of the best group of non-essential prime implicants to complete a function is not always easy merely by inspection of the prime implicant chart. However, a systematic method is available for writing down all possible solutions from which the best one can be selected.

Consider the prime implicant chart shown below where the prime implicants have been given letter designations for identification purposes.

	3	5	8	9	10	12	13	14	19	23	25	26	27	28	31
*A	⊗								⊗						
*B		⊗					⊗								
C				X							X				
D					⊗							X			
*E						⊗								⊗	
F											X		⊗		
G												X	⊗		
H			⊗	X		⊗	⊗								
*I			⊗		⊗	⊗		⊗							
*J									⊗	⊗			⊗		⊗

The essential prime implicants include all minterms except 9, 25, and 26. Minterm 9 can be included with prime implicant C or H, 25 with prime implicant C or F, and 26 with D or G. Or, stated another way, the function must consist of: A and B and E and I and J, and C or H, and C or F, and D or G. This statement can be directly translated into a Boolean function:

$$A\ B\ E\ I\ J\ (C+H)\ (C+F)\ (D+G).$$

When fully expanded with redundant terms removed by application of the theorem $X+XY=X$, this expression represents all possible non-redundant, minimum, sum-of-products solutions to the problem:

$$ABEIJ\ (C+H)\ (C+F)\ (D+G) =$$
$$ABEIJ\ (C+CH+CH+FH)\ (D+G) = ABEIJ$$
$$(C+FH)\ (D+G) = (ABEIJC+ABEIJFH)\ (D+G) =$$
$$ABEIJCD + ABEIJCG + ABEIJFHD + ABEIJFHG$$

Thus, we have 4 solutions to the problem. Of these, 2 require 7 prime implicants, and 2 require 8 prime

TABLE 1

DEFINITIONS OF SOME SWITCHING THEORY TERMS

Minterm	— A product term in which each function variable appears in either the normal or complemented form. A function expressed as a sum of minterms is in standard form.
Implicant	— A product term formed by combining two or more minterms so that one or more variables drops out of the expression. Essentially the same as a subcube on the Karnaugh map.
Prime Implicant	— Simply an implicant which cannot be contained in another implicant. The map analogy would be a subcube which cannot be contained in a larger subcube.
Essential Prime Implicant	— A prime implicant which must be used in the simplified expression by virtue of the fact that it is the only prime implicant that contains a particular minterm of the original function.
Prime Implicant Table	— A table of prime implicants versus minterms whose entries indicate which minterms are included by each prime implicant.

implicants. Thus, the simplest expression for the function would be:

$$A+B+C+D+E+I+J \text{ or } A+B+C+E+G+I+J$$

where A through J are letters which identify the prime implicants on the prime implicant chart. These prime implicants would have to be converted back to algebraic form to get a Boolean expression for the simplified function.

Optional Terms

Any of the methods described can handle "don't care" or optional terms with no difficulty. In this case, all optional terms are included in the list of minterms when the prime implicants are being formed. When the prime implicant chart is made, however, only the essential minterms are included. This process assures that the optional terms will be used to best advantage.

REFERENCES

1. **"The Logic Design of Transistor Digital Computers"**, Maley and Earle, pp. 53-56 and pp. 92-97.
2. **"Switching Circuits and Logical Design"**, Caldwell, pp. 145-158 and pp. 162-169.
3. **"Logical Design of Digital Computers"**, Phister, pp. 68-75.

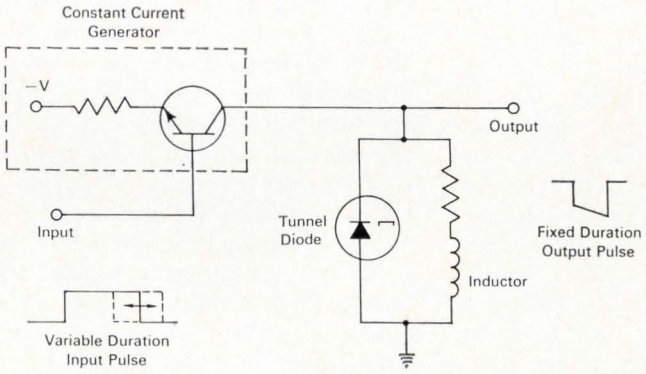
NASA TECH BRIEF

A SUMMARY OF A SPECIFIC TECHNICAL INNOVATION DERIVED FROM THE SPACE PROGRAM. ISSUED BY THE TECHNOLOGY UTILIZATION DIVISION OF NASA.

Simple Circuit Produces High-Speed, Fixed Duration Pulses

THE PROBLEM

To generate an output pulse of fixed duration from a variable duration input pulse ranging from 50 to several hundred nanoseconds. Prior art differentiated the input pulse to obtain a trigger pulse to be applied to a monostable or blocking oscillator. This method requires complex circuitry that consumes a relatively large amount of power.



THE SOLUTION

A circuit consisting of a tunnel diode in parallel with an inductance driven by a constant-current generator. Input pulses of variable width in the nanosecond range yield output pulses of fixed width.

HOW IT'S DONE

The variable duration pulse applied to the input of a constant-current generator, as shown in the accompanying diagram, allows a current to flow through a parallel network. When this current is first applied to the parallel network, the initial high impedance of the inductor causes the entire current to flow through a tunnel diode. This current is adjusted to be greater than the peak current of the tunnel diode, causing the tunnel diode to switch to its high-voltage state. Current through an inductor, initially zero, increases with time and the tunnel diode current and voltage decrease until the valley point of the tunnel diode is reached, causing it to switch to its low-voltage state. Because the inductor now has a relatively low impedance, the output voltage will be approximately zero for the duration of the input pulse.

NOTES

1. Close control of output pulse width is easily accomplished by varying the value of the inductor.
2. This circuit should be of interest to designers of computer and pulsed communications equipment.
3. Inquiries concerning this invention may be directed to: Technology Utilization Officer, Goddard Space Flight Center, Greenbelt, Maryland 20771, Reference: B65-10228.

PATENT STATUS

NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C. 20546. **END**

NEW PRODUCTS

INCREMENTAL RECORDER

New incremental digital recorder accepts randomly occurring digital data at rates from zero to 200 steps per second for the automatic preparation of 200-bit per inch magnetic tapes of computer compatible format. Price of the new model, the PI-1167 is $3,650. According to the company, previous digital recorders with this performance cost approximately $6,000 or more. With solid-state electronics, the compact recorder also can record digital characters received synchronously at 500 steps per second. The PI-1167 uses 10½-inch reels of standard one-half inch computer tape to produce a seven-channel NRZ format digital tape. Internal electronics automatically generate inter-record gaps, parity check characters, end-of-file gap and tape mark. Precision Instrument Co., Palo Alto, Cal.

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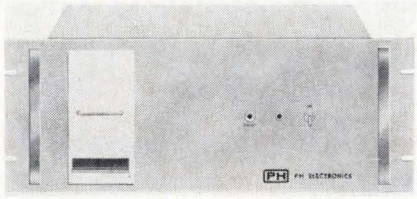


DIGITAL PRINTER

Low-cost digital printer operates on a counting principle thus avoiding the problem of precise synchronization circuitry. Upon applying a binary code, the printer quickly counts to the decimal equivalent indicated by the code and prints out with one operation of a platen. All columns are printed simultaneously. Print speed is 1 line per second. Number of columns is from 1 to 20. The unit measures 7″ H x 19″ W x 15″ D and may be rack or table mounted. Typical cost of an eight-column printer is less than $900. PH Electronics, Clifton Heights, Pa.

Circle No. 184 on Inquiry Card

CALCULATOR/COMPUTER

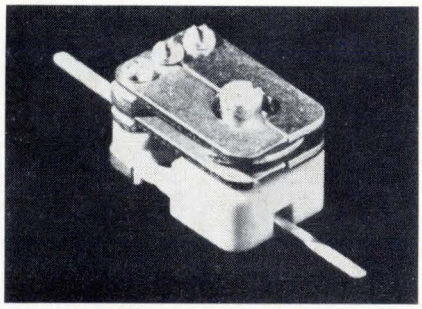
A new auxiliary program memory storage unit greatly expands the computational capabilities of an electronic calculator/computer. Called the APS (for Auxiliary Program Storage), the new unit in conjunction with the company's standard desk top calculator/computer provides 48 to 88 individually addressable storage registers plus 480 steps of program memory. Data, formulas, and programs are entered directly through a simple calculator-type keyboard using ordinary algebraic language including parentheses. Up to 18 prewired programs, of 48 steps each, may be incorporated into the unit and entered automatically by the program or with a touch of a button. Decimal points are located automatically and all answers are printed out to 8 or 9 significant digit accuracy with a 2 digit power of 10 exponent. In addition to the storage registers and program memory, 5 separate registers are used for arithmetic manipulations. Number capacity is 100 columns. Optional accessory units include a paper tape punch and reader with page printer, remote location keyboard, and direct entry punched paper tape reader. Mathatronics, Inc., Waltham, Mass.

Circle No. 146 on Inquiry Card

SHAFT ENCODING SYSTEMS

Precision shaft angle-to-digital and digital-to-shaft angle conversion systems utilize a solid-state resolver/synchro. The new resolver/synchro is said to be extremely versatile because it can use CX, CT, CDX, or any resolver or synchro configuration and requires no modification of existing equipment. The resolver/synchro generates sine and cosine trigonometric conductances as a function of a linear digital angle, and has a response time within 5 usec. (or less) of the digital change. Typical performance characteristics include an accuracy to 20 bits with resolution greater than 20 bits. The analog input can be any voltage and any frequency up to 10 kc. The digital input/output can take any digital format. Reeves Instrument Co., Garden City, N. Y.

Circle No. 122 on Inquiry Card



VARIABLE-TC CAPACITOR

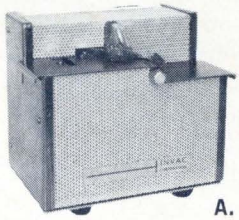
Adjustable temperature co-efficient is the unique feature of a new 2.3 pF capacitor known as the Thermotrimmer. Although the component looks like a differential air-spaced trimmer with a ceramic base, adjustment of the rotor alters not the capacitance but the temperature co-efficient, to any desired value from +1700 ppm through zero to −1700 ppm. Capacitance changes linearly with temperature. The variation at maximum + co-efficient is from 2.3 pF at 20C to 2.6 pF at 100C. A similar negative co-efficient is produced simply by turning the rotor through 180°. Thermal compensation of an oscillator which incorporates a Thermotrimmer is quickly achieved, the manufacturer claims. The frequency is noted upon switching on. After warm-up, the oscillator is re-tuned to its original "cold" frequency by adjustment of the Thermotrimmer. This one adjustment provides a high degree of compensation and eliminates the need for tedious capacitor substitution. The Thermotrimmer measures 0.6″ x 0.4″ x 0.4″. BREL Corp., Washington, D. C.

Circle No. 133 on Inquiry Card

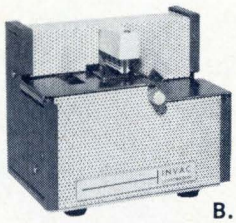
Direct photoelectric encoding is one of the major reasons for the extreme reliability of Invac's new Universal Photoelectric Keyboard. There are no switches and no complicated diode matrix. The problems associated with contact bounce and RFI are eliminated. Keyboard touch (operator feel) compares favorably with that of the best typewriters. A unique mechanical interlock prevents depression of more than one key at a time, for all banks.

New Universal Photoelectric Keyboard joins the Invac family of highly reliable Peripheral Equipment

The basic Invac Keyboard is a self-contained unit with 10 to 75 keys which generates directly any binary code up to 8 bits including ASCII. In addition to the 8 data channels, a strobe and a spare channel are also provided. Output data is parallel by bit, and serial by character. Burst speeds of greater than 20 characters per second are possible. When desired, the keyboard can be integrated into a console.



A.



B.

C.

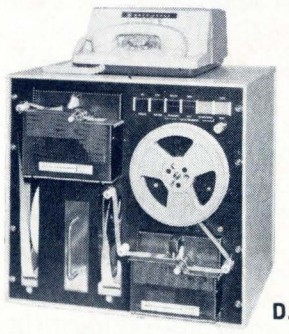
A. Tapes Punches
100,000,000 operations

B. Photoelectric Tape Readers
no motors . . . no clutches

C. Input/Output Typewriters
transmit and receive data in coded form

D. Tape Systems
for Off-Line and On-Line Applications

Write for Data Sheets



D.

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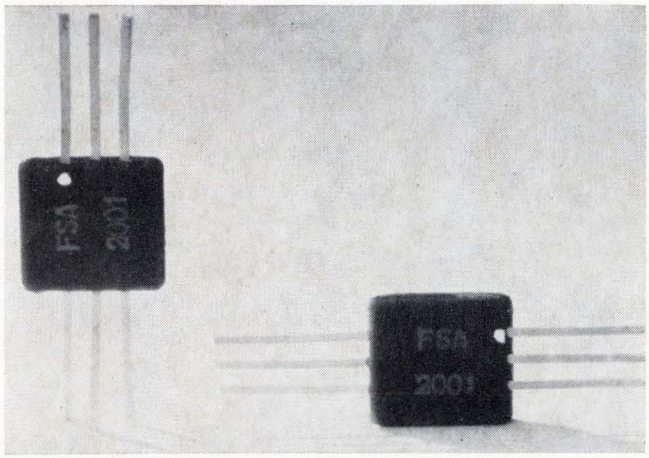
CIRCLE NO. 45 ON INQUIRY CARD

NEW PRODUCTS

HIGH-SPEED CORE DRIVERS



New family of 8 ultra-fast diode arrays were designed especially for high-speed core driver applications. The new units, all of silicon Planar epitaxial construction, are hermetically-sealed to permit operation to 400 milliwatts. The family includes a sixteen diode core driver array in a basic 10-lead TO-5 package and also in a ceramic package, eight diode core driver arrays in 10-lead, TO-5 packages, and ceramic packages, and eight diode common anode and common cathode arrays. Typical specs include maximum forward voltages of 1.50 volts at forward currents of 500 milliamps, peak forward voltages of 5.0 volts, breakdown voltages of 60 volts minimum, and maximum reverse recovery times of 25 nanoseconds. Fairchild Semiconductor, Mt. View, Cal.

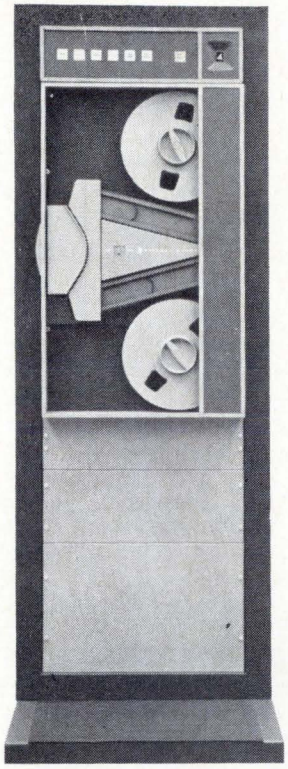
Circle No. 156 on Inquiry Card

DATA GENERATOR

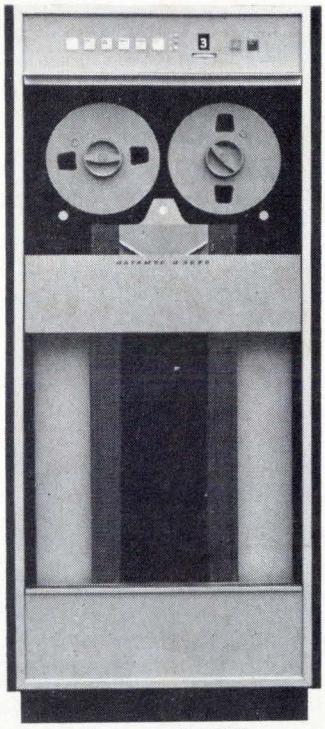
A 25 MHz general-purpose digital data generator is said to be the first unit of its kind to supply independent delay for each of the two output channels operating in NRZ as well as in a variable width pulse output mode. The generator utilizes integrated circuits and is designed to be housed within a 5¼-inch high package. Capabilities of the new instrument are applicable to a wide range of requirements for data simulation, particularly those required for development of integrated circuit computers, delay line memories, and high-speed telemetry systems. It may be used as a digital data parallel-to-serial converter. Multiple units may be interconnected to provide subcommutation or additional channels. Delay and width of each channel are independently controlled to 5 milliseconds. Polarity is selectable as positive or negative, with amplitude variable to 5 volts into 50 ohms. Rise time is less than 3 nanoseconds. Datapulse, Inc., Inglewood, Cal.

Circle No. 168 on Inquiry Card

How good are Datamec Tape Units?

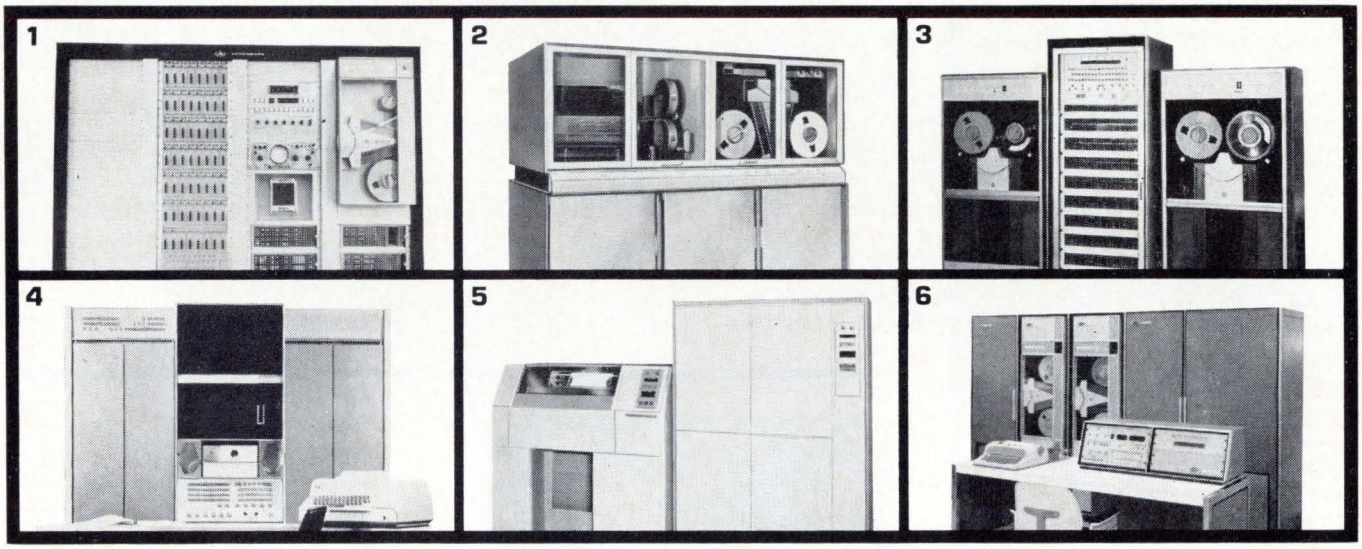


Datamec D 2020



Datamec D 3030

Ask any of the people who build or use these computer systems.*



1. **Astrodata Inc.**
   Automatic Data Acquisition System
2. **Benson-Lehner Corp.**
   B-L 120 off-line Microfilm Printer/Plotter
3. **Cubic Corporation**
   Computer Tape Synchronizer
   for European Air Defense System
4. **Digital Equipment Corp.**
   Programmed Data Processor-7
5. **Digitronics Corporation**
   Model 522 Dial-o-verter
   Magnetic Tape Terminal
6. **Raytheon Computer Operation**
   Raytheon 520 System

Perhaps you, too, have a program that would profit from **low cost/high reliability** in computer tape handling. Check with the company that stresses service to its customers. Write Tom Tracy at Datamec, 345 Middlefield Road, Mountain View, California 94041. Better yet, phone Tom at (415) 968-7291.

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* *Sorry there's space for so few pictures. If you'd like a lot more names, contact Tom.*

CIRCLE NO. 48 ON INQUIRY CARD

NEW PRODUCTS

MAGNETIC CARD MEMORY

Magnetic card memory provides an on-line random access storage capacity of 100 million bits with a maximum access time of 50 milliseconds. The unit uses long-wearing flexible magnetic cards contained in interchangeable cartridges as the storage medium. Each cartridge holds 64 cards and can be loaded or unloaded in less than 5 seconds, according to the company. A single 32-track dual-gap magnetic head provides read-after-write capability and the maximum data rate is 10.4 megabits/second when 32 tracks are processed in parallel. There are 128 recorded tracks on each magnetic card divided into four groups of 32 tracks each. Moving the magnetic head from one group to another takes less than 20 milliseconds. The unit includes a transport mechanism, two electronics chassis, and one power supply chassis all housed in a self-supporting metal cabinet 6.5′ high by 25″ wide by 30″ deep. All cooling is incorporated so that in normal computer applications no special temperature control is required. Prices start at $18,000. Computer Accessories Corp., Santa Barbara, Cal.

Circle No. 179 on Inquiry Card

D/A CONVERTER NETWORKS

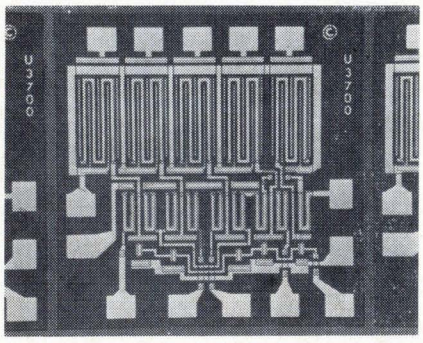
With a new stable digital/analog converter ladder network, straight binary conversion is available to 14 bits with $\pm\frac{1}{2}$ least significant bit accuracy — giving a capability of recognition to 1 part in more than 30,000. Precision wire-wound resistors are used in the new ladder network to produce a highly-stable voltage output of ± 10 ppm, one year operating, referenced to input voltage. The units' height is held to 0.250 inch to make them compatible for use with standard 0.250 inch components used in high-density circuitry packages. Ultronix, Inc., Grand Junction, Colo.

Circle No. 131 on Inquiry Card

AUTOMATIC CABLE TESTER

New testers check cables, chassis wiring, printed circuit boards, connectors, etc., which contain up to 50 circuits. It tests each circuit for continuity to 1 ohm (adjustable) and checks each circuit to all other circuits for shorts to 200 megohms (adjustable). All tests are performed automatically at 4 tests per second. Unit stops and positively identifies all faults. It can automatically test branched-circuits. V. J. Electronics, Ontario, Cal.

Circle No. 175 on Inquiry Card



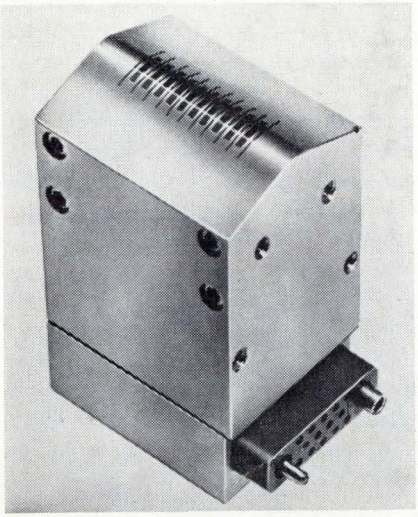
MONOLITHIC MULTI-CHANNEL COMMUTATOR

Built as a monolithic integrated circuit structure, a multi-channel commutator was designed for use in multiplexing and telemetry systems where low on-resistance and low channel leakage are required. The circuit offers an on-resistance of less than 200 ohms and a channel leakage of less than one nanoamp per channel. Using MOS field-effect transistors as active resistors, the device has all channel blanking capability for four channel operation. Five channel operation is also available. Each gate is diode-protected. Input analog signal voltage is ± 10 volts, and output capacitance is 40 picofarads. Channel turn-on time is 500 nanosecond, and turn-off time is 2 microseconds. Fairchild Semiconductor, Mountain View, Cal.

Circle No. 144 on Inquiry Card

MAG TAPE HEADS

Magnetic tape playback heads, incorporating micro-miniaturized preamplifiers as part of the unit, are designed for low signal applications ranging from 100 cycles to 2.5 megacycles. In addition to eliminating the need for extra equipment and space requirements, the new heads



are said to improve the reliability and accuracy of system operation; there is less likelihood of transmission error and high signal-to-noise ratio. Units are supplied with up to 20 channels per inch of tape width. Either differential or single ended output may be selected. Typical specs include output impedance, 50 ohms maximum; voltage gain, 10 nominal; frequency response, 100 cps to 2.5 mcps minimum; temperature range, −55C to +85C. Western Magnetics, Glendale, Cal.

Circle No. 148 on Inquiry Card

MODULAR POWER SUPPLIES

Two new models added to a line of modular supplies are dual output modules supplying ±12 volts and ±15 volts at 300 ma, respectively, and feature automatic self tracking to maintain the relative accuracy of both outputs. In addition, these compact modules, designed for system integration, feature 0.1% regulation, 0.5 mv ripple, remote sensing, and operate in environments up to +71C without derating. Units measure 5 inches high x 4⅛ inches deep x 3¼ inches wide. Trygon Electronics, Roosevelt, L.I., N.Y.

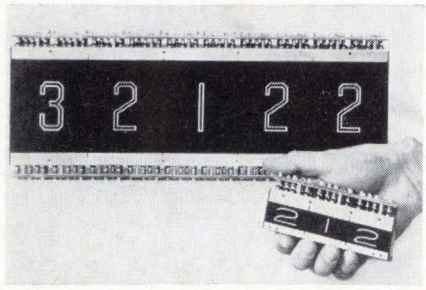
Circle No. 147 on Inquiry Card

NEW PRODUCTS

DATA LOGGING SYSTEM

Accepting high-level analog data from up to 16 sources, a new data logging system time-division multiplexes these channels, converts each sample of each channel into a 12-bit binary number, organizes the information into computer-compatible format, and writes it onto digital magnetic tape. The system uses rectangular plug-in digital logic modules for flexibility and low maintenance costs. Asynchronous sampling rate is 100 samples per second; synchronous, 500 samples per second. It can be converted to a high-speed system (50,000 sps) with the addition of a higher speed recorder. Control and Communication Div., Radiation Inc., Melbourne, Fla.

Circle No. 162 on Inquiry Card



ILLUMINATED DISPLAYS

Improved series of compact illuminated in-line visual display readouts has increased character or numeral recognition up to 30′ at viewing angles of 45° on the smaller units. Surface and interface reflections have been reduced with Polaroid filtering. Single or multiple visual display decades are available with characters as small as ½″ in height. Miniature decade assemblies require 1⅜″ x 2¾″ x 2″ space — including connector plate clearance. Transformer Engineers, San Gabriel, Cal.

Circle No. 182 on Inquiry Card

PHOTON-COUPLED ISOLATOR

Solid-state photon-coupled isolator incorporates an improved gallium arsenide diode injection luminescent photon source and an improved silicon diode photodetector. The isolator is packaged in a 4 lead, JEDEC TO-18 size, hermetically-sealed case permitting its use on PC boards as a conventional semiconductor component. The anode of the input diode is connected to the case. The working voltage rating between input/output is 200v peak maximum, and the photon-coupled current transfer ratio is of the order of 0.001 from dc to the cutoff frequency of 10 MHz. The unit is intended for use in circuits where economical input/output common mode isolation of moderate levels is required. One important application is the interruption of common ground currents in various digital and analog circuits. hp associates, Palo Alto, Cal.

Circle No. 136 on Inquiry Card

PELLET RESISTORS

New experimental kit contains an assortment of microminiature solid cermet pellet resistors that have an extremely high power-to-size ratio, i.e., a minimum of 15 watts per cubic centimeter, with tolerances as low as ±1%. According to the manufacturer, they will not short out under any operating conditions, are extremely stable under extreme environments, and are not affected by radiation. Resistance range is 15 ohms to 200K ohms. The resistors operate at 175C hot spot without leads and are available with leads or terminating surfaces for soldering or welding. Kit contains resistors with and without leads in random resistances and in the following sizes: 0.050″ dia. x 0.030″; 0.050″ dia. x 0.062″; 0.100″ dia. x 0.030″ and 0.100″ dia. x 0.062″. Kit price is $10.00. CTS Research, Inc., W. Lafayette, Ind.

Circle No. 139 on Inquiry Card

DC POWER SUPPLIES

Specifically designed for systems use, new power supplies offer outputs from 0 vdc to 51 vdc in fourteen models. Each model has a range of about 5 volts. Modules are available with currents from 5 A to 14 A. Prices, in the $300 bracket, are said to be about $100 less than comparative wide voltage range laboratory supplies often used in systems. All the modules are unconditionally guaranteed for five years and have a MTBF of 35,000 hours, calculated according to Mil Handbook 217. Units are packaged in standard half-rack widths thus permitting systems engineers to achieve high amounts of power in a single rack. They have a regulation (line and load combined) of ±0.05% or ±2mv, whichever is greater. Silicon transistors permit operation to 75C and a response time of 25 microseconds. Consolidated Avionics, Westbury, N. Y.

Circle No. 129 on Inquiry Card

PRINTED CIRCUIT CONNECTOR

A new series of edge connectors for printed circuit cards were specifically designed for dip soldering. They contain gold-plated Duometal contacts; half beryllium copper for high tensile strength, and half brass for maximum soldering reliability and conductivity. The series is furnished with a single row of 6, 10, 15, 18, or 22 contacts. These connectors will accept printed circuit boards ranging from 0.054 to 0.071 inch in thickness and include corrosion-resistant, passivated, stainless steel inserts with 4-40 NC threads for mounting. In addition to meeting all applicable provisions of MIL-C-21097B, MIL-C-21097/1, and MIL-C-21097/6, they have also passed successfully the rigid industrial specifications set by a computer manufacturer and have been used in tape handling and other peripheral equipment. U. S. Components, Inc., Bronx, N. Y.

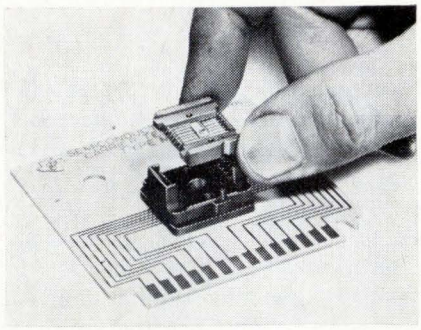
Circle No. 124 on Inquiry Card

NEW PRODUCTS

READOUT CONVERTER/DRIVER

A 4-line BCD converter that converts low level logic signals into numeric display driver currents is a correlated package of a transistor/resistor decoder circuit module, to drive company's series of numeric readouts. The unit's design permits the use of only a single power supply to drive both the converter and the readout. Its low current requirements and wide voltage range of required logic inputs are said to enable it to be used directly with many integrated circuit designs and thus eliminate the need for additional buffers. Specs include power supply of +5.5 vdc at 0.65 amp max. including readout lamp supply, logic levels of +2.0 to +15.0 and 0 to +0.5, a required logic drive of 0.3 ma at +2.0 vdc, and an operating temperature range of 0 to 70C. Microphysics, Incorporated, Westbury, N.Y.

Circle No. 149 on Inquiry Card



IC TEST BOARD

A new test board was developed for the testing and prototype operation of integrated circuits in equipment utilizing standard printed circuit card connectors. The board can incorporate flat-pack integrated circuits of up to 14 leads mounted in carriers. The board is designed for plug-in operation to a standard 15 position edge connector with contacts spaced on 0.156″ centers. An associated connector can be purchased separately for use in permanent test installations, prototype design, and production packaging. Metals & Controls, Inc., Div. of Texas Instrument, Attleboro, Mass.

Circle No. 140 on Inquiry Card

RESISTOR POTENTIOMETER

New component combines the features of a precision resistor with the adjustability of a trimmer potentiometer. It has been named a varizistor. Several dozen models of varizistors can replace over a hundred thousand individual fixed value resistors, according to the manufacturer. They can be adjusted to provide extremely accurate resistance values in various circuit applications in computers and other commercial and industrial equipment. The varizistor consists of a deposited metal, thin-film resistance element bonded to the inside surface of a ceramic housing. A multi-contact wiper is attached between an insulator and a lead, which runs through the body of the unit, making contact with the resistance element. The entire body slides, within fixed limits, moving the wiper across the resistance element, providing an approximate 20% variation in resistance value, above and below the nominal value. Since there is a continuous film element, rather than the conventional wire-wound type, resolution is high. One of the major advantages of the varizistor is that units can be installed in assembly line fashion and then adjusted to "tune the circuit" at final inspection. It is said to be ideally-suited to computer servicing where minute resistance adjustments are required. Resistance values from 0.5 ohms to 1 megohm are available in 42 units with ratings from ¼ watt to 1 watt. Vacco Electronics Div., Vacco Valve Company, El Monte, Cal.

Circle No. 138 on Inquiry Card

IC TEST SET

New test set determines operating temperature characteristics of integrated circuit chips and discrete components in a broad range of temperatures. Designated Model 898, the unit includes a three stage thermo-electric cooling module with an enclosure and "O" ring seal for high vacuum use. The heat sink supplied can be of forced convection type or water cooled. The power supply-controller allows the operator to adjust and monitor cold surface temperature through the unit's operating range. Circuits to be tested are easily mounted on the cold plate and terminals are provided for external connection to the circuit tester. In a vacuum of 10^{-5} torr, no-load cold junction temperatures will be between −72 to −78C with a heat sink temperature of +27C. The cooler operates at an optimum power of 12 amps at 1 volt and varying current below 12 amperes yields temperatures between minimum and ambient. The system will maintain cold surface temperature within 1C with variations in load and ambient temperature. Borg-Warner Thermoelectric Dept., Borg-Warner Co., Des Plaines, Ill.

Circle No. 137 on Inquiry Card

PAPER TAPE SYSTEM

A complete tape preparation, duplication, and verification system consists of a paper tape punch, two paper tape readers, an encoding keyboard, and an indicating master control panel. The system is housed in a free standing cabinet, operates from 115 volts, 60 cycles, and can punch and read paper, Mylar, or metalized Mylar tapes. At all times, the indicator control panel visually indicates in which mode the unit is operating, as well as showing at any instant which bits are being read. Should the system stop due to an error, the cause can be instantly detected and corrected by use of the keyboards. The system can skip "zero" and "delete" codes (all 8 holes punched). Ohr-Tronics, Inc., New York, N. Y.

Circle No. 130 on Inquiry Card

NEW PRODUCTS

TOUCH-OPERATED SWITCH

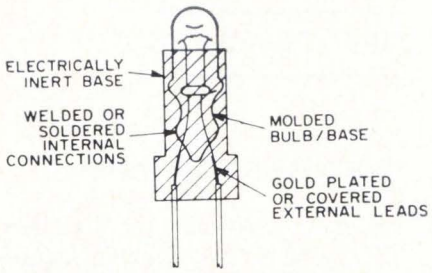
Based on a semiconductor surface effect which is sensitive to touch, a new switching device features fast action, high repeat rate, and freedom from switching transients. In use, the operator or simile thereof, is isolated from the power circuit. The "touch" sensitive area may be any size from as small as a finger button to as large as a wall in a room. Thus, the switch may be used for a wide variety of applications from the simplest appliance switch to the most complex computer control. For voltage ranges up to 24 volts rms, models will handle 100 ma, 1 amp, and 5 amps. For 24 to 120 volts rms, and for ranges from 120 to 230 volts rms, models will handle 500 ma, 1 amp, and 5 amps. Hall-Barkan Opticon, Tuckahoe, N.Y.

Circle No. 178 on Inquiry Card

FLEXIBLE PRINTED CIRCUITS

A versatile new family of flexible copper-clad materials for printed circuits includes copper-clad glass-reinforced polyester, copper-clad glass-reinforced epoxy, a low-cost paper-reinforced copper-clad material, and copper-clad Mylar. The insulating materials, in thicknesses from 2 to 12 mils are furnished with 1-oz., 2-oz., or 3-oz. copper bonded to one or both sides. Treated or untreated copper, as rolled or electrodeposited foil, can be bonded to the insulation. The insulating material, without copper, is also supplied, bondable on one or both sides, for use as binder and cover sheets in construction of multilayer circuitry. Electrical characteristics of glass-reinforced epoxy and polyester systems are comparable. Surface resistivity for both glass-epoxy and glass-polyester copper-clad materials is 1×10^6 megohms per square under test conditions of 96 hr. at 35C and 90 per cent relative humidity. Dissipation factor at 1 megacycle is less than 0.05 for both. Similarly, dielectric strength, short-time, Condition A, is 1,500 volts per mil for glass-epoxy and glass-polyester. However, the dielectric constant for glass-polyester approaches 3, while for glass-epoxy it is less than 4. Flexibility of the copper-clad materials is said to afford economies in the fabrication of printed circuits by the use of continuous machinery. They can be soldered for example, by standard production methods on dip or wave soldering machines. In addition, flexible printed circuits eliminate much wiring during manufacture. Westinghouse Electric, Insulating Materials Div., Trafford, Pa.

Circle No. 163 on Inquiry Card



COMPUTER LAMPS

The integrally-molded base is said to be the first major development in subminiature lamps in over a decade. Designed for the specific requirements of the computer industry, this integrally-molded base lamp differs from the conventional lamp in that it employs a plastic (nylon or other thermoplastic materials) base molded to a standard bulb. It replaces not only the separately attached metal base but also the mated socket which it requires. The new lamps are said to provide significant advantages in reliability, economy, and design freedom over the conventional types. The most important advantage of the new lamps will probably be the ability to make entire lamp assemblies as a single piece of equipment for direct installation into a system. Present production units which, according to the company, have been successfully proven out in pilot installations over the past year are printed circuit board indicators, long lead photocell actuators, and many complex shaped packages. Tung-Sol Industries, Incorporated, Newark, N.J.

Circle No. 176 on Inquiry Card

EPITAXIAL DIODES

A new line of silicon planar epitaxial diodes for high speed switching and computer applications are miniature glass units packaged in a standard DO-7 case. Application of advanced epitaxial technology is said to provide greater reliability, increased yield, and reduced cost. It offers extremely low forward voltage drop at higher forward current. Operating over a temperature range of −65C to +175C, these diodes have a peak reverse voltage of −100 v for Types 1N914 through 1N916A, and −75 v for Type 1N3064. Nucleonic Products Co., Inc., Los Angeles, Cal.

Circle No. 128 on Inquiry Card

CD HANDBOOKS AND REPRINTS

"CAUSES AND CURES OF NOISE IN DIGITAL SYSTEMS"

A 56-page, pocket-size, design reference handbook gives basic guideline rules and design tips for eliminating or minimizing noise in digital systems. The discussion is divided into 3 sections: Part 1 — Systems Design Considerations; Part 2 — Noise Elimination in Digital Modules; Part 3 — Control of External Noise.

Price: $1.75 per copy

"TELETYPEWRITER FUNDAMENTALS HANDBOOK"

A 32-page, pocket-size, handbook explains the basic principles of teletypewriter equipments — how they operate and how they are used. A glossary of teletypewriter terminology and descriptions of typical machines are included.

Price: $1.50 per copy

"PERFORATED TAPE READERS"

The industry-wide survey of perforated tape reading equipment that appeared as a Product Reference File feature in COMPUTER DESIGN is available as a 20-page reprint. It serves as an excellent reference for evaluating and selecting a tape reader for a particular application.

Price: $0.50 per copy

"PAPER TAPE PUNCHES"

This 12-page reprint of another CD Product Reference File feature describes the performance characteristics of commercially-available paper tape punch units. Typical punch mechanisms are also described in this survey.

Price: $0.50 per copy

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____copy(ies) of "Paper Tape Punches" at $0.50 each

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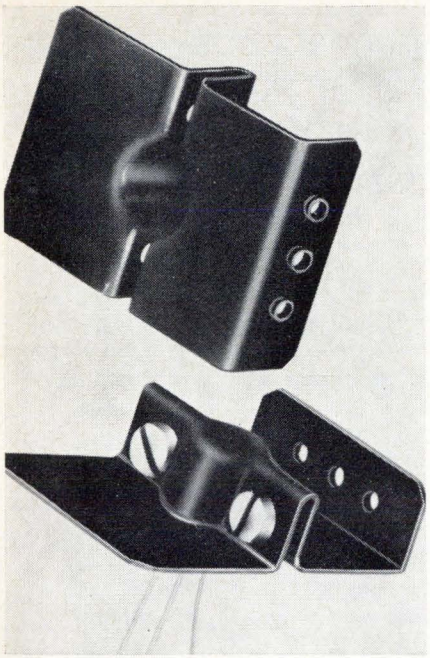
NEW PRODUCTS

TIME SHARING COMPUTER

Designed specifically for time sharing, the SDS 940 computer features multi-programming, real-time processing, on-line remote data processing, and simultaneous access to the central processor. The SDS 940 time sharing system will provide up to 32 users with simultaneous access. A response time of two to three seconds facilitates rapid communication between the user and the 940. For up to six simultaneous conversational users, the response time is less than one second. Memory protection is provided to prevent one user from accidently destroying or gaining access to the programs or data of another user. Another important feature of the computer is its ability to load programs continuously in any available portion of core memory so that users do not have to wait for a specific memory location. Programming languages included with the system are Fortran II; CAL, a conversational algebraic language; SNOBOL, for string manipulation; QED, a conversational text editor; a macroassembler that permits programs to be written in machine language, LISP, a list processing language, and a machine-language debugging system. Memory cycle time is 1.75 microseconds with memory expandable to 65,536 words. The computer features a 24 bit word size and 48 bit capability for floating point arithmetic. Other features include built-in "multiply" and "divide" logic circuitry, automatic checking of memory transfers and input/output operation, multiple-level indirect addressing with indexing at any level, and up to 1,024 levels of priority interrupt, each with a unique priority and address in memory. A typical 940 system includes a minimum of 24,576 words of core memory; two random access discs, each providing 2,000,000 characters of auxiliary storage; two magnetic tape transports; teletype multiplexer; card reader, and eight on-line user stations. The 940 configuration is $430,050. Scientific Data Systems, Santa Monica, Cal.

Circle No. 166 on Inquiry Card



PC HEAT SINK

New printed circuit board heat sinks are said to exhibit good performance characteristics with TO5 transistor cases: a case rise of 36C at 1 watt with bright aluminum natural finish or 30C rise with black anodize finish. The area required for mounting is only 0.375 sq. in. Two #4 x ¼" long sheet metal screws are used to clamp the TO5 case in the Type 150 heat sink. Three eyelets extruded from the mounting base provide keying to the circuit board. A sheet metal screw in the center eyelet anchors the heat sink to the pc board and the two outer eyelets are set for permanent positioning. Cost is less than 3¢ each in volume quantities without black anodizing. Wakefield Engineering, Inc., Wakefield, Mass.

Circle No. 142 on Inquiry Card

ELECTRONIC TRIGGERS

For low frequency applications (from 40 cpm to 1000 cps), with high power (up to 100 watts), new solid-state electronic triggers provide a square wave output from a dc input which is said to be ideal for flip-flop action. Applications for the custom triggers, include special lights which require alternate on-off action, time-lapse photography, heart pumps, and a variety of other low frequency pulsing operations. Space/Defense Corp., Birmingham, Mich.

Circle No. 171 on Inquiry Card

NEW PRODUCTS

MAGNETIC TIMER

A field-programmable magnetic timer was designed to perform a wide variety of timing and sequencing operations in the most demanding aerospace environments. Weighing only 5 pounds, the unit provides discrete timing and interval stepping for 12 sequential events and features complete field-programming capability of all 12 intervals. It can be kept in stock and programmed as needed to meet specific requirements, thereby reducing lead time. A resistor matrix employs interchangeable plugs readily accessible behind a removable panel. By the appropriate placement of these hand-insertable plugs at each of 168 intersections, the entire program can be set up very quickly for all 12 events. A combination of core transistor logic elements and magnetic commutator elements are used to perform all logic and control functions. A low-frequency magnetic core oscillator serves as the master time base and 14-stage presettable magnetic core binary counter determines the time duration of each event. A plugboard programming matrix controls the countdown duration of the binary counter for each of the 12 desired time intervals between successive relay contact transfers. A 13-stage magnetic shift register/relay driver combination is used to trigger the latching doublethrow relays at the conclusion of each time interval and is also used to preset the binary counter for the next event time. Di/An Controls, Incorporated, Boston, Mass.

Circle No. 154 on Inquiry Card

DIGITAL STRIP PRINTER

A digital strip printer, priced at less than $300, prints a single line along a ½"-wide paper tape featuring a full complement of 64 alphanumeric characters. The Model 120A strip printer measures only 3" W x 6⅛" H x 8⅝" D and weighs less than 5 lbs. Franklin Electronics, Inc., Bridgeport, Pa.

Circle No. 132 on Inquiry Card

DRUM MEMORY SYSTEM

Complete with clocking, read-write, and address decoding electronics, a new drum memory combines economical 80-track storage capacity of 10,000 to 200,000 bits with random access capability and a data rate of 200 kc. The system is priced below $5,000. Normal operation of the drum is from a 120 volt, 60 cycle, single-phase source, providing speeds of either 1800 or 3600 rpm, with maximum access time of 34 or 17 milliseconds. Higher speeds may be obtained with a 400 cycle power source. Use of Manchester non-return-to-zero (phase modulation) recording produces playback voltages which are either fully positive or fully negative at strobe time. Therefore, according to the manufacturer, effective playback signal is twice the amplitude of that produced by other recording methods. The Model 52 system comprises two separate items: the magnetic drum, measuring 11 x 11 x 15 inches, and mounted on four shock mounts; and associated circuits, mounted on a standard module chassis. Vermont Research Corp., No. Springfield, Vt.

Circle No. 152 on Inquiry Card

TIME CODE GENERATOR

With 13 simultaneous serial code outputs, a new time code generator was designed to provide precision standards for time-correlating data from magnetic tape recorders, visual recorders, cameras, digital printers, and computers. The generator accumulates time from a high stability crystal oscillator and provides the capability of close synchronization to external time standards such as radio station WWV or a high-stability external frequency standard. The basic unit generates seven serial time codes, six of which are in both the modulated carrier and dc level shift forms. In addition to time correlation, the pulse rate outputs can also be used to time synchronize computers, digital printers, and other external digital equipment. Prime features of the unit include a stability of 2 parts in 10^9 per day; thirteen simultaneous serial time code outputs; direct synchronization from external time standard; extremely low power consumption; and wide-angle decimal display with long-life "Super-Nixie" tubes. Astrodata, Inc., Anaheim, Cal.

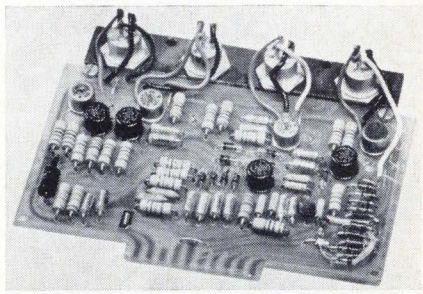
Circle No. 151 on Inquiry Card

PHOTOSENSORS

Two miniature photosensors have been developed for use in tape and card readers, optically-coupled circuits, encoder-decoders, character recognition devices, and process control applications. Both units are silicon and feature planar passivation for long term device stability. The FPM-100 phototransistor has a special response extending from 0.4 to 1.1 microns and features a maximum power dissipation of 75 mw at 25 degrees C. Collector current rises from a maximum dark value of 0.1 microamp to typical values in the range 1.5 to 2.5 milliamps upon illumination. Typical rise time is 3 microseconds. Packaged in a hermetically sealed cylinder with a diameter of 0.08 inches and length of 0.18 inches, the FPM-100 "reads" at the top end of the cylinder through a flat polished window. By using a flat window, a divergence angle of 70 degrees has been obtained. The avoidance of any optical magnification eliminates the possibility of a hot spot developing to introduce random errors, and since the flat window is flush with the cylinder body, an array of units may be placed in physical contact with a moving tape without abrading the tape. Cross-talk is also said to have been eliminated by this feature. The companion photodiode, FPM-200, is packaged in the same cylindrical welded case. The dark current maximum is 25 nanoamps and the light current minimum is 13 microamps when illuminated with a source of radiation equivalent to 15 mw/cm² at a color temperature of 2870 degrees K. Rise time for the FPM-200 is typically 3 microseconds. Fairchild Semiconductor, Mountain View, Cal.

Circle No. 121 on Inquiry Card

NEW PRODUCTS



DIGITAL CONTROL MODULES

Factory-stocked to aid designers of direct-digital controls, data printers, XY plotters, counters, incremental tape and other digital systems, a line of step-servo control modules plug in between a serial pulse train and a stepper motor bidirectionally. Three different models have 0.7, 1.5, and 5.0 amp current-carrying capabilities. IMC Magnetics Co., Westbury, N.Y.

Circle No. 177 on Inquiry Card

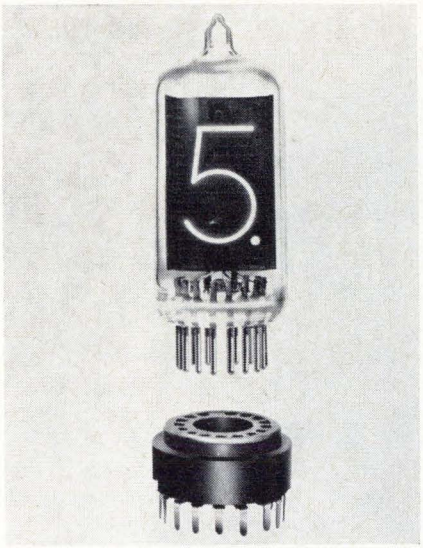
NO-DRIFT SCOPE

Push-button controlled oscilloscope is said to be entirely free of dc drift. Every major function is programmable by external circuit closures. Settings for any desired series of wave-form observations may be preselected, displays presented in rapid order, and repeated exactly. With drift eliminated and correct settings assured, testing is fast and errors are reduced. The Model 155A oscilloscope is a 5 mv/cm, MHz instrument with illuminated push-button controls. A companion to the oscilloscope, the Model 1550A programmer has 18 buttons, each of which will, at one touch, select an entire set-up on the scope. The preset combination will include not only sensitivity, sweep, and offset (i.e., vertical position), but also input coupling (ac or dc), trigger source, and trigger slope. Programs are determined by the position of plug-in diodes in the programmer's circuit boards. Programmers may be cascaded, extending the number of available programs without limit. Hewlett-Packard, Palo Alto, Cal.

Circle No. 173 on Inquiry Card

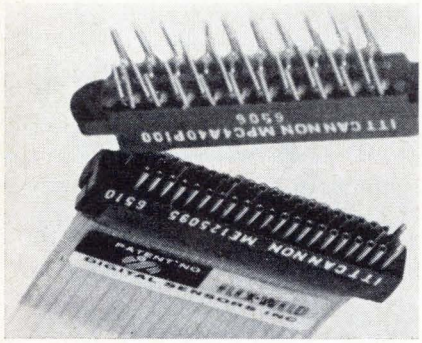
NEW NIXIE TUBE

A Nixie tube of new design and construction, which will sell for $4.95 in quantities of 1000, is a side-viewing tube with a 0.750″ maximum bulb width for 0.8″ center-to-center spacing and a 0.6″ character height in a bulb only 1.8″ maximum height. The stem of the new tube has been designed to afford maximum printed-circuit line width and spacing of the associated circuitry, permitting high printed-circuit board packaging density. New sockets which permit flush mounting of the tube for up-front viewing are available for wiring applications and printed circuit applications. Internal, independently-operable decimal points which are positioned on both sides of the numeral are an optional feature of the tube. Another version of the tube providing "plus" and "minus" indication is also available. The new Nixie is expected to replace many other kinds of numerical readouts,



such as projection and electro-luminescent types, in numerous applications because of its simple operation, brightness, long life, and lower cost. Burroughs Corp., Electronic Components Div., Plainfield, N.J.

Circle No. 185 on Inquiry Card



DIGITAL TRANSMISSION LINES

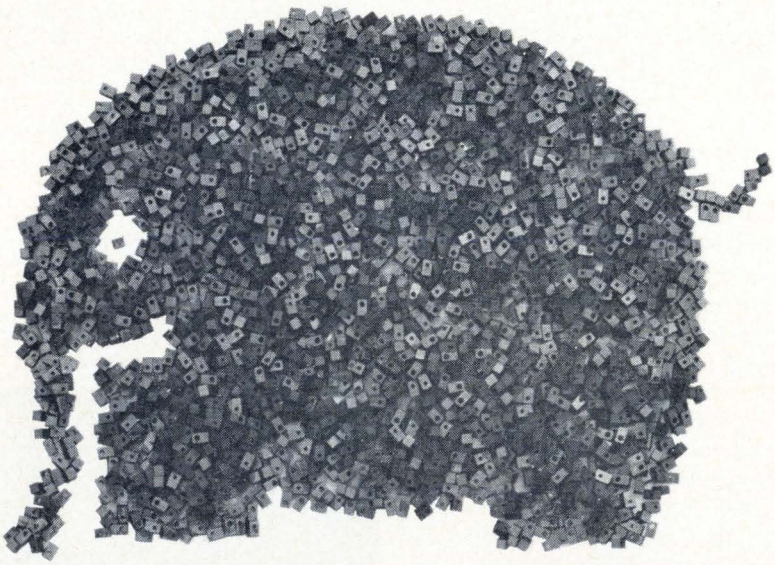
Supplied as complete cable assemblies with connectors, new high-frequency transmission lines were designed especially for such applications as transmission of digital data in computers. Offering consistent impedance characteristics, these 93-ohm dual lines have 20 pairs of conductors, terminated in a double row of 0.050″ center distance connectors. Cable assemblies are constructed of 33 gauge round silver-plated copper wire and are insulated with homogeneous TFE Teflon. The dual line assemblies are 0.028″ thick by 1 inch wide. Digital Sensors Inc., Los Angeles, Cal.

Circle No. 143 on Inquiry Card

DECIMAL PROGRAMMER

New, 60-position, decimal plugboards with 16 decimal digits for each square inch of panel face can be used as 60/1-digit switches, 30/2-digit switches, or 20/3-digit switches. Bussing between common input and output signal lines is accomplished in a simplified manner. Space is provided behind each module for mounting isolation diodes eliminating holding pins or remote diode mounting. Applications include decimal memory, decimal-oriented program control, decimal format control, temperature limits, voltage limits, counter presetting digital control, time code generation, analog comparison, and pulse pattern detection and generation. Spring loaded pins of varying lengths provide the switching capabilities. Molded finger tip pins are permanently numbered 0 through 9 for value identification. The panel mounts in a cutout 1.81″ wide by 2.72″ high. The frame face is 2.30″ wide by 4.21″ high. Verselector Co., Burbank, Cal.

Circle No. 127 on Inquiry Card



NEW PRODUCTS

PLUG-IN IMPULSE DISPLAY

Impulse-actuated and magnetically-detented display was especially designed for miniaturized readout applications in computer and data annotation systems. Called the Logicator II, it is described as a fast-acting readout module available in integral packages of from three to eight units, each of which is independently operated through a three-wire system by computer or converter codes. Each modular wheel has 12 positions: 10 for 0-9 numerals, and 2 for letters or symbols. Inherent memory magnetically holds all readout positions without any power input until change pulses are received. Plug-in nature of the individual wheel modules, which are immediately accessible behind the assembly faceplate, facilitates almost instant replacement of damaged modules or substitution of other desired readout configurations. Total response time is half a second, maximum, for adjacent numerals; and one second, maximum for numerals requiring 180° of wheel rotation. Each wheel requires 1.5 watts of 24 vdc pulsed power. A five-wheel assembly case measures 1.937″ across the reading face, 0.9″ in height, and 2″ in length. Bowmar — Fort Wayne Div., Fort Wayne, Indiana.

Circle No. 155 on Inquiry Card

DATA PRINTERS

New printers are parallel-entry recorders capable of printing a line of 20 characters at the rate of two lines per second. Standard inputs are low-level 8421 BCD codes. Standard characters are the ten decimal digits, a minus sign, and a blank space. Units are designed for continuous operation in industrial and scientific systems. Standard, solid-state plug-in modules are used to increase serviceability; the modules are also available for implementing custom logic designs. Control Equipment Corp., Needham Heights, Mass.

Circle No. 135 on Inquiry Card

IC CARDS

Both TO-5 and flat pack types of integrated circuits can be breadboarded on new integrated circuit cards. These cards are of gold-plated glass epoxy with flat pack mounting tabs on one side and TO-5 pads on the other. Six integrated circuits can be intermixed on the boards in any combination. Price of the new integrated circuit cards is $4.95 each in lots of 50-99. Triad Distributor Div., Litton Industries, Huntington, Ind.

Circle No. 167 on Inquiry Card

SCIENTIFIC CALCULATOR

A solid-state, desk-top instrument was designed for high-speed engineering and scientific calculations. The new unit is said to provide the engineer and researcher with an extremely flexible, relatively low-cost tool for performing a broad range of normally tedious and time-consuming calculations. It can execute all normal arithmetic operations $(+, -, \times, \div)$ within a fraction of a second. In addition, it has the capability of providing, with a single keystroke, the square, square root, natural logarithm, and exponential of any number previously entered or calculated. All data entered are automatically converted to natural logarithms, are operated on in this form, and then are reconverted to decimal form for readout. This process greatly simplifies and speeds the internal arithmetic of the instrument, and extends its capabilities substantially beyond those of any other device within its price range, according to the company. The Model 320 consists of a small keyboard-and-display console scarcely larger than a telephone, together with a compact electronics package (less than ½ cubic foot in size) which can be placed in any convenient location up to 200 feet from the console. Entries and results are displayed instantaneously on the console. The Model 320 with one keyboard and electronics package is priced at $2095, and additional keyboard units list for $495 each. Wang Labs, Tewksbury, Mass.

Circle No. 134 on Inquiry Card

NEW PRODUCTS

MATRIX PROGRAM BOARDS

New 3-D program boards with rigid 0.106 dia. 2-D and 3-D pins, shorting and coaxial type, are said to widen the function of matrix switching. Crosspoints are on ¼" centers. Full line interface contact of pin to closed entry contact strips provides reliable electrical characteristics. Standard matrices from 100 to 625 crosspoints are offered; custom units to 11,000 crosspoints are also available. These program boards have been used as variable diode matrices, systems interfaces, computer memories, circuit selectors, and variable process programmers. CO-ORD Switch Div. LVC Industries Inc., Corona, N. Y.

Circle No. 181 on Inquiry Card

LOGIC CARDS

A new logic card with two adjustable fast recovery one-shots is capable of operating in a temperature range from −20C to +70C. Pulse width stability in this range is ±0.06%/C. Both circuits can be adjusted by potentiometers mounted on the 1/16 inch thick, flame resistant, glass impregnated epoxy board. With a nominal pulse width of 25 usec. ±10 percent, the one-shot's maximum pulse with an external capacitor is 10 seconds. AC set input loading is 2.5C per input, amplitude is 10 ±2 volts, and rise time is 0.5 usec. maximum. DC set and reset input loading is 1.5N per input, with an amplitude of −10 ±2 volts and a duration of 5 usecs. maximum. Wyle Laboratories, El Segundo, Cal.

Circle No. 145 on Inquiry Card

PHOTOELECTRIC KEYBOARD

A completely solid-state photoelectric keyboard can be adapted to almost any encoding and power requirement. The keyboard utilizes long-life lamps which excite an arrangement of photo-sensitive devices. When a key is depressed, a given arrangement of shutters, unique to that key, blocks the light path to a series of photoelectric sensors, and initiates a delayed clock pulse. Data cannot be released for external use until this delayed clock pulse has been accomplished, thus eliminating ambiguous codes. Keys are in modular rows and each row can generate eight bits plus a clock pulse. Keys are spaced on multiple centers of 0.750 inch, both horizontally and vertically, to any customer arrangement. Quantity of keys per row and number of rows per keyboard are controlled by the customer's configuration. This button spacing feature and the modular row approach means that a wide range of "special" keyboards can be implemented quickly and economically. This solid-state keyboard is said to offer other advantages over its electro-mechanical counterparts including extremely high reliability since only one mechanical part per key travels, and switching is accomplished by the presence or absence of light on highly reliable solid-state sensors. MTBF of the lamps is above 20,000 hours. An added feature of the keyboard over its electro-mechanical counterpart is the nine output connections to be wired, against possibly hundreds of connections on an electro-mechanical keyboard. Telemetrics Div., TMC, Santa Ana, Cal.

Circle No. 153 on Inquiry Card

COMPUTER POWER SUPPLIES

Rack-mounted dc power supplies have been developed primarily for use with data processing, computer, and automation equipment. Available in single and multiple output configurations, they offer such options as overvoltage protection, voltage margining, energy storage, and instantaneous turn off during a short circuit to prevent burn-up of logic wiring. Standard specs include input range of 100-130 vac, 47-63 cps, regulation of 0.1% for fluctuations of line and load, ripple 1 mv rms maximum, and transient response of 40 microseconds. Output voltages up to 100 vdc, and currents up to 50 amps, are available. Powertec, Inc., Van Nuys, Cal.

Circle No. 180 on Inquiry Card

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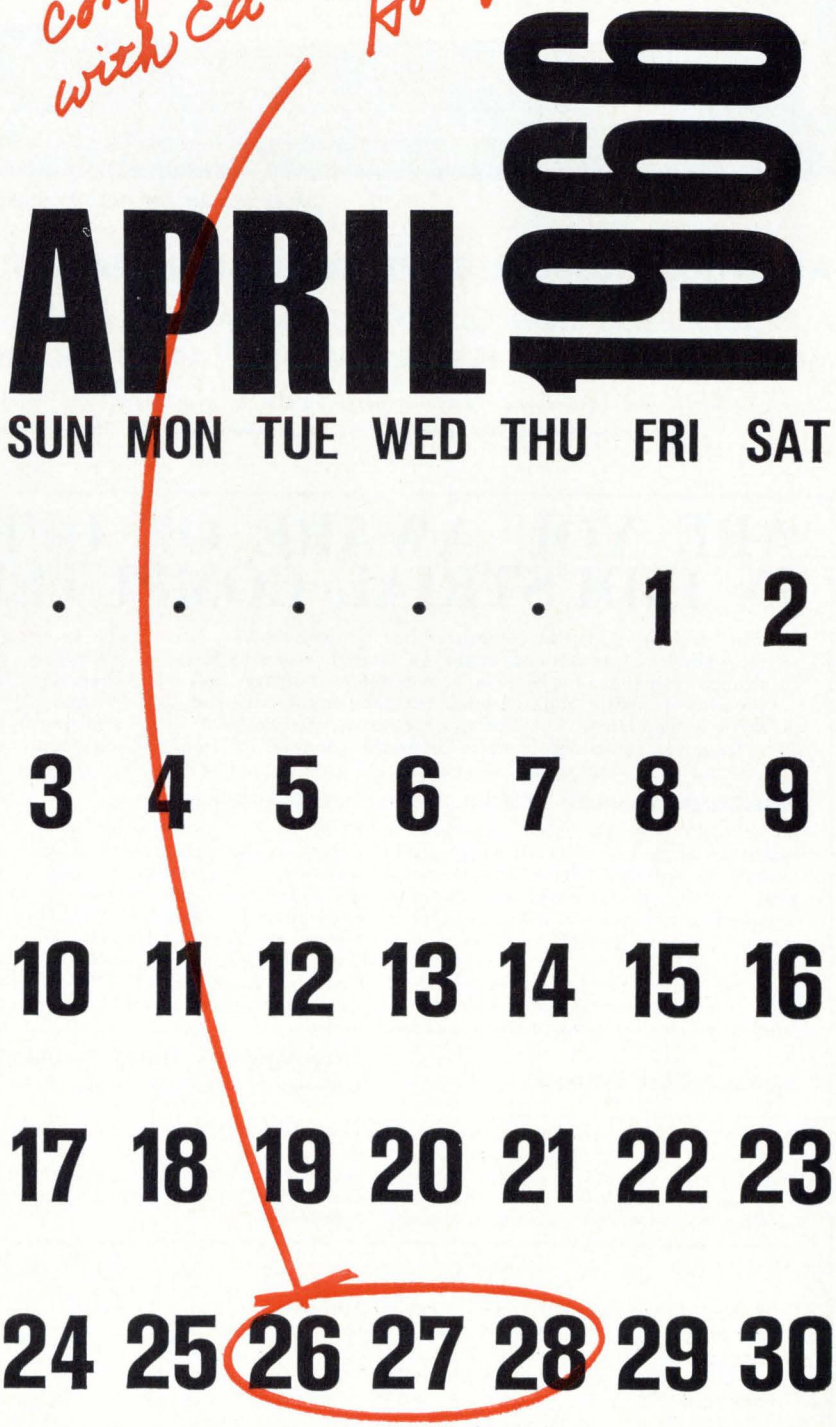

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LITERATURE

Digital Instruments

A new six-page catalog describes standard line of frequency counters and timers, pulse and time delay generators, printers, and specialized digital systems capabilities. Computer Measurements Co., San Fernando, Cal.

Circle No. 226 on Inquiry Card

Digital Plotting Systems

16-page bulletin summarizes the characteristics of a plotting system. The literature also presents pertinent points of consideration in the evolution of plotting systems and provides comparative specifications on various models. California Computer Products, Inc., Anaheim, Cal.

Circle No. 217 on Inquiry Card

Indicator Lights

A 16-page catalog presents a wide array of miniature and large indicator lights (many of which meet or exceed the requirements of MIL-L-3661) for use with neon or incandescent light sources and tamper-proof open-type assemblies and lens caps for panel mounting. Covered are indicator lights for mounting in 9/32", 7/16", 11/16", and 1" clearance holes — each fully documented with data, materials and finishes, and catalog number charts to simplify selection and procurement. Hot-stamped or engraved legends are available with many series for readout applications. Lamp charts listing appropriate lamps for use with any given indicator light are included. Dialight Corp., Brooklyn, N.Y.

Circle No. 227 on Inquiry Card

Pulse Generator

Variable linear rise time to 4.0 ns, variable baseline level, rep rates to 40 mc, and other features of a new pulse generator are illustrated with waveform photos in a technical bulletin. Datapulse Inc., Inglewood, Cal.

Circle No. 215 on Inquiry Card

Stepping Switches

A 34-page stepper catalog contains a concentrated "short course" for designers of multiple circuitry. Included are photographs, working drawings, specs, and operating data. Special sections include application guides, stepper terminology, a guide to stepper selection, and ordering information. Guardian Electric Mfg. Co., Chicago, Ill.

Circle No. 222 on Inquiry Card

Dual Output Supply

Data sheet describes a dual output power supply designed to meet the requirements of MIL-E-16400 and intended for use in instrumentation and systems in ground support applications. The power supply operates from a 115 volt 60 cps source and delivers dual outputs of +26 to +30 volts and −26 to −30 volts at up to 6 amps, both highly regulated to within 0.1% for a ±5% line or load swing. Chatham Electronics, Div. of Tung-Sol Electric Inc., Livingston, N. J.

Circle No. 207 on Inquiry Card

Automatic Voltage Regulations

Four-page bulletin describes a new line of automatic voltage regulators which provide closely regulated ac output voltages from varying input voltages. The units utilize solid-state control to maintain a pre-selected output voltage level within an accuracy of ±1 percent. They can be cabinet or relay rack mounted. General Electric Co., Schenectady, New York.

Circle No. 223 on Inquiry Card

LITERATURE

IC Guide

An 8-page quick reference guide presents schematic diagrams, design features, and complete model designations of 64 digital and linear integrated circuits. The digital circuit line includes a wide range of devices, such as NAND gates, flip-flops, pulse binary counters, line drivers, level-detector/Schmitt triggers, diode arrays, monostable multivibrators, AND or NAND gates, interface circuits, level shifters, and destructive readout bit drivers. Many of the circuits are available with numerous combinations of inputs, nodes, and collector resistors. Westinghouse Molecular Electronic Div., Elkridge, Maryland.

Circle No. 209 on Inquiry Card

PC Reed Switches

An 8-page specification and application data booklet describes and illustrates a complete line of printed circuit dry reed switches called Correeds. Dimensional diagrams are used to illustrate ten basic forms. Corresponding tables list coil resistance and turns, the operate-release-maximum voltage for nominal dc voltages, and indicate those modules available directly from stock. Technical information includes timing curves and explanations of the use of magnetic biasing. Automatic Electric Co., Northlake, Ill.

Circle No. 202 on Inquiry Card

Data Processor

New solid-state data processor which can be used with most dual beam spectrophotometers without major changes in existing equipment is described in a four-page bulletin. The unit compares specimens against a standard specimen, integrates pen position, corrects spectrophotometer 100% line, and digitizes and punches output on paper tape. Hoffman Electronics Corp., Industrial Products Div., Santa Barbara, Cal.

Circle No. 220 on Inquiry Card

Systems Programmers...

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ADVERTISERS' INDEX

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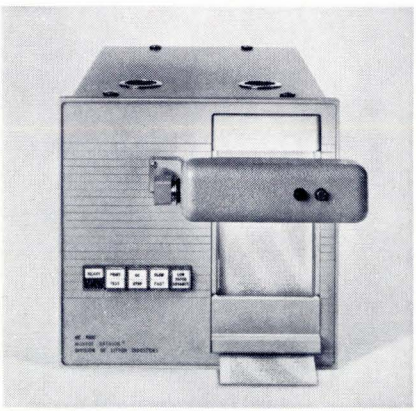

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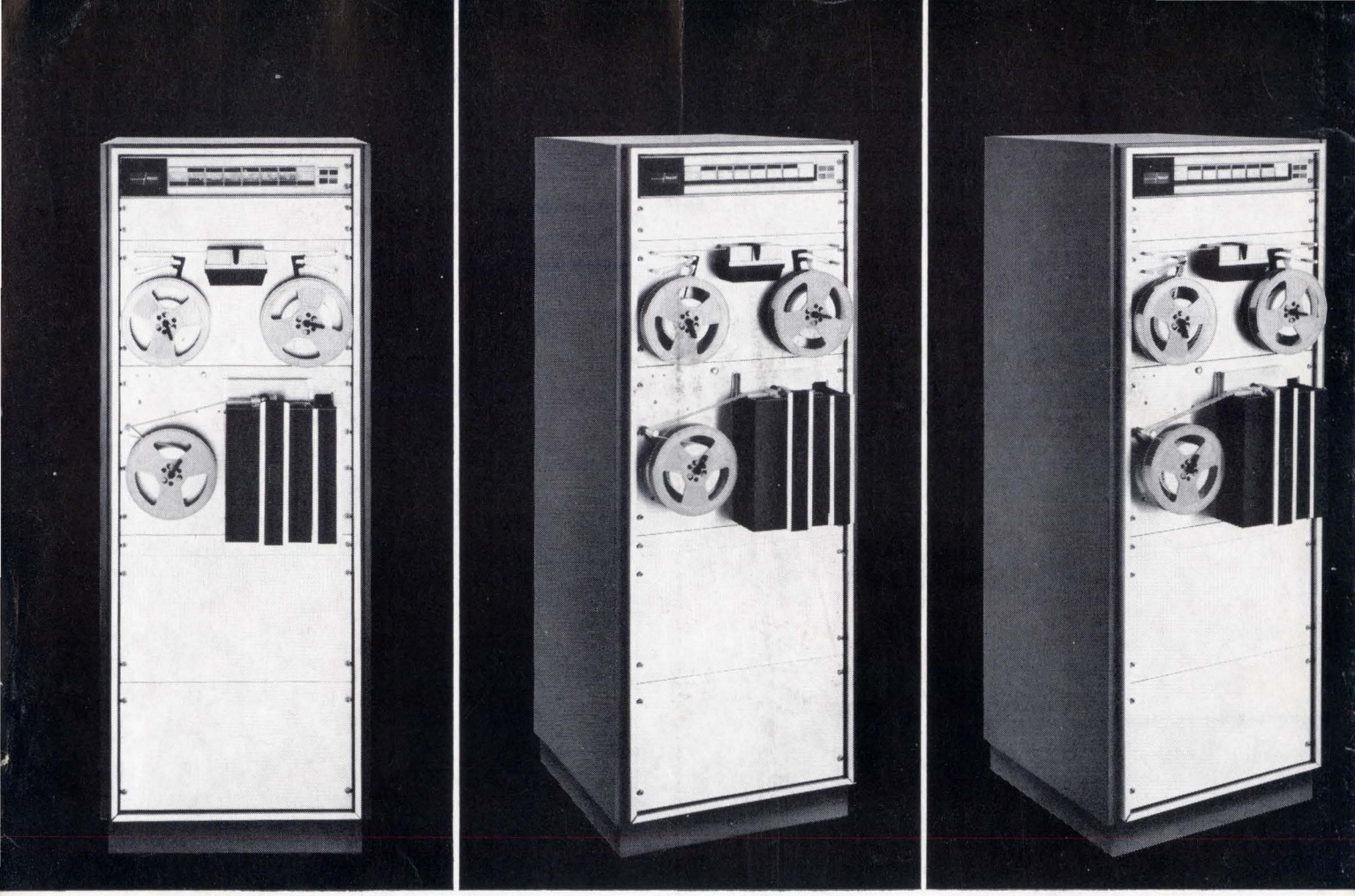
CIRCLE NO. 67 ON INQUIRY CARD



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Now you can get error free data from here to there (or there to here) at 1200 words per minute.

The new Tally Business Communications System 311 Send/Receive Terminal is the most versatile perforated tape station ever offered and the only one which detects and deletes errors. Use the System 311 for transmitting and receiving data over ordinary dial up telephone lines at 120 characters per second and for off-line tape duplication and editing in its spare time.

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