

# THE ELECTRONIC ENGINEER

a CHILTON publication / JANUARY 1972

January 2, 1972: the era of the New Electronics begins.  
Dr. Peter Goldmark on the communications revolution

A survival manual for the 1970s:  
Technology or profit?

Finding your way through the memory maze:  
A guided tour, with maps, to available memories



**DAMN  
IT,  
DON'T  
INVENT.**

**INNOVATE!**

Dr. Peter C. Goldmark

**CBS  
LABS**

PLUS

**DATA  
COMMUNICATIONS**

# It doesn't cost any more for a quality connector. It could cost less.

How do we do it?

Well, first we design a totally new miniature rectangular connector that practices economy without losing sight of reliability. After all, you need both.

That's good, but we go beyond that. We offer you AMPECONOMATION—fast working automated application machinery in your own plant for high speed application of contacts. Depending on your requirements, machine capacities range from 2,000 to 12,000 finished terminations per hour with single applicator. So, whichever machine you choose, you're assured the greatest number of reliable contacts at the lowest applied cost.

Put them together—quality, low initial cost and lowest applied cost, and you've got a miniature rectangular connector that's hard to beat. Which is exactly as we planned.

Sound reasonable? It's more than that. It's downright economical, and the facts to prove it are available now. Just write **AMP Incorporated, Harrisburg, Pa. 17105**

**AMP**  
 INCORPORATED

AMP locations worldwide: Barcelona, Brussels, Buenos Aires, Frankfurt, London, Mexico City, Paris, Sao Paulo, s'Hertogenbosch (Holland), Sydney, Stockholm, Tokyo, Toronto, Turin, Vienna.

Accepts #26-18 AWG, solid or stranded wire in insulation diameters of .050" to .110".

Positive locking feature on housing prevents disengagement of connector halves or dislodgement from panel.

Available in 1, 2, 3, 4, 6, 9, 12, 15, 20, 24 and 36 positions.

Pin or socket crimped in same applicator.

Available in tin or gold plating on contacts.

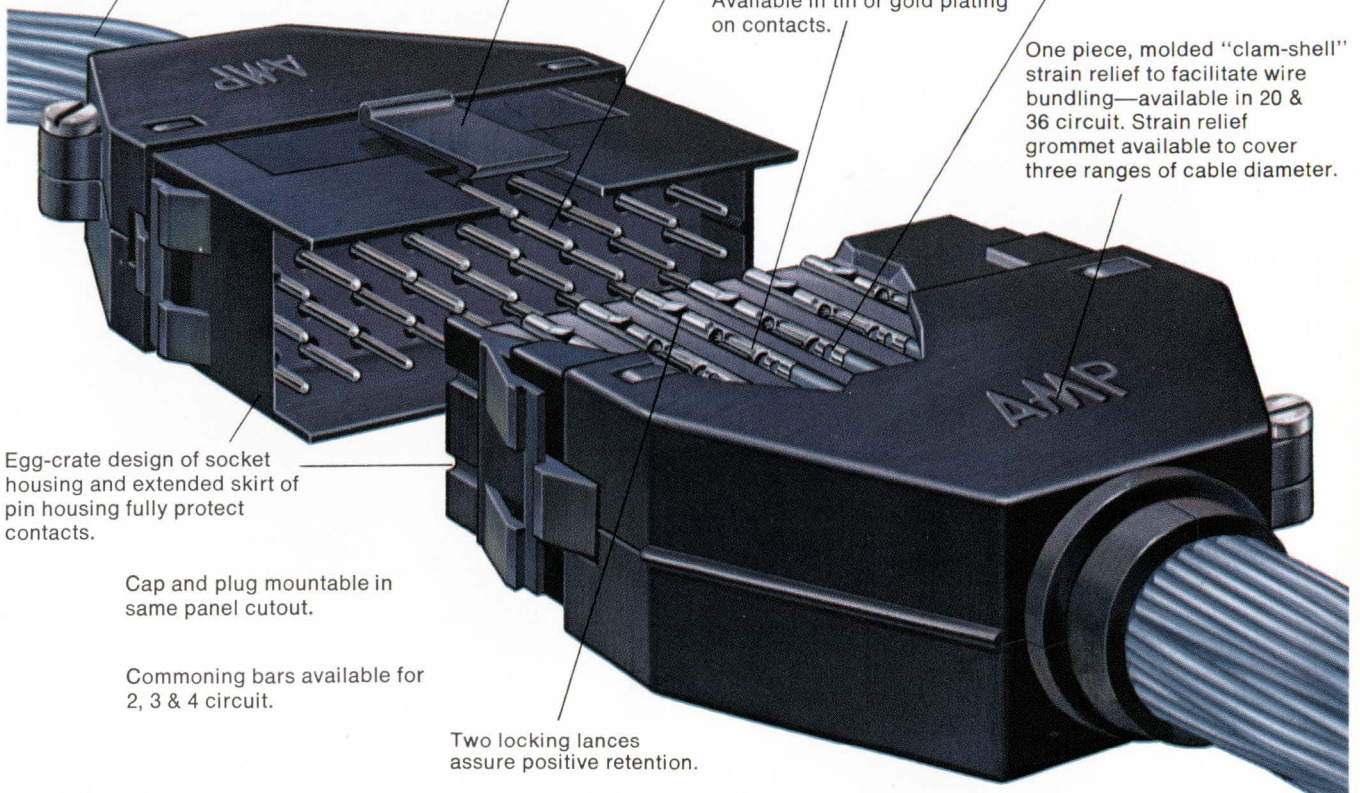
One piece, molded "clam-shell" strain relief to facilitate wire bundling—available in 20 & 36 circuit. Strain relief grommet available to cover three ranges of cable diameter.

Egg-crate design of socket housing and extended skirt of pin housing fully protect contacts.

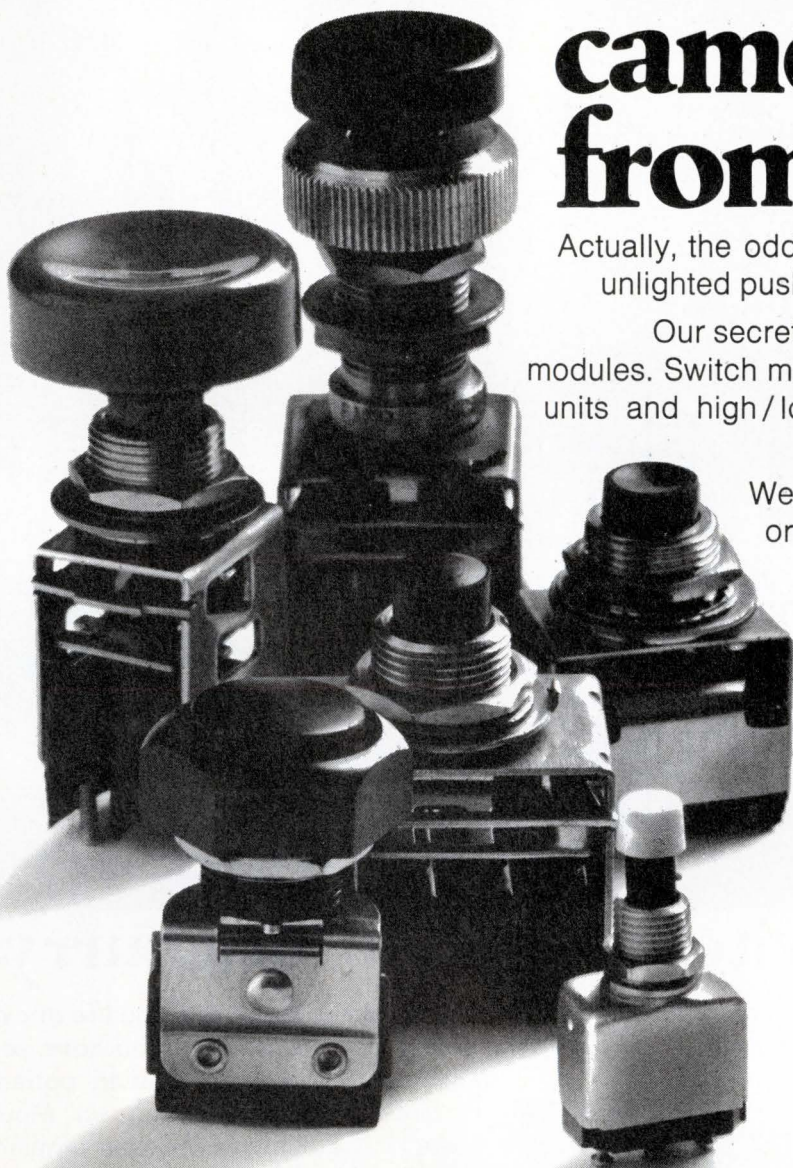
Cap and plug mountable in same panel cutout.

Commoning bars available for 2, 3 & 4 circuit.

Two locking lances assure positive retention.



# There's plenty more where these came from.



Literally, thousands more.

Actually, the odds are in your favor that we have the unlighted pushbuttons you need, right-off-the-shelf.

Our secret is interchangeable parts. Pushbutton modules. Switch modules (including hermetically sealed units and high/low temperature versions). Facenuts.

Even a selection of colored buttons.

We also give you a choice of momentary or alternate action. Or a combination of both. And finally, a pick of one, two, three or four pole circuitry.

Which gives you the opportunity to customize your panel — front and back. To make it the way you want it. And to do it economically.

For more information, call your MICRO SWITCH Branch Office or Authorized Distributor (Yellow Pages under "Switches, Electric").

Or write for Catalog 51.

**MICRO SWITCH**  
FREEPORT, ILLINOIS 61032  
A DIVISION OF HONEYWELL

MICRO SWITCH products are available worldwide through Honeywell International.



## Minilever<sup>®</sup>. The switch for people in a hurry.

There they are, waiting in line with their credit cards. Or, rushing to check a hotel or airline reservation. All done by remote computer terminals.

The operator of that terminal has to be fast and accurate or those nice people will get angry. And that's where Minilever comes in.

Minilever is a lever actuated thumbwheel switch. You can rapidly set any group of digits with excellent visual and mechanical control. When you've finished checking one customer, a sweep of the hand resets everything back to zero.

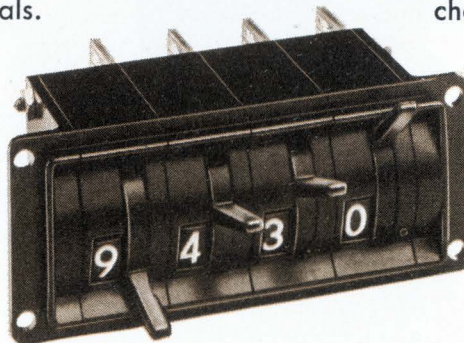
Available in 10 or 12 detent-position modules, you

can expect Minilever to have a switching life of over 1,000,000 detent operations. And, you have your choice of numerous coding options.

So, think of the end-user. Mount a Minilever on your terminal.

You'll help a lot of people get through that waiting line a little sooner. After all, you might be one of those people someday.

Write for our catalog.



### THE DIGITRAN COMPANY

A Division of Becton, Dickinson and Co. **B-D**

855 South Arroyo Parkway, Pasadena, California 91105

Phone: (213) 449-3110, TWX 910-588-3794

Circle Reader Service #3

# THE ELECTRONIC ENGINEER

---

January 1972 Vol. 31 No. 1

**Cover:** For many people, retirement means a gearing down to enjoy some lazy days in the sun. But for Dr. Peter Goldmark, retirement from his presidency of CBS Laboratories on Dec. 31, 1971, meant an opportunity to launch a new concept in business, the Goldmark Communications Corp., on Jan. 2, 1972. With his new company Goldmark, who was responsible for starting new electronic industries with his inventions, will concentrate on innovating with available communications technology. For it is only through technical innovation and not invention, this foremost inventor believes, that we can solve some of our most pressing social problems and at the same time create a new industry. For more on this fascinating man and his plans, see page DC-4. (Photo: J. Naughton)

- 5 Publisher's Comment
- 6 Editorial
- 10 Up to Date
- 26 Speak Up
- 29 Systems
- 33 Editorial Calendar
- DC-1 Data Communications
- DC-10 Data Communications Products
- DC-14 Data Communications News
- 54 Product Roundup
- 56 New Product Features
- 58 New Products
- 62 Microworld New Products
- 66 Lit Roundup
- 68 Literature
- 72 Samples
- 73 Advertising Index
- 74 International Corner

---

## 16 TECHNOLOGY OR PROFITS?—PART 1 By A. Socolovsky

Can an industry hit by the collapse of the biggest sources of its support, defense and aerospace spending, meet the challenge of this decade? For a painstaking analysis of the meaning of the changes in our industry and a formula for individual and corporate survival, read this must piece.

---

## 29 CHARTING THE MEMORY MARKET By Stephen A. Thompson

Once again we've attempted to bring order out of the chaotic memory market. A year ago we plotted representative semiconductor memories as to capacity in bits, performance, and price. We now take a fresh look at these, plus plated wires, bulks, cores, AROMs, and PROMs.

---

## DC-1 DATA COMMUNICATIONS following page 38

This month we take a broader look at all communications with former research guru Dr. Peter C. Goldmark, ex-President of CBS Labs. For the implications of Dr. Goldmark's \$750,000 commitment to communications and the latest data products and news, turn to page DC-1.

---

## DC-4 HOW TO START A REVOLUTION AT 65 (electronic, that is) By John McNichol

Two electronic industries were fathered by Dr. Peter C. Goldmark's inventions—color TV and the long-playing record. Now retiring at 65 from CBS Labs., he has started his own company to innovate with present-day communications technology for the "huge" demand he foresees.

---

## DC-11 LOW-NOISE GHZ TRANSISTORS—WHO'S GOT WHAT

Wondering what low-noise amplifiers are available? And how they differ? Here's a quick survey that puts the low-noise GHz transistor field in perspective. Packaging, reliability, and what to look for in the future share the spotlight in this microwave communications story.

---

## 54 BEST PRODUCTS OF 1971

Assembled here are the top new products, published in 1971, and selected by you, the reader.

---

## 66 BEST LIT OF 1971

What were the most wanted literature items of 1971? Check to see if your favorites are here.

---



# KEPCO TALKS POWER SUPPLY TECHNOLOGY:

## How to interpret "offset" specifications

Traditionally, power supplies have been described in terms of their "regulation" or immunity to the influence of a changing source, load, or temperature. Such specs are a pretty fair figure of merit for comparing similar devices but aren't much good for actually calculating the result of a given influence change.

The main reason is that the regulation figures are composites of the reference errors, amplifier offsets, etc., and each of these components contributes to the output error through a slightly different formula which involves the output setting or feedback ratios and the absolute magnitude of the *ratio* elements.

Whenever a power supply is controlled, perhaps externally from a programmer, with a different set of control constants and feedback ratios than were used by its maker in determining its "regulation specs." The actual performance will be quite different from the published figures.

INFLUENCE QUANTITIES	VOLTAGE AMPLIFIER OFFSETS		VOLTAGE REFERENCE
	OFFSET VOLTAGE $\Delta E_{io}$	OFFSET CURRENT $\Delta I_{io}$	
<b>SOURCE:</b> 105-125/210-250V a-c	<10 $\mu$ V	<2 nA	0.0001%
<b>LOAD:</b> No load — full load	<200 $\mu$ V	<5 nA	—
<b>TIME:</b> 8-hours (drift)	<20 $\mu$ V	<2 nA	0.005%
<b>TEMPERATURE:</b> Per °C	<20 $\mu$ V	<5 nA	0.005%

To resolve this problem, Kepco publishes for all its operationally programmable power supplies, a complete table of specifications listing the effect on the supply's reference plus the effect on its amplifier's offset voltage and offset current, given by the major influences of load change, source change, temperature change and the passage of time (drift). The offset table for the Kepco JQE series of programmable power supplies is reproduced above.

A very simple algebraic equation relates these quantities to the output effect ( $\Delta E_o$  for a voltage stabilizer).

$$\Delta E_o = \Delta E_{ref}(R_f/R_i) \pm \Delta E_{io}(1+R_f/R_i) \pm \Delta I_{io}(R_f)$$

where  $R_f$  is the power supply's feedback resistor and  $R_i$  is the input resistor from the signal reference.

The very complete specifications that characterize Kepco power supplies give you the tools you need to calculate such things as the minimum voltage you can use for programming with acceptable signal-to-noise ratios or the drift-rate in a capacitor-feedback "hold" circuit or the maximum usable feedback resistance.

For a look at a proper power supply specification, ask for our catalog. For a brief essay on how to use the data, request *Operational Power Supply Technology*.



Write Department EE-19

KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352  
(212) 461-7000 • TWX #710-582-2631

# THE ELECTRONIC ENGINEER

January 1972  
Vol. 31 No. 1

Bernard M. Gittelman.....Publisher  
Alberto Socolovsky.....Editor  
Arthur J. Boyle.....Managing Editor  
Smedley B. Ruth.....Associate Editor  
John E. Hickey, Jr.....Features Editor  
Sheldon Edelman.....Western Editor S. F.  
Stephen A. Thompson.....Western Editor L. A.  
John McNichol.....New Directions Editor  
Deborah P. Wilkins.....Assistant Editor  
Dr. O. M. Salati.....Consultant  
Anne Axe.....Editorial Assistant  
Lynda Rothstein.....Editorial Assistant  
Mae Moyer.....Editorial Reader Service  
Andrew Mittelbrunn.....Chilton Art Director  
Phaue Featherson.....Artist  
George Baker.....Washington News Bureau  
Neil Regeimbal.....Washington News Bureau  
K. Robert Brink.....Publishing Vice President

**Executive and Editorial Offices:**  
One Decker Square, Bala-Cynwyd, Pa. 19004  
Tel: (215) SH 8-2000

**Address Mail to:**  
56th & Chestnut Sts., Philadelphia, Pa. 19139

**Western Offices:**  
Stephen A. Thompson  
3727 W. 6th St., #202, Los Angeles, Calif. 90005  
Tel: (213) DU 7-1271

Sheldon Z. Edelman  
199 First St., Rm. 335, Los Altos, Calif. 94022  
Tel: (415) 941-6655

**Chilton Officers & Directors:** Robert E. McKenna, President; John H. Kofron, Charles W. Hevner, William A. Barbour, Sr. Vice Presidents; Richard H. Groves, K. Robert Brink, Publishing Vice Presidents; James Miades, Vice President, Finance; James A. Naughton, Vice President, Creative Services; Christian H. Miller, Secretary; Thomas J. Casper, Spencer H. Collmann, John P. Kushnerick, Raymond O. Nelson, Eugene C. Beaudet, William A. Phair, David Acton, Donald P. Jones, Richard C. Sorlien.

Monthly publication of Chilton Company, Chestnut & 56th Sts., Phila., Pa. 19139. (Area Code 215) SHERWOOD 8-2000. Controlled circulation postage paid at Philadelphia, Pa. \$1 a copy. Subscription rates U. S. and U. S. Possessions: 1 yr. \$12.00; 2 yrs. \$20.00. Canada 1 year \$14.00; 2 yrs. \$25.00. All other countries 1 yr. \$20.00; 2 yrs. \$35.00. © Chilton Company 1972. Title Reg. U.S. Patent Office. Reproduction or reprinting prohibited except by written authorization. Microfilm reproductions of **The Electronic Engineer** and its predecessors, **Electronic Industries** and **Tele-Tech**, may be obtained from University Microfilms, 313 N. First St., Ann Arbor, Mich.

**The Chilton Electronics and Instrumentation Group**  
The Electronic Engineer  
Instruments and Control Systems  
Instrument & Apparatus News  
Medical Electronic News  
Electronic Components News

Chilton

### The memory thinker

A year ago our western editor, Steve Thompson, called editor Alberto Socolovsky and asked: "How big can I make my column? I think I have a handle on the memory market."

Steve's "expanded" column turned into a major feature. He had been scanning data sheets for weeks, convinced that any multi-million dollar market could not be as disorganized as memories appeared to be. Traditional plots of speed or price against cost left him cold, because they did not map into each other. After he asked himself the key editorial question, "How would I buy a memory if my boss gave me the responsibility?" He arrived at the underlying assumptions for what are now called the "Thompson Charts," which first appeared in *The ELECTRONIC ENGINEER*, December 1970, pp

Steve launched what amounts to a major marketing survey, useful to manufacturers and users alike. His method is so powerful that he can spot errors in the data when it doesn't "fit." Since then, he has called some manufacturers to tell them that they were calling ROM a product which was really a RAM, or that they were misquoting speed or price. Some vendors have even admitted doing this to make their products appear more competitive.

Steve readily admits, "I really don't know if I understand memories any better, but now that I can plot them all in straight lines, I know what users ought to pay for them.

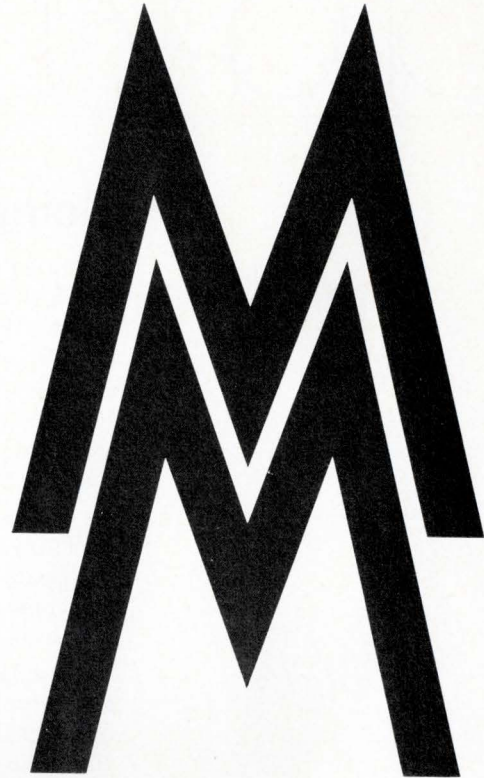
Others agree. Steve has become the foremost memory editor in the country. He compiled our seven-chapter "Memories Course" (*The ELECTRONIC ENGINEER*, Feb.-Aug. 1971) and chaired the session, "Selecting Main Frame Memories," at the Computer Designer's Show last year. He has teamed with our managing editor, Art Boyle, to present a Professional Advancement Course, "MOS and Computers," at the same show this year. Cutler-Hammer invited him to give the "Overview of Memories" at its recent Design Symposium for the company's designers.

Steve has covered a lot of bits on his own initiative. Manufacturers and users alike will benefit from the thousands of calculations he has made in order to bring a better way of thinking to the memory field.

With as much detachment as we can muster, we like to feel that Steve's dedication to editorial excellence is another example of the input that makes *The Electronic Engineer* distinctly unique among electronic magazines.



Bernard Gittelman  
Publisher



## The Dynamic Centre of Trade and Research

### Leipzig Trade Fair German Democratic Republic

## 12/21 March 1972

The research man, the development man, the think man, the man whose thoughts are turned on tomorrow—he knows Leipzig Fair. At Leipzig, the international products displays close the gap between today's ideas and tomorrow's realities; and international leaders in science and technology point the way even further ahead in a unique programme of conferences and lectures. Meet tomorrow—and the day after tomorrow—at Leipzig today.

Fair Cards and information about travel to Leipzig obtainable from Globe Travel Service, Inc. 127 North Dearborn Street, Chicago, Illinois 60602 Tel. DEarborn 2-0090 • Krueger's Travel Service, Bergenline Ave. at 65th St., P.O.B. 209, West New York, N.J. 07093, Tel. 868-9623 (N.J. Area Code 201), 564-6654 (N.Y. Area Code 212). Trans-Global Travel Bureau, 6333 Wilshire Blvd., Los Angeles, Calif., 90048, Tel. 651-0560 or at the GDR State frontier.

Circle Reader Service #5

## Going out of our way

"You fellows are like dogs," goes a famous quote attributed to the legendary Dr. Leslie Hoffman of semiconductor fame, "going back to p--- on the same tree every time."

The "tree" the good doctor had in mind was a market. Even in the early days of semiconductors, it revolted him to see his reps just going around the select circuit of Boeings, of Douglasses, and of Jet Propulsion Labs. Dr. Hoffman understood that when a manufacturer cultivates mainly one type of user, he also ties his future to that type of user.

At no time has Dr. Hoffman's parable been more timely than now. For the past 20 years, the electronics industry has tied its growth to this military and aerospace market. With the decline of that market, the growth of the industry has come to a halt. And, as in the doctor's canine example, we must blaze a new trail.

In trailblazing to look for new opportunities and new markets lies the solution to the problems that today affect the engineers, beset the industry, and bewilder the government. And this solution can only be achieved through a concerted effort by all three members of this trilogy: *engineers, industry, and government*. It is high time the engineers consider the economic aspect as an important design constraint instead of blaming marketing when a new product doesn't sell. It is time the industry funds its creative urges with its own resources, instead of hoping for a windfall appropriated by the military and underwritten by the taxpayer, so it can put ideas to an early test for profitability. And it is time for government to understand that its most important role is to create the proper climate for, rather than control, new developments.

We too, at **The Electronic Engineer** magazine, have been going out of our way to serve you under these changing conditions. We have preferred the practical to the esoteric, the user's reaction to the scientific self-satisfaction. And, built upon a solid technical base, you will see a constant referral to the economic picture. We started on this road two years ago, with our series of practical courses on new technology, and by bringing into the magazine the challenges from men who control the new opportunities for our industry. We continue to do it in this issue with an analysis of the problems that have beset engineers and our industry recently, and we will in future issues with a look at new opportunities.

After all, if to water the same tree every time is for the dogs, to serve a forward-looking reader and industry is for leaders. And leadership is what we want you to find in these pages in the months ahead.

---

## Let not his vision die with him

David Sarnoff (1891-1971) of RCA, the man who more than any other electronics executive symbolized the progress of his company, is gone. He has been praised for his accomplishments, criticized for his tenacity. But he will be remembered for his vision, the vision that allowed him to see through the haze that separates a technical development from a successful product.

In this issue, Dr. Peter Goldmark of CBS, another pioneer of communications and a rival of Sarnoff's company, calls for innovation, not invention, as the key to success in the 1970's. It takes men of Goldmark's caliber to innovate. It will take men of Sarnoff's vision to recognize innovation. Let his vision live.

*Alberto Socolovsky*  
Editor





# Incredible. A Heinemann circuit breaker in your product could ultimately cost you less than a fuse.

## Case in point:

The machine in the picture is a non-impact data printer, the Repco 120.

It was designed at the outset to be more reliable than competitive machines. And sell for a lower price.

Yet it's protected with a Heinemann circuit breaker instead of a fuse.

The breaker costs more, of course.

Or does it?

Consider. Consider the cost of a service call to replace a blown fuse. Perhaps, a fuse that gave up the ghost because of something as harmless as a surge in the power line.

Repco calculated that the cost of one unnecessary service call

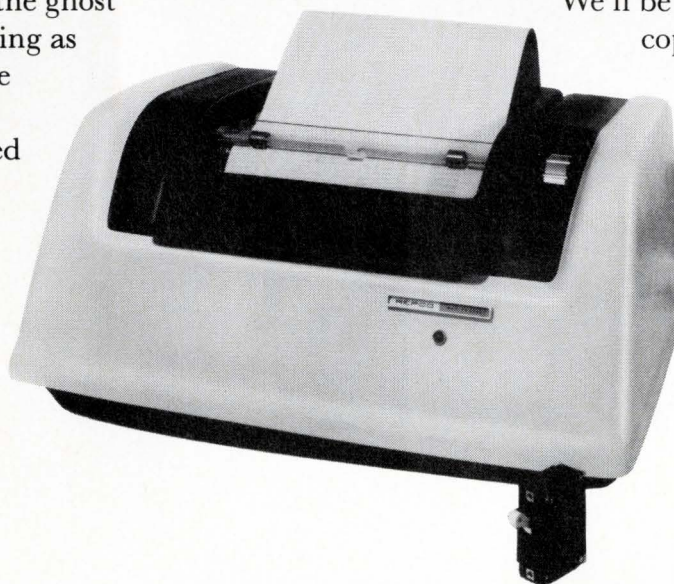
would more than pay for the price of the circuit breaker.

And the company got a little bonus in the bargain. The 120 Printer uses our breaker as the main on-off power switch as well as the overload protector.

The breaker in the Repco 120 Printer is our JA model. Its OEM price, in reasonable quantities, is quite reasonable. Not cheaper than a fuse, though.

Just cheaper than a service call.

We'll be glad to send you a copy of our Bulletin 3350, which gives complete data on the JA breaker line. Heinemann Electric Company, 2806 Brunswick Pike, Trenton, N.J. 08602.



**HEINEMANN**

**EASY ECL  
EVEN EASIER  
WITH 12  
NEW DEVICES**

---

## 9500 Easy ECL Family offers designers lower power, higher speed, lower cost systems.

The addition of 4 new MSI circuits — along with 8 new SSI devices — gives our *temperature compensated* ECL family the breadth, depth, variety and flexibility that makes designing with ECL/MSI functions easy as using TTL/MSI.

Since MSI is even more significant in ECL systems design than in TTL, our Easy ECL 9500 series is essentially an MSI family. That's why we now offer 7 key MSI functions — 22 circuits in all. Why all 9500 Series devices are fully temperature compensated for adequate noise immunity to allow problem-free SSI-to-MSI interfacing. Why MSI design in ECL systems is practical for the first time.

### ECL/MSI ASSURES LOWEST SYSTEM POWER DISSIPATION

Comparison of unloaded and system power dissipation per gate of 9500 Easy ECL functions. With an MSI function, the termination power is amortized over many gates thereby assuring lowest system power dissipation.

Device	Description	Gates/ Function*	Power Dissipation (mW/Gate)										
			0	15	30	45	60	75	90	105	120		
SSI — Gates													
9502	General Purpose Dual OR-NOR	2	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
95H02	High Speed Dual OR-NOR	2	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
95L22	Low Power, High Speed Dual OR-NOR	2	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9503	General Purpose Triple OR-NOR	3	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
95H03	High Speed Triple OR-NOR	3	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
95L23	Low Power, High Speed Triple OR-NOR	3	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9582	Triple Line Receiver/Amplifier	3	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9504	General Purpose Quad NOR	4	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
95H04	High Speed Quad NOR	4	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
95L24	Low Power, High Speed Quad NOR	4	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9505	Four Wide OR-AND	5	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9507	Quad AND-NAND	5	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9595	Dual ECL-TTL Converter	2	not applicable										
SSI — Flip-Flops													
95H29	250MHz J-K	9	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9528	Dual 160MHz D-Type	12	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
MSI Elements													
9538	1-of-8 Decoder	12	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9581	8-Input Multiplexer	12	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9578	Quad EX-OR/Comparator	16	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9579	Quad 2-Input Multiplexer	16	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
9534	Quad Latch	24	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
95H84	High Speed Adder/Subtractor	29	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										
95H90	250MHz VHF Prescaler	29	[Bar chart showing typical dissipation at ~10mW and system dissipation at ~110mW]										

\*Number of on-chip ECL Gates not discrete TTL equivalents.

■ Typical Device Dissipation ■ Additional Dissipation in system due to termination scheme.

### MSI + SSI = EASIEST ECL.

Key to easiest ECL design is the lower power dissipation afforded by maximum use of MSI functions — with ancillary SSI low power gates and flip-flops. That way you get the speed and performance of ECL with economic and reliability advantages of MSI design. You get the most favorable speed/power trade-offs.

For example, basic ECL/SSI gates are approximately two times faster than TTL; but with the design advantages of ECL, the MSI functions are four to eight times faster at similar power dissipation.

### NOW NEW IN EASY ECL.

#### Four new MSI Circuits:

**95H84 adder-subtractor** with full on-chip carry lookahead that permits addition or subtraction of two 64-bit words in 22nS. Fastest adder function on smallest board area available.

**9534 quad latch** with gated input and output enable features. Buffering of outputs insures glitch-free operation with approximately 4nS delay. Applications: register, ALU, parallel-serial conversion.

**9578 quad exclusive-OR** function also for use as 4-bit comparator or dual differential line driver. 3nS delay.

**9579 quad 2-input multiplexer** with 2.6nS delay. Common select line reduces external wiring for variety of function-generation and multiplexing applications.

#### Low-Power SSI

New **95L22, 23, 24 low-power gates** are pin-identical with standard and high-speed gates. 20mW power dissipation (20% lower than any other available ECL gates), and 2nS propagation delay at no price premium. 60K ohm on-chip pulldown resistors.

For use in an area of high-power density (e.g., memory arrays), and as receiving element at end of long data bus lines.

#### High-Speed SSI

Three new high-speed gates and a new high-speed flip-flop:

**95H02, 03, 04 gates**, pin-identical with standard and low-power gates. 1.6nS delays at similar power as standards.

For clock-driving with flip-flops, registers, large synchronous arrays, where maximum speed required. Also as high-speed logic function where multiple gate decisions must be made within short clock period (e.g., loading a universal shift register within a narrow clock pulse).

**95H29 J-K flip-flop** with 250 MHz toggle frequency features non-ones catching master-slave circuit with multiple gating on inputs. For high-speed counting, register, data storage.

#### Low-Cost Standard SSI

**9507 quad and 2-input AND, 8-input NAND gate.** Eliminates a number of external connections in computing and general logic applications. 2.3nS delays without deterioration in rise-and-fall performance under heavy loading conditions.

#### AVAILABLE NOW

All 12 new members (and their 10 older relatives, of course) of our Easy ECL family are now available in production quantities from your friendly Fairchild distributor. Additional sources: N. V. Philips/AmpereX and Raytheon.

**MADE IN  
FAIRCHILD**

Circle Reader Service #7

**International trade** . . . on consumer electronic products continues to show an unfavorable balance for the U.S. this year. According to the EIA and the Dept. of Commerce, imports during the first nine months of 1971 for both domestic and foreign labels were over \$891 million. This is higher than for the same period last year, and on its way to topping 1970's \$1.2 billion mark. U.S. exports were close to \$61.5 million, with color TV sets and video tape equipment emerging as the major export items.

**P-I-N-ning down applications** . . . for these (p-intrinsic-n) diodes is going slowly, at best. True, the PIN-diode market is growing, with most applications still in agc circuitry for CATV. But even though prices have dropped to around \$2 each, it seems that word hasn't gotten around to manufacturers of front-end attenuators for the hi-fi market, so the PIN market hasn't blossomed yet. Hewlett-Packard is sampling some now. For more information on what they have in mind

**Circle Reader Service #265**

**Introducing the PDP-11/45** . . . Digital Equipment Corp. has done it again, this time introducing a member of their PDP series that allows communications systems to handle data throughput rates and a larger number of lines than other price comparable computers. Other capabilities that make it a good buy are memory segmentation, hardware and software priority interrupt scheduling, and multiprogramming. And you can choose bipolar, MOS, or core memory (or any combination of these) in up to 124k 16-bit words.

**Circle Reader Service #266**

**There's hope for the American calculator** . . . thanks to Eldorado Electrodata's "all-American" machine that sells for just \$199. The calculator, made in America, uses Texas Instruments' new one-chip calculator circuit. It features 8-digit readout, full 4-function keyboard, and a floating point capability. If you receive Spiegel's mail order catalog, you'll find it listed there. And if you'd like more details on this all-American machine, write to Eldorado Electrodata Corp., 60 Chalamar Rd., Concord, Calif. 94520, or

**Circle Reader Service #267**

**Philips is handing the world a line** . . . Philips Data Systems, a division of N. V. Philips in the Netherlands, is introducing a complete OEM product line to the world wide minicomputer market. Their P850, P855 and P860 16-bit minicomputers and peripherals will compete directly with the most advanced mini's available on the U.S. and international OEM markets. And as for software, you can get 8k FORTRAN IV compilers, basic monitor, real time monitor, one-pass assemblers, linking loaders, edit routines, complete mathematical library, drivers for all peripherals, and complete diagnostics and utility routines.

**Circle Reader Service #268**

**Analog Devices: taking stock in monolithics** . . . In an agreement with Nova Devices Inc., Analog Devices will acquire all of Nova Devices' outstanding stock. The acquisition of Nova Devices is part of a plan introduced three years ago to design and manufacture Analog's line of modular op amps and converter products in monolithic form. Nova Devices, founded in Sept. 1969, was largely financed by Analog Devices. Their IC products have been sold exclusively under the ADI brand name and through ADI's marketing network.

**Two-pronged effort** . . . American Micro-systems is attacking both the asynchronous and the synchronous communications markets. AMI has already introduced its S1757 universal asynchronous transmitter/receiver (**The Electronic Engineer**, Dec. 1971, p. DC-18), and now will offer two products for the synchronous market. One, the S1868, is an error-correcting code generator. This unit generates the error-detecting characters sent at the end of transmission of a block of data. The second product is the S1869, a synchronous-communications receiver/transmitter. The SCRT is a full-duplex receiver/transmitter (any eight-level code) suitable for direct-wire and telephone-type applications.

**Circle Reader Service #269**

**Engineers getting it together** . . . Engineers and scientists, frustrated by the lack of a single organization to lobby for all of them in the halls of Congress, have found a champion. PACES (Political Action Committee for Engineers and Scientists), a registered and authorized lobbying group, will try to exercise political clout in such areas as employment for jobless engineers, portable pensions, patent law reform, and national standards of technical competence and ethics. According to PACES spokesman Harold Ammond, they hope for 50,000 members by July. The fee is \$10 per year for employed engineers, \$2 for the jobless or retired. For membership or details, write to PACES, Suite 809, 1140 Connecticut Ave., N.W., Washington, D.C. 20036, or

**Circle Reader Service #270**

**Investing your talent** . . . As part of Pres. Nixon's \$42 million package for the unemployed, a self-help program for jobless engineers is spreading across the country. Under a contract for \$149,695 from the Department of Labor and the sponsorship of the American Institute of Aeronautics and Astronautics, VEST (Volunteer Engineers, Scientists, and Technicians) opens the facilities of state employment offices to out-of-work engineers. From these offices the men organize and run the job hunting project on a strictly voluntary basis, with the employment people handling the support functions. About 600 of its 3000 participants since June 1 have already found and accepted jobs. VEST, soon to be in 25 states, is a self-service organization, so if you're interested help yourself by calling on your local state employment office.

# Now JAN high voltage power switching transistors...

it's a point worth repeating.

And they're available from Unitrode — optimized for the best combination of switching speed, saturation voltage and second breakdown to help you design more efficient power switching circuits. The result is performance features like these . . .

Series	I <sub>C</sub> (max)	V <sub>CE</sub> (sus) (min)	V <sub>CE</sub> (sat) (max)	E <sub>SB</sub> (min)	t <sub>ON</sub> (max)	t <sub>OFF</sub> (max)
2N5660	2A	to 400V	0.8V @ 2A	1.00mj	0.25μs	0.85μs
2N5664	5A	to 400V	1.0V @ 5A	1.25mj	0.25μs	1.50μs

The 2N5660 — 2N5667 series is available in TO-5 and TO-66 packages as JAN and JANTX power switching transistors to MIL-S-19500/454 and /455. Now that the best has been officially accepted, all that's needed is your approval. For fast action, call Sales Engineering collect at (617) 926-0404, Unitrode Corporation, Dept. 1 W, 580 Pleasant Street, Watertown, Mass. 02172.



**UNITRODE**

Circle Reader Service #8

## Now JAN high voltage power switching transistors...

It's a point worth repeating. And they're available from Unitrode — optimized for the best combination of switching speed, saturation voltage and second breakdown to help you design more efficient power switching circuits. The result is performance features like these

Series	I <sub>C</sub> (max)	V <sub>CE</sub> (sus) (min)	V <sub>CE</sub> (sat) (max)	E <sub>SB</sub> (min)	t <sub>ON</sub> (max)	t <sub>OFF</sub> (max)
2N5660	2A	to 400V	0.8V @ 2A	1.0mj	0.25μs	0.85μs
2N5664	5A	to 400V	1.0V @ 5A	1.25mj	0.25μs	1.50μs

The 2N5660 — 2N5667 series is available in TO-5 and TO-66 packages as JAN and JANTX power switching transistors to MIL-S-19500/454 and /455. Now that the best has been officially accepted, all that's needed is your approval. For fast action, call Sales Engineering collect at (617) 926-0404, Unitrode Corporation, Dept. 1 W, 580 Pleasant Street, Watertown, Mass. 02172.



**UNITRODE**

## Now JAN high voltage power switching transistors...

It's a point worth repeating.



**UNITRODE**

# Memory System Kits

Now Intel produces all interfacing ICs necessary to build complete TTL-compatible memory systems using Intel 1103's, the 1024-bit dynamic MOS RAM that's become an industry standard.

You can get a ready-to-plug-in system from us, or you can build your own system with Intel components and design assistance that begins with a 28-page handbook of instructions for designing with 1103 RAMs.

Any system you buy or build will accept standard TTL inputs and generate standard TTL outputs. All clock drivers, decoders, level shifters, and other TTL interfaces can be on the same board with 1103's.

For example, the board pictured here, Intel Memory System in-16, is a complete functional memory storing 4K 9-bit words per board. To expand the word length or number of words you simply add boards. Maximum cycle time is 950 ns. Price when built by us is about 1¢ per bit in OEM quantities.

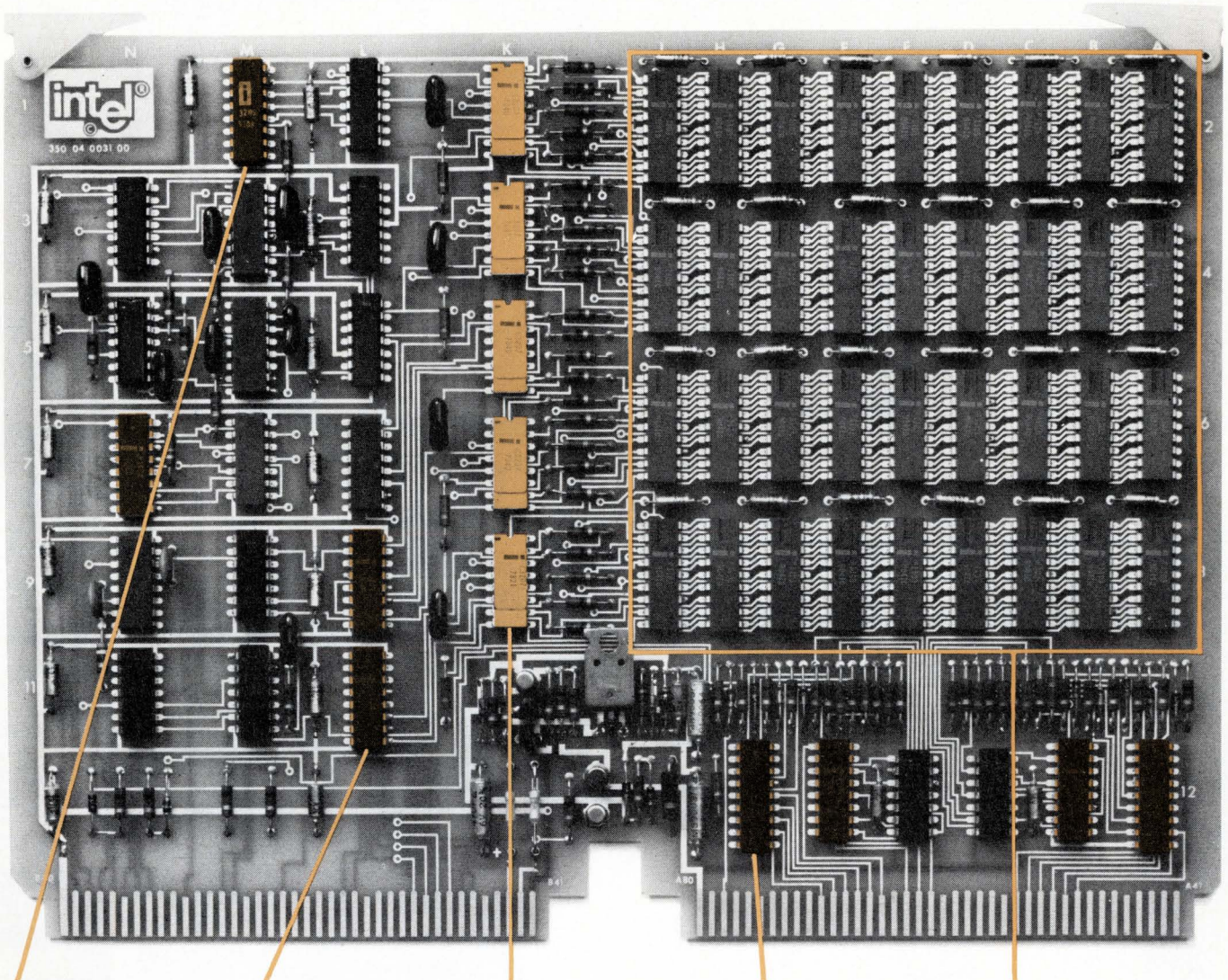
Also available off-the-shelf are faster memories like System in-10, an 1103 memory with a maximum system cycle time of 450 ns, smaller, compact memories like System in-20, which uses Intel's 256-bit static MOS RAM to store 1K 12-bit words per 6" x 8" board, and bipolar memories like system in-50, a 100-ns system that stores 512 8-bit words.

All system components called out on the page opposite are now in stock. For immediate delivery phone your local Intel distributor: Cramer Electronics, Hamilton Electro Sales, Industrial Components, or Electronic Marketing.

For further information on memory systems, phone Intel or our nearest sales office: Tustin, Calif. (714) 838-1126, Florham Park, N.J. (201) 822-0044, Lexington, Mass. (617) 861-1136 or Bloomington, Minn. (612) 925-3144. In Europe contact Intel at Avenue Louise 216,B 1050 Bruxelles, Belgium. Phone 492003. In Japan, contact Intel Japan, Han-ei 2nd Bldg., No. 1-1, Shinjuku, Shinjuku-ku, Tokyo 160. Phone 03-354-8251.

Intel Corporation is headquartered at 3065 Bowers Avenue, Santa Clara, Calif. 95051. Phone (408) 246-7501.

# New interface ICs simplify 1103 systems. Easy to build. Easy to buy.



**Chip-select decoder.** Intel 3205 converts the chip-select signal from a binary code to a voltage on 1 of 8 terminals. Maximum delay is 18 ns.


**Latch.** Intel 3404, a 6-bit latch with 12 ns maximum delay, stores write data and addresses momentarily for input to 1103's.

**Driver.** Intel 3207 accepts standard TTL input and creates correct voltage levels for both clock and address inputs of 1103 RAMs.

**Sense amp.** Intel 3208 converts output current of 1103 to proper voltage levels for TTL circuits.

**1103 RAMs.** There are 36 here, storing 36,000 bits of data.


intel<sup>®</sup>  
delivers

 **TELEDYNE  
PHILBRICK**

**4008**

12-bit bcd  
D/A converter

101

 **TELEDYNE  
PHILBRICK**

**4110**

tracking 8-bit  
A/D converter

102

**4111**

 **TELEDYNE  
PHILBRICK**

dual slope  
12-bit bcd  
A/D converter


106

 **TELEDYNE  
PHILBRICK**

**4010**

10-bit  
D/A converter

103

 **TELEDYNE  
PHILBRICK**

**4109**

dual slope 12-bit  
A/D converter

104

 **TELEDYNE  
PHILBRICK**

**4022**

economy 10-bit  
D/A converter

107

 **TELEDYNE  
PHILBRICK**

**4002**

precision 14-bit  
D/A converter

105

 **TELEDYNE  
PHILBRICK**

**4020**

economy 8-bit  
D/A converter

108



# To show them all would take another 15 pages.

 **TELEDYNE  
PHILBRICK**

**4103**

successive  
approximation  
12-bit A/D converter


109

 **TELEDYNE  
PHILBRICK**

**4004**

12-bit  
D/A converter

110

 **TELEDYNE  
PHILBRICK**

**4016**

high speed current 13-bit  
D/A converter

111

Circle the appropriate reader service number for complete information on data conversion modules shown here. You'll also receive the 1972 Product Guide. More information is also available from your local Philbrick representative or Teledyne Philbrick, Allied Drive at Route 128, Dedham, Mass. 02026. For toll-free data (800) 225-7883. In Mass. (617) 329-1600.

## Philbrick Data Converters. A bit ahead of the rest.

# The Challenge of This Decade: Technology or Profit?

**Engineers as well as the industry  
face formidable challenges in the '70s.  
Will they succeed or fail?**

## **PART I**

**By Alberto Socolovsky, Editor**

The decade of the '70s began with both a sharp warning and a formidable challenge to the electronics industry. The *warning*, precipitated by sharply declining sales in 1970, told the industry that the lush years of the '60s were over. Those were the years when the procurement policies of the Defense Department fueled the growth of virtually the entire industry. Now those policies have been reversed and the abundant flow of money has, in many instances, come to an abrupt halt. Even though the military is still the industry's major customer for both components and equipment, the *growth* it provided has virtually ended.

The *challenge*, of course, is both pertinent and obvious, and requires that we find and develop markets other than the military that will provide continuous growth, prosperity and full employment for the electronics industry. Our biggest obstacle is breaking with the past. If we persist in developing and marketing products as we did in the '60s when the industry was "spec oriented," there will be no growth.

### **Marketing and Technology**

Being "spec oriented" is the tendency for a company to develop a new product by *improving the specifications on an already existing product*. Now we must be "service oriented" or "customer oriented" and develop new products that will solve problems or make money for customers in industries which we have never approached before.

No one has summed up this problem better than William Glavin, president of Xerox Data Systems, when he said: "*It's time we quit trying to sell what we have on the drawing board and start drawing what sells.*"

Mr. Glavin's comment shook a large segment of the industry but what he says is undeniably true. The only question is, why did it take us 20 years to face up to this fact?

To put it bluntly, it is apparent that *marketing is now as important to our growth as is our technology*. More than ever before the engineer, the technical catalyst of the industry, must become involved in the pursuit

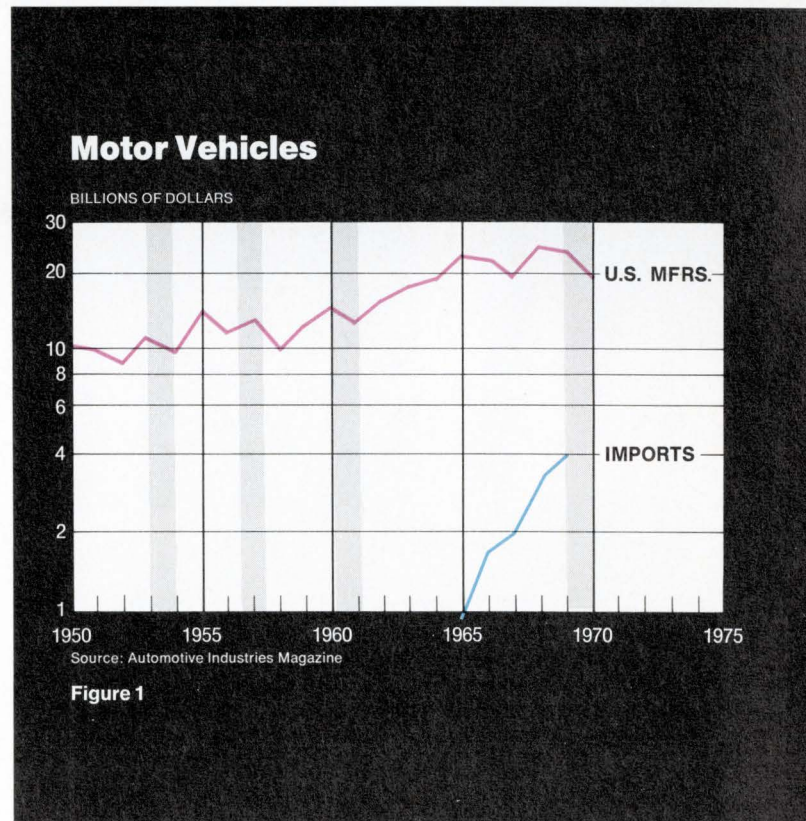
of profit. He must not only be inventive in advancing the technology, but he must be inventive in developing products that satisfy all kinds of needs, both consumer and industrial. In today's complex and highly competitive marketplace he has no other choice.

John Kenneth Galbraith says that "Technology is the systematic application of scientific knowledge to practical tasks." Let us underscore the word "practical." Today's engineer is now as much involved in marketing success as is the top management of his company. *It is a new experience.* For he must relentlessly ask himself not only will it work but "*will it sell?*"

This is the challenge of this decade, a challenge that we must face up to. It is a challenge to our own and the industry's *maturity.*

## Maturity

Let's look at what we mean by maturity by examining another industry that is considered mature even though few regard it as being innovative, the motor vehicle industry. **Figure 1**, at right, reveals that for the past 20 years sales of motor vehicles in the United States show a strong growth curve although periodically their sales volume seems to parallel the erratic ride of a roller coaster. The gray bars in the graph represent vehicle sales during recessionary periods. Notice that motor vehicle sales declined not only during recessions but even in years when there were no recessions. But in each period of declining sales the manufacturers rolled with the punches and subsequently brought sales back up to another new high. Not so much on the appeal of innovation, but on the sheer strength and persistent application of marketing knowhow. Notice another problem of maturity this industry must contend with: imports—which are growing at a rate faster than that of total vehicle sales. In both its domestic and foreign marketing, this industry *expects* to be in a tough fight for dominance or profitability or both. It is a tough, fighting industry because it has matured in a highly competitive and continuing struggle for survival. *And that's*



## A Growth Industry?

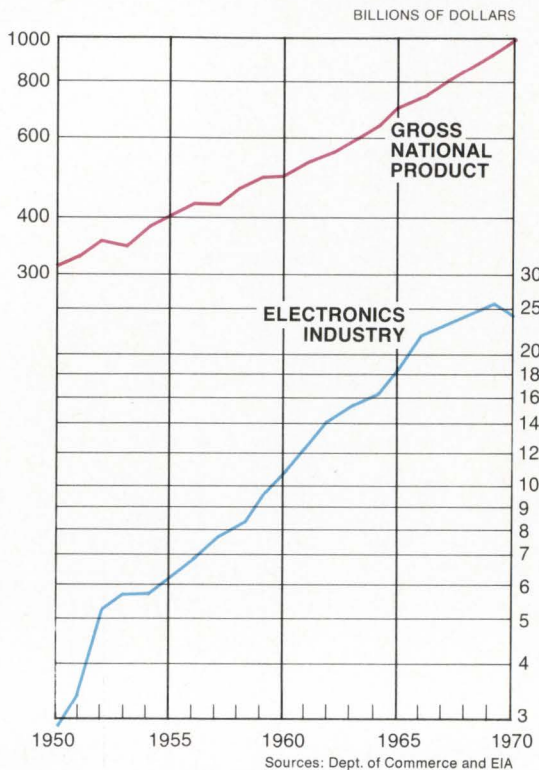


Figure 2

what we must learn. For tough competition is here to stay in the electronics business.

### Electronics vs. GNP

Is electronics a mature industry? Not yet, but we will be. After the traumatic experiences of 1970, many people in our industry wonder if we are in a growth industry at all. **Figure 2**, top left, shows that for the past 20 years the Gross National Product (GNP) has tripled from over \$300 billion to almost a trillion dollars. In that same period total sales of electronics manufacturers have increased from about \$3 billion in 1950 to almost \$26 billion in 1969, a dazzling growth rate of over 8 times!

These comparisons show that the electronics market actually grew at a far faster rate than did the GNP simply because we have operated in a growth industry *during a time of tremendous growth for the nation as a whole*. At least it was until 1970 when, for the first time, sales of American electronics manufacturers plummeted. Many blame 1970's poor performance on that year's recession. But the facts refute this belief. Let's examine the record for the last few years as shown in **Figure 3**, bottom left, and see what *did* happen.

### Gross National Product

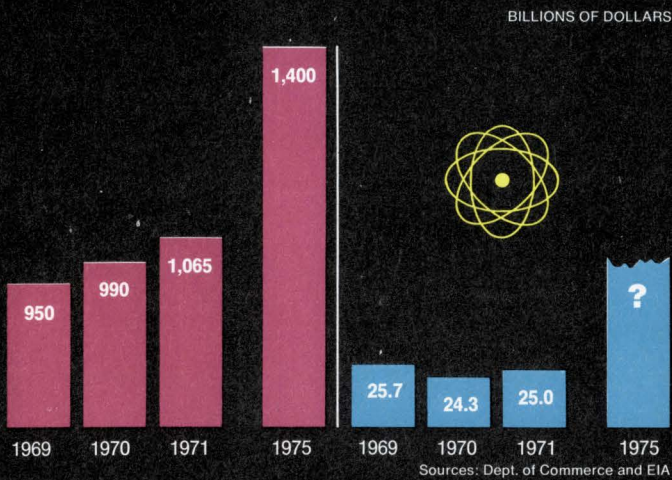


Figure 3

From 1969 to 1970 the GNP grew. It grew very little but it grew, from \$950 billion to \$990 billion\*. By the end of 1971 the GNP is expected to have grown to over a trillion dollars. The Administration also tells us that prospects for the years ahead are very bright indeed and predicts a GNP of \$1400 billion by 1975. That's a growth rate of almost 8% a year.

Will the electronics industry match that growth? We wonder. Between 1969 and 1970 our industry didn't grow even a little. As a matter of fact, it actually went *down*. Sales declined from the all-time high of \$25.7 billion in 1969 to about \$24.3 billion in 1970. It is expected to recover slowly this year to about \$25 billion. Faced with this trend we cannot even assume that electronics sales will grow *with* the economy, let alone *faster* than the economy. Unless we get up and fight

\*These figures are in current dollars.  
If we consider the effect of inflation, the GNP actually went down.

it is unrealistic to expect that the industry will grow at 8% per year through 1975.

### The Industry's First Recession

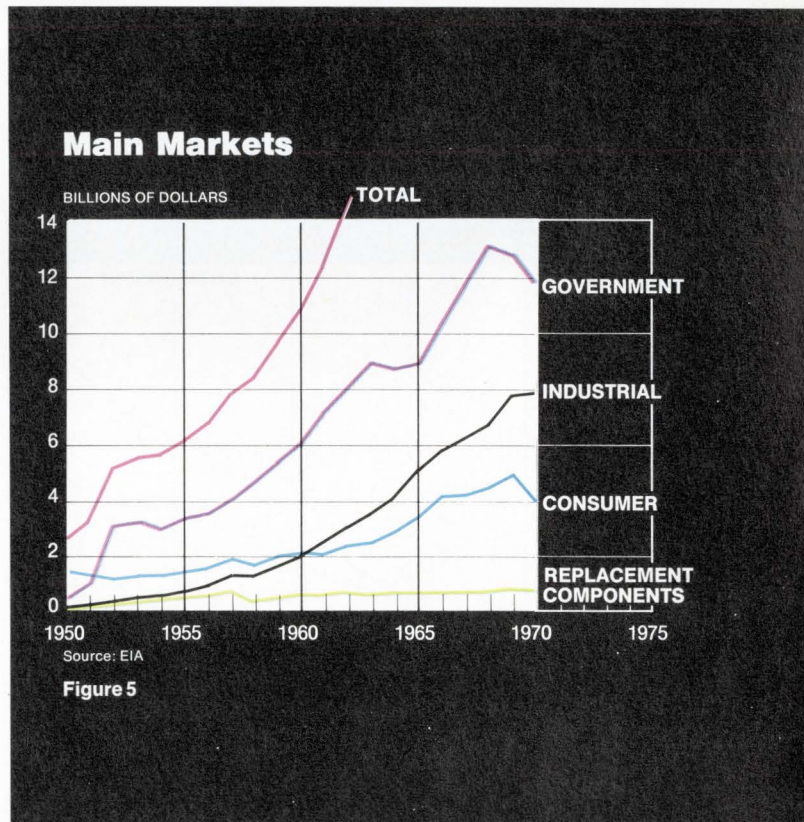
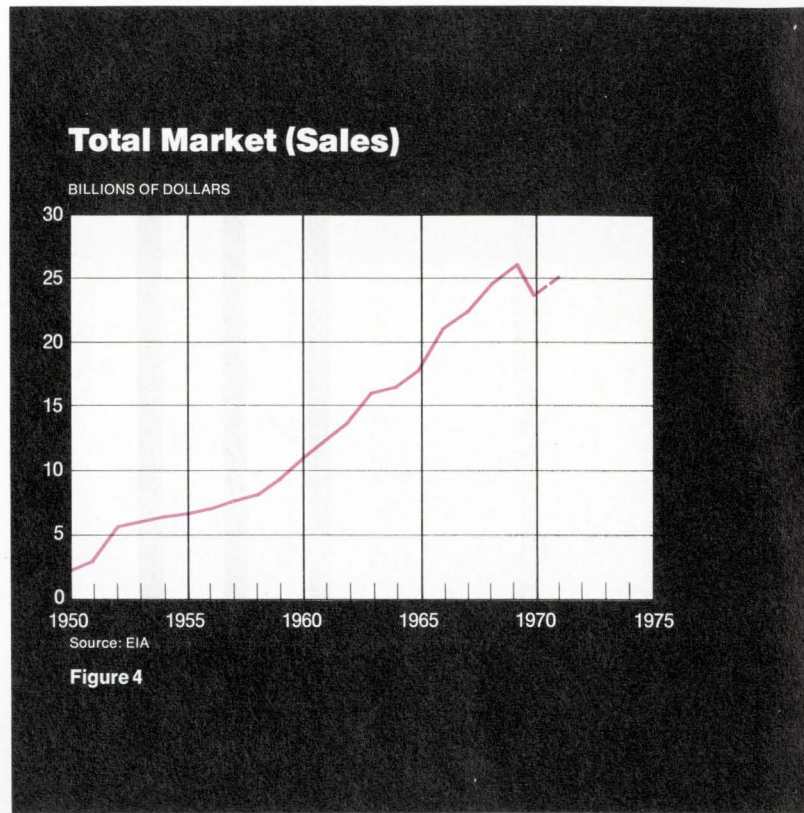
Now let's take a closer look at the figures in **Figure 4**, top right. This graph is based on figures from the 1971 Electronic Market Data Book published by the Electronic Industries Association. The gray bars on the graph represent periods of recession in the overall national economy and which, as we have seen, affected sales of motor vehicles. Yet during these recessionary periods, electronics sales did *not* decline. Actually we had sales *increases* during three of these periods, especially in 1961.

This means that we are experiencing a recession *for the first time* in the history of our industry! But, if we shrug off the sales decline of 1970 and assume that business will automatically improve with the GNP, we are in for bad weather ahead. That such a comeback is unlikely is apparent when we look at **Figure 5**, bottom right, where total industry sales are shown by major markets as defined by the Electronic Industries Association. They are: *government* procurement for electronic components and equipment; *industrial* sales which consist primarily of computers and data processing equipment, instrumentation and communications equipment; and sales to *consumers*.

We have stated that many blame 1970's poor industry performance on the state of the national economy. However, **Figure 5** shows us that the reasons for the decline are traceable to both the government and consumer markets. The downturn in consumer sales *can* be blamed on the current recession because in 1970 the consumer preferred to keep his money in the bank. On the other hand, the industrial market held its own, thanks primarily to strong sales of computers and data processing equipment which represent a major portion of the industrial market.

### The Early Warning

But the graph also shows that the main cause of the overall decline was the loss of sales



## Government

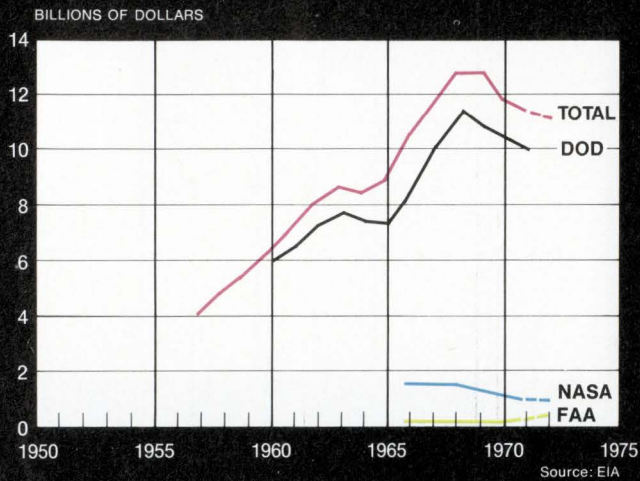


Figure 6

in the government electronics market. But we had warning flags on this as early as 1969 when this decline began. Most of us saw it coming but we didn't do anything about it. Largely because we did business in 1970 just about the same way we had through the 1960s. And, that spelled disaster.

If we examine the government market as shown in **Figure 6**, left, we will see why such a disaster was inevitable. The main segment which accounts for about 90% of the government's procurement of electronic components and equipment, is that which is controlled by the Department of Defense. The record shows that DOD procurement actually started to decline in fiscal year 1968 and has been going down ever since. It will continue to do so dragging down with it the combined total of government procurement. According to the federal budget for fiscal year 1972, DOD procurement will stabilize at the end of 1972 at a level just below \$10 billion. We repeat: it will stabilize, *not grow*. Consequently, total government procurement won't grow either. That is, until the *non*-military agencies of the government will begin their new procurement programs. Most important of such *non*-military agencies are the Department of Transportation, the Department of Health, Education and Welfare, the Department of Housing and Urban Development and, of most interest today, the one-year-old Environmental Protection Agency.

Despite the fact that we saw the decline in military procurement coming in 1969, we failed to react to its implications promptly. We failed to realize that we could no longer count on this market for growth. And we suffered. Have we learned a lesson from our inaction? What can we expect if we haven't?

## Turnaround

**Figure 7**, bottom left, represents the same markets which were illustrated in figure 5 but are now projected to 1975, and assumes that we don't learn the lesson of 1970. These projections take into account the effect of President Nixon's recent economic moves, even though

## Main Markets

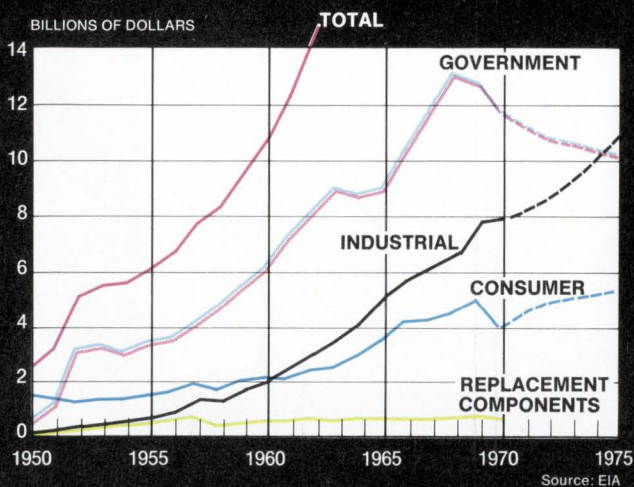


Figure 7

it's still too early to fully evaluate the effect of Phase II of his plan on our industry.

Let's start with the consumer market which suffered sharply in the 1970 recession. Thanks to a return in consumer confidence it is recovering nicely. While the 10% surcharge on non-quota imports will probably help this market, we are projecting for after 1971 a return to the same kind of sluggish growth slowdown in consumer electronics sales that we had in the late '60s. The surcharge itself is not enough to offset the lower labor costs that Far Eastern manufacturers enjoy—to offset it would require a surcharge as high as 30%. In addition, our assumption implies that the known growth markets, such as that for video recording equipment, will end up as a prize for foreign manufacturers.

On the other hand, we do expect that the industrial market will profit handsomely from President Nixon's economic program. Growth will come primarily from sales of computers and peripheral equipment because these will benefit most directly from two of the President's measures: the first of which is the tax investment credit which will help spur the sales of capital equipment in the United States. The other is the "floating" of the American dollar in the international money markets, which will make American equipment more competitively priced abroad.

The industrial curve in **Figure 7**, bottom left, shows this segment holding its own in 1971. It will improve further in 1972 because of an increase in U. S. business. Even more substantial growth will occur in 1973 from the combined effect of improved domestic sales and increased exports. The prospects for the largest segment of this market—computers and peripherals—will be discussed in part II of this article, which will appear in the February issue.

### **No Place to Go**

However, there is nothing in the Nixon economic program that can improve prospects in the government market. On the contrary, one of the president's decisions was to cut almost \$5 billion

from government spending. Consequently **Figure 7** reflects a continuing reduction in government expenditures due to the decline in military procurement until such time when the government market will stabilize and perhaps recover as a result of civilian-oriented procurement. But, that is unlikely before 1975.

If we review our discussion thus far and add up all the sales estimates that are projected for each year, we anticipate a slight recovery in our business in 1971 to a total of about \$25 billion. And, from then on a very slow growth to about \$26.7 billion in 1975. And that is nothing like the 8% annual growth the administration is predicting for the economy as a whole.

This is the kind of slow growth we can expect unless we actively seek out opportunities for product development in the new markets that represent maximum opportunities for future growth. To do this successfully we must remember to get rid of the spec-oriented mentality of the '60s. Only then can we tool up mentally to provide the new products for those markets where electronics can do the best job at a competitive price.

### **A National Study**

Did electronics companies learn much as a result of the business disasters of 1970? And, if so, what did they do? More important—what do they plan to do in the foreseeable future? To find out, this magazine went about it in the only logical way: we commissioned an exhaustive research study among executives of major electronics companies. This national, industry-wide study was conducted by Chilton Research Services, the second largest industrial research organization in the country. The companies studied consisted of manufacturers of components, of materials\*, instruments, and of subsystems components such as minicomputers and communications products. The study was also conducted among distributors because in our opinion they will become an increasingly important link in the marketing chain. The companies studied were asked to provide

\*This category groups manufacturers of plastic, ceramic, magnetic and shielding materials for electronic components and equipment.

answers to two kinds of questions:

1. Which particular markets were you selling in 1970?
2. How do you expect sales in those markets to vary in the next few years?

Once the results of the study had been compiled, we consulted with the U. S. Bureau of Domestic Commerce and this organization recommended that we sum up the findings in the form of a matrix such as you see in **Figure 8**, at the bottom of page. The *types of companies* included in the research study are listed *horizontally* on the top line of the matrix. The markets of their *customers* are recorded *vertically* at the extreme left of the matrix.

### The Picture for 1970

The particular markets these manufacturers concentrated on in 1970 are represented in the cells of the matrix. The numerals within these cells represent the dollars *spent*

by users expressed as a percentage (or a range of most common percentages) of the total dollar volume *sold* by manufacturers.

### IN OUR NEXT ISSUE

**The matrix of Figure 8 applies to 1970. What's the picture for the next few years?**

**Since most of our readers work on the segments of the electronics industry that head the rows of the matrix, we will explore the prospects for some of those segments in our February issue. The success of the manufacturers heading the columns of the matrix is ultimately linked to the markets of the rows**

**In the February issue we will see that the future of the industry can be viewed optimistically but only if we face up to the challenge of this decade. The challenge is to the engineer, as well as to his company, to provide the new products that will sell in the new markets the electronics industry must penetrate in the '70s.**

## Matrix

Copyright 1971 The Electronic Engineer Magazine

USERS	MFR'S.	Passive Comp's.	Semiconds. (Discrete)	ICs	Hybrid Circuits	Linear Modules	Microwave Comp's.	Materials	Connectors	Relays	Panel Meters	Read-Outs	Power Supplies	Lab Instr's.	Commun. Prod's.	Minicomp. & Peripherals	Distributors
COMPUTERS & PERIPHERALS		20-35	15	20-50	10-30	2	3	10-30	30-40	5-10	2	10-20	20-50	5	5	5-20	15
INSTRUMENTATION		5-10	10	5	5	10-20		5	8-10	2	10-30	10-20	20-60	5	3	5-20	3
COMMUNICATIONS SYSTEMS		10-20	10	5-10	5	2	15	5	10-20	50	5-10	10-20	5-10	5-10	10	5-20	5
CONSUMER ELECTRONICS		10-25	20	5-10	10-20	2	1	5	10-15	1	10	5-10	2	4	2	1-2	5
INDUSTRIAL CONTROL SYSTEMS		5-15	15	10-20	10-20	5-10	5	5	5	5	10-15	5-10	10	3	5-10	5-15	1-5
COMPONENTS & SUBASSEMBLIES			5	2	1-5		2	5	1		5	2	5-10	10	5	2-20	1-5
GOVERNMENT (MILITARY & AEROSPACE)		30-50	20-40	15-30	20	35-50	50-95	5-10	35-50	15-35	40-80	5-20	20-70	40-70	20-40	20-45	50-70
GOVERNMENT (CIVILIAN)		2-3	5-10	2	1								1	1	10-25	6-10	2
MEDICAL ELECTRONICS				3	1-5	5-15	5	2	2	2-5	5-10	5	5-10	3		5-10	2
BUSINESS MACHINES		5-15	5	5-10	5-10		3	5-10	3	10-20		5	2-5	2	20-25	2	8
RESEARCH LABORATORIES		5	2		1	10	5		2	1	1	2	2	10		10-30	1
AUTOMOTIVE								15-25		8	2-5			1			
NON-OEM USERS										6					10	10-40	
AIRLINES						5						2-10	2	10	5	10	10

Figure 8





# It's as popular as a PDP-8.

Back when PDP-8 first came out, we knew it was going to be well-received.

And that's just what happened. Over 15,000 PDP-8's have been installed already.

In fact, more PDP-8's are coming off our production line every month than all the other minis put together.

Of course it takes more than big production lines to make a runaway best seller. PDP-8 does have a lot going for it.

Like the exclusive OMNIBUS™ construction that makes interfacing a snap.

And all those PDP-8 peripherals. Over 60 standards. Plus specials.

And nobody ignores PDP-8's

library of programs. It's the biggest collection of minicomputer software in the world.

But when you get right down to it, all we did was take a great idea and bottle it.

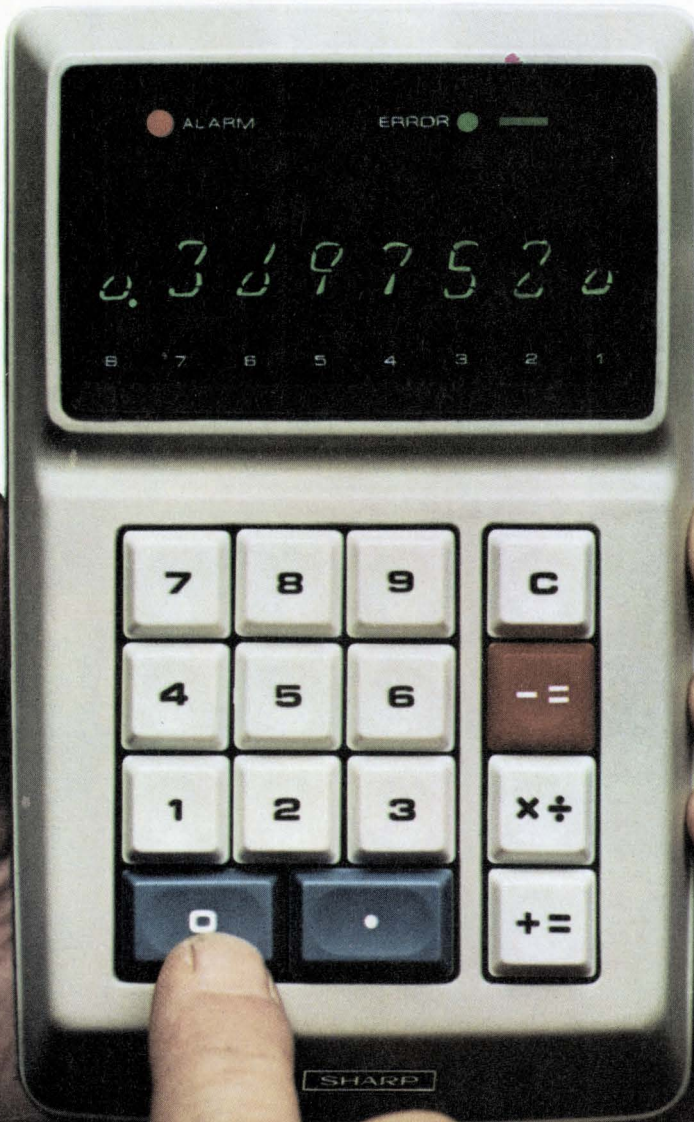
Digital Equipment Corporation, Maynard, Mass. 01754. (617) 897-5111.

**digital**

Circle Reader Service #10

# How to get to the top?

## *Be first with the right Answers!*



Now you can be the "answer-man" . . . the one who comes up with the right answer . . . anytime . . . anywhere . . . instantly . . . thanks to your Sharp Personal Portable Calculator. You can throw away your slide-rule, the Sharp is faster and easier to use.

**This amazing miniature calculator could be the most important investment you ever make . . . the key to your future success. The man who always has the right answer first is generally the one to make it to the top first.**

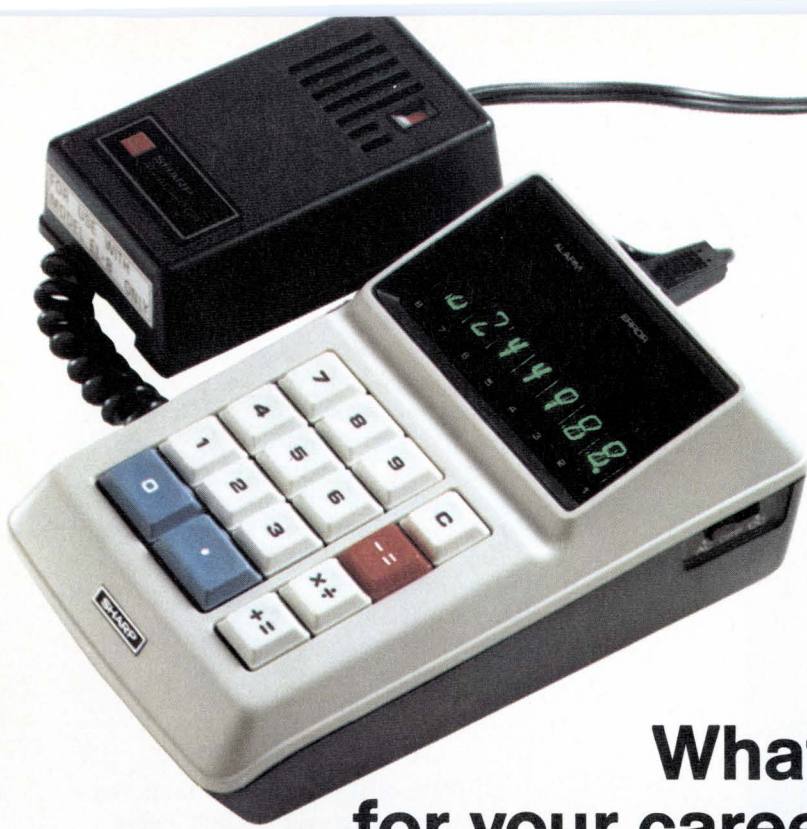
All great businessmen . . . past, present, and future . . . were great because they came up with the right answers first. John D. Rockefeller, Henry Ford, Andrew Mellon, Dale Carnegie, Thomas Edison — all were regarded as geniuses in their respective fields because of this quality. Now thanks to this tiny calculator you can get ahead of the competition . . . soon everyone will automatically look to you for the right answer!

**The Sharp Calculator is the right tool for the businessman.**

**This Personal Calculator is conveniently compact, portable, versatile and accurate.**

- **At 3½" x 5½" and a mere 26-ounces you can take this calculator with you anywhere.** Tuck it in your briefcase and get your answers on the plane, in a cab, at home . . . anywhere. If you choose the model with self-contained battery you can charge it for 3 hours on the adaptor (regular current) and run it on battery for 3 hours more.
- **It adds, subtracts, divides and multiplies . . . even does mixed calculations for you in split seconds.** It's easy to operate . . . with the instruction book included you'll be using it right away to solve your most complex problems. The answer pops up in bright, easy-to-read illuminated computer numerals on a blackout face.
- **You need never worry about the decimal point again.** The floating decimal point and the over-flow protection system help to eliminate embarrassing errors.
- **Works as silently as your mind.** So you can take it with you to a meeting or use it on the plane and the others won't even know you're using it.

All this technical excellence is due to the Sharp Calculator's advanced circuitry. It uses 4 ELSI-8 circuit packages . . . each is only ⅛" square . . . yet it does the work of 1,875 electronic components. These 4 packages are the most advanced, most miniaturized circuits in and out of the world. They're so dependable NASA harnesses them to send men to the moon.



**GUARANTEED**  
for one full year

Sharp Electronics Inc. guarantees both models of the calculator and the adaptor against any and all defects, with free repair for one year from the date of purchase, except in case of misuse. The customer must fill out the warranty card enclosed with the calculator in order to be protected by the warranty. The customer retains the completed warranty card which then must accompany the machine if repairs are required. Returns must be made to the nearest Sharp Electronic Service Center: Paramus, N.J.; Troy, Mich.; LaGrange, Ill.; Long Beach, Calif.; San Antonio, Texas; Atlanta, Ga.

# What the SHARP can do for your career is Really Exciting!

You'll soon find that the Sharp Calculator (with or without the self-contained battery) is invaluable. I'm sure you've been in meetings where executives . . . top level men . . . wasted their time working figures by hand or on an old-fashioned slide-rule. Most of them wouldn't want to be seen with a big, noisy adding machine . . . and they certainly wouldn't lug one up to an important meeting. Yet this is where the need for quick, on-the-spot answers is most crucial. Oftentimes the variety of answers they come up with is astonishing . . . and embarrassing to some. **With your Sharp Calculator YOU will be the one to provide the correct answer.**



**YOU'LL BE ABLE TO GET THE JUMP ON THE COMPETITION** . . . because you'll be able to spend more of your time thinking and less on figure work. **You can use the time saved being an "idea man" . . . an important executive quality.** If you do as few as 10 calculations a day you can save 43 minutes a week! Think what you can accomplish in that time. Doubly important . . . with a calculator this quick and easy to operate you'll be able to double-check everything quickly . . . to run over someone else's figures to arrive at a more thorough understanding of the matter at hand.

**YOU'LL USE YOUR TIME MUCH MORE EFFECTIVELY** . . . this is another mark of an up-and-coming executive.



Most great businessmen are noted for their ability to use their time effectively. Since you'll be able to get more done in a given time period . . . you'll be able to work enroute or at home . . . you will be using more

of your time . . . better. In no time at all, you'll notice growing respect for you . . . the "answer-man" among your colleagues.

**IT WILL PAY FOR ITSELF** . . . in time saved! For example, if you make \$10 an hour, do 10 calculations a day you'll save 8.7 minutes a day or 2.9 hours a month. That's \$348 a year in time . . . more than the calculator costs. And if you're in business for yourself it may be tax deductible.



**USE IT ON YOUR PERSONAL BUSINESS** . . . take it home with you and figure your taxes or balance your checkbook . . . use it while paying bills to check the store's figures (they *do* make mistakes sometimes). Your wife will appreciate it, too.

## Use it for 15 Days Absolutely FREE.

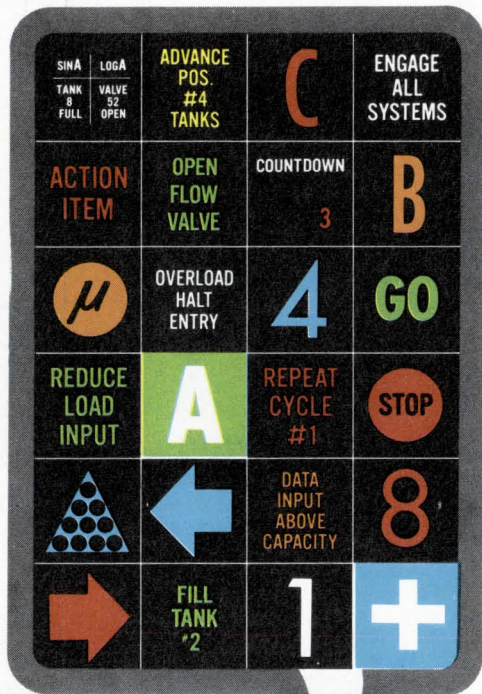
We believe that once you use the SHARP CALCULATOR for a few days you'll never want to be without it. You'll have the right answer every time . . . and you'll save precious time every day. **THIS COULD BE AN IMPORTANT INVESTMENT IN YOUR CAREER.** Try it for 15 days . . . if you can part with it, then send it back for full credit or refund. If you keep it you can charge it to your Master Charge or American Express Card Account.

Circle Reader Service #11

## Yours for as little as \$19.15\* per month

for 12 months including shipping and handling. This price is for the model *without* the self-contained battery. You can still use it anywhere on regular household current. The total price is just \$224.91\* plus \$4.95 shipping and handling. OR, pay just \$22.08\* per month for 12 months, including shipping and handling. This is for the most portable, most versatile model . . . *with* the self-contained battery. The total price is just \$259.95\* -plus \$4.95 shipping and handling. **SIGN AND SEND YOUR FREE TRIAL CARD TODAY!**  
\*Plus sales/use taxes, if applicable.

# When your machine has more to say...



## IEE Readouts provide the vocabulary.

When your machine has more to say, IEE rear projection readouts let it speak out with an eloquence that make other display systems seem taciturn.

For instance, just one IEE rear projection readout will improve the vocabulary of your machine with up to 64 new phrases expressed in any combination of alphanumeric, in any language, accompanied by the symbols of any discipline, all displayed in a variety of colors and in the type styles that go best with your panel decor.

No gas discharge tube, or LED or what have you, can make that statement.

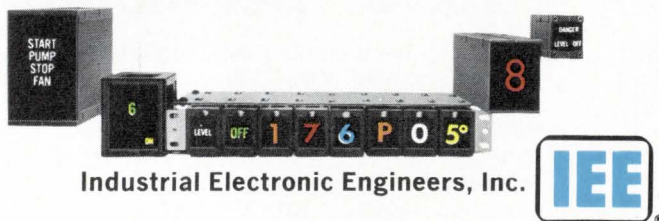
### IEE units communicate—loud and clear!

Our big Series 80 rear projection readout lets your machine shout in huge 3 3/8-inch characters. Or we can say things discretely

with our fit-anywhere 1/2 x 3/4-inch Series 345 model.

All with single-plane viewing, variable brilliance, and the capability to change vocabularies right in the field. To assist, we have a powerful new low-cost hybrid driver/decoder for any of the readouts. Plus a host of other driver/decoders... all, competitively priced... purchased separately or customer mounted.

Rear projection readouts give you an order of display versatility a world apart from other techniques, and IEE builds more of them than anybody. Send today for our Short-Form Catalog on units that are long on talk. Industrial Electronic Engineers, Inc., 7740 Lemona Ave., Van Nuys, California 91405. Telephone: (213) 787-0311 • TWX 910-495-1707



Industrial Electronic Engineers, Inc.



Circle Reader Service #12

## SPEAK UP

### More DVMs

Dear Sir:

You're asleep... How can you talk about the "four more manufacturers of DVM's" ("DVMs revisited," *The Electronic Engineer*, November 1971, p. 31), without any acknowledgement of a fifth one, Precision Standards Corp.?

We have found them to offer some new units with impressive standards of performance, economy, and engineering integrity in their new 4 1/2 digit and 5 1/2 digit models.

Enough said.

Robert A. Pease  
Staff Engineer  
Teledyne Philbrick  
Dedham, Mass.

EDITOR'S NOTE: With readers of *The Electronic Engineer* of Bob Pease's caliber endorsing their DVMs, it may seem that Precision Standards Corp. doesn't need our listing. But we were asleep. Their 4 1/2-digit digital multimeter is \$690, the 5 1/2-d is \$995. If this isn't enough said, circle the following Reader Service numbers on the Inquiry Card.

4 1/2-digit DMM                      Circle No. 260

5 1/2-digit DMM                      Circle No. 261

Also, we omitted the Tektronix 7D13 DVM plug-in for their 7500 and 7700-series scopes, which uses the mainframe's character generator to provide a 3 1/2-digit readout (\$560 with probe).

Today for about \$1,500, an engineer can equip himself with three portable (under 10 lbs), battery operated tools: a digital multimeter that will measure ac and dc, current and voltage, ohms, and frequency; a 20-MHz scope; and a pretty powerful calculator. All three can be put into one large briefcase and carried without a fork lift.

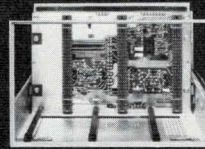
Tek may be on the way to combining two of those instruments, though the 7500 and 7700 series scopes are not portable, nor is the 7D13 a complete digital multimeter. Perhaps we will see the evolution of the portable multimeter-scope with built-in calculator for \$1,000. Who knows? With a modem, it could even double as a computer terminal—the keyboard and display are already there.

Circle No. 262

# A low-cost oscilloscope that keeps up with changing applications

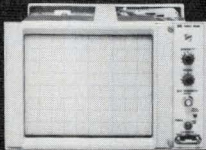
When you shop for a low-frequency oscilloscope, you'll want to know about the measurement capabilities, exclusive cost-saving features and flexibility provided by the new TEKTRONIX 5100 Series.

First, you start with the 5103N three plug-in mainframe.

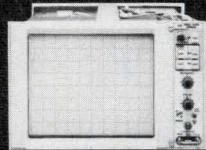


Then, select your display from four interchangeable units with 6-1/2 inch CRT's:

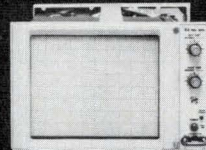
single beam



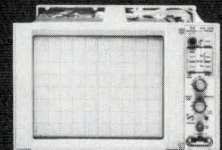
single-beam storage



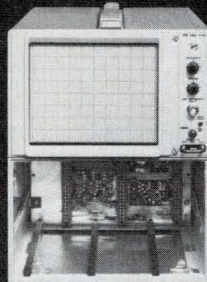
dual beam



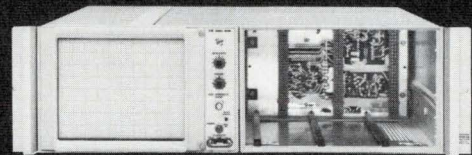
dual-beam storage



Assemble the mainframe and display unit into a cabinet



or rackmount.



Now, add the low-cost plug-ins of your choice.

Today, there are six vertical amplifiers and three time bases to choose from with more on the way. Bandwidth is DC to 2 MHz, depending upon the amplifier plug-in.



When your applications change, just buy components instead of a complete oscilloscope. Interchangeable display units let you update to dual beam, or storage, or dual-beam storage by simply buying a module—not a new scope. Here's another way to save. When your applications call for a new configuration, you can change these oscilloscopes from cabinet to 5-1/4 inch rack-mount and back. It takes only a few minutes and a low-cost kit. And with plug-in flexibility you solve many measurement problems in one mainframe.

**The most exciting part—low-cost.** If you choose a D10 Single Beam Display Unit assembled with the 5103N, 2 ea. 5A20N 50  $\mu$ V/div 1-MHz Differential Amplifiers and the 5B10N Time Base, here's what you get.

**The cost? Only \$1045** in cabinet or rackmount (includes slide assemblies). You can choose an X-Y oscilloscope, cabinet or rackmount, for as little as \$590.

U.S. Sales Prices FOB Beaverton, Oregon

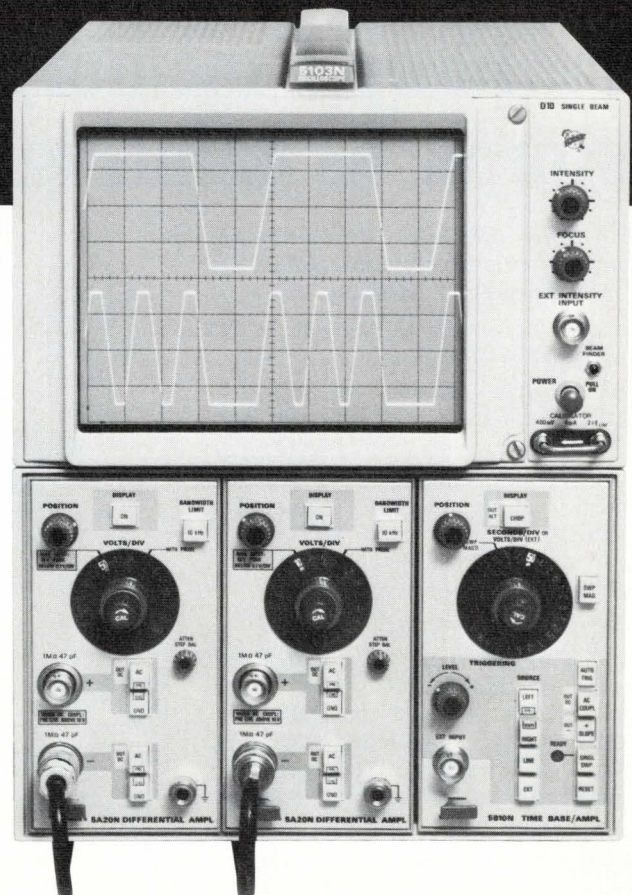


**TEKTRONIX®**

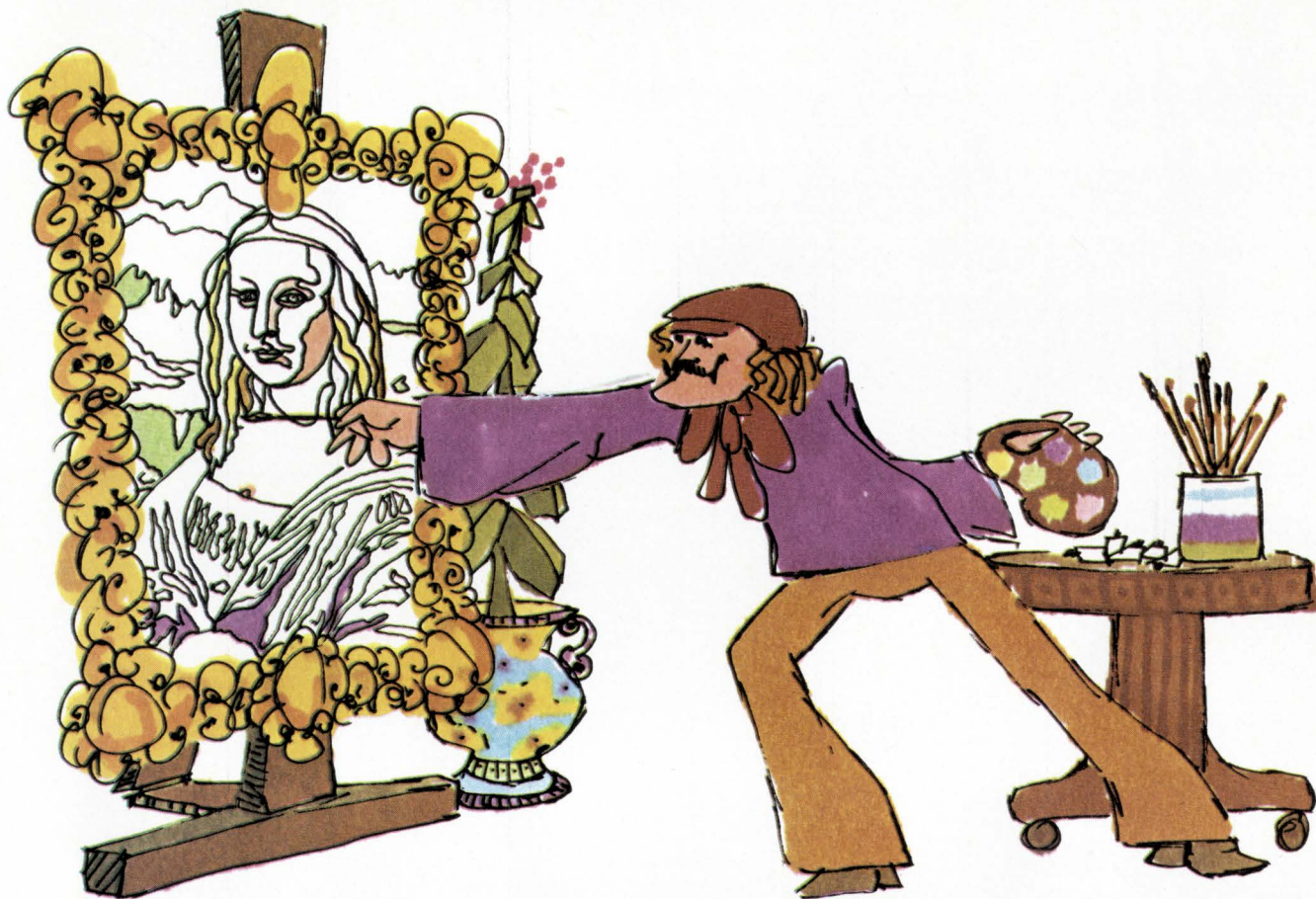
committed to  
technical excellence

Contact your local  
Field Engineer for a  
demonstration and  
complete details.

THE ELECTRONIC ENGINEER • Jan. 1972



Circle Reader Service #19



## With our Do Your Own Thing card, building a memory-oriented system is as simple as painting by the numbers.

Building one (or a few) special memory-oriented systems, controllers or minis can be a headache.

Sure, you can handle the design, but who's to fabricate?

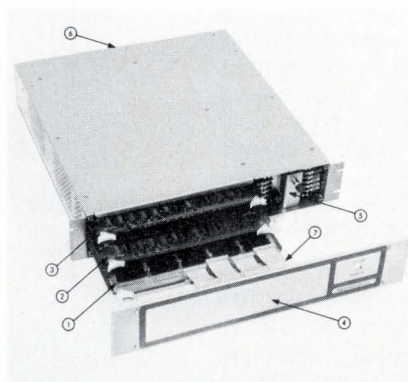
Allow Signal Galaxies to gently remove you from the horns of this dilemma.

The solution is our low-cost MOS memory system with the unique "Do Your Own Thing" card. With it, you end up with a finished product without getting up from your desk.

Here's how it works:

(1) This "Do Your Own Thing" PC board contains 140 IC sockets which will accept 14 or 16-pin DIPs. Design your special system and send us the logic wire lists. We'll wrap the board to your specs. Upon delivery, you merely plug in the ICs.

(2) and (3) Our MOS memory



Write for our full color brochure

### **SIGNAL GALAXIES, INC.**

A Subsidiary of the Signal Companies Inc.  
6955 Hayvenhurst Avenue  
Van Nuys, California 91406  
Telephone (213) 988-1570

**The Compleat Memory Makers**

cards have capacity to 147,456 bits. Common configurations include 4K x 18, 8K x 9 with one card and 4K, x 36, 8K x 18, or 16K x 9 with two cards.

(4) We'll furnish a blank 3½ inch rack panel for mounting switches, lamps and other hardware.

The other essential ingredients to make your task easier include:

(5) A built-in modular power supply, (6) Rear input/output connectors, and (7) Handy cables to connect our circuitry to your front panel.

Got the picture? About as simple as painting by the numbers.

By the way, if you need only a MOS memory, we have the complete line. Cards, small systems, large systems, built-in power supplies and memory testers. The works!

# Charting the memory market: order out of chaos

Stephen A. Thompson, Western Editor—Los Angeles

In December of 1970,\* when we set out to try to make some sense out of the memory market, we published the initial version of the charts which appear in this article. Those first-cut versions plotted representative semiconductor memories: MOS and bipolar, and ROMs and RAMs. When a calculated figure of merit, based on price and performance was plotted against memory capacity, some very interesting characteristics were observed. At that time we speculated what would happen if we extended the analysis to other types of memories. Another interesting question was how the various memory technologies would improve their figures of merit over a year's time. Well, here are the answers a year later.

## Mainframe RAMs and ROMs

The memory spectrum chart illustrates many things. Let's begin with mainframe random access memories (RAMs) and ROMs. Data for both magnetic and bipolar semiconductors are plotted. The MOS products are treated separately, as are programmable ROMs (PROMs) and alterable ROMs (AROMs).

This year, as last, the data for RAMs and ROMs fall into two distinct bands, which overlap at only a point or two. The newly charted core and plated wire RAMs and linear transformer ROMs follow the linear pattern established for bipolar semiconductors last year, although they extend the capacity range considerably.

Within each band, any data point can be fairly accurately represented as lying on one of a series of straight lines. Each of these lines has an equation of the form:  $Y = KX$ . The constant of proportionality,  $K$ , positions the line verti-

cally on the chart, and  $K = b/(t_a \cdot \$)$ . (See the box for explanations of symbols). The top line bounding each band passes through the product with the state-of-the-art price/performance tradeoff.

Table I shows that the average  $K$  values for all types of RAMs are pretty similar. This implies a well-established market. You deliver a product that toes that line, or perish.

(text continued on page 35)

## The rules of the memory game

"A way of thinking about memories" in the Dec. 1970 issue of **The Electronic Engineer** details the assumptions underlying the plots. Briefly, they are:

1. The memory user is primarily concerned with three things: capacity in bits,  $b$ ; performance; and price. Factors such as power dissipation and volatility are secondary. See "Memories: the users speak out,"

**The Electronic Engineer**, Dec. 1971, for evidence that non-volatility does not affect memory price.

2. The measure of price is bits per dollar,  $b/\$$ . The measure of performance, speed, or computing power is access rate,  $b/t_a$ , where  $t_a$  is worst case access time in ns. Access time is chosen over cycle time, because it is an inherent memory property, unaffected by system design. Access rate measures a manufacturer's technical capability;  $b/\$$  measures his manufacturing capability.

3. The cost and performance ratios,  $b/\$$  and  $b/t_a$ , can be traded in the marketplace. Therefore, their product,  $b^2/(t_a \cdot \$)$ , is defined as a figure of merit,  $M$ , for a given capacity. The charts are plots of  $M$  versus  $b$ .

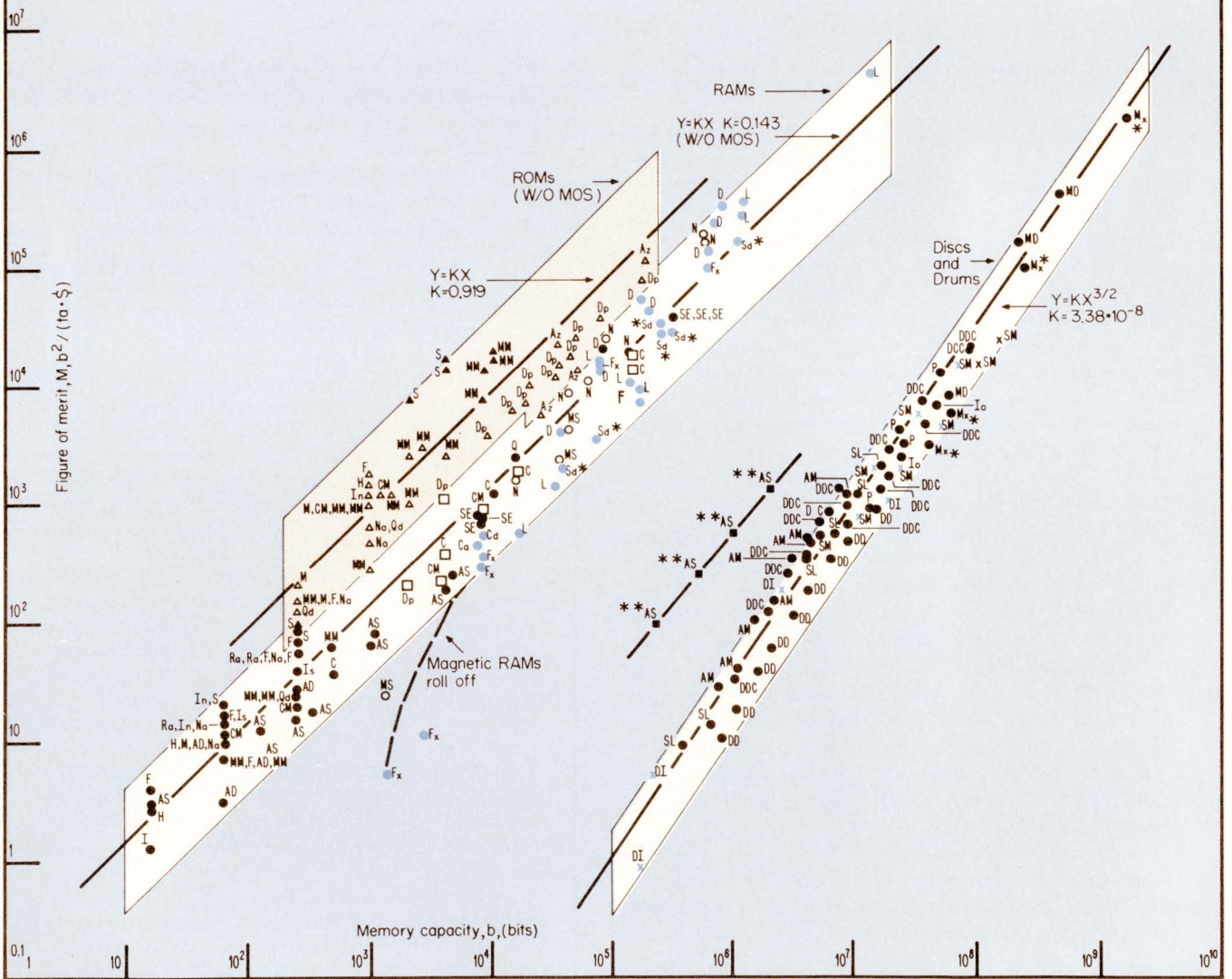
The author will happily discuss the merits and limitations of the assumptions. For now, data linearity over nine orders of magnitude in capacity and eight in figure of merit has been left to fend for itself.

\*"A way of thinking about memories," **The Electronic Engineer**, December 1970, p. 30.

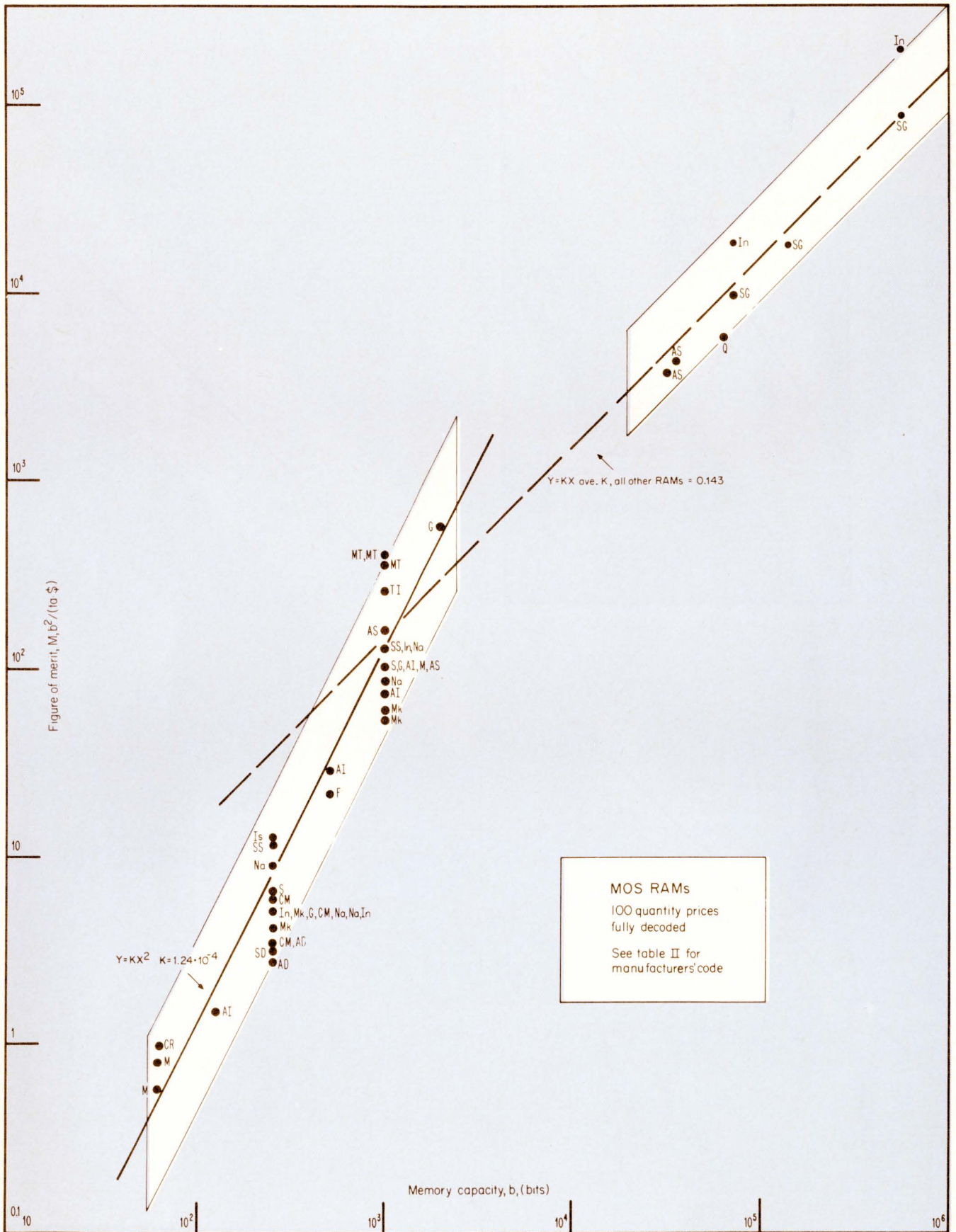
**Memory spectrum chart**  
 100 quantity prices unless noted, fully decoded memories

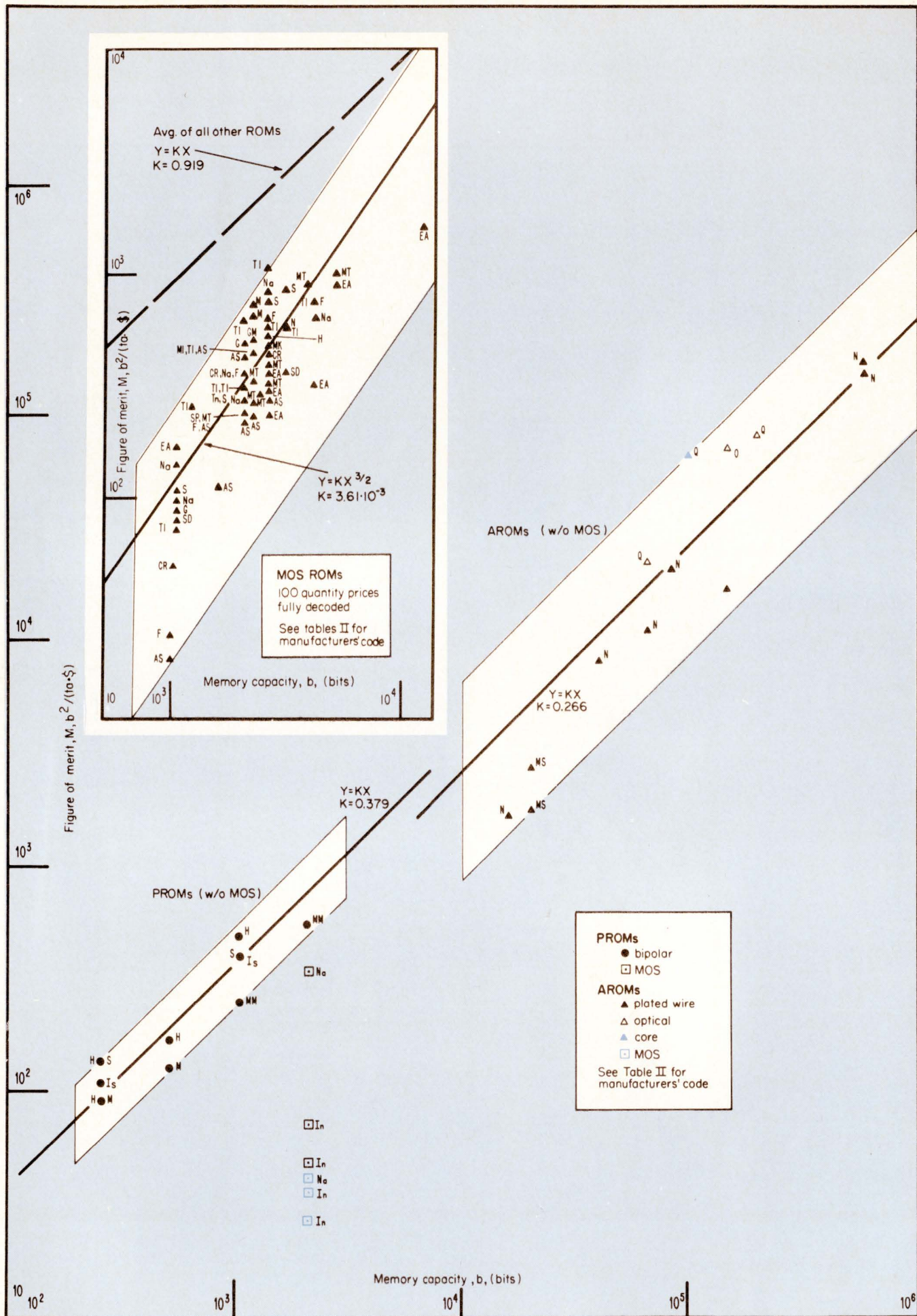
Main frame memories	Bulk memories
<b>RAMs</b>	● discs
● bipolar	× drums
□ bipolar & MOS hybrid	□ MOS serial
● core	
○ plated wire	* indicates unit price
<b>ROMs</b>	** indicates 50 price
▲ bipolar	
△ linear transformer	

See table II for manufacturers' code









## *January*

**challenge:**

Interview—Dr. Peter Goldmark of CBS "I'll teach you guys how to design..."

**special report:**

"A way of thinking about memories"

**systems technology:**

Special section on Data Communications

**the '70s:**

Technology or profit?

## *February*

**challenge:**

When will you learn that cost is measured in \$\$? Interview with top automotive engineer

**packaging course:**

I—Components come in small packages

**special reports:**

Electronics in Automobiles. New Products at Computer Designer Show

**systems technology:**

Special section on Data Communications

**the '70s:**

Technology or profit?

**meetings:**

ISCC: 16-18, Philadelphia  
Computer Systems Design: 22-24, Anaheim

## *March*

**packaging course:**

II—PC boards

**special reports:**

New Products at INTERCON (IEEE Show)  
Paris Components and Computer Designer Shows

**systems technology:**

Special section on Data Communications

**meeting:**

IEEE Convention (INTERCON): 20-23, New York

## *April*

**packaging course:**

III—Back-panel wiring—1

**challenge:**

Think profits

**special report:**

Data conversion modules

**systems technology:**

Special section on Data Communications

**meetings:**

Salon des Composants: 6-11, Paris  
Computer Systems Design: 18-20, Boston

## *May*

**packaging course:**

IV—Back-panel wiring—2

**special report:**

Passive components in Dual-in-line packages

**systems technology:**

Special section on Data Communications

**meetings:**

SJCC: 15-18, Atlantic City  
Int. Instrument & Automation Show: 8-12, London

## *June*

**packaging course:**

V—Enclosures

**special report:**

Digital IC Charts

**systems technology:**

Special section on Data Communications

**meeting:**

International Communications Conf.: 19-21, Philadelphia

## *July*

**packaging course:**

VI—Packaging applications

**course:**

Readouts I

**special report**

**and computer update:**  
Operational Amplifiers

**systems technology:**

Special section on Data Communications

## *August*

**course:**

Readouts II

**special report:**

Products at WESCON Show

**systems technology:**

Special section on Data Communications

## *September*

**challenge:**

Keeping your company in the right markets

**special report:**

Low cost digital instruments—Counters

**course:**

Readouts III

**systems technology:**

Special section on Data Communications

**meetings:**

Computer Conf.: 12-14, San Francisco  
WESCON: 19-22, Los Angeles  
Japan Electronics Show: 21-27, Tokyo

## *October*

**special report:**

Low cost digital instruments—voltmeters, panel meters and multimeters

**course:**

Readouts IV

**systems technology:**

Special section on Data Communications

**meetings:**

ISA: 9-12, New York  
Electron Devices Meeting: 15-18, Washington, D.C.

## *November*

**SPECIAL ISSUE:**

30th ANNIVERSARY OF THE MAGAZINE

**course:**

Readouts V

**systems technology:**

Special section on Data Communications

**meetings:**

NEREM: 1-3, Boston  
FJCC: 13-16, Las Vegas  
Electronica: 23-29, Munich

## *December*

**course:**

Readouts VI

**special report:**

Power Semiconductors

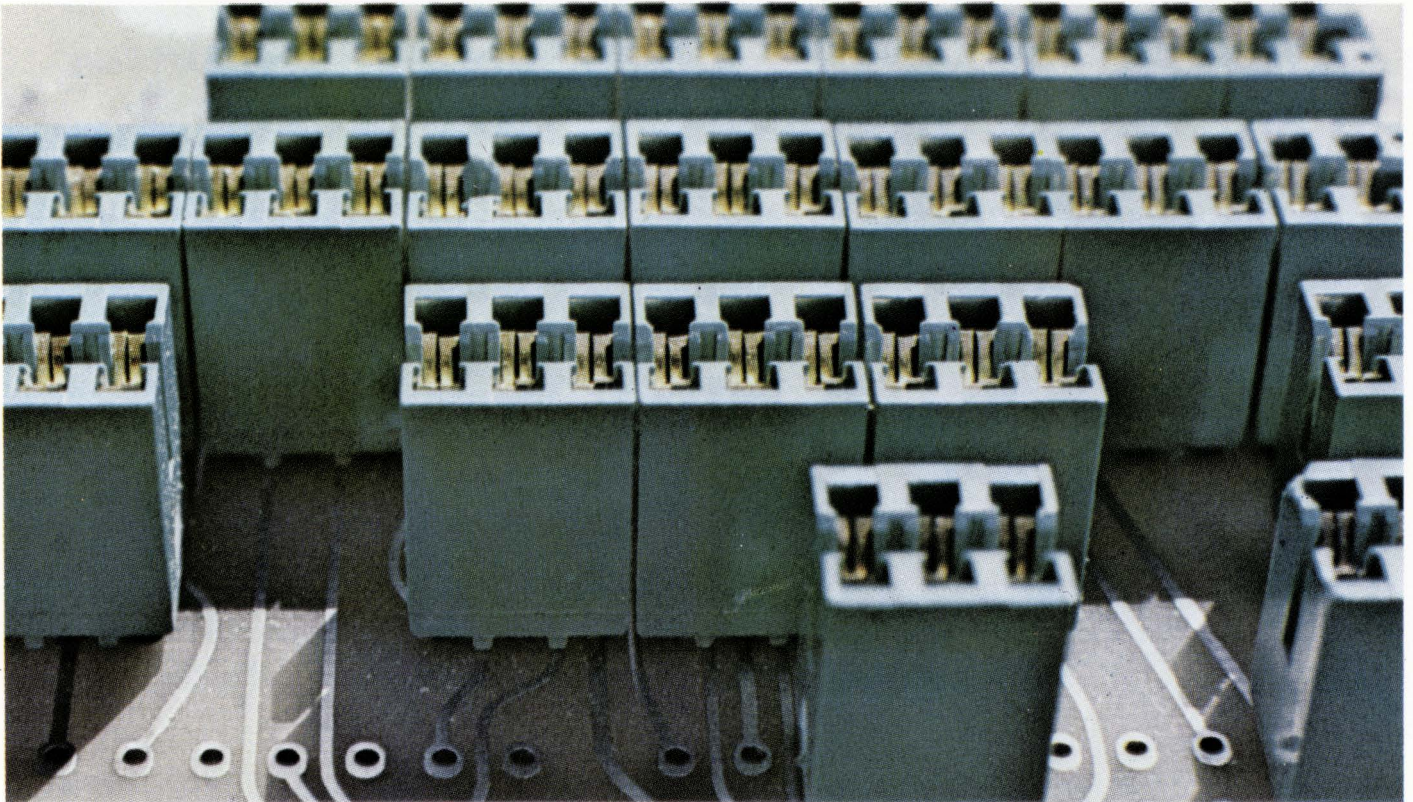
**systems technology:**

Special section on Data Communications

## **Elco Connectronics**

can satisfy all your connector needs.  
Everything from a plain solder receptacle  
to a completely terminated package.





# A NEW DIMENSION IN P.C. BOARD CONNECTING

Solderless connector modules with .156-inch spacing. In two sizes: all with dual readout contacts—center modules with six, and end modules with four. With these two sizes, you can custom design your connector to accommodate just about any size p.c. board.

Without soldering.

Simply push the contact tails of these Mojo™ connectors through the plated through holes of the p.c. board. And you'll have a gas tight, corrosion proof, vibration immune connection that's as electrically and mechanically sound as the best soldered joint. But more easily assembled than any soldered connection. More economically. And without the heating problems that automatic soldering methods often impose.

And Mojo gives you more.

Such as preloaded contacts that firmly grip the p.c. card, but keep their distance when the card is removed. Easily accessible square wire-wrapping posts in the event you have to make any extra back-panel interconnections. And you'll move smoothly and economically from prototype to production with just two connector modules to carry in inventory.

Did we say just two modules? Sorry, we meant four. Because Elco still makes available Mojo connectors with contacts at .150-inch centers. Same specs, same special features as the new .156-inch. Just that little .006-inch difference.

For full details and specifications on Mojo connectors, contact:

Elco, Willow Grove Division,  
Willow Grove, Pa. 19090  
(215) 659-7000



Elco, Pacific Division, 2200 Park Place,  
El Segundo, Calif. 90245  
(213) 675-3311

		$K=b/t_a \cdot S$	$K=1/t_a \cdot S$	$K=b^{1/2}/t_a \cdot S$	Percent gain or < Loss > since (1) June 1970 (2) Dec. 1970	
RAMS	Bipolar	0.139	$1.24 \times 10^{-4}$		150% (1)	
	MOS (below 4-kbits)				115% (1)	
	MOS (above 4-kbits)	0.156				
	Hybrid (MOS-bipolar)	0.124				133% (1)
	Core	0.159				357% (2)
	Plated wire	0.155				28% (2)
Average		0.143				
ROMS	Bipolar	1.182	$3.61 \times 10^{-3}$		351% (1)	
	MOS				70% (2)	
	Linear transformer	0.459				
	Average	0.919				
PROMS	Bipolar	0.379	$3.59 \times 10^{-5}$			
	MOS					
AROMS	MOS		$8.33 \times 10^{-6}$			
	plated wire	0.177			19% (2)	
	Core	0.654				
	Optical	0.403				
	Average	0.266				
BULK MEMORIES	Discs		$3.38 \times 10^{-8}$		77% (2)	
	Drums				$2.56 \times 10^{-8}$	< 1.5% > (2)
	MOS				$6.38 \times 10^{-7}$	

Code	Manufacturer	Reader Service No.	Code	Manufacturer	Reader Service No.
AS	Advanced Memory Systems	201	MD	Marshall Data Systems	225
AD	Advanced Micro Devices	202	Mx	Memorex	226
AI	American Micro-systems	203	MS	Memory Systems	227
AM	Applied Magnetics	204	MM	Monolithic Memories	228
Az	Aztec Data Systems	205	MT	MOS Technology	229
Ca	Cambridge Memories	206	Mk	Mostek	230
C	Cogar	207	M	Motorola Semiconductor	231
CR	Collins Radio	208	Na	National Semiconductor	232
CM	Computer Microtechnology	209	N	Nemonic Data Systems	233
DD	Data Disc	210	O	Optical Memory Systems	234
Dp	Datapac	211	P	PERTEC	235
D	Dataram	212	Q	Quadri	236
DI	Datum	213	Qd	Qualidyne	237
DDC	Digital Development	214	Ra	Raytheon	238
EA	Electronic Arrays	215	SE	Semi. Electronic Memories	239
F	Fairchild	216	SL	Singer-Librascope	240
Fx	Ferrocube	217	SG	Signal Galaxies	241
G	General Instrument	218	S	Signetics	242
H	Harris Semiconductor	219	SS	Solid State Scientific	243
In	Intel	220	SD	Solitron Devices	244
Is	Intersil	221	Sd	Standard Memories	245
Io	Iomec	222	SM	Systematics/Magnehead	246
I	ITT Semiconductor	223	TI	Texas Instruments	247
L	Lockheed Electronics	224			

Below about 10 kbits, the figures of merit for magnetic RAMS drop off. They are getting into a size range where they cannot compete. Semiconductors dominate up to about 16 kbits. The area between 16 and 32-kbits is the semiconductor versus magnetic battleground. The technology that gains vertical position, i.e., improves its  $K$  value faster, will gain dominance. Wherever one technology establishes a vertical lead over the competition it then tends to expand horizontally and capture neighboring capacity ranges.

It is tempting to concede the victory to semiconductors. But before you do, consider that in December 1970, the average  $K$  value for cores was lower than what bipolar had achieved in June of 1970. Cores, which improved their price/performance tradeoff an impressive 357% in nine months, now average better than bipolars. This is one reason why semiconductors have taken off more slowly than anticipated.

The scarcity of price data hinders the analysis of core memories. Many manufacturers were asked but few responded, because core vendors tend to disregard all sales as negotiated contracts.

As for the plated wire representatives, the number of data points is small, because only Nemonic Data Systems and Memory Systems supply commercial memories domestically.

Although hybrid MOS-bipolar memories are supposed to benefit from low cost MOS and high-speed bipolar contributions, something is wrong. Their average  $K$  value is the lowest of all RAM classes. The average of all RAMS, is exceeded by only one, the Datapac 4096-bit unit, which is conspicuous by its excellence in an otherwise depressed portion of the curve. There is a slight bow to the data, centered in the 1 to 10-kbit area, where a transition from memory components to memory systems occurs.

The 10-kbit line divides semiconductor and magnetic ROM technologies too. Linear transformers exist almost exclusively above that capacity, and bipolars below. Three Signetics' ROMS are in a class by themselves and force the band to be 50% wider than it would be if they were absent. As a rule, it's true that semiconductors have a much higher average  $K$  value, but a word of caution is in order. At 100 quantity levels, there are often one-time mask charges that can change the picture significantly. We have not allowed for these charges in this data. As orders get larger, those charges are usually dropped.

### Bulk memories

No matter how inexpensive per bit a RAM is, if you keep buying larger ones, eventually someone tells you, "Look, the absolute cost is too high. Do the job some other way." As a result, enter bulk memories.

They are an order of magnitude cheaper per bit and about four or five orders of magnitude slower. This creates an entire new hierarchy of memories at about a megabit in the first chart.

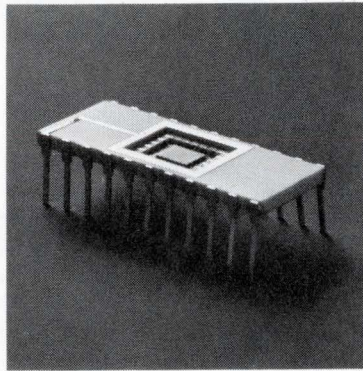
Bulk memories form a tightly packed band and the points within that band tend to lie along a line of the form  $Y = KX^{3/2}$ . In other words, the bulk constant of proportionality,  $K_{bulk}$ , is  $b^{1/2}/(t_a \cdot S)$ . The reason for this slope could be that bulks are a volume proposition. They physically approximate spheres, where the bits crammed inside increases as  $r^3$  and cost increases as the surface area, or as  $r^2$ . There is very little speed difference in all of the rotating memories.

Disc memories have moved ahead in the past nine months, while drums have stagnated. If this trend continues drums will be relegated to military applications only.

There is a fly in the disc ointment. Advanced Memory Systems calls it an SSU. It is a serial MOS memory that has

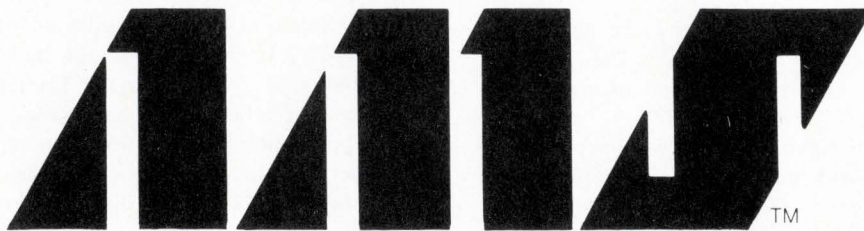
# 11051

of the semiconductor  
memory systems built  
and operating today use the  
AMS 6002 MOS RAM.



The AMS 6002 MOS RAM has already established more than 16 million hours of field performance in more than 40 installations. Six months after its introduction, the 6002 is still the fastest 1024-bit RAM available with 150 nanosecond access and 250 nanosecond cycle times. It is the only MOS RAM that utilizes field-proven P-channel processing *and* a ceramic package.

That's why most of the systems out there today use the 6002.  
Shouldn't you?



**Advanced Memory Systems, 1276 Hammerwood Avenue, Sunnyvale, Ca 94086 (408) 734-4330**

Powell/Philadelphia  
S. Island Road/Box 8765  
Philadelphia, Pa. 19101  
(215) 724-1900

Powell/Washington  
10728 Hanna Street  
Beltsville, Md. 20705  
(301) 474-1030

Powell/Huntsville  
Box 488, Fayetteville  
Tenn. 37334  
(615) 433-5737

Powell/Florida  
2049 W. Central Blvd.  
Orlando, Fla. 32814  
(305) 423-8586

Powell/California  
411 Fairchild Dr./Box 997  
Mountain View, Ca. 94040  
(415) 964-0820

Powell/California  
Southern California  
(213) 988-3330  
(213) 873-6431

Apollo Electronics, I  
101 Binney Street  
Cambridge, Mass. 0  
(617) 868-3120

a 135- $\mu$ s access time and 16-Mbyte data transfer rate. Forming a new memory hierarchy level, it is two orders of magnitude faster than discs, while only one order of magnitude more expensive.

### MOS begins to mature

Because MOS does not behave like other technologies, it must be treated separately. Last year, MOS products distributed themselves on a line of the form  $Y = KX^2$ , where  $K_{MOS}$  becomes  $1/(t_a \cdot \$)$ . This means that memories with similar access times cost the same, regardless of size. The prediction that this could not continue is beginning to come true, as seen in the MOS RAM chart.

The MOS RAMs form two groups. At the component level, the slope is still very steep. At the card level, above 10-kbits again, they group linearly and their average  $K$  is virtually identical with cores and plated wire when computed the same way. Card systems and some 1024-bit components compete nicely on a price/performance tradeoff basis. Below 1024-bits, MOS cannot compete that way. Its cost advantage is not sufficient to offset the speed advantage of bipolars, probably because chip costs are incidental to packaging and testing costs in that range. In this category, the MOS are probably bought when cost is the overriding concern.

As with last year, 1024 bits is the dividing line between MOS RAMs and ROMs. The ROMs are plotted separately for clarity. When plotted together, ROMs appear to be an extension of RAMs and do not form a higher price/performance band as with other technologies. This results from ROMs not having reached a capacity where they are tradeoff competitive, and are therefore sold strictly on price to customers who are indifferent to speed.

The average MOS RAM  $K$  value for components was computed on a square law basis and the average for ROMs on a 3/2 power law basis for two reasons. Those values yielded the least spread in the data for each class, and somewhere between 1 and 10 kbits the MOS curve becomes linear.

### PROMs and AROMs

We define a programmable ROM (PROM) as one which can be changed once by the user. An alterable ROM (AROM) is one that can be changed many times, whether electrically, photographically, or whatever the technique. Linear transformers were included in the unalterable ROM class earlier because they require wiring changes.

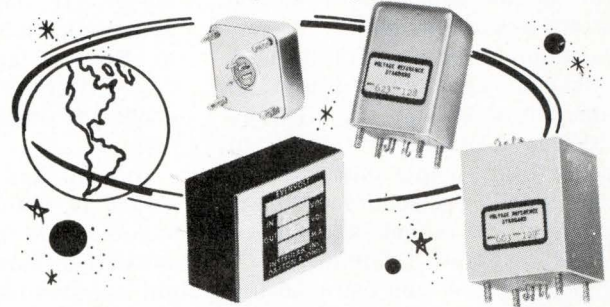
The fine structure of the memory market is apparent when you compare the average  $K$  value of all types of memories. The  $K$  value, of course, does not take into account how much more valuable one bit of RAM is when compared to a bit of ROM. The market, however, does take this into consideration. The highest  $K$  values belong to the least adaptive memories—ROMs. In order of decreasing  $K$  values, the line-up is ROMs, PROMs, AROMs and RAMs at the bottom.

The author is grateful for the data provided by the companies represented in the charts. They are listed in Table II along with Reader Service Numbers for obtaining more information about their products.

#### INFORMATION RETRIEVAL

Charts and Nomographs      Computers & Peripherals

## D. C. VOLTAGE REFERENCE STANDARDS for Aerospace Applications



- Less than 1 PPM/°C T.C. over 140° span (—55° to +85°C)
- Less than 1 PPM  $V_{out}$  change for  $\pm 1\%$   $V_{in}$  change.
- Long term stability less than 50 PPM/Year.
- AC or DC inputs available less than 0.01 pf equivalent capacitance on AC types (input to output).
- Standard or Custom Designs.
- Mil-Spec Conformity.

#### TYPICAL APPLICATIONS

Guidance Systems  
GSE Checkout Devices  
Fire Control Computers

Aircraft  
Space Vehicles  
Missiles

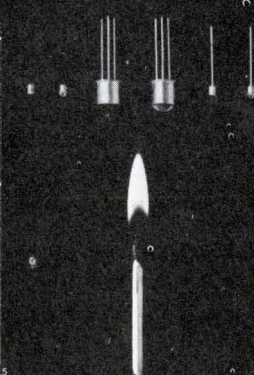
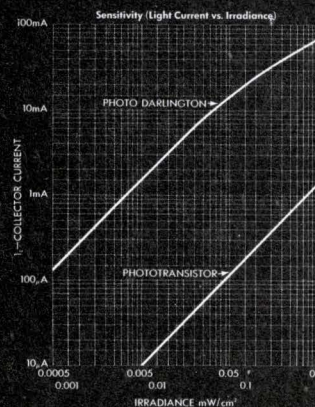
Manufacturers of precision  
Voltage References • Digital  
temperature indicators  
• Solid State, Non-Indicating  
Temperature Controllers.

**INSTRU/AB, INC.**

1205 Lamar St.  
Dayton, Ohio 45404  
(513) 223-2241

Circle Reader Service #15

## Clairex phototransistors give you higher sensitivity at extremely low illumination levels...and they cost no more.



One of our customers is using our phototransistors to detect signals from an LED at distances up to 60 feet. If you need phototransistors to give you more current at lower light levels, call (914) 664-6602, or write Clairex®, 560 South Third Avenue, Mount Vernon, New York 10550.

**CLAIREX ELECTRONICS**  
A DIVISION OF CLAIREX CORPORATION

Circle Reader Service #16

Now, there's a digital voltmeter that offers a combination of capabilities never before available. The new Hewlett-Packard 3403A.

Outstanding features of the 3403A are its eight-decade bandwidth, its six-decade ac voltage range (10 mV to 1000 V full-scale), its ability to measure both simple and complex signals with great accuracy ( $\pm 0.2\%$  reading  $\pm 0.2\%$  range), and its advanced, solid-state 3-digit display.

With the 3403A, you can measure ac, dc, or ac + dc, with **true-RMS accuracy**—and get your readout in either volts or dB. Its wide voltage range, and **extraordinarily wide fre-**

**quency range** give it unprecedented versatility. Its **direct readout in dB** makes it a "natural" for all kinds of communications work. And its ability to measure complex signals with crest factors as high as 10:1 makes it especially useful for noise measurement.

The 3403A is available with a wide variety of options and accessories, including dB display, autoranging, isolated or nonisolated digital output, isolated remote control, printer cables, active probes, and a rack adapter frame...making it ideal for systems applications, as well as lab and production work.

The 3403A's price ranges from \$1400 to \$2100, depending on options. An ac-only version, the 3403B, is also available, starting at \$1150. For further information on the versatile new 3403A, contact your local HP field engineer. Or write Hewlett-Packard, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

091/19

HEWLETT  PACKARD

DIGITAL VOLTMETERS

## HP's new 3403A voltmeter puts it all together... at an amazingly low price

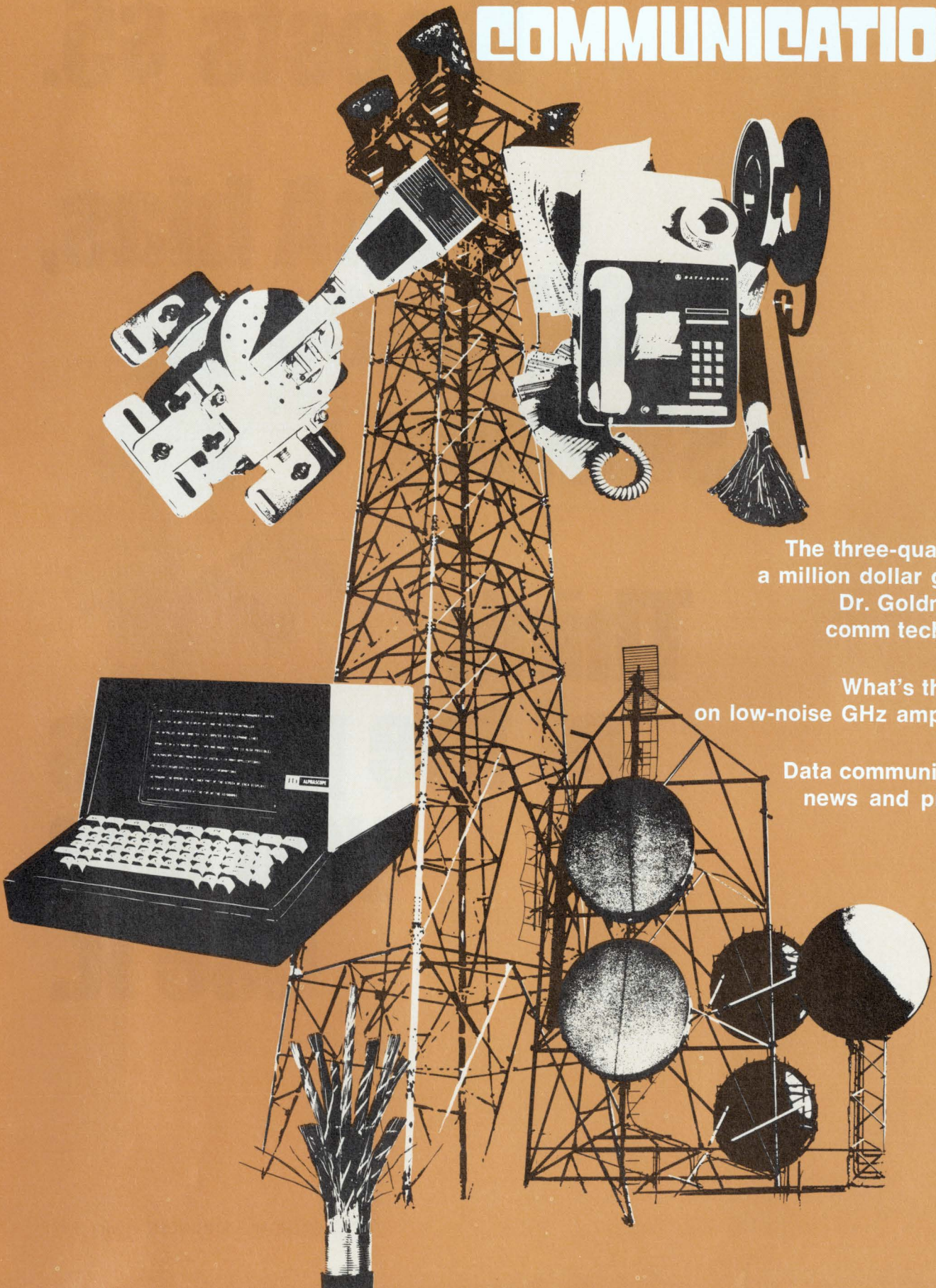
- True-RMS accuracy
- AC from 2 Hz to 100 MHz, plus DC
- Digital readout, in volts or dB





JANUARY 1972

# DATA COMMUNICATIONS



The three-quarters of a million dollar gamble:  
Dr. Goldmark on  
comm technology

What's the story  
on low-noise GHz amplifiers?

Data communications  
news and products

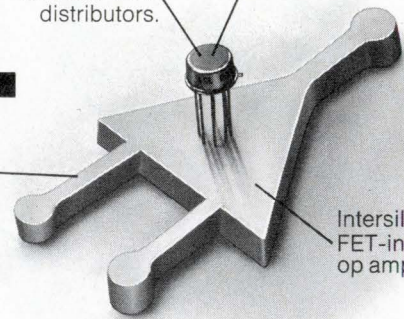
**It costs \$5.**

**2pA bias,  
6V/ $\mu$ sec  
slewing.**

Pin compatible with  
101A, 709, 740, 741.

Free sample  
available from  
distributors.

Standard 8-lead  
TO-5 can.



Intersil 8007  
FET-input  
op amp.

**Think  
of the places  
you can  
use it.**

### **For instance.**

Here's an op amp that's price competitive with the 101A, the 709, 740 and the 741. In its TO-5 can it's pin compatible with them all—and not a bit bigger.

But in performance it stands tall among the large complex modules.

It's the perfect answer for when  $100k\Omega$  to  $500k\Omega$  source impedances make amplifier input currents marginal, but price constraints force you to use a low cost bipolar op amp.

### **Surprise!**

It's a FET-input op amp, the Intersil 8007. It costs only \$5.00 in 100-piece quantities, and has a typical input bias of 2pA. (Model 8007A is available with  $I_B$  down to 1pA max.) It has a  $6V/\mu\text{sec}$  slew rate (@  $A_{CL}=+1$ ) and internal frequency compensation.

### **Get one free.**

Try it. Ask your Intersil distributor for a sample 8007 op amp. Discover the superb performance and design freedom it gives you compared to a marginal bipolar. Or use it instead of a big expensive module and save both dollars and real estate.

### **What you need in analog.**

Remember the company that put it all together in analog technology. Intersil. 10900 N. Tantau Ave., Cupertino, CA 95014.

### **Get it here.**

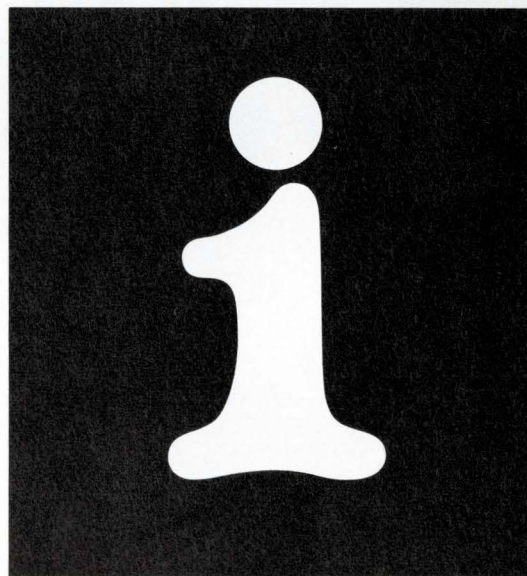
**Intersil stocking distributors.** Schweber Electronics; Century Electronics; Semiconductor Specialists; DeMambro Electronics; R.V. Weatherford Co.

**Intersil area sales offices.** Los Angeles (213) 370-5766; Metropolitan New York (201) 567-5585; Minneapolis (612) 925-1844; San Francisco Bay Area (408) 257-5450.

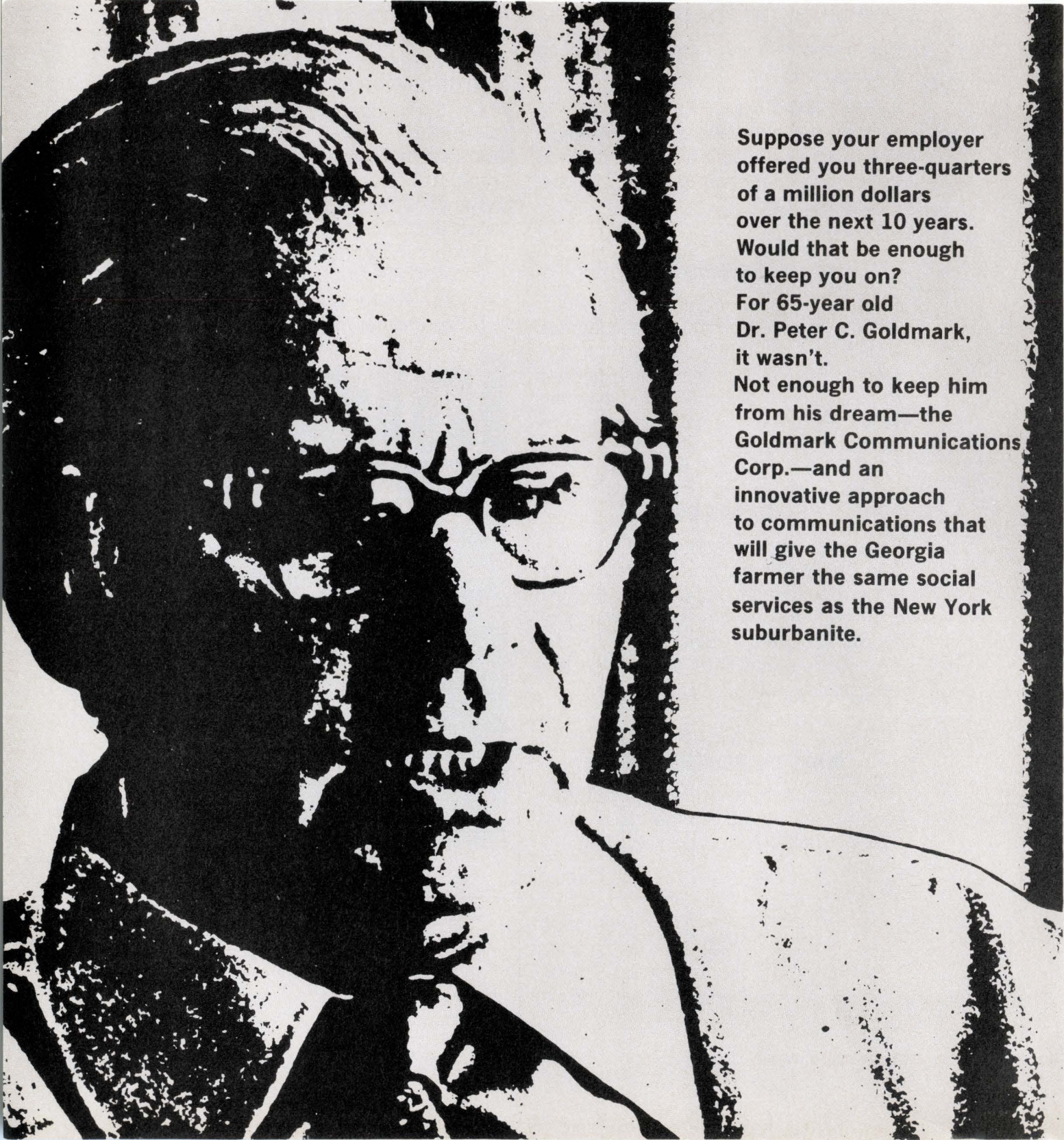
**Overseas representatives.** Clichy, France: Tranchant Electronique. Amsterdam, Holland: Klaasing Electronics. Tokyo, Japan: Internix. Zurich, Switzerland: Laser & Electronic Equipment. London, U. K.: Tranchant Electronique. Munich, West Germany: Spezial Electronics.

**U. S. representatives in all major cities.**

# Intersil



# How to start a revolution



Suppose your employer offered you three-quarters of a million dollars over the next 10 years. Would that be enough to keep you on? For 65-year old Dr. Peter C. Goldmark, it wasn't. Not enough to keep him from his dream—the Goldmark Communications Corp.—and an innovative approach to communications that will give the Georgia farmer the same social services as the New York suburbanite.

# at 65 (electronic, that is)

John McNichol, New Directions Editor

Why would anyone walk away from three quarters of a million dollars? Even if you spread it over a 10-year span, it's a great deal of money, particularly for inventors—a notoriously ill-paid lot. But for this well-paid inventive genius, now turned innovator, Dr. Peter C. Goldmark, it's not enough. Not enough to keep him from his dream: The Goldmark Communications Corp.—a new concept in business—and his involvement with communications to change the face of America. And at the same time he acknowledges that communications technology may just create a demand for the electronic industries' products and the electronic engineers' skills greater than anything seen in the past.

Sound blue sky? Not according to Goldmark, "We don't have to invent a damn thing; we just have to innovate—use our imagination." A strange remark from this inventor. As the former President of CBS Labs. from 1936 until last month, he has compiled an unequaled track record as an inventor. The holder of some 160 patents, Dr. Goldmark was responsible for the first practical color TV

system in 1940, the long-playing record, Electronic Video Recording (the CBS video cassette technique\*), the first high-speed photocomposition system, the high-resolution readout and ground recording system used in the Lunar Orbiter space program, and on and on. "It's as natural for Peter to invent things as to eat," Dr. Dennis Gabor\*\* says of him. An inventor in his own right, Gabor has worked for Goldmark at CBS Labs.

## Life begins at 65

What brings Goldmark to such grandiose plans at an age when many of his contemporaries contemplate nothing more exhilarating than of 390-yard, dogleg par 4 on a Florida golf course? "The time is right," he says. "I thought of my retirement from CBS as the natural conclusion to a phase.

\*For more information on the CBS process and others, see "The great video cartridge race," *The Electronic Engineer*, Feb., 1971, p. 38.

\*\*Dr. Gabor won the 1971 Nobel Prize in Physics for his work in holography. Like Goldmark, von Karman, von Neumann, Teller, Szilard and other giants of 20th century science, he came from Hungary.

## COMMUNICATIONS AND WINDHAM COUNTY, CONN.

Seated high in the northeast corner of Connecticut, Windham county remains a quiet, peaceful symbol of our rural past. Only 25 miles east of Hartford, its 326 square miles are 82% undeveloped. Only 5% of the county is classified as urban.

However, if Dr. Peter Goldmark has his way, Windham may be a precursor of the 21st century. Although it may retain its basic character, Windham's citizens no longer will be handicapped because they are far from the sophisticated services of a major city. Goldmark's plan is to bring these services—whether business, legal, educational, medical, or whatever—to the 10-town area of the county. Hopefully, these services will make living in Windham so attractive that the expected surge of 2 million more people within the next thirty years for Connecticut will settle in areas like Windham instead of the already overpopulated southwest counties of the state. At present, 75% of the 3 million citizens of Connecticut reside on 25% of the land.

With Goldmark's guidance, the National Academy of Engineering's Committee on Communications Technology selected Windham as an ideal site because of the town of Willimantic. Perched on the river of the same name, the town offers a college, a medical institution, and several important businesses. Because these businesses include some large branch offices of the Southern New England Telephone Co. and the Connecticut Light and Power Co., this area is partic-

ularly attractive for large broadband communications experiments. A two-way microwave link exists between the town and Hartford.

For these experiments, the Committee plans to have such transmission equipment to permit simultaneous two-way transmission between terminal points at 5 MHz. A microwave link would connect the 10-town area involved.

In addition, there would be terminal and studio equipment. This would allow conference television, which would be invaluable for medical consultation; and rapid facsimile, including hard copy output (1-10 seconds per page) and CRT displays.

As of Sept. 28, 1971, Connecticut officially endorsed this concept. If the Department of Housing and Urban Development sees fit to authorize the \$400,000 for the one-year pilot program, business, medical care, education, and the ordinary citizens of Windham County should benefit from Dr. Goldmark's vision. A HUD spokesman recently announced that the project was under "very serious consideration."

If this pilot project is successful and the tremendous growth of telecommunications makes more Windhams feasible, then Goldmark will have been successful in offering a true alternative. Reflecting on this, he says, "The next 50 million people may choose to live in cities. That's fine. But give them a choice."

"When I made this decision," reflected the solidly built Goldmark, his heavy glasses glittering, "I didn't know that CBS would make this generous offer (\$75,000 a year for the next 10 years) to retain me as Chief Scientist. However, CBS' main business is entertainment and I now want to concentrate on the planning of communications technology."

And it's the bright prospects for communications that makes Goldmark so eager to set to work. He's already been frustrated that Jan. 1 was a holiday. "I would like to start right away. I see," says Goldmark, "a wealth of applications coming from a communications *troika*: satellite, cable, and cassette."

Speaking in his characteristically low tones, Dr. Goldmark taked of the homes of the future, each with their own TV-cassette setup, receiving programming from both satellites and cable. Cable, which now reaches some 5 million homes, will be expanded to 50 million. Satellites, in turn, may link smaller cable networks to create giant nets. But what of those thinly distributed rural areas where cables cannot reach economically? "The broadcaster," he says, "will pick up the remaining homes. With satellites, he can do this if he's smart; the broadcasters will have to wake up."

Acknowledging that cable will always offer more capacity, he points out some of the advantages of satellites. For instance, he proposes that, in addition to traditional broadband applications, satellites can offer narrow band for inquiry and interaction modes.

## Troika and future shock

The triangular cornerstone of cable, cassette, and satellite can put communications to use for "new and better ways to educate the home, as well as such other social uses as health care and much, much more." With these applications, it will be possible, he believes, to move the U.S. population from its present (90%) concentration on 10% of the land to new rural satellite cities—the cities of the future.

But it's not just a question of moving people from the cities. "You can't do that," Goldmark emphasizes. "It is a question of giving people a choice of living in a small town or a big city. I believe communications technology can give people such a choice, which they don't have now."

Goldmark acknowledges the magnitude of the project—"The task is so huge and the time is so short"—while pointing to some very real rewards. According to him, "We're talking about a new industry which will be bigger than anything we've ever seen. The need for electronic products will be tremendous." Quite a bullish prediction when you consider this is the man who fathered two major

electronic industries—color TV and the long-playing record—with his inventions.

## The mechanism

Lighting up one of his ever-present Weekenders' cigars, Goldmark talked of how to encourage lightning to strike a third time. One suggestion: "We have to establish some national goals; a national commitment is a must. I don't know whether that means one large organization leading us or it may be a policy backed with funds provided by the government. I would like to see an institute started by the government to coordinate all this activity."

One governmental means that Dr. Goldmark is using to nudge the growth of communications technology is Sen. Hubert Humphrey's Subcommittee on Rural Development. As of April of last year, the Subcommittee began to draft a bill, Senate S. 2223, with Goldmark's help, that seems assured of passage. This legislation, allocated for \$2 billion over a 10-year period, will use a combination of credit means, subsidies, and special aids to help relocating industries. According to a spokesman for the Subcommittee, this will make possible "a number of model communities scattered all over the country, instead of just trying to remake New York City."

## A new concept for a new age

Goldmark's personal commitment to his belief in communications—a three-quarters of a million dollars' one—is the Goldmark Communications Corp. "What we're trying to do is to invent a new age of communications, so now we need a new type of company to fit this age," he says. When the Goldmark Communications Corp. opened its doors on January 2, it represented a prototype of this new category—a core company.

With a cool composure that belied a reputation for rare bursts of Hungarian temper that can intimidate a vice president, Goldmark leans forward in his chair as if to get closer to the future. "What I have in mind," he says, "is an organization that will develop a technical concept, study the markets for it, establish the most likely uses for the product, and obtain a licensee. I don't want to spend time on technical speculation unless all factors can come together simultaneously. It will all be timed and PERTED out." Interestingly enough, the former CBS research chief puts as much emphasis on marketing, finance, and the other business aspects as the scientific development. "Actually, it shouldn't be much different from going to the government with a very businesslike proposal," he says, reflecting the experience of a man who went after and won many government contracts with "very businesslike" proposals. (Cont'd. on page DC-8)

*For all types of 1/4 x 1 1/4" fuses and fuseholders:*

# **BUSS** YOUR ONE SOURCE

**Normal Blowing Fuses**

**AGC GLH MTH**

From 1/500 to 30  
amps, for 32V, 125V,  
or 250V

**Time Delay Fuses**

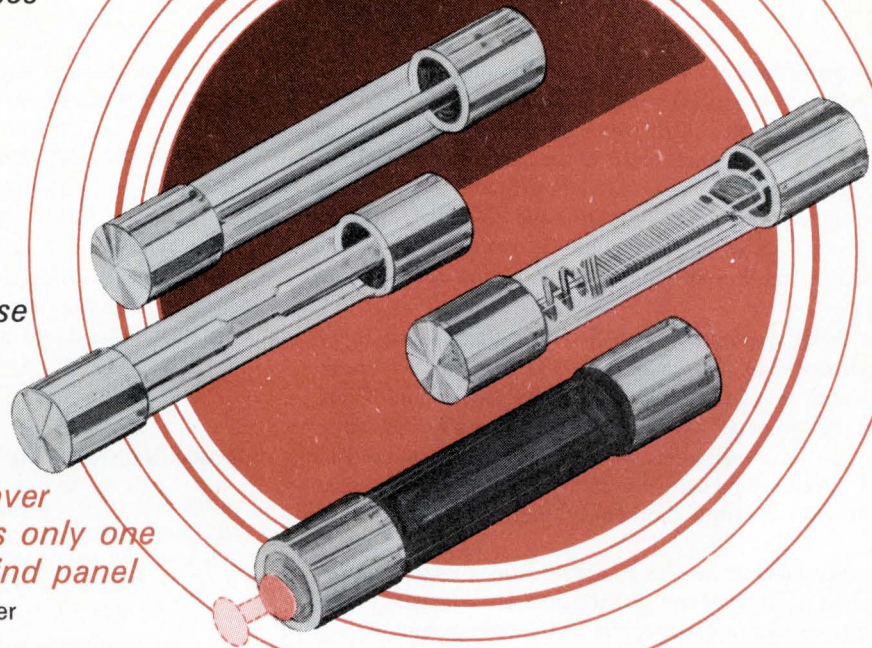
**MDL MDX**

From 1/100 to 30 amps,  
for 32V, 125V, or 250V

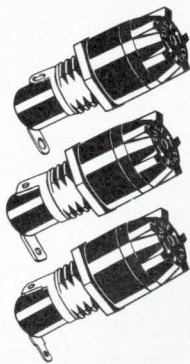
**Visual Indicating Fuse**

**GBA** (Red Indicating  
Pin)

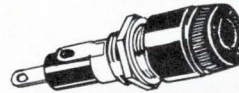
From 3/4 to 5 amps,  
125V



**Space-Saver**  
—projects only one  
inch behind panel



**HTA** (Solder  
Terminals)  
**HTA-HH** (1/4"  
Quick-Connect  
Terminals)  
**HTA-DD** (3/16"  
Quick-Connect  
Terminals)



**HKP** (Solder Terminals) **HKP-HH** (1/4" Quick-Connect Terminals)  
*The Fuseholder for All-Purpose Applications*



(Solder Terminals) **HLD** **HLD-HH** (1/4" Quick-Connect Terminals)  
*Visual Indicating Fuseholder*



**HKL** (Octagon Knob) **HKL-X** (Flat-Sided Knob)  
*Lamp Indicating Fuseholder*

**FUSEHOLDERS**

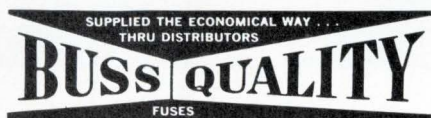
*All Have These Features in Common* • Rated for 15 amps at 250 volts • Dielectrically capable of withstanding 1500 amps a.c. between terminals and between terminals and panel • Bayonet-type knob grips fuse so that fuse is withdrawn when knob is removed; strong compression spring assures good contact • Made for installation in D-hole to prevent turning in panel • Terminals are mechanically secured as well as soldered in holder

This is only a sampling — use the coupon below to get a full description of the complete BUSS line of fuses and mounting hardware.

**BUSSMANN MFG. DIVISION, McGraw-Edison Co.**  
St. Louis, Missouri 63107

*Please send me a copy of BUSS Bulletin SFB*

Name \_\_\_\_\_  
 Title \_\_\_\_\_  
 Company \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_



The significance of Goldmark's core concept is that it can be a means of implementing technology in a relatively short space of time, all of which spells jobs for electronic engineers. For instance, core companies, such as Goldmark's, will need innovative engineers who can develop practical, marketable ideas. Also, the so-called "peripheral" companies or licensees could be formed by engineers who realize the business potential of a core company innovation.

The fledgling company will first investigate cassette TV and telemedicine. On cassette TV, Goldmark can speak with authority as the inventor of CBS' Electronic Video Recording process. "I developed cassette TV," he says, "because it is a marvelous way to teach in the home. But what I have in mind can be applied to all systems, not just EVR. It will integrate the subject matter with the technique."

On telemedicine, he sees communications improving the utilization of doctors and instruments. He contends that a large percentage of patients can be treated through the use of TV clinics and two-way communications. For instance, pointing to the Windham County, Conn., experiment, Goldmark contends that para-medical technicians scattered throughout the county could, with diagnostic tools linked by cable to doctors in the Hartford Hospital watching monitors, successfully handle 90% of the cases.

### Let's get to work

But beneath the bright prospects, the long-time CBS veteran sees one major flaw: the Japanese electronics invasion as a symptom of a far-reaching American problem. With stinging words he indicts the American attitude, "Most of the inventions were made right here, but what happens is that we're lazy, we want more money for less work, and our workmanship is lousy. The Japanese are just the opposite. They love their work; workmanship and quality are everything for them.

"We may be writing ourselves out of business completely. It's happened with our automobiles, business machines, household goods and clothes. The tendency towards less work for more money is killing us. Eventually we may have all the money, but there will be no work left to do."

Analyzing further, Dr. Goldmark pointed to our obvious success with large systems and machines. At the same time, the man, who has spent his life developing products for consumer electronics, bitterly scored the U.S. consumer industry. "Once we were fine," he said, "but something has changed that and now other countries do better. It might be, because the consumer is an individual, that he looks for attractive appearance, size, weight, convenience, and all those other human factors. All these attributes can

only come from a simple four-letter word—CARE. We just don't give a damn."

### Innovation—not invention

It has been said that an inventor is someone who converts fancies into facts. But Dr. Peter C. Goldmark is more than that, he can turn fancies into facts and those facts into entire industries. He's an innovative genius.

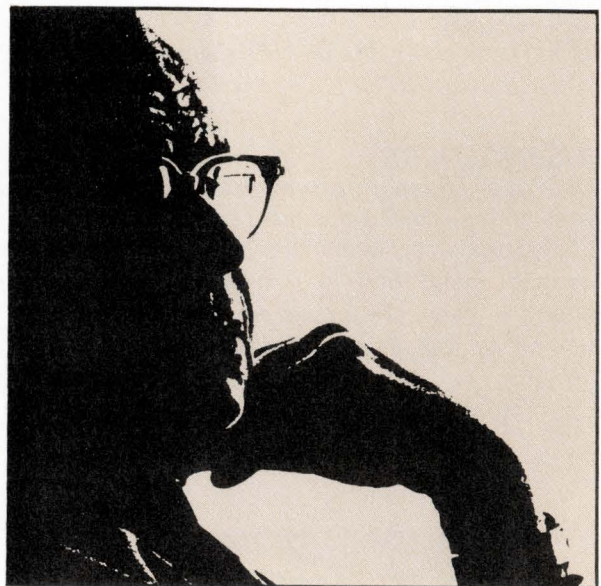
And innovation is what he's asking for from electronic engineers who would become involved in the cities of the

---

### COMMUNICATIONS INNOVATOR: DR. PETER C. GOLDMARK

In the late 1920's, a young Hungarian physicist then living in Vienna, put together a do-it-yourself receiving kit of a device invented by a Scottish stocking salesman. With it, Dr. Peter C. Goldmark was able to pick from the B.B.C. in London a TV picture on John Logie Baird's remarkable invention. Looking back, Goldmark reminisced, "The picture was postage-stamp size. You could hardly make it out, it flickered so. It was also in color, all red. But it was the most exciting thing in my life."

Since then, Goldmark has had a remarkable number of exciting triumphs. Leaving Vienna in 1931, he, equipped with his Ph.D from the University of Vienna, went to England where he joined Pye Radio Ltd. After two years as the head of the TV engineering department there, he left for the U.S. with \$250. and his cello—eager to advance the cause of television.





future concept. "When the need is made clear and the urgency it requires is understood, then there is innovation," he says. "You know, innovation is an inventive process. It's just making better use of inventions already known. For the average systems engineer, it's a far more exciting and interesting concept than invention."

An unusual amalgam of qualities, Goldmark is an inventor turned innovator, a research chief who recognizes the importance of marketing, a scientist and a businessman, and a pragmatic social reformer. Perhaps there is

something in that mix responsible for his success. And there is no arguing with his obvious success in the toughest game in town—consumer electronics.

Now poised to leap into the greatest challenge of his career at 65, he may be pointing the way for a whole new age of communications through innovation.

## INFORMATION RETRIEVAL

### Careers

Among some of the inventions associated with Goldmark during his long tenure at CBS, there is the long-playing record, Electronic Video Recording (the CBS video cartridge system), the first high-speed photocomposition system, the high resolution photographic system used by NASA's Lunar Orbiter, and a miniature color TV camera to photograph the action inside the stomach.

Yet busy as he is in the professional sector, he has somehow found time for other activities. Some of the other hats he wears are musician, he at one time played concert-level cello and piano, and architect, he designed his own home for his wife and six children. His Goldmark-designed house reflects his interests. For instance, his workroom is located next door to the kitchen so there are no wasted steps when he senses a solution to a problem. The living room has a sound system—still unpatented—which engulfs the listener in music.

Another interest in recent years has been that of social action. Deeply involved in the anti-poverty movement in Southfield Village, a slum area of Stamford, he has done much to change the social climate to one of hope through a tenant-participation plan and other schemes. Also, he has been instrumental in setting up the Windham county, Conn., project to bring medical, legal, business, and other services to rural communities by means of communications technology.

A member of many technical societies, he has received honorary degrees from Fairfield University and Polytechnic Institute of Brooklyn. Among his professional awards are the Morris Liebmann Memorial Prize for electronic research, the Vladimir K. Zworykin Television Prize, the National Urban Service Award "for his efforts in the war on poverty," the David Sarnoff Gold Medal Award, and the 1972 Industrial Research Institute Medal.

After being turned down by RCA where Vladimir Zworykin had just invented the iconoscope, Goldmark was offered a job by Paul Keston, a vice president of CBS, on the basis of



one of his technical papers. Shortly after this Dr. Goldmark was directing the construction of a TV station on top of the Chrysler Building for CBS.

In the same year, 1936, CBS gave Goldmark the responsibility for setting up an industrial research laboratory. Starting with two technicians and one room, he has built CBS Laboratories to a 500-man organization with an international reputation.

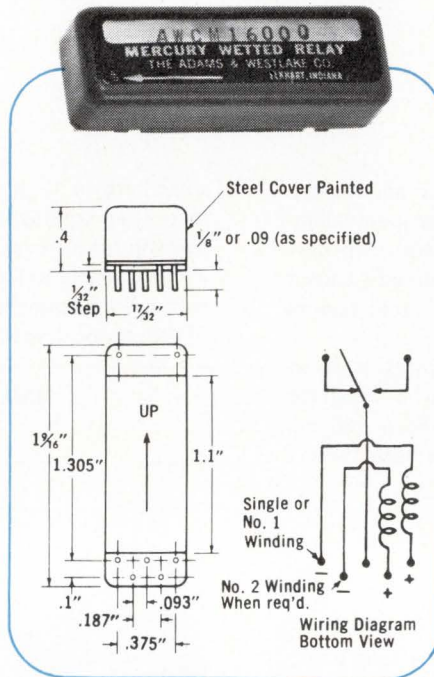
Yet much of that reputation has been the result of just one man's response to a stimulus. For instance, Goldmark, who believes that irritation is the mother of invention and tenacity its father, saw his first color movie, "Gone with the Wind," in 1940. His inventive processes irritated by the prospects of color, he made a proposal to the CBS management by March of that year, and three months later there was the first practical color TV systems. Ironically, although RCA finally won the color war with their compatible system after many skirmishes, they had to pay CBS royalties for the right to use the shadow mask tube developed by the Labs.

# SENSITIVE MERCURY WETTED CONTACT RELAYS

Ultra-reliable, highest quality Sensitive Relays with mercury wetted contacts are ideal for critical applications, such as digital and analog computers, telecommunication systems, multiplex, industrial control equipment and power control devices. New type MWK (center off—SPST) is ideal for multiple channel switching.

## ELECTRICAL (Type AWCM):

- Contact Arrangements:  
Form C and D
- Insulation Resistance:  
1000 Megohms minimum
- Current Rating:  
Up to 2 amps or 500 VDC
- Contact Resistance:  
50 milliohms maximum
- Life:  
1 billion operations
- Contact Bounce:  
NONE
- Contact Rise Time:  
10 nano seconds or less
- Operating Speed:  
To 200 operations/second



## PACKAGING (Type AWCM):

- Environmental Protection: Hermetically sealed contacts, potted metal case
- Shielding: Internal shielding available
- Shock and Vibration: Withstands all normal handling/transportation effects
- Mounting: Printed Circuit

Advanced manufacturing methods and stringent quality control procedures assure highest quality. Many types available directly from stock. Engineering and applications assistance available. Surprisingly short delivery schedules.

## MERCURY DISPLACEMENT RELAYS

Time delay and load relays meet the toughest, most demanding switching applications. Non-adjustable time delay relays offer contact forms A and B with delays up to 1/2 hour, current ratings to 15 amps. Load relays switch from 30 to 100 amps with contact forms A and B.

## DRY REED RELAYS

Miniature, intermediate, and standard sizes offer A and B contact forms with from 1 to 4 poles of switching. Typical life is  $20 \times 10^6$  operations (rated load) or  $500 \times 10^6$  operations (dry circuit).

USE READER-SERVICE NUMBER FOR COMPLETE INFORMATION



**THE ADAMS & WESTLAKE COMPANY**

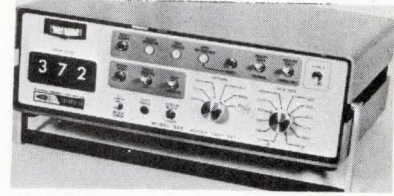
Elkhart, Indiana 46514 • (219) 264-1141 • TWX (219) 522-3102 • TELEX 25-8458 • Cable ADLAKE

SUBSIDIARY OF  
**ALLIED PRODUCTS CORPORATION**

Circle Reader Service #20

## MODEM TEST SET

Model 225 simplifies the testing of



both synchronous and asynchronous transmission systems, modems, multiplexers and error control systems. Major features include testing full duplex, half duplex and simplex systems, a bias meter for mark/space bias distortion measurement and direct display of bit or block, error count. Systron-Donner Corp., Datapulse Div., 10150 W. Jefferson Blvd., Culver City Calif. 90203.

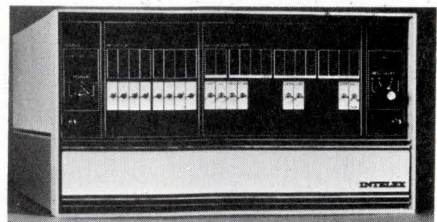
Circle Reader Service #310

## ORDER ENTRY TERMINAL

The 100-OED source data terminal consists of a data entry and control keyboard, two magnetic tape cassettes, an impact-type incremental printer, and a CPU data channel, all under control of a powerful built-in microprocessor. The microprocessor can be programmed by exchanging ROM program boards to accommodate changing functional requirements. Computek, Inc. 143 Albany St., Cambridge, Mass. 02139.

Circle Reader Service #311

## MICROPROCESSOR



The RACE microprocessor is a communications-oriented minicomputer designed for use as a "building block" in larger systems. It features dual memory busses, a microprogrammed ROM, a comprehensive command vocabulary of 190 instructions, and an input/output channel that can accommodate 32 peripheral devices. Intelix, Inc., 2612 National Circle, Garland, Tex. 75041.

Circle Reader Service #312

## Low-noise GHz transistors—who's got what

Communications is a big industry. Microwave communications is a big part of that industry. And communications needs low-noise amplifiers.

In a three-or-more stage amplifier, most halfway-decent transistors can fill the needs of the later stages. But the first stage or two are critical in terms of noise performance and power gain. So special laurels will go to the manufacturer who can corner the market for the most stages in a multistage, low-noise, gigahertz amplifier.

Nippon Electric Company started the whole thing when, sometime back, it introduced its V578. Since then, several companies (including some of NEC's old customers) have jumped on the bandwagon and introduced their own, updated versions of that popular unit.

Right now, there are four major sources of low-noise, GHz transistors: AvanteK (phosphorous-diffused emitters); Fairchild MOD (arsenic-diffused); HP (arsenic); and NEC (phosphorous).

No European company is, as yet, a factor in the game.

The bombshell that HP exploded is the pricing of its entry: nobody, so far, can match HP's low-priced combination of noise figure and gain.

Another factor is the transistor package. All of the units are stripline, of course, and all are hermetic and will meet Mil specs. Even so, the problem with microwave transistors has been the fragility of their packages. Most packages are glass/metal or glass/ceramic. Nippon Electric and AvanteK are the exceptions, with ceramic/metal packages.

NEC already has a reputation for hirel above and beyond the call of Mil-spec duty. But its V913 and V914 transistors are housed in a new, NEC-designed, ceramic/metal, 80-mil-square package so rugged that you can, literally, step on it without hurting the transistor. This is expected to be a real boon to the industry, particularly if the other

sources pick up on it.

Each manufacturer is practically out of breath trying to outpace its competition. The low-noise race is so fluid that it's difficult to lockup in print. For instance, NEC's V914 is expected to be officially announced about the time you're reading this. HP's entry may be superseded in the near future. And MOD may have an "A" version of its MT 4578, together with a revised price structure.

What's in the future? Well, for one thing, definitely be on the lookout for extended frequency specs (example: NEC's V914 may be classed as a triple-6 transistor—6-dB gain and 6-dB NF at 6 GHz; MOD's MT 4000 and 4100 have 5.0- and 5.5-dB NFs, respectively, at 6 GHz), more ionimplanted bipolar structures, and GaAs FETS.

For more information, contact the manufacturers at these addresses:

● **AvanteK, Inc.**, 2981 Copper Rd., Santa Clara, Calif. 95051. (408) 739-6170.

**Circle Reader Service #313**

● **Fairchild MOD**, 3500 Deer Creek Rd., Palo Alto, Calif. 94304. (415) 493-3100.

**Circle Reader Service #314**

● **Hewlett-Packard**, 1601 California Ave., Palo Alto, Calif. 94304. (415) 493-1501.

**Circle Reader Service #315**

● **NEC: California Eastern Labs.**, 1540 Gilbreth Rd., Burlingame, Calif. 94010. (415) 697-6670.

**Circle Reader Service #316**

MFR.	TYPE NO.	2 GHz		4 GHz		PRICE EA., (\$)		READER SERVICE NO.
		NF, (dB)	MATCHED P.G., (dB)	NF, (dB)	MATCHED P.G., (dB)	UNIT QUANTITY	100-UP	
AvanteK	AT-501	3.5	14	6.0	7.0	165	100	248
Fairchild MOD	MT 4000	2.2	15	3.7	8.0	249*	170*	249
	MT 4100	2.7	14	4.2	7.5		*	
	MT 4578	3.5	14	5.5	7.5	148	92*	
HP	35862E <sup>1</sup>	3.0	16	4.5	10	75	65	250
	35865E <sup>2</sup>							
NEC	V578A	3.0	13	6.0	7.0	125	80	251
	V913A	2.7	13.5	4.5	8.0	200	125	
	V913B	3.0	13	5.5	7.5	125	80	
	V914 <sup>3</sup>	2.5	16	4.0	10.0	280	200	

NOTES:

(\*) Prices being revised and renewed.

(1) 70-mil package.

(2) 130-mil package.

(3) Target specs.

### BIT ERROR RATE TESTER

The BERT 901 provides complete data system testing and evaluation in a single, lightweight, portable unit. In addition to bit errors, it counts block errors to measure the true effectiveness of data transmission systems. Bit error count, block error count, and block count are displayed for each test. II Communications, Willow Grove, Pa.

**Circle Reader Service #317**

### ENCODED KEYBOARDS

This line includes five standard low-profile encoded keyboards for communications and data entry terminals. Designated the dc series, they use an elastic diaphragm switch concept, and are offered in 13 and 15 in. frame, 49 to 71 key models for dual and tri-mode operations. Datanetics Corp., 18065 Euclid St., Fountain Valley, Calif. 92708.

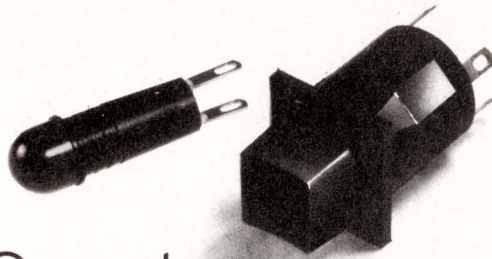
**Circle Reader Service #318**

### ACOUSTIC COUPLER

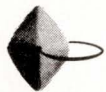
Instead of the more common threshold detection circuits, the design 76 series of 300 baud couplers uses a different method of data detection. These units look at the quality of the carrier and will only allow transmission when a valid carrier signal is present. Design Elements, Inc., 1356 Norton Ave., Columbus, Ohio 43212.

**Circle Reader Service #319**

# Marco... First LED Switches & Indicators with Greater Brightness, Wide- Angle Visibility



Graded LED'S for consistent luminous intensity and exclusive micro-grooved lenses for improved light dispersion mean greater brightness over a wide viewing angle in new low-cost, IC-compatible Series 590/D LED Switches and QT/D LED Indicators . . . the Marco D-Line — designed specifically for computer and control panel displays. Midget-flange based LED for switches . . . front panel service. For complete details, write or call:



## MARCO-OAK

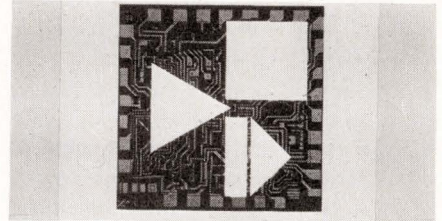
Subsidiary of OAK ELECTRO/NETICS CORP.  
P.O. Box 4011 207 S. Helena Street  
Anaheim, Calif. 92803 • Tel. (714) 535-6037

MARCO D-LINE . . . Innovative LED Display and Control Applications.  
**Circle Reader Service #21**

# DATA COMMUNICATIONS PRODUCTS

## CUSTOM COMM SUBSYSTEMS

This product, called the XR-system, is a multi-function building block that can



be produced in about three weeks as a custom circuit or as a custom multi-circuit subsystem. Aimed primarily at the speech and data communications field, the building block functions handle analog or digital signals over all the signal-level, power supply, and freq. ranges generally used in the communications industry. Exar Integrated Systems, Inc., Sunnyvale, Calif.

**Circle Reader Service #320**

## MULTIPLEX MODEM SYSTEM

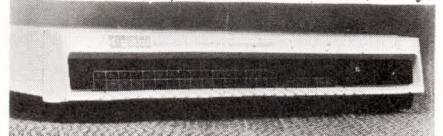


Model 5150 permits up to 24 channels over a std. 3002 nonconditioned line. Transmitter and receiver are on individual modules which include plug-in filters to provide selection of any line freqs desired. All modules provide strapping options for EIA, CCITT, TTL, DTL or Teletype interfaces. Basic Cost/channel, \$285. RFL Industries, Inc., Boonton, N.J. 07005.

**Circle Reader Service #321**

## OEM COMPUTER

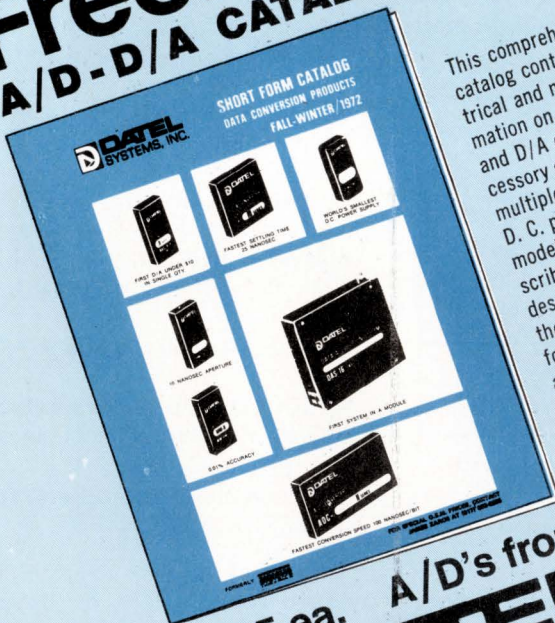
The PDP-11/03 is a low cost, very



small communications oriented computer designed for distributed computer systems. It comes with 2K, 4K, 8K or 16K bytes of memory in a 3 1/2 in. high enclosure. With a price tag as low as \$2,560 in quantity, DEC sees the 11/03 as a natural for use in intelligent terminals. Digital Equipment Corp., Maynard, Mass. 01754.

**Circle Reader Service #322**

# Free! A/D-D/A CATALOG



This comprehensive 12-page catalog contains detailed electrical and mechanical information on ultraminiature A/D and D/A converters, plus accessory sample and holds, multiplexers and miniature D. C. power supplies. Eighty models of 17 series are described in detail. Hardware the basic building blocks for many forms of data acquisition, data analysis, data reproducing and graphic display equipment.

D/A's from \$9.95 ea. A/D's from \$59.00 ea.



FORMERLY  
**VARADYNE**  
SYSTEMS  
A DIVISION OF VARADYNE INC

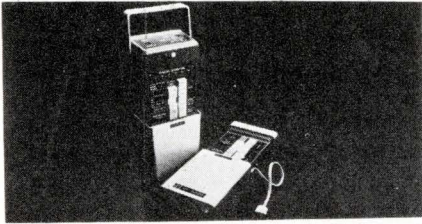
1020 TURNPIKE STREET, CANTON, MASS. 02021 / TEL. (617) 828-6395

TWX 710-348-0135

**Circle Reader Service #22**

## COMM TEST EQUIPMENT

The Model 404 pattern generator and



data analyzer each weigh < 4 lb and will sell for under \$500 ea. Features include true start-stop distortion measurement; simultaneous peak and bias/end distortion readouts; 5, 7, or 8 level "fox" messages; and four pushbutton-selectable distortion levels in the pattern generator. Data Products, 6219 DeSoto Ave., Woodland Hills, Calif. 91364.

**Circle Reader Service #323**

## PHONE DECODER

This unit decodes the standard telephone two-tone signal into 16 mA 5V TTL digital logic outputs. The contact closure of the sending instrument can be duplicated on the receiving end as a bounceless strobe which can actuate machinery or write data into a computer. Kenics Systems Corp., 125 Harvard St., Cambridge, Mass. 02139.

**Circle Reader Service #324**

## CASSETTE RECORDER

The Model 240 gives you a tape path similar to that of large reel-to-reel transports. It provides precision tape guidance and positive tape tension control in all operating modes without need for pinch rollers, pressure pads or tape guide forks. Bell & Howell Electronics & Instruments Group, 360 Sierra Madre Villa, Pasadena, Calif. 91109.

**Circle Reader Service #325**

## DATA COUPLER

Model 2000 collects information, to your specific format, with time reference and selected fixed data. The information can be printed, recorded on tape, or coupled to a modem. Optional features include automatic entry of sample, number, time of day, and custom systems interfacing. Data Entry Systems, Inc., Faulkner St., N. Billerica, Mass. 01862.

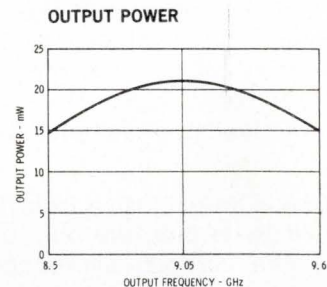
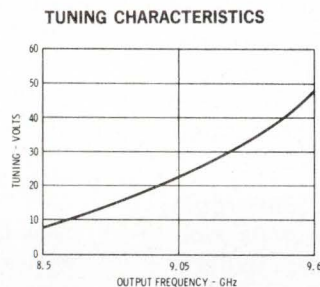
**Circle Reader Service #326**

# SPOTLIGHT ON VOLTAGE-CONTROLLED OSCILLATORS

from  
**250 MHz - 11 GHz**

WJ-2807-3 is one of a family of voltage-controlled oscillators produced by Watkins-Johnson for applications where small size, low power requirements and high reliability are essential. It delivers 10 mW min. power output in the 8.5 to 9.6 GHz range with +50 Vdc max. tuning voltage required.

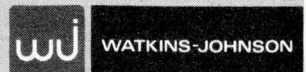
**WJ-2807-3**



Specifications for other members of the family are shown below. These solid state devices employ varactor tuning to ensure high tuning input impedance characteristics. Tuning voltage vs. frequency curves are approximately exponential and monotonic, allowing ease of linearization.

**GUARANTEED SPECIFICATIONS**

Frequency Range (GHz)	Type	Output Power (mW min.)	Tuning Voltage (Vdc max.)
0.25-0.5	WJ-2811	100	+60
0.5-1.0	WJ-2800	100	+60
1.0-2.0	WJ-2803	100	+60
2.0-4.0	WJ-2804-40	40	+60
4.0-8.0	WJ-2806-6	20	+45
4.0-5.6	WJ-2817	20	+45
4.0-6.0	WJ-2817-1	20	+45
5.6-8.0	WJ-2818	20	+45
6.0-8.0	WJ-2818-1	20	+45
8.5-9.6	WJ-2807-3	10	+50



3333 HILLVIEW AVE., STANFORD INDUSTRIAL PARK, PALO ALTO, CALIF. 94304 • (415) 326-8830

**Circle Reader Service #23**

# NOW...

*the only one of its kind available!*

## A Course in MOS INTEGRATED CIRCUITS

The editors of *The Electronic Engineer* have just compiled a complete 9 part course on MOS technology, applications and costs which appeared originally in *The Electronic Engineer*. It is a definitive volume that provides you with all the background you need as a user or a designer to master this new technology.

This state of the art course in MOS technology presents completely authoritative, up-to-the-minute guidance in using every aspect of this dynamic science. It covers the processing of MOS circuits, applications of MOS circuits, complementary MOS, MOS memories (random access, read only, associative memories and cost) and the testing of complex MOS integrated circuits.

This course is an exclusive from *The Electronic Engineer*. It is, in fact, the only one of its kind available. The authors, all recognized experts in their respective fields, take you with technical precision from the fundamentals on through to the most sophisticated phases of this dramatic technology. This course is the *one* authoritative way to keep ahead in these changing times.

Order your copy of the *only* course available on the new MOS technology and manufacturing processes for only \$5.00 per copy. Send your order today to: *The Electronic Engineer*, One Decker Square, Bala Cynwyd, Penna. 19004, Dept. E-1

---

Enclosed is my check or money order for \$\_\_\_\_\_ for \_\_\_\_\_ course(s) on MOS technology at a cost of \$5.00 each. Send as soon as possible to:

Name \_\_\_\_\_

Address \_\_\_\_\_ Company \_\_\_\_\_

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

Send me special quantity prices  E-1

## DATA COMMUNICATIONS PRODUCTS

**Switching over . . .** Hewlett-Packard Associates is readying a solid-state transmit-receive switch to compete with mechanical T-R switches. The small, plastic, 50  $\Omega$  stripline package is suitable for lumped-constant circuitry, and includes two PIN diodes. Typical isolation is about 30 dB at 500 MHz, which is adequate for most commercial services at the 100-W level. Drive currents are about the same as for mechanical T-R switches; the operating bandwidth ranges from 50 MHz to 1.2 GHz.

*Circle Reader Service #327*


**Higher frequencies, lower costs . . .** In a recent proposal to the TV networks, MCI Lockheed, a combine going after the satellite communications business, offered "studio-to-studio links between 374 TV stations across the nation at a cost only 40% of current charges for nationwide microwave and coaxial cable hookups." Following the network's specifications for the use of 4 and 6-GHz bands, the MCI Lockheed Group went on to suggest that further economies could be made if the 12 and 14-GHz bands were used.

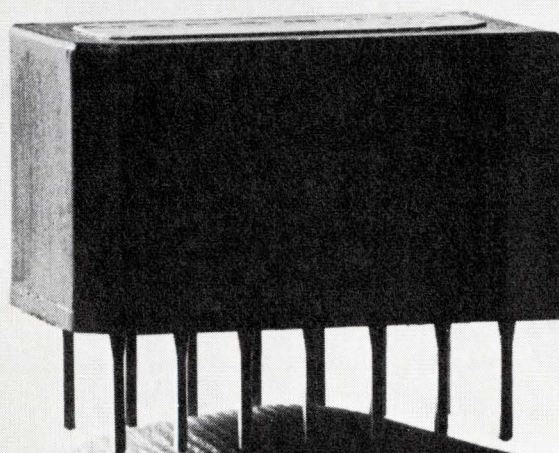
**Interconnection solution? . . .** The PBX Advisory Committee of the FCC may be setting the trend for an industry-wide solution to the knotty interconnection problem. The Class II or "barrier" PBX would be a certified PBX which "does provide sufficient protection against potential harms introduced by uncertified equipment or wiring on the line (customer) side of the PBX unit. Therefore, except for the PBX unit itself, customer equipment and wiring need not be certified."

**Second sourcing . . .** National Semiconductor is expected to announce next month that they have available a universal asynchronous receiver/transmitter to compete with the four already on the market (See *The Electronic Engineer*, Dec. 1971, pp. DC-18-DC-19). The National product, according to a company spokesman, will have improved performance over those now available.

*Circle Reader Service #328*

**It's a big world, according to ADL . . .** A recent study by Arthur D. Little, the well-known consulting firm, projects the world market for comm equipment will double within the next seven years. The \$500,000 project, sponsored by such American firms as AT&T, GTE, AMP, Hewlett-Packard and others, as well as European and Japanese companies, studied the communications market in 35 countries. Among the trends to watch is the shift from a North American-dominated business in 1970 (39%) to a European-dominated business (38%) by 1980. Also, data communications is the fastest growing segment of the comm business, e.g., the demand for modems in some European countries will double every four years. An ADL spokesman commented, "If you're on the edge of this business, you'd better jump in with both feet. Even the computer companies will be going after the electronic switching business."

**It you've been looking for a miniature crystal-controlled clock oscillator in a 14 pin DIP package to fit standard PC board sockets, stop looking and start writing for the K1091A spec. sheet from Motorola Component Products Dept. 4545 W. Augusta Blvd. Chicago, Ill. 60651.  **MOTOROLA****



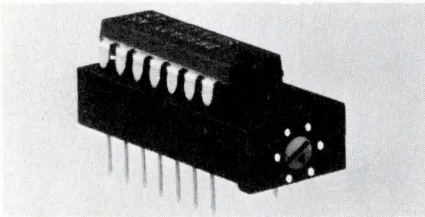
*Circle Reader Service #43*

Specifications: 4 to 20 MHz range; 0.01% stability; prototype quantities available for immediate delivery in 4.9152 MHz, or 5.0, 10.0 or 20.0 MHz.

# The best of '71

Here's your chance to catch up on the items that generated the most interest last year.

## "PIGGYBACK" SWITCH



Here's a switch that's 100% IC compatible, that has a "piggyback" feature to let you plug any std. 14-pin device into it, and that you can couple in "tandem" for design versatility. Only 0.230 in. high, the switch lets you stack PC cards in 1/4 in. increments. The company can, through the use of only a few basic shapes, build almost any desired program into the DIP switch without any special tooling and assembly costs. Daven Div., McGraw-Edison Co., Manchester, N.H. 03101.

**Circle Reader Service #252**

## COMMUNICATIONS SUBSYSTEM

The LM373 is designed for a-m, fm and ssb applications. There are two amplifier sections (four gain/limiters), a gain-control stage, a fully balanced fm/ssb detector, and an active a-m/ssb peak detector whose output matches the AGC characteristics. The three primary operating modes are: an a-m i-f strip with an AGC range of 70 dB; fm i-f strip with the quadrature detector input balanced by an active network; and ssb i-f strip with audio-operated AGC, double-balanced quadrature detector, and automatic mixer balancing. National Semiconductor, 2900 Semiconductor Dr., Santa Clara, Calif. 95051.

**Circle Reader Service #253**

## SEVEN SEGMENT INDICATOR

Because of its unique construction, the Data-Lit 3 can be plugged into a PC board edge card connector for a vertical display. Since it requires only 1.7 V/segment you can power the display from the same supply as the logic card. Litronix, 10440 N. Tantau Ave., Cupertino, Calif. 95014.

**Circle Reader Service #254**

## DIGITAL READOUT

This digital readout plugs directly into a std. 0.050 in. center edge connector, solving existing readout packaging problems and saving space. The Lite-Pak display also features low voltage (3 to 5 V), low current (as low as 8 mA), and long life (100,000 h). It is readable in direct sunlight and has distortion-free viewing. Pinlites Inc., 1275 Bloomfield Ave., Fairfield, N.J. 07007.

**Circle Reader Service #255**

## 7-SEGMENT READOUT

New microminiature, low current readout (3015F-CN) features a 700 fL brightness at 5 V. The rectangular units may be installed in PCBs or 16-pin DIP IC socket mountings on 0.5 in. centers. Slanted characters are 0.36 in. high x 0.20 in. wide with 8 mA/segment. Shelly Associates, 111 Eucalyptus Dr., El Segundo, Calif. 90245.

**Circle Reader Service #256**

## STEREO PROCESSING CIRCUITS

This line includes a 19 kHz amplifier, frequency doubler, stereo indicator lamp, and stereo demodulator. The four new devices, Types ULN-2120A, ULN-2122A, and ULN-2128A are housed in 14-lead DIPs and operate from -30 to 85°C. Sprague Electric Co., North Adams, Mass. 01247.

**Circle Reader Service #257**

## HYBRID VOLTAGE REGULATOR

With this 85-W power hybrid voltage regulator you can lower the cost of your power supplies and in-house power supply manufacturers can simplify their designs. If you want to build your own power supply, the only components you need are a transformer, two semiconductor rectifiers, and a filter capacitor. Attach the LAS 2000 hybrid package to these four components and you're in business. Lambda Electronics Corp., 515 Broad Hollow Rd., Melville, N.Y. 11746.

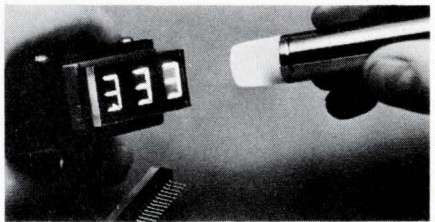
**Circle Reader Service #258**

## IC DECODER

This tone and frequency decoder version of the manufacturer's phase locked loop is suitable for such applications as telephone tone decoding, carrier-current remote control, ultrasonic control, monitoring and control of frequencies, communications paging and wireless intercom. The 567 tone decoder will sink up to 100 mA when a sustained freq. within the detection band is present. The center freq. is adjustable between 0.01 Hz and 500 kHz, and you can adjust the detection bw from 1 to 14% of center freq. Signetics Corp., 811 Arques Ave., Sunnyvale, Calif. 94086.

**Circle Reader Service #259**

## LIQUID CRYSTAL DISPLAYS



This display consists of a thin layer of normally transparent liquid crystal material between two electrodes. When an electric field is applied, the material becomes turbulent, reflecting and scattering amb. light. Optel Corp., Box 2215, Princeton, N.J. 08540.

**Circle Reader Service #263**

## DISPLAY—DECODER/DRIVER

The MC4050 counter-latch-decoder combines the functions of an NBCD (Natural Binary Coded Decimal) counter, four-bit latch, and LED decoder/driver. This monolithic MSI package replaces three others. It comes in a 16-pin DIP ceramic or plastic version. The MOR 33 seven-segment monolithic LED display has a 0.125 in. char. height. The pn GaAsP 350 mW display emits in the visible red (6600 Å). Brightness is typ. 200 fL/segment at 10 mA. Motorola Semiconductor, 5005 E. McDowell Rd., Phoenix, Ariz. 85036.

**Circle Reader Service #264**



# 1 to 80 Amp Germanium Power PNP TRANSISTORS for Immediate Delivery

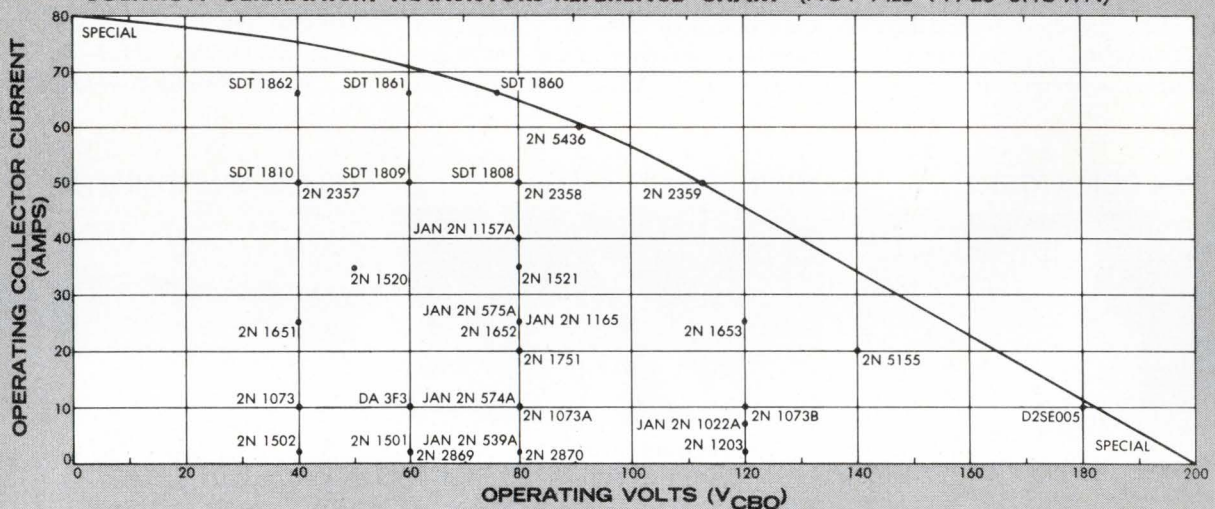
## FEATURING:

- 80 Amp  $I_C$  capability with  $V_{CE}$  (sat) in low mV ranges for inverter/converter applications.
- 1.0 Amp  $H_{FE}$  to closely matched specifications for audio/amplifier applications.
- 200 Volt  $V_{CEO}$  capability with fast switching DAP transistors.
- Many popular JAN devices in stock for immediate delivery.
- High Reliability processing available to customer specifications.
- "Off the shelf" delivery on all standard TO-3 and TO-68 types.
- Custom designed units for special requirements.

Solitron is now the industry's largest manufacturer and supplier of Germanium PNP Power Transistors! We've been a pioneer in the development of germanium power since purchasing the original lines from Honeywell and Bendix some years ago. We continued to develop new germanium technology and packaging while others were getting out of the business.

Today, no other semiconductor company can meet your germanium needs as fast as we do. Only Solitron offers such a wide line of standards. They're in stock . . . in quantity . . . for a multitude of functions. Automotive. Airborne. Marine. Communications. Data Processing. Entertainment. And if we don't have a type to meet your specific needs, we'll custom design it for you. You name it. We'll produce it.

**SOLITRON GERMANIUM TRANSISTORS REFERENCE CHART (NOT ALL TYPES SHOWN)**



For complete information, prices and engineering application assistance, dial toll-free 1-800-327-3243. Or write:

# Solitron

**DEVICES, INC.**

1177 BLUE HERON BLVD. / RIVIERA BEACH, FLORIDA / (305) 848-4311  
TWX: (510) 952-7610

SAN DIEGO, CAL.  
8808 Balboa Avenue  
FET & Dual FET  
Transistors  
MOS/FET Devices  
MOS Memory Arrays  
Shift Registers  
Monolithic IC's  
Small Signal  
Transistors

RIVIERA BEACH, FLA.  
1177 Blue Heron Blvd.  
Hi-Rel Power Transistors  
SI & Ge. Power  
Transistors  
Hi-Rel Power Hybrids  
PNP-NPN Industrial  
Transistors

PORT SALERNO, FLA.  
Cove Road  
Microwave Connectors  
Plaxial (R) Cable  
Precision RF Coaxial

JUPITER, FLA.  
1440 W. Indiantown Rd.  
Microwave Stripline  
Components  
Microwave Semiconductor  
RF Semiconductor  
Microwave Integrated  
Circuits

TAPPAN, N. Y.  
256 Oak Tree Road  
Diodes & Rectifiers  
Zeners  
High Voltage  
Assemblies  
Power Rectifiers  
Thick Film Hybrid  
Circuits  
Ferrite & Ferrite Devices

KENT, ENGLAND  
Tubbs Hill House  
London Road,  
Sevenoaks  
Solidev, Ltd.  
Full line of  
Solitron devices

BEN BARAQ, ISRAEL  
51 Hayarkon Street  
AEL Israel, Ltd.  
Full line of  
Solitron devices

TOKYO 105, JAPAN  
No. 5, 3-Chome  
Shibahamamatsu-Cho  
Minato-Ku  
Matsushita Electric  
Trading  
Full line of  
Solitron devices

# NEW PRODUCTS

## Do-it-yourself IC design

Two companies have announced design kits that help IC users design their own ICs. Not a new idea—TI pioneered the concept with "Masterslice" back in 1963—the kit approach to IC design is perhaps best described as an idea whose time has come. Advances in process technology, component density, and interconnection now make the kit idea a viable solution to custom IC design.

In the past, users who designed their own ICs worked with a breadboard of jumbled wires and discrete components. Then, for a fee of between \$10,000 and \$60,000, and after a waiting period of four to six months, the custom ICs would be ready for evaluation.

All too often, the evaluation showed an IC which only approximated the original breadboard's performance.

These new design kits give the user a final IC that closely matches the performance of the breadboard simulation. How? By supplying the designer/user with a selection of components to simu-

late the final IC design. These components are the same as on the final monolithic structure, and are processed and packaged in the same way as is the final IC.

The design kit from Interdesign Inc. is called Monochip™. Monochip supplies the user with 16 DIPs for breadboarding the circuit function, chip component-layout drawings on which the designer shows the final interconnections, and a comprehensive design manual. The manual details the characteristics of all the components on the chips and is, in effect, an IC design manual.

The kit costs \$85, and is available not only from Interdesign, but also from Qualidyne Corp., through a joint marketing agreement.

The second kit is from Exar Integrated Systems, and is called the XR-C100 design kit. This kit contains 22 IC packages, and differs from the Monochip in that the XR-C100 chips include

some sub-functions such as doubly-balanced modulators. Again, the kit contains a design manual and chip layout drawings. The XR-C100 design kit costs \$80.

Note that the kit prices are for the kit alone. Both Interdesign/Qualidyne and Exar provide 100 prototypes of the user's design at an additional cost of \$2800. Interdesign claims a two-week delivery time for the prototypes, while Exar calls out a two- to four-week cycle.

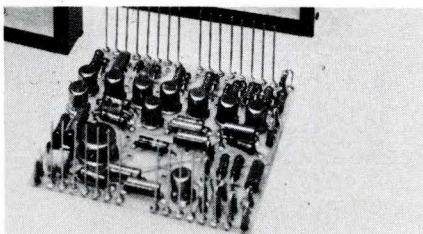
For more information on the Monochip, contact Interdesign Inc., 165 S. Murphy Ave., Sunnyvale, Calif. 94086.

**Circle Reader Service #337**  
or Qualidyne Corporation, 1230 Bordeaux Dr., Sunnyvale, Calif. 94086.

**Circle Reader Service #338**  
For more information on the XR-C100 design kit, contact Exar Integrated Systems, Inc., 733 N. Pastoria Ave., Sunnyvale, Calif. 94086.

**Circle Reader Service #339**

### 12-BIT D/A CONVERTERS



This family of converters includes high-speed current-output (DAC 3721), high-speed voltage output (DAC 372WB), and medium-speed voltage output (DAC 372) units. They settle in 300 ns, 950 ns, and 10  $\mu$ s, respectively. From \$39.00 (1 to 9). Hybrid Systems Corp., 95 Terrace Hall Ave., Burlington, Mass. 01802.

**Circle Reader Service #340**

### WIDEBAND OP AMP

Model 9722 provides FET differential input and large gain BW coupled with a slewing rate of 200 V. Optical Electronics Inc., Box 11140, Tucson, Ariz. 85706.

**Circle Reader Service #341**

### MICRO CALCULATOR



This electronic calculator is a full four function, 8-digit device (16-digit capacity) with a floating decimal point. It will operate for more than a year on throw-away batteries. About \$100.00. Ragen Precision Industries, Inc., 9 Prete Ave., N. Arlington, N.J. 07032.

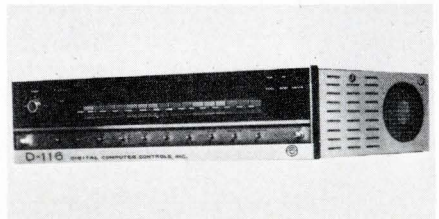
**Circle Reader Service #342**

### AMPLIFIER KIT

This all-ss broadband power amplifier (0.5 to 100 MHz, 2.5 W cw) in kit form accepts inputs of am, ssb, pulse and other complex modulation. It can be assembled in about 3 h. Larkton Scientific, Box 302, Monroeville, Pa. 15146.

**Circle Reader Service #343**

### LSI/MSI MINICOMPUTER



This 16-bit minicomputer's complete logic processor (CPU) is on a 15 x 15 in. PC board (225 sq. in.), as is a 4,096-word, 16-bit memory module. The D-116 has a 1.2  $\mu$ s core memory cycle time and can execute logical or arithmetic instructions in 1.35  $\mu$ s. Digital Computer Controls, Inc., 12 Industrial Rd., Fairfield, N.J. 07006.

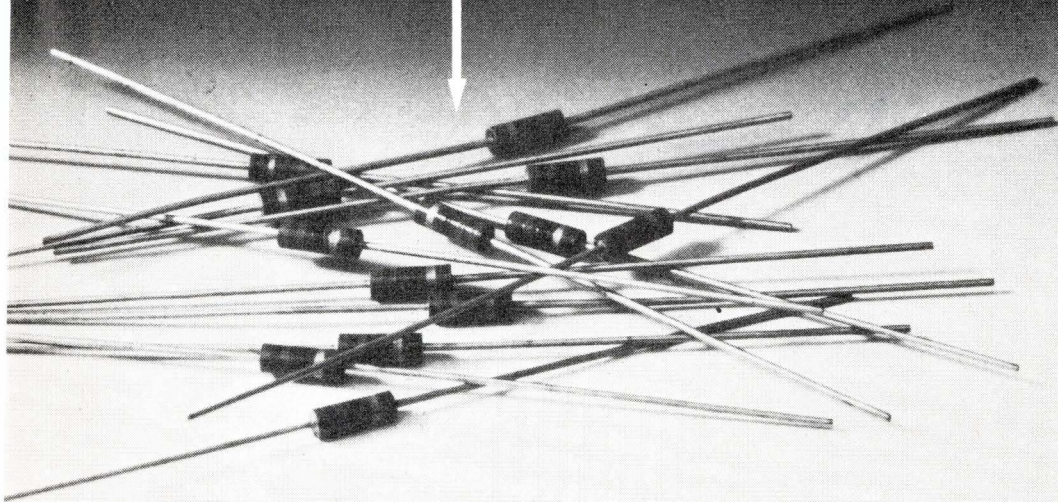
**Circle Reader Service #344**

### GaAs TUNING DIODES

These GaAs tuning varactor diodes feature liquid-phase, epitaxially-grown abrupt pn junctions to provide very high tuning ratios. Varian, Solid State Div., Salem Rd., Beverly, Mass. 01915.

**Circle Reader Service #345**

13 STANDARD RESISTORS



13 STANDARD RESISTORS



# Helipot's one-piece money saver saves time and space, too.

To keep working with discrete standard resistors just isn't logical. Not when there are ceramic DIPs available that do the same jobs in less space—quicker, easier and cheaper. Whether inserted automatically or by hand.

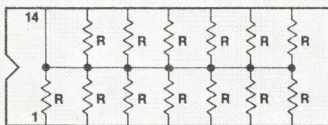
Stocked locally for immediate delivery, too. At "on the board" cost-saving prices, in small or large quantities.

(Check the specs.) No wasted time while they're "made to order," unless you want custom modifications, which we can do fast.

And remember, ceramic. Ceramic reliability at plastic prices.

Why wait? Call your local Helipot Representative now for applications assistance or more information.

**Beckman**  
INSTRUMENTS, INC.  
HELIPOT DIVISION  
Fullerton, California

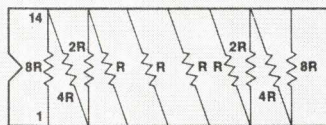


**MODEL SERIES 899-1**

*Resistance Values (ohms):* 100, 150, 220, 330, 470, 680, 1K, 1.5K, 2K, 2.2K, 3.3K, 4.7K, 6K, 6.8K, 10K, 15K, 22K.  
*Common Applications:* Digital pulse squaring; MOS/ROM pull-up/ pull-down; "wired OR" pull-up; power driver pull-up; open collector pull-up; TTL input pull-down; TTL unused gate pull-up; high-speed parallel pull-up.

*Standard Tolerance:* ± 2.0%  
*Pricing:*

1-99	\$1.45
100-499	1.12
500-999	0.97

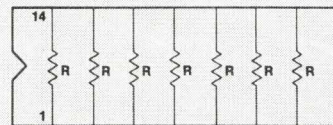


**MODEL SERIES 899-2**

*Resistance Value (ohms):* 10K  
*Common Applications:* Inverting operational gain; potentiometric gain; differential gain; noninverting gain; gain adjustment.

*Standard Tolerance:* ± 2%  
*Pricing:*

1-99	\$2.75
100-499	2.15
500-999	1.86



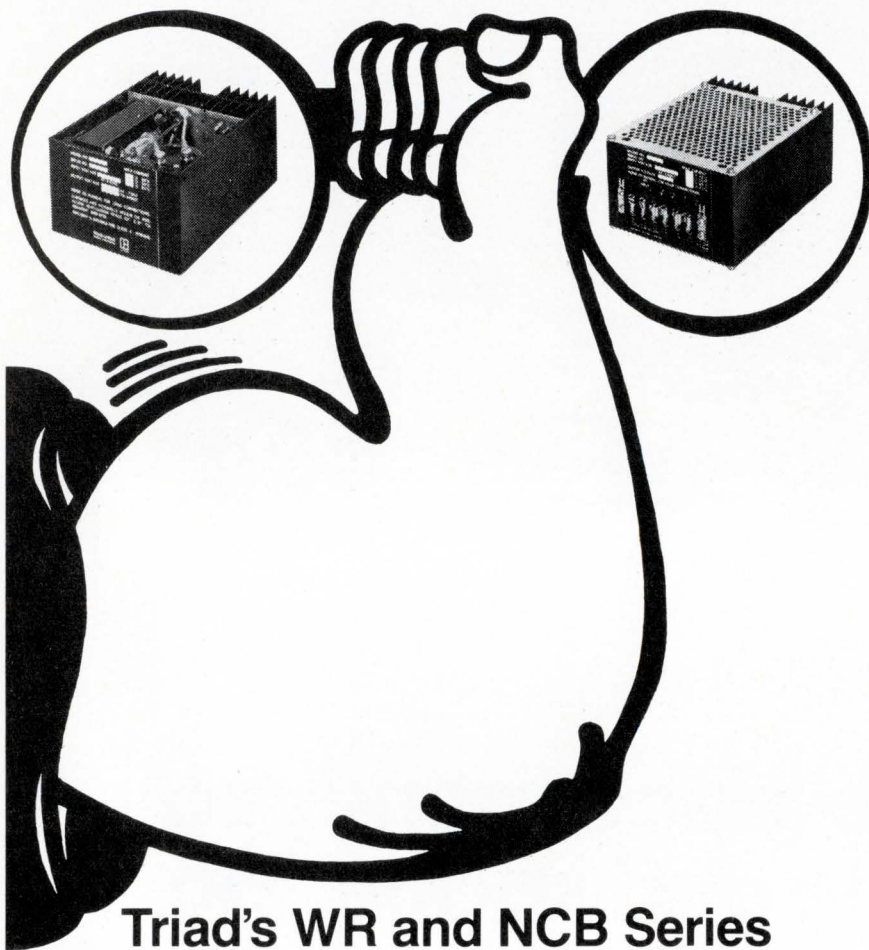
**MODEL SERIES 899-3**

*Resistance Values (ohms):* 68, 100, 110, 150, 220, 330, 470, 680, 1K, 1.5K, 2.2K, 3.3K, 4.7K, 6.8K, 10K, 15K, 22K.  
*Common Applications:* Line termination; long-line impedance balancing; power gate pull-up; ECL current pull-down resistors; LED current limiting; power driver pull-up; "wired OR" pull-up; TTL input pull-down.

*Standard Tolerance:* ± 2%  
*Pricing:*

1-99	\$1.25
100-499	0.99
500-999	0.86

# Meet the newest members of a powerful family.



## Triad's WR and NCB Series — standardized, regulated DC power modules for OEM systems.

Backed by unexcelled power supply design talent and more than 25 years of transformer production, Triad-Utrad now introduces two new lines of power supplies.

The WR Series of four models feature 115V  $\pm$  10%, 47-440Hz input, open top construction, extruded integral heat sink housing, all silicon semiconductors, 10-year life computer grade capacitors, FR glass epoxy printed circuit boards, and electrostatically shielded transformers. All units are convection cooled, meet UL-CSA requirements, and have an MTBF of 50,000 hours per MIL-HDBK-217.

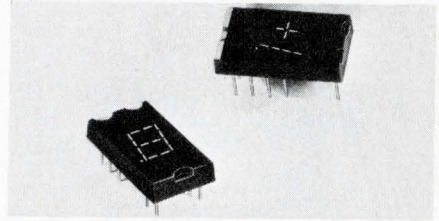
The NCB Series comprises five B size slot supplies ranging from 5V-5.1A to 28V-1.5A. Recommended for the most exacting applications where long life, extreme reliability, minimum down time or temperature extremes are important considerations. Models feature 115V  $\pm$  10%, 47-440Hz input, extruded integral heat sink housing, built-in overvoltage protection, 10-year life computer grade capacitors, all silicon semiconductors,  $\pm$  10% voltage adjustment, and full current rating to 45°C. Designed to meet UL-CSA requirements and guaranteed 5 years. In stock now at your local distributor or write Triad-Utrad Distributor Division, 305 N. Briant St., Huntington, Ind. 46750.

**T** Triad-Utrad Distributor  
A DIVISION OF LITTON INDUSTRIES

Circle Reader Service #31

## NEW PRODUCTS

### LED READOUT



New 745-0003, 745-0004 and 745-0006 displays are available as digits or plus-minus 1 symbol. They come in a 0.270 in. char. height and in a std. 14-pin DIP. GaAsP is the light source. Dialight Corp., 60 Stewart Ave., Brooklyn, N.Y. 11237.

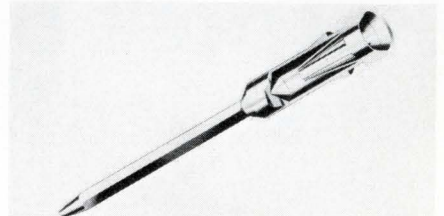
Circle Reader Service #346

### PC BOARDS

Two new pc board lines, econofab and econofab heavy duty, have Underwriters Laboratories SE-O flame-retardant approval. Both materials offer decreased fabrication cost due to ease of handling and volume availability. Westinghouse Electric Corp., Westinghouse Bldg., Pittsburgh, Pa. 15222.

Circle Reader Service #347

### SOCKET TERMINAL



New tapered socket terminal provides quick and efficient loading of ICs on packaging panels. The sockets have a machined opening which is about four times the entrance size of regular type sockets—0.060 in. as compared to 0.028 in. This allows ICs to be automatically machine-loaded. Augat, Inc., 33 Perry Ave., Attleboro, Mass. 02703.

Circle Reader Service #348

### MICROELECTRONIC PACKAGES

Sealox packages can be supplied with standard ceramic or alloy lids, or with spatial lids where additional clearance is needed in the bonding cavity. Packages are available with Berlox beryllia, alumina, glass of F15-61T alloy base, and a variety of bonding areas. National Beryllia Corp., Plumsteadville, Pa. 18949.

Circle Reader Service #349

# Tri-State\* logic marches on...

## Then:

DM8093 Tri-State Quad Buffer  
DM8230 Bus Line Demultiplexer  
DM8831 Party Line Driver  
DM8551 Quad-D Flip Flop  
DM8094 Tri-State Quad Buffer  
DM8598 (SN7488 Compatible) 256-  
Bit Expandable ROM  
DM8214 Dual 4-Line-to-1  
Multiplexer



## Now:

DM8599 (SN7489 Compatible) 64-Bit RAM  
DM8214 Dual 4-Line-to-1 Multiplexer  
DM8093 Tri-State Quad Buffer  
DM8094 Tri-State Quad Buffer  
DM8230 Bus Line Demultiplexer  
DM8551 Quad-D Flip Flop  
DM8123 (FSC9322 or SN74157  
Compatible) Quad 2-Input  
Multiplexer  
DM8121 (SN74151 Compat-  
ible) 8-Channel  
Multiplexer  
DM8831 Party Line Driver  
DM8597 (SN74187  
Compatible)  
1024-Bit ROM  
DM8598 (SN7488 Com-  
patible) 256-  
Bit Expandable  
ROM

## Soon:

DM8095 Hex Buffer  
DM8553 8-Bit Latch  
DM8096 Hex Inverter  
DM8554 Binary Counter/  
Latch  
DM8552 Decimal Counter/  
Latch  
DM74200 (SN74200  
Equivalent)  
256-Bit RAM

DM85L51 Low Power Quad-D Flip Flop  
DM0000 Quad Transceiver-Transmitter  
Disable  
DM0000 Quad Transceiver-Transmitter/  
Receiver Disable

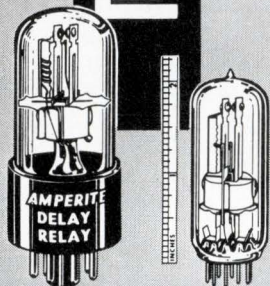
If what you're doing has anything to do with  
mini computers or *any* digital design, why  
not deal directly with the source:

National Semiconductor Corporation,  
2900 Semiconductor Drive, Santa Clara,  
California 95051. Phone (408) 732-5000.  
TWX: (910) 339-9240. Cable: NATSEMICON.

# National

\*Tri-State is a trademark of National Semiconductor Corporation.

# AMPERITE



## Thermostatic DELAY RELAYS

*Glass enclosed*

For TRUE HERMETIC SEALING

Delays: 2 to 180 seconds\*

Actuated by a heater, they operate on A.C., D.C., or Pulsating Current... Being hermetically sealed, they are not affected by altitude, moisture, or climate changes... SPST only — normally open or normally closed... Compensated for ambient temperature changes from -55° to +80°C... Heaters consume approximately 2 W. and may be operated continuously. The units are rugged, explosion-proof, long-lived, and inexpensive!

TYPES: Standard Radio Octal and 9-Pin Miniature.  
List Price, \$4.00

\*Miniatures Delays: 2 to 120 seconds.

All Amperite Delay Relays are recognized under component program of Underwriters' Laboratories, Inc. for all voltages up to and including 115V.

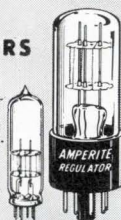
PROBLEM? Send for Bulletin No. TR-81.

## AMPERITE BALLAST REGULATORS

Hermetically sealed, they are not affected by changes in altitude, ambient temperature (-50° to +70°C), or humidity... Rugged, light, compact, most inexpensive.

List Price, \$3.00

Write for 4-p. Bulletin No. AB-51.



# AMPERITE

600 PALISADE AVE., UNION CITY, N.J. 07087

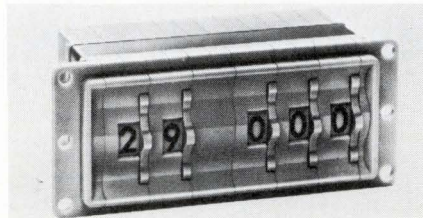
Telephone: 201 UNION 4-9503

In Canada: Atlas Radio Corp., Ltd.,  
50 Wingold Ave., Toronto 10

Circle Reader Service #27

## NEW PRODUCTS

### THUMBWHEEL SWITCH



The modular Series 29000 Economy switch has an in-line display with large 0.200 in. black characters against a light background. Modules are only 0.350 in. wide x 1.200 in. high, and as many switch modules as needed may be ganged together. The Digitran Co., 855 S. Arroyo Pkwy, Pasadena, Calif. 91105.

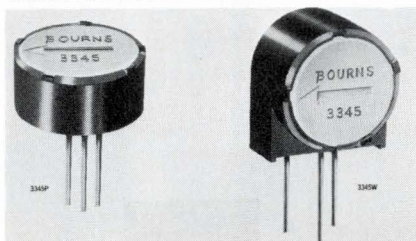
Circle Reader Service #350

### PRECISION PLIERS

These Swedish made precision pliers and nippers are for miniature and micro-miniature work. The Micro series is machined from solid bar stock. Also, special Swedish alloy tool steel can now be used, which provides increased hardness and resistance to wear. Hammel, Riglander & Co., Inc., Box 222, New York, N.Y. 10014.

Circle Reader Service #351

### BUCK-A-WATT POT



Model 3345 is a 1/2 in. dia. wirewound, single-turn pot with a 1 W power rating. Standard range is 10 Ω to 50 kΩ, TC is 70 ppm/°C and temp. range is -55° to +150°C. \$1.00 ea. (5000 pcs.). Bourns Inc., 1200 Columbia Ave., Riverside, Calif. 92507.

Circle Reader Service #352

### MINIATURE RELAYS

Series 1360 relays are enclosed two-pole and single-pole types. All terminals are on 0.1 in. grid spacing so that you can mount them directly to a pc board—or thru a chassis cutout using special mating socket. Guardian Electric Mfg. Co., 1550 E. Carroll Ave., Chicago, ILL. 60607.

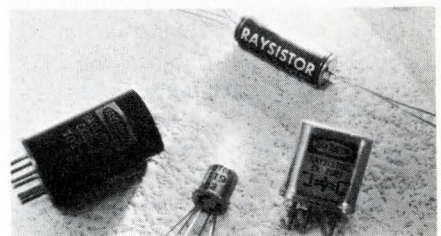
Circle Reader Service #353

### IR EMITTERS

New high power efficiency IR emitters are the TIL31 in an hermetic TO-18 metal case, and the TIL32 in a molded clear epoxy package with two leads. These emitters have outputs that are spectrally compatible with silicon sensors. Texas Instruments, Incorporated, 13500 North Central Expressway, Dallas, Tex.

Circle Reader Service #354

### OPTICAL COUPLERS



Four new dual-cell Raysistor® optical couplers for applications such as dual-function controls in analog and switching circuits, voltage controlled resistors, stereo volume controls, voltage and signal isolators, multiplier and divider circuits, and tracking filter circuits. Raytheon Co., Lexington, Mass. 02173.

Circle Reader Service #355

### H-V PLASTIC TRANSISTORS

These transistors are useful for high-speed switching and linear amplifier, chroma output, and video output applications. Types 2N6175, 2N6176 and 2N6177, can dissipate 20 W at case temps. to 25°C. Dissipation rating of RCA -40885, 40886 and 40887 transistors is 1.4 W at amb. temps. to 25°C. RCA Commercial Engineering, Harrison, N.J. 07029.

Circle Reader Service #356

### LEAD WIRE

New 600-V Nomex wire is suitable for use in sealed and hermetic systems. Its construction permits continuous operation to 180°C, and intermittent overloads in excess of 200°C. Belden Corp., Box 5070A, Chicago, Ill. 60680.

Circle Reader Service #357

### 14-MIL MEMORY CORES

These fast-switching lithium cores (MT-1401) have a typical peak time of 50 ns and a typical switching time of 100 ns. Data Products, 6219 DeSoto Ave., Woodland Hills, Calif. 91364.

Circle Reader Service #358

# we're big in

SOLITRON can satisfy most requirements in ROMS. They're available in a wide range of organizations, memory capacities, and operating voltages. SOLITRON ROMS are bipolar compatible and meet both commercial—MIL specifications. The following models are now in stock and available for immediate delivery:

**NEW—4608 bit**  
UA3533

**NEW—4096 bit**  
UA2596/  
UA3596

**4096 bit**  
UC7596S

**3072 bit**  
UA2572/  
UA3572

**2240 bit**  
UC7541

**2240 bit**  
UA3540

**2048 bit**  
UA2548/  
UA3548

**2048 bit**  
UC7523

**1024 bit**  
UC6525/  
UC7525

**1024 bit**  
UC7526

Static keyboard encoder • 128 coded key capability • 4 modes • 512 unique 9 bit codes • Keybounce effects eliminated by internal strobe control • Two key rollover • Single switch closure addressing • Shift lock with indicator capability • Ignores false pulses up to 4 $\mu$ s

512 x 8, 1024 x 4, 2048 x 2, 4096 x 1 organization • Direct bipolar compatibility—both input and output—no external pullup resistors required • Programmable chip select inputs and tri-state outputs for direct coupled memory expansion • 750ns typical access time • Low power consumption in standby mode

1024 x 4 • Static ROM sequentially addressed by two clock inputs chip enable and reset • DC to 100 KHz operation •  $V_{DD} = -15V$ ,  $V_{SS} = +5V$

256 x 12 • Programmable chip selects for memory expansion • 750ns typical access time •  $V_{DD} = -15V$ ,  $V_{SS} = +5V$

5 x 7 x 64 character generator with 5 direct inputs column sweep • Outputs expand to any number from 7 to 14 • 500ns typical access time •  $V_{GG} = -12V$ ,  $V_{SS} = +12V$

5 x 7 x 64 character generator with 3 input decoded row sweep • 500ns typical access time •  $V_{DD} = -15V$ ,  $V_{SS} = +5V$

256 x 8, 512 x 4, 1024 x 2, 2048 x 1 organization • 750ns typical access time •  $V_{GG} = -15V$ ,  $V_{SS} = +5V$

256 x 8, 512 x 4 organization • 850ns typical access time •  $V_{GG} = -12V$ ,  $V_{SS} = +12V$

128 x 8, 256 x 4, 512 x 2, 1024 x 1 organization • 500ns typical access time •  $V_{GG} = -15V$ ,  $V_{SS} = +5V$ ,  $V_{DD} = -5V$

128 x 8 • 130 mW power dissipation • Commercial applications •  $V_{GG} = -22V$ ,  $V_{SS} = +5V$ ,  $V_{DD} = -8V$

We're also big in RAMS, CMOS, FETS, and LIC's . . .

Give us a quick call today, and test our producibility.



Solitron Devices, Inc., P.O. Box 1416  
San Diego, California 92112

Telephone 714/278-8780  
TWX 910-335-1221

SAN DIEGO, CALIF.  
8808 Balboa Ave.  
CMOS, PMOS Circuits  
Diodes, Rectifiers, &  
Zeners  
FET & Dual FET  
Transistors  
High Voltage Assemblies  
Linear & Monolithic IC's

TAPPAN, N.Y.  
256 Oak Tree Road  
Diodes & Rectifiers  
Ferrite & Ferrite Devices  
High Voltage Assemblies  
Power Rectifiers  
Thick Film Hybrid Circuits

RIVERA BEACH, FLA.  
1177 Blue Heron Blvd.  
Hi-Rel Power Hybrids  
Hi-Rel Power Transistors  
PNP-NPN Ind. Transistors  
Si & Ge Power Transistors

JUPITER, FLA.  
1440 W. Indiantown  
Road  
Microwave IC's  
Microwave Semi-  
Conductor  
Microwave Stripline  
Components  
RF Semiconductor

PORT SOLERNO, FLA.  
Cove Road  
Microwave Connectors  
Plaxial (R) Cable  
Precision RF Coaxial

BEN BAROQ, ISRAEL  
AEL Israel, Ltd.  
Full line of Solitron  
devices

KENT, ENGLAND  
London Road, Sevenoaks  
Full line of Solitron devices

TOKYO 105, JAPAN  
Rm. No. 21, Kyodo Bldg.  
No. 4-10, 2 Chome  
Higashi Shinbashi  
Minato-ku  
Full line of Solitron devices

# R

# O

# M

# S

## STATIC MOS RAM

The MM1101A2 is a 256 x 1 device with a max. access time of 500 ns and the same power dissipation (typically < 1.5 mW/b) as the slower 1101 series. National Semiconductor.

**Circle Reader Service #359**

## 256-BIT TTL RAM

The SN74200 is fully decoded and features typical access times of 15 ns from memory-enable input and 45 ns from binary address inputs. Texas Instruments.

**Circle Reader Service #360**

## 9500 SERIES ECL

Raytheon Semiconductor will offer the 9500 Series of ECL digital logic circuits, originally introduced by Fairchild Semiconductor in 1970. Raytheon is the first domestic manufacturer to second source the 9500 series.

**Circle Reader Service #361**

## FM SOUND CHANNEL

The ULN2129 consists of a multistage i-f amplifier-limiter section, a power supply Zener regulator, a fm detector, a buffer amplifier and an af preamplifier. Sprague Electric.

**Circle Reader Service #362**



Hotwatt® Miniature Stainless Steel Sheathed Cartridge Heaters for special applications where space is at a premium and heat requirements are high.

Hotwatt Miniature Heaters deliver up to 1250°F. max. surface temp. and are available in these sizes: 1/8", 3/16" round; 1/8", 3/16" square; and 1/8" x 3/8" rectangular. They are manufactured in lengths of 1" — 12" and longer, in all diameters, which makes them readily adaptable to a wide variety of special requirements. Send for the MINI/MAXI Catalog today.

**FREE CATALOG**  
All the facts.



# HOTWATT

HOTWATT, INC., 128 MAPLE STREET  
DANVERS, MASSACHUSETTS 01923

## PLATED WIRE SENSE AMP

The MC1544 is a capacitively-coupled, 4-channel sense amplifier. Propagation delay is only 18 ns and a dc level restore circuit eliminates repetition rate problems. Motorola Semiconductor.

**Circle Reader Service #363**

## LOW DRIFT OP AMP

The monolithic AD504 has an offset drift of less than 1μV/°C and will handle 1000pF loads with a single compensation capacitor. Analog Devices.

**Circle Reader Service #364**

## CMOS ANALOG SWITCH

The HI-1800 has two independent DPST switches with a TTL compatible addressing scheme. Harris Semiconductor.

**Circle Reader Service #365**

## MONOLITHIC 6-BIT D/A

The MC1406 is complete except for op amp and reference. It's \$3.95 each in 100 quantities. Motorola Semiconductor.

**Circle Reader Service #366**

## LOW POWER 12-BIT A/D

ADC-12QL operates from a single polarity 15V battery. Quiescent power dissipation is only 600 μW. Analog Devices.

**Circle Reader Service #367**

## PRECISION VOLTAGE REGULATOR

This monolithic regulator, the 5723, operates in positive or negative supplies as a series, shunt, switching or floating regulator. Signetics.

**Circle Reader Service #368**

## 3-PACKAGE CHROMA SYSTEM

These three circuits form a complete chroma system for color tv receivers. They are the N5070B, a chroma signal processor, the N5071A, a chroma amplifier and the N5072A, a chroma demodulator. Signetics.

**Circle Reader Service #369**

## MONOLITHIC TRANSISTOR ARRAYS

These npn arrays include 4- and 5-transistor versions plus a dual diff amp unit. Lithic Systems, Inc.

**Circle Reader Service #370**

## CONSUMER PREAMP

The ULN-2126 is a dual preamplifier IC for low-level signals in low-noise applications. It's suited for stereo tape players and recorders, dictating equipment, movie projectors and similar applications. Sprague Electric.

**Circle Reader Service #371**

## ANALOG MULTIPLEXER

This monolithic CMOS circuit is an 8-channel analog multiplexer. The MS-504 operates over a ±8V signal range. Ragen Semiconductor.

**Circle Reader Service #372**



#### TTL MEMORY

The SN74172 is a 16-bit quadriport register file with simultaneous read/write capability. Texas Instruments.

**Circle Reader Service #373**

#### SEQUENTIAL MOS ROM

US6596S is a 1024-word by 4-bit sequentially addressed ROM. Solitron Devices.

**Circle Reader Service #374**

#### 1024-BIT ROMs

The HPROM-1024 series includes a mask-programmable device and two field-programmable versions, one with tri-state outputs and the other with open collector outputs. Harris Semiconductor.

**Circle Reader Service #375**

#### 64-BIT BIPOLAR RAM

The 8225 is organized 16 by 4. It is intended for scratch pad and high speed buffer applications. Signetics.

**Circle Reader Service #376**

#### PROGRAMMABLE ROMs

The MCM5003AL/5004AL is a 64 x 8 field programmable device. An additional bit in each word allows testing before programming. Motorola Semiconductor.

**Circle Reader Service #377**

#### SHIFT REGISTER

This 1024-bit shift register, the MM4013/MM5013, comes in 8-pin DIPs and TO-100 cans. It features tri-state outputs and 400 Hz to 2.5 MHz operation. National Semiconductor.

**Circle Reader Service #378**

#### STATIC MOS REGISTERS

The 2518B is a hex, 32-bit register array and the 2519B is a hex, 40-bit version. Typical clock and data rate is 3 MHz. Signetics.

**Circle Reader Service #379**

#### MULTIPLE PORT REGISTER

The 9338 is an 8-bit TTL register. You can simultaneously write into any one of the eight locations while reading any two locations. Fairchild Semiconductor.

**Circle Reader Service #380**

# OUR LATEST CONTENDER



## PACKS A MIGHTY BLOW!

For cooling applications requiring high volume air-flow (120 CFM), low noise levels (45.8 dB SIL), and field-proven reliability, you'll find our Model 4600 ready to meet the toughest challenges!

The latest in the rugged PAMOTOR line of *optimized* cooling devices, the 4600 is a miniature, shaded-pole axial fan that is designed to deliver years of dependable service. Of all-metal construction, the fan features computer-designed and impulse-welded impellers that are dynamically balanced to within five *microns* in each plane.

Incorporating a unique, more powerful inside-out motor, the Model 4600 delivers greater torque at lower internal temperatures. The results are less friction, longer fan life and greater performance for your fan dollar! And when you consider the 4600's over-sized bearings and unique lubrication system (designed for 100,000 hours of continuous operation), it should be evident that the Model 4600 will probably outlast the equipment it cools.

Call your nearest PAMOTOR distributor for complete details on our Model 4600 . . . the little "champ" that's a sure bet on performance!

Send for Valuable Technical Literature — Free 12-page Short-Form Catalog contains performance data and mechanical specifications for the complete PAMOTOR line. Our six applications monographs, Nos. 7041 — 7046, on "How to Select the Optimum Fan for Your Application," contain comprehensive data on each of the six major factors involved in cooling system design and fan application.

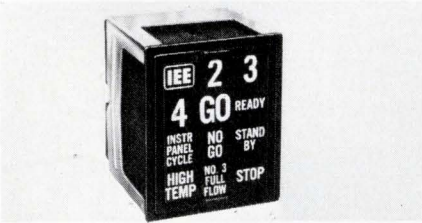


**PAMOTOR**  
ONE OF THE PURDY GROUP OF COMPANIES

770 Airport Boulevard  
Burlingame, California 94010 (415) 347-1203

**Circle Reader Service #380**

## 12 MESSAGE DISPLAY



Series 0280 status indicator is a compact, backlit display for indicating conditions in a system, status of process, sequential instructions, operating procedures, signal alarms and so forth. Industrial Electronic Engineers, Inc. 7720-40 Lemona Ave., Van Nuys, Calif 91405.

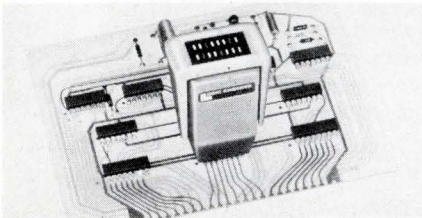
**Circle Reader Service #381**

## HERMETIC DIPs

Features of the 1100 series DIP include a ceramic combination glass and nickel-iron-cobalt alloy for higher reliability at lower cost. All packages are plated with  $50 \mu$  in gold/Mil-G-45204B. They can pass a  $1 \times 10^{-8}$  std.cc/s He leak rate. Glasseal Products, Inc. 725 Commerce Rd., Linden N.Y. 07036.

**Circle Reader Service #382**

## LOGIC CHECKER



Model 101 aids in checking the logic state on 14- and 16-pin DIP (TO-116, MO-001, or equal) ICs. It will test most TTL and DTL bipolar circuits (except expandable gates or circuits using non std. voltage levels). It requires no power cord or batteries. Alcolite Div., Alco Electronic Products, Inc., 1551 Osgood St., No. Andover, Mass. 01845.

**Circle Reader Service #383**

## REGULATED POWER SUPPLIES

P741 series of miniature encapsulated, dual output supplies provide all the essential requirements for most  $\mu$ A741 and equivalent applications. There are eight off-the-shelf models. Semiconductor Circuits, Inc., 306 River St., Haverhill, Mass. 01830.

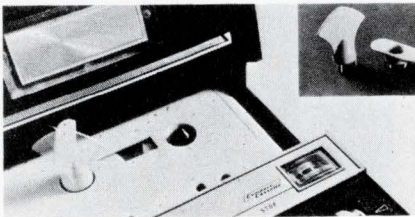
**Circle Reader Service #384**

## MONOLITHIC FILTER

Two 2-pole monolithic units are contained within one TO-5 holder to yield a four pole design. This design features small size, light weight, and high reliability. These filters are useful for miniature receivers and paging systems. McCoy Electronics Co., Mount Holly Springs, Pa.

**Circle Reader Service #385**

## REEL MOTION INDICATOR



This indicator lets you easily monitor tape recorder operation. It gives you instant visual warning of end of tape, broken tape, jammed tape and battery failure. Two different models are included in each package to permit open or closed recorder operation. \$1.29 postpaid. Graf-Pacific, 12222 Bristol Dr., La Mirada, Calif. 90638.

**Circle Reader Service #386**

## SERVO CONTROLLER

IC Model LC-500 offers complete metal fatigue testing control. Closed-loop control mechanism measures and compares actual load imposed on test specimen against programmed load. AVCO Information Systems, 4807 Bradford Dr., Huntsville, Ala.

**Circle Reader Service #387**

## TRANSISTOR SOCKET

This  $\frac{1}{4}$  turn socket, part #027-1702, accepts TO-5 type transistors and is for installation into an unchamfered D shaped chassis hole. Circuit Components Div., Sealectro Corp., 225 Hoyt St., Mamaroneck, N.Y. 10543.

**Circle Reader Service #388**

## BANDPASS FILTERS

Series BPF passive bandpass filters are computer designed for operation from 1 to 100 KHz. They have a center freq. stability of  $\pm 0.5\%$  over the range  $-40^\circ$  to  $+70^\circ\text{C}$ . Beukers Laboratories, Inc., 1324 Motor Parkway, Hauppauge, N.Y. 11787.

**Circle Reader Service #389**

## CONDUCTIVE COATING



New conformal coating is a one-component, air drying coating which conforms to various substrate materials. It has good electrical conductivity, adhesion, flexibility and impact resistance. Technit, 129 Dermody St., Cranford, N.J. 07016.

**Circle Reader Service #390**

## LED EXPERIMENT KIT

Here's a kit that enables you to experiment with light-emitting diodes without a large cash outlay. Included in the kit are 3 LEDs, 6 resistors, 1 ft. of 20 mm plastic fibre optic light pipe and instructions. The kit, (stock No. 41,597) costs \$5.95. Edmund Scientific Co., 380 Edscorp Bldg., Barrington, N.J. 08007.

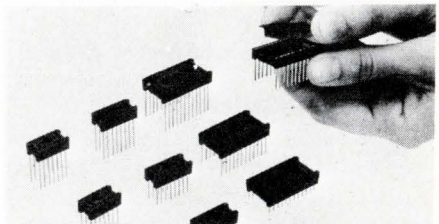
**Circle Reader Service #391**

## CERMET TRIMMER

"Centrim" line trimmer has a hi-alumina substrate on which the cermet track is bonded; a knob completely covers the resistance track and wiper. It is also available without a knob for "set and forget" uses. Under \$0.20 in quan. Centralab, 5757 N. Green Bay Ave., Milwaukee, Wis. 53201.

**Circle Reader Service #392**

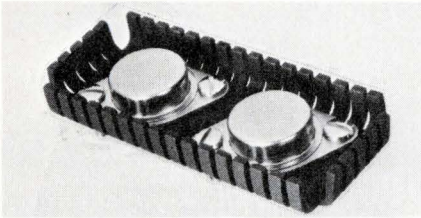
## DIP SOCKETS



Improved line of DIP sockets have removable covers. Available in 14-, 16-, and 24-pin configurations there are three different length contact pins for each configuration. The CA sockets are designed for use in low profile, high density logic panels. Circuit Assembly Corp., 3025 So. Kilson Dr., Santa Ana, Calif. 92707.

**Circle Reader Service #393**

## HEAT DISSIPATOR



Designed for use on PC boards, the UP10-TO3-2U lets you operate at over twice the power with no increase in the case temperature rise. It takes little more height and board space than the TO-3's themselves. International Electronic Research Corp., 135 W. Magnolia Blvd., Burbank, Calif. 91504.

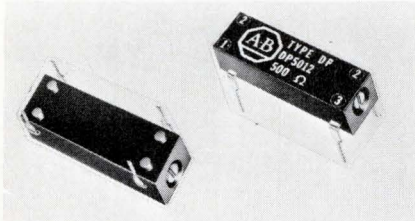
**Circle Reader Service #394**

## DIGITAL ANNUNCIATOR

Model MDDA Mini-Diget series displays are available in any number of decades from 3 to 8. The alphanumeric display features readout on cold cathode display tubes with a character height of 1.4 in. Instrument Displays, Inc., 18 Granite St., Haverhill, Mass. 01830.

**Circle Reader Service #395**

## CERMET TRIMMER



Type DP trimmer comes in an immersion-sealed DIP for automatic insertion. Resistance values from 100  $\Omega$  to 1 M $\Omega$  are available with the new 20-turn trimmer. Allen-Bradley Co., 1201 S. Second St., Milwaukee, Wis. 53204.

**Circle Reader Service #396**

## PHOTOTRANSISTORS

Opto-Pak microminiature logic level npn phototransistors mount on 0.087 in. centers, making them ideal arrays for reading all types of punched cards and tape now in use, including 96 and 80 column cards. The STPT-260P "Opto-Pak" provides an output of 2mA at 1mW/cm<sup>2</sup>, switches at 6  $\mu$ s speed, and has a peak spectral response of 800 nm, typical. (60% output at 655nm and 960nm.) Sensor Technology, Inc., 7118 Gerald Ave., Van Nuys, Calif. 91406.

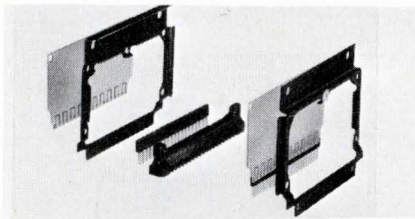
**Circle Reader Service #397**

## TANTALUM CAPACITOR

New solid tantalum capacitors come in a range of 0.0047  $\mu$ V/20 V through 0.47  $\mu$ F/2 V in a 0.050 x 0.040 x 0.100 in. package. The ZZ series is for applications such as hearing aids, watches, and other miniature circuits. Dickson Electronics Corp., Box 1390, Scottsdale, Ariz. 85252.

**Circle Reader Service #398**

## MODULE CONNECTOR



This miniature 40-pin connector can be easily disassembled and re-assembled for wave-solder installation of PC boards or for field service and retrofit. It has been accepted as a component of the Navy Standard Hardware Program. Cinch Unit, TRW Electric Components, 1501 Morse Ave., Elk Grove Village, Ill. 60007.

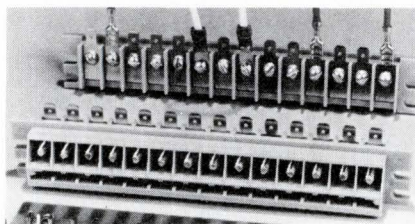
**Circle Reader Service #399**

## LED DISPLAYS

The Data-Lit 34 is a four-digit array of seven segment LED displays. It has 0.125 in. character height and a brightness of 200ft.L at 5mA. Segments of each numeric are connected in parallel for multiplexing and each segment can be addressed independently. \$3.80/digit (1,000 pc. quan.). Litronix Inc., 19000 Homestead Rd., Cupertino, Calif. 95014.

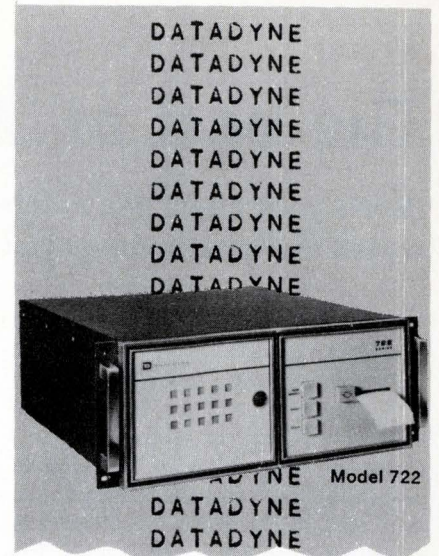
**Circle Reader Service #400**

## TERMINAL BLOCK



Multi-Tap printed circuit edge connector is essentially a combination card edge connector/terminal block. It facilitates wiring changes, and will accommodate large wire sizes. AMP Incorporated, Harrisburg, Pa. 17105.

**Circle Reader Service #401**



# World's Fastest Low-Cost Digital Printers

- numeric or alphanumeric, including 64-character ASCII code.
- 22 columns or less.
- 40, 30, 20, or 10 lines per second.
- all solid state with TTL logic.
- buffered data inputs.
- plug-in IC's for quick maintenance.
- monolithic main casting.
- programmable zero suppression.
- programmable column inhibit.
- programmable format control.
- external paper advance.
- out-of-paper indication.
- ball bearing drum support.
- mating connector supplied at no extra cost.
- reliable, ribbon-reverse mechanism.
- only two moving parts per column.
- small size, light weight.
- rack or table mounting.
- maintenance-free operation.



**DATADYNE  
CORPORATION**

Building 37A • Valley Forge Center  
King of Prussia, Pa. 19406

(215) 265-1793

**Circle Reader Service #32**

# The best of '71

Here's your chance to catch up on the items that generated the most interest last year.

## Probability analysis

Correlation and probability analysis is the subject of a very readable 20-page bulletin. Random variables, distributions, and densities involved in probability analysis, and concepts and properties of correlation functions and signal enhancement are all covered. Examples of functions are provided, as are pertinent equations and block diagrams. Signal Analysis Industries Corp., 595 Old Willets Path, Hauppauge, N.Y. 11787.

**Circle Reader Service #402**

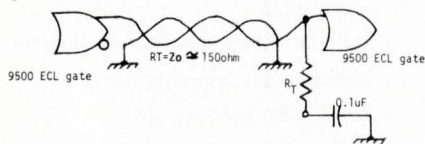
## Computer glossary

A must for anyone involved with computers is this 14-page glossary of commonly used terms. It includes everything from "access time" to "zero-suppression," and table illustrations are supplied where necessary. You'll become familiar with all of the up-to-date terms and definitions related to the field with this glossary offered to you by General Automation Inc., 1402 E. Chestnut, Santa Ana, Calif. 92701.

**Circle Reader Service #403**

## ECL: application and wiring

It's hard to pack an introduction to ECL (emitter coupled logic) with system application into a 24-page booklet. But Fairchild does it in an "application brief" on their new 9500 series ECL ICs. As a matter of fact, most of the booklet is devoted to wiring rules, a most important concern in preserving the speed

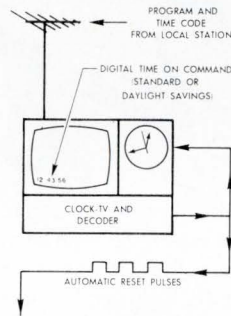


of nonsaturated logic circuits such as ECL. Ground planes, wiring on single sided PC boards, terminations, twisted pair lines, strip lines, and other high-speed wiring methods are discussed, with attention to the effects of noise and transmission line mismatch. Fairchild Semiconductor, 313 Fairchild Dr., Mountain View, Calif.

**Circle Reader Service #404**

## TV time and frequency system

Proposed to distribute accurate time and frequency over the nation's commercial networks, this system is described for you in a 12-page bulletin. Features of the system you'll find detailed are the clock-reset pulse circuit,

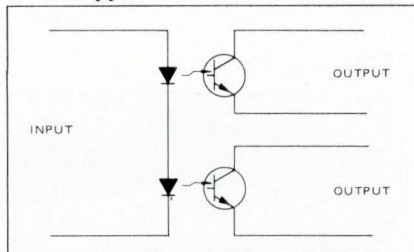


hours-minutes-seconds code, the 1-MHz frequency standard, the alphanumeric message channel, and message-processor or control functions. U.S. Department of Commerce, National Bureau of Standards, Time & Frequency Div., Boulder, Colo. 80302.

**Circle Reader Service #405**

## Optoelectronic devices

Light emitters, light detectors, and monolithic phototransistor and photodiode arrays are discussed in this 96-page collection of application notes and product information. "Theory and Characteristics of Phototransistors" and "Applications of Phototransistor



and Electro-Optic Systems" are the titles of the papers. Product data includes maximum ratings, sensitivity charts, circuit diagrams, dimensional diagrams, and illustrations. Motorola Semiconductor Products Inc., Box 20912, Phoenix, Ariz. 85036.

**Circle Reader Service #406**

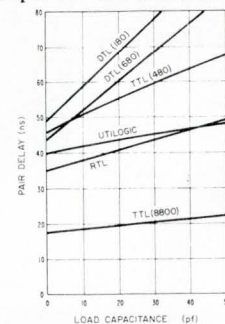
## TTL family catalog

Here are 112 pages (plus a fold-out chart) of solid product information describing probably the most complete line of TTL circuits available today. These logic, memory, and interface functions are standard, off-the-shelf building blocks that interface directly with each other. Because the line is extensive, you can choose almost any speed/power combination that you may need. Fairchild Semiconductor, 313 Fairchild Dr., Mountain View, Calif.

**Circle Reader Service #407**

## Applications handbook

Originally published in 1969, this fat paperback (some 400 pages) has been reissued, and still proves to be a most useful guide for the user of ICs. There are 56 applications memos divided into eight groups: an introduction to digital



logic; digital family considerations; decoding and steering; counters, registers, and memories; interface and display elements; linear considerations; timing circuits; and parallel data handling. Signetics Corp., 811 E. Arques Ave., Sunnyvale, Calif. 94086.

**Circle Reader Service #408**

## MECL applications handbook

Motorola's emitter coupled logic system design handbook offers you 211 pages of data for easy design of high speed digital systems using MECL logic. The various MECL families and their use, system design, test results, and applications are all covered, with nearly 200 illustrations accompanying the text. Copies are available for \$2 each from Motorola Inc., Box 20924, Phoenix, Ariz. 85036.

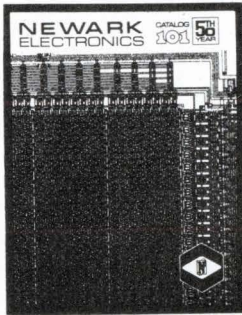
### MSI handbook

For digital systems designers, this handbook is a must. The 100-page book provides specs, descriptions, and typical applications of MSI ICs. Vol. 2 of the Designer's Choice Logic handbooks, this book covers shift and buffer registers, gating steering and decoding arrays, and decoder/driver displays, among others. As with Vol. 1, this edition is fully supplemented with schematics and diagrams, and graphs illustrating special characteristics. Signetics Corp., 811 E. Arques Ave., Sunnyvale, Calif. 94086.

**Circle Reader Service #409**

### Newark's newest directory

Here it is again—Newark's giant 736-page catalog that serves as a directory and guide to the standard components of over 500 internationally recognized manufacturers of high quality electronics. Simply select the components



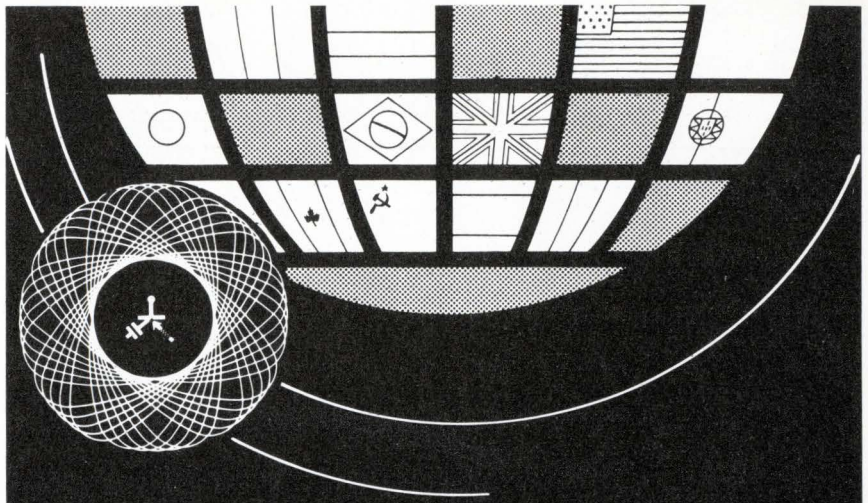
you need and contact the Newark facility nearest you. Choose from literally thousands of ICs, semiconductors, resistors, capacitors, switches, wire and cable, tools, instruments, and many more, all at current OEM prices. Newark Electronics, 500 N. Pulaski Rd., Chicago, Ill. 60624.

**Circle Reader Service #410**

### Active filters

A new supply of a popular booklet is now available. "Universal Active Filters—Theory and Application," outlines the operating characteristics and performance advantages of active filters. The 54-page book has extensive information on the use of such filters in telemetry systems, avionics gear, vocoders, touch-tone equipment, etc. Two appendices review network synthesis and graphically describe a number of common transfer functions. Kinetic Technology Inc., 3393 De La Cruz Blvd., Santa Clara, Calif. 95050.

**Circle Reader Service #411**



PARIS, APRIL 6, 7, 8, 10 AND 11, 1972  
PORTE DE VERSAILLES

# 15<sup>th</sup> INTERNATIONAL ELECTRONIC COMPONENTS EXHIBITION

The world's most important event  
in the electronic field.

Organized by the S.D.S.A.

For further information and complimentary entrance card please contact :  
French Trade Shows, 1350 Avenue of the Americas,  
New York, N.Y. 10019. Tel. (212) 582.4960



Detach here

I would like to receive information on the 15th Paris International Electronic Components Exhibition, as well as an entrance card.

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

Company \_\_\_\_\_

Address \_\_\_\_\_

Zip code \_\_\_\_\_

ME

Please send this coupon to : FRENCH TRADE SHOWS, 1350 Avenue of the Americas,  
New York, N. Y. 10019.

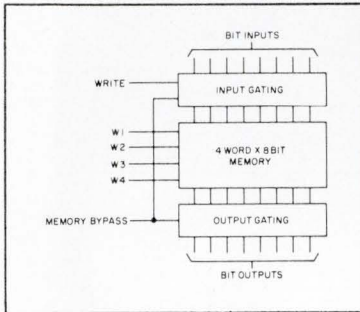
PUBLI-SERVICE

**Circle Reader Service #38**

# LITERATURE

## COS MOS by RCA

Cos mos is RCA's trademark for its line of complementary digital mos integrated circuits, the only type of mos ics this company makes. Forty-four standard types, including 13 recently introduced or now under development,



**Quad 8-bit storage register**

are included in this 8-page brochure, and are conveniently categorized by function—gates, flip-flops and latches, adders, decoders-multiplexers, counters, shift registers, and storage registers. RCA, Commercial Engineering, Harrison, N.J. 07029.

**Circle Reader Service #271**

## Timing and control devices

Standard and custom-built miniature timing and control devices are pictured and described in this 28-page catalog. You'll find reference easy with the products divided into four color sections—indicators, motors, timers, and fault isolation systems. Operating data is also included. A. W. Haydon Co., 232 N. Elm St., Waterbury, Conn. 06720.

**Circle Reader Service #272**

## Computers and communications

Two new brochures introduce two new entries into the communications field. One is a disk monitor system/binary synchronous communication system (IBM 1130 compatible) that allows point-to-point communications, multipoint communications, full I/O operation during communications, and real-time response to auto answer. The other is a family of minicomputers for industrial use. You'll get the essential data for each from General Automation Inc., 1055 S. East St., Anaheim, Calif. 92805.

**Circle Reader Service #273**

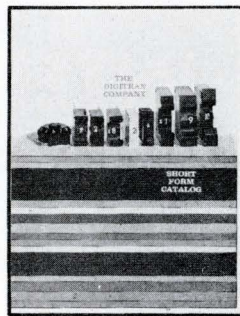
## Digital multimeter-counter

The "syncrocount" technique described in this brochure enables this digital multimeter-counter to directly measure dc from 0.1 mV to 1000 V, resistance from 0.1  $\Omega$  to 10 M $\Omega$ , and count frequency from 1 Hz to 10 MHz. And to complete the description of this multifunction instrument, features, specs, and prices are included. California Instruments Co., 5150 Convoy St., San Diego, Calif. 92111.

**Circle Reader Service #274**

## Thumbwheel switch lines

Here's a 6-page brochure that efficiently summarizes all of Digitran's modular thumbwheel switch product lines. The standard size Digiswitch and the miniature Miniswitch lines are described. You'll find them ideal for appli-



cations that require accurate manual setting, legible in-line readout, and coded electrical outputs. "Special standard" switches are covered, too. The Digitran Co., 855 S. Arroyo Parkway, Pasadena, Calif. 91105.

**Circle Reader Service #275**

## ICs with a plus

A 20-page ic catalog details some of the pluses of Analog Devices' products. Suggested for the circuit designer who anticipates encountering sophisticated circuit design problems, the brochure describes industry's first (and to date, only) complete analog multiplier on a single chip, a low-drift ic amp, a high-speed ic op amp, and an instrumentation amp. Electrical characteristics are included, as is an ic op amp selection guide. Analog Devices, Inc., Route 1 Industrial Park, Box 280, Norwood, Mass. 02062.

**Circle Reader Service #276**

## Terminal system

A programmable terminal system which features programmable micro-processors enables a single terminal to be used for a variety of applications. A data package contains descriptions for the stand-alone system, which includes a CRT display, a typewriter style keyboard, a programmable system controller, and a universal modem interface, all contained in a compact desktop unit. Sanders Associates Inc., Daniel Webster Hwy., Nashua, N.H. 03060.

**Circle Reader Service #277**

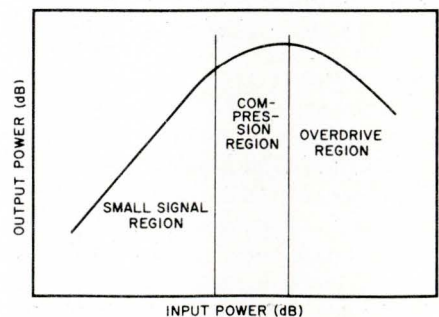
## Standardized filter designs

Through advances in network theory and computer-aided design, Nytronics can show you how to get filters with the cost and delivery benefits of standard products without sacrificing design flexibility. In their 12-page catalog low pass, high pass, and bandpass filters are grouped into basic "family designations." Feasibility envelopes show acceptable range for impedance and cutoff frequency within a family. It's a new idea in specifying filters, and it's brought to you by Nytronics Inc., Third Ave., Alpha, N.J. 08865.

**Circle Reader Service #278**

## Traveling wave tubes

This 28-page catalog serves as both a product guide and a reference handbook. There are product listings for low, medium, and high power cw TWTS, TWT amplifiers, pulse TWTS, etc. And



**Typical gain characteristic**

you'll also find data on fundamental concepts, modulation methods, gain, efficiency, phase characteristics, and more. Varian, 611 Hansen Way, Palo Alto, Calif. 94303.

**Circle Reader Service #279**

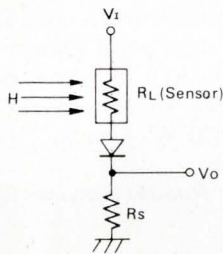
### Microprogramming handbook

The great success with the first edition encouraged MicroData to publish a second edition of their programming handbook. Telling you how to microprogram, why the concept is effective, and when it is appropriate, these 448 pages give you details on microprogrammed computer applications, a Micro 800 user's manual, a Micro 1600 reference manual, a firmware manual, and text on systems design. The round up is expanded data on products, their new microprogramming system, and their minicomputer series. MicroData Corp., 644 E. Young St., Santa Ana, Calif. 92705.

**Circle Reader Service #280**

### Card reader

Optical static card readers have been designed for reading punched credit and badge cards with or without embossing. The models consist of a 10-row x 10-column CdS light sensor matrix, light



source, and insertion slot. General features and specs are covered in a short-form catalog, which also includes a matrix wiring diagram. Matsushita Electric Corp. of America, Industrial Div., 200 Park Ave., New York, N.Y. 10017.

**Circle Reader Service #281**

### Data-processing systems

"Four new data processing systems to automate mechanical testing" is the title of Bulletin IC-3-51 which introduces a new line of systems for automating the acquisition, processing, and reduction of mechanical testing. It is suggested for applications where many repetitive tests must be performed and analyzed, or where complex mathematical treatment of results is required. The systems described range from a digital data display and printout for one machine to an on-line computer facility involving multi-station operation. Instron Corp., 2500 Washington St., Canton, Mass. 02021.

**Circle Reader Service #282**

### Terminal equipment interface

An industrial electronics engineering bulletin reviews the method of operation of data terminal equipment and data communication equipment that interface according to EIA standards. While the procedures discussed are not the only ones possible, they do illustrate typical methods that conform to provisions of EIA's standard RS-232-C. EIA, 2001 Eye St., N.W., Washington, D.C. 20006.

**Circle Reader Service #283**

### Solid-state catalog

You'll find every solid-state device that Solitron Devices makes in this catalog—single and dual field effect transistors, linear ICs, random access and read-only memories, dynamic and static shift registers, and multiplexers. And unique features are pointed out. For example, neither translators nor external resistors are required for inputs or outputs on their completely bipolar compatible 1024-bit static ROM. Solitron Devices, Box 1416, San Diego, Calif.

**Circle Reader Service #284**

### How to buy a minicomputer . . .

. . . is the title of this 32-page pamphlet that answers the most commonly asked questions about minicomputers. You'll find material on minicomputer architecture, new memory techniques, types of instruction sets, what software and peripheral equipment should be available with a minicomputer, and more. Data General Corp., Southboro, Mass. 01772.

**Circle Reader Service #285**

### Double balanced modulator IC

Although intended for use as a channel modulator in frequency division multiplex telephone equipment, this IC is also very suitable in applications as a balanced modulator, frequency doubler and carrier generator, or as an amplitude modulator with modulating index control. All the details of the circuit are explained, and supplemented with a generous number of schematics and graphs. European Electronic Products Corp., 10150 W. Jefferson Blvd., Culver City, Calif. 90230.

**Circle Reader Service #286**



## THE CHOMERICS EF KEYBOARD IS AMERICA'S No.1 SOFT TOUCH.

No key motion. Low profile: .156" above panel; .430" below panel (including pin-depth). 100,000,000 cycles. Up to 4 bits per key. Available in 12 keys and 16 keys.

For a volume order of the 16-key board, we'll touch you for as little as \$4 per. For the 12-key, that can become \$3.

A 12-key sample comes for \$7.

The catalog's free.



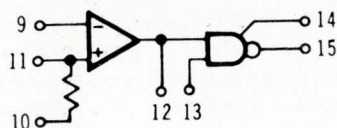
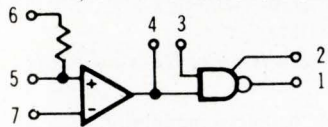
**CHOMERICS, INC.**

77 Dragon Court, Woburn, MA 01801 (617) 935-4850  
America's #2 soft touch is Chomerics' EB keyboard

**Circle Reader Service #35**

## Line drivers and receivers catalog

Your selection of drivers and receivers is simplified with this thorough 36-page catalog. For each of seven drivers and eight receivers you get descriptions, features, package outlines, and pin configurations. There are typical performance curves, charts of electrical charac-



Pin configuration

teristics, logic diagrams, test circuit schematics, charts of absolute maximum ratings, and application information. In other words, it's packed with useful technical data. Qualidyne Corp., 1230 Bordeaux Dr., Sunnyvale, Calif. 94086.

**Circle Reader Service #287**

## Angle position indicator

A resolver/synchro-to-digital converter features high-speed continuous conversion of 400-Hz data to digital form. The instrument tracks input data at a rate of 2000°/s and features solid-state silicon plug-in modules and precision transformer elements. A data sheet provides a complete description and operating specs for the indicator. North Atlantic Industries Inc., Terminal Dr., Plainview, N.Y. 11803.

**Circle Reader Service #288**

## CRC applications

Here's an application note discussing cyclic redundancy check (CRC) character generation for designers of nine-track tape systems. Its 16 pages describe a simplified code generation technique, the use of the CRC in error detection, and the CRC error correction technique that corrects error bursts of unlimited lengths in any one of the nine tracks of an IBM-compatible formatted magnetic tape. And there are tables and diagrams to help you understand every process. Pertec Peripheral Equipment, 9600 Irondale Ave., Chatsworth, Calif. 91311.

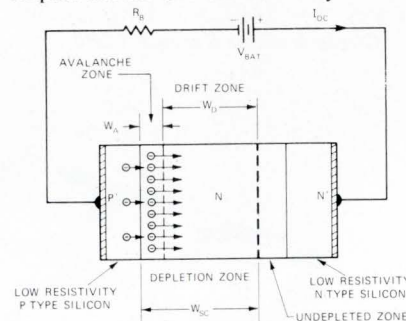
**Circle Reader Service #289**

## Filter application book

Recognizing that the proper application of filters is one of the most important aspects of electromagnetic control, CDE is publishing a book on the solutions to EMC problems as they relate to the electronic data processing industry. In addition to guidance in the application of filters, the book will introduce a family of filter hardware that will enable you to select the most desirable filter for your EMC problems. Reserve your copy now by writing on company letterhead to Cornell-Dubilier Electronics, 150 Avenue L, Newark, N.J. 07101.

## Impatt diode applications

The specific application discussed in this 32-page note is the use of Impatt diodes for microwave power generation and amplification. You'll learn the principles of operation and construction of Impatt diodes and see how they are de-



signed into oscillator and amplifier circuits. Electrical and mechanical diagrams and circuit performance graphs make the text even more informative. Hewlett-Packard Co., 1601 California Ave., Palo Alto, Calif. 94304.

**Circle Reader Service #290**

## Photomultiplier manual

This paperback manual is a must for designers and users of electro-optical equipment. Besides providing a better understanding of modern photomultiplier tubes, the 192-pager includes information on the construction and operation, and methods of measuring photomultiplier characteristics. Typical applications are featured, as is data dealing with the measurement of light and radiant energy, noise statistics, and spectral matching factors. Available from RCA, Electronic Components, Harrison, N.J. 07029 for \$2.50.

## Capacitor fundamentals

Because you usually don't have the time or equipment to investigate every potential circuit component before installation, ATC has developed a wide-band test fixture to measure the  $v_{SWR}$ , insertion loss, and s-parameters of a range of capacitance values you're most likely to use. This short note explains the process to you and shows a computer printout of several sample values measured. American Technical Ceramics, 1 Norden La., Huntington Sta., N.Y. 11746.

**Circle Reader Service #291**

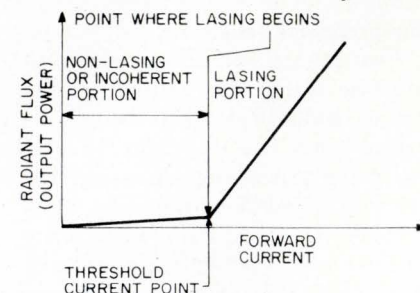
## Semiconductors

A comprehensive 24-page catalog contains a listing of discrete semiconductors. Included in the rundown are silicon rectifiers and bridge assemblies, MOS FETS, silicon diodes, high-voltage assemblies, germanium diodes, and transistors. Circuit diagrams, tables of characteristics, and a cross reference of General Instrument's semiconductor products as well as other manufacturers' are provided. General Instrument, 600 W. John St., Hicksville, N.Y. 11802.

**Circle Reader Service #292**

## Lasers and diodes

A concise description of RCA's semiconductor photon emitting devices, including IR emitting diodes and single and multiple diode lasers, is included in an 11-page catalog. The products discussed utilize either gallium arsenide or gallium aluminum arsenide junction



**Radiant flux vs forward current**

materials. Comparison, selection and application charts are included, as are characteristics for the various products. A glossary of optoelectronic terms is also provided. RCA, Solid State Div., Somerville, N.J. 08876.

**Circle Reader Service #293**



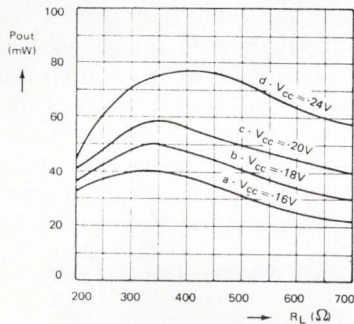
### Storage tubes

A new family of storage tubes, which can be used in a range of applications because of their simple systems operation, low price, small size, and long tube life, are discussed in catalog TEV 6006. Operating principles of the new tubes are covered, and graphs depicting operating characteristics are provided. Thomson CSF Electron Tubes Inc., 50 Rockefeller Plaza, New York, N.Y. 10020.

**Circle Reader Service #294**

### Channel amplifier

A low-power channel amplifier for use in frequency division multiplex and pulse code modulation telephone equipment is detailed in this 8-page application note. All the necessary informa-



Output power versus load

tion on input and output, circuit design, applications, and circuit performance is provided. European Electronics Products Corp., 10150 W. Jefferson Blvd., Culver City, Calif. 90230.

**Circle Reader Service #295**

### Computer bibliography

If you're in any way involved in the computer and data processing field, you'll find this bibliography a must. Its 190 pages are a useful and up to date reference guide to all the recent literature in the computer field. The books and periodicals it lists cover management, systems, programming, operations, manufacturing, services, software, and more. New entries are added to its more than 200 categories quarterly. Buy a single copy for \$10 or subscribe annually for \$29.50. If you want more information, circle the reader service number for a descriptive brochure. Applied Computer Research, 8900 N. Central Ave., Suite 208, Phoenix, Ariz. 85020.

**Circle Reader Service #296**

### Solid-state research

A 45-page report details the solid-state research work of the solid-state division of Lincoln Laboratory for February 1-April 30, 1971. The topics discussed include solid-state device research, materials research, and physics of solids and microelectronics. Tables, graphs, charts, and references are included. Lincoln Laboratory, MIT, Lexington, Mass.

**Circle Reader Service #297**

### TV chroma system

Three monolithic ICs constitute a complete chroma system for color TV receivers, and they're detailed for you in this 16-page application note. The note explains how the signal processor, amplifier, and demodulator interact in the system, and provides schematics and functional diagrams for each circuit. All is brought together in the end with thorough application information. Signetics, 811 E. Arques Ave., Sunnyvale, Calif.

**Circle Reader Service #298**

### Direct digital frequency synthesis

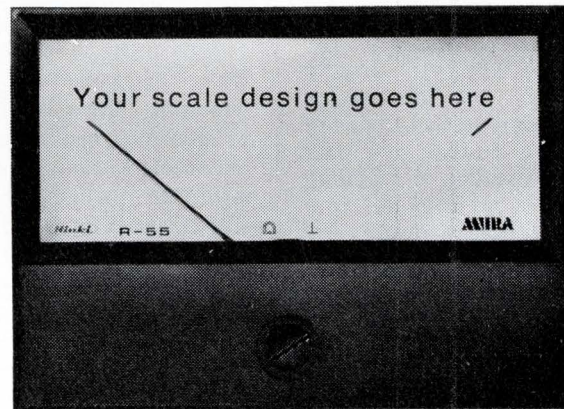
The advantages of direct digital frequency synthesis are discussed in this application note. It compares the various approaches and advantages to direct and indirect analog techniques. Short term stability, no switching transients, and precise phase control are among those covered. Rockland Systems Corp., 131 Erie St. E., Blauvelt, N.Y.

**Circle Reader Service #299**

### Designers' relay handbook

Just about everything you need for choosing the right relay for any application is included in this handbook. In addition to product information, you'll find a glossary of relay terms, a discussion of the principles of operation of relays, application and design considerations, style and characteristic data, and specifying and testing information. Limited copies are available to qualified persons, so write to Magnecraft Electric Co., 5575 N. Lynch Ave., Chicago, Ill.

## MURA/HIOKI PANEL METERS



### TOP QUALITY AND FULLY GUARANTEED

Made by Hioki, Japan's leading manufacturer of quality panel meters, these fine instruments can be used wherever precision measurement is an absolute requirement. They come in various sizes from 2" x 2 1/2" to 6" x 4 1/2" with either d'Arsonval or taut-band movements. Resistances and scale designs can be tailored to your special needs. Distributed in the United States only by Mura Corp., they are attractively priced and fully guaranteed. Sold only in O.E.M. quantities of 300 and up.

**MURA** 50 SOUTH SERVICE ROAD, JERICHO, N.Y. 11753  
Telephone: (516) 334-2700 Telex: 967-879

Mura is the world's largest supplier of miniature panel meters.

**Circle Reader Service #36**

# SAMPLES

## YOU CAN MASTER THE MEMORIES TECHNOLOGY with this 7-PART COURSE

It took almost one year for the editors of *The Electronic Engineer* to research and compile the most comprehensive memory course available. Seven chapters guide you through this complex field, from delay lines to magnetic bubbles, with schematics and applications all along the way.

Thirty-six top engineering specialists from every phase of memories contributed their expertise. Inter-technological ballyhoo has been stripped away to reveal each aspect on its merits and show where it properly fits. The course covers:

**fundamentals . . . memory types**  
**. . . magnetic mainframes . . .**  
**non-magnetic mainframes . . .**  
**bulk storage . . . systems applica-**  
**tions . . . future memories**

This Course on Memories costs only \$5.00 postpaid and includes an examination. Those who wish to take the examination will receive a *Certificate of Completion* free of charge. Send the coupon and your check or money order to: Course Editor, *The Electronic Engineer*, One Decker Square, Bala Cynwyd, Pa. 19004. E-1

Send me your new Course on **Memories**. Payment of **\$5.00** is enclosed. Send the Course to me at:

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

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

E-1

Check here for quantity prices.

### Conductor ribbon cable

A free sample of a section of cabling accompanies a data sheet on flat bonded round conductor ribbon cable. It's available in a variety of round wire gauges, colors, and configurations; operates in a temperature range of  $-55^{\circ}$  to  $105^{\circ}\text{C}$ ; and insulation is rated at 600 and 1000 V rms. Bi-Tronics Inc., 76 Main St., Tuckahoe, N.Y. 10707.

**Circle Reader Service #300**

### The IC jitters

. . . are going around, and you may be susceptible. There's a lot to know about ICs and new applications are introduced every day. There's always more to know about ICs and the thought of all you don't know just might give you the IC jitters. Here's a sample of something that will make sure you and your staff will never suffer from it. Send for it and see. Bell & Howell Schools, Industrial Training Div., 4141 Belmont Ave., Chicago, Ill. 60641.

**Circle Reader Service #301**

### Bonded dry film lubricant

Sample metal washers coated with a bonded dry film lubricant are yours with this offer. And they'll satisfy your typical applications in rotating shafts, wear rings, sleeve bearings, and slides, or any other applications that involve intermediate and low speeds, break-in difficulties, galling, lubrication, corrosive environments, and high temperatures. PennDixon Co., 300 Madison Ave., Clifton Heights, Pa. 19018.

**Circle Reader Service #302**

### Self-mailer carton

This is one product you'll find interesting especially if you, too, are interested in sending samples. It's a self-mailer carton that requires no inside or overpackaging—great for product sampling and mail order shipping. The partially perforated top provides security during shipment and twists off for opening and reclosing. You can design the outside as you like, and the postal indicia can be printed directly on the package. It's offered to you by Niemand Bros. Inc., 45-10 94th St., Elmhurst, N.Y. 11373.

**Circle Reader Service #303**

### Spring contact probes

See for yourself how qualified these "snap-out" spring contact probes are for interfacing electrical circuit terminations. You can get them in a variety of sizes and tip configurations, and they are highly reliable, with mechanical life exceeding  $10^6$  deflections. Plus they permit density up to 400 contact points per sq. in. Everett/Charles Inc., 2806 Metropolitan Pl., Pomona, Calif. 91767.

**Circle Reader Service #304**

### Miniature ceramic filters

These miniature ceramic reed and ladder filters are ideal for applications in fm radio, citizen band radio, telephone answering devices, and telecontrols. The reed filters have a constant bandwidth and can set adjacent signals at intervals of 15 or 30 Hz. The ladders feature low impedance and are a low-cost replacement for mechanical and crystal filters. Samples are offered by Matsushita Electric Corp. of America, 200 Park Ave., New York, N.Y. 10017.

**Circle Reader Service #305**

### Component drafting aids

Along with an 84-page catalog on electronic component drafting aids you'll receive free samples of several of the products. These include, among others, precision grids, drafting films, TO can patterns, dual-in-line and flat pack patterns, connector patterns, slit artwork tapes, and reference designations. And the catalog will give you hundreds of time and money-saving hints. Bishop Graphics, 7300 Radford Ave., North Hollywood, Calif. 91605.

**Circle Reader Service #306**

### Reactance calculator

This handy reactance calculator gives you the capacitance or inductance value you need in one easy step. Simply set the inner or outer frequency scale on the desired capacitance or inductance value and read your answer at the arrow. On the back you'll find circuit diagrams for high and low load impedance and insertion loss values. For your free calculator, write on company letterhead to Cornell-Dubilier Electronics, 150 Ave. L, Newark, N.J. 07101.

# THE ELECTRONIC ENGINEER

## DISTRICT SALES MANAGERS

- EDWARD G. SHAUD**  
BALA-CYNWYD, (Pa.) 19004  
One Decker Square  
(Area Code 215) SHERWOOD 8-2000
- JOSEPH DRUCKER**  
NEW YORK 10016-600 Third Ave.  
(Area Code 212) OXFORD 7-3400
- JOHN W. BERNHARDT**  
CHICAGO 60606-120 S. Riverside  
Plaza  
(Area Code 312) 782-1400
- G. T. ALFANO**  
NEEDHAM HEIGHTS, MASS. 02194-  
570 Hillside Ave.  
(Area Code 617) 444-0010
- TERRENCE D. BUCKLEY**  
**THOMAS R. BORIS**  
LOS ANGELES 90020-3727 W.  
Sixth St. # 202  
(Area Code 213) DUNKIRK 7-1271
- RALPH PETERSEN**  
LOS ALTOS (San Francisco) 94022  
199 First St., Room 335  
(Area Code 415) 941-6655
- RICHARD DUTE**  
CLEVELAND 44114-601 Rockwell Ave.  
(Area Code 216) SUPERIOR 1-2860
- NEWTON B. COLLINSON**  
ATLANTA 30309-1776 Peachtree St.  
N.W.  
(Area Code 404) 872-4723
- MILES G. THORNTON, JR.**  
DALLAS 75206-Meadows Bldg.  
Expressway at Milton  
(Area Code 214) EMERSON 3-6426
- HAROLD E. MOTT**  
**R. DENT SHILLINGLAW**  
Houston 77027  
4151 Southwest Freeway  
Suite 735  
(Area Code 713) 621-7550

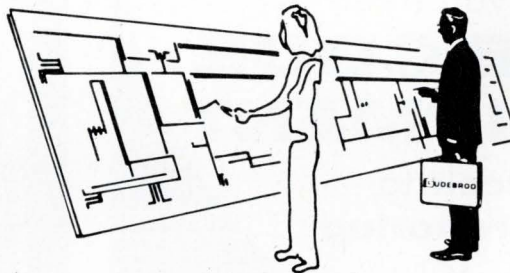
## INTERNATIONAL BUSINESS OFFICES

- London, SW1Y 6PB ..... Max F. Holsinger  
67-68 Jermy St. St. James's ..... Dir. European Sales  
01-839 6318-9 ..... K. J. Hendry, S. K. Elliott  
Cables ..... WHIP, LONDON S. W. 1
- Manchester M22 5RQ ..... D. I. Goulden  
Haletop, Wythenshawe Civic Centre ..... 061-437 3293
- 4 Dusseldorf-Nord ..... E. Hillerbrand  
Eitelstrasse 32 ..... R. Schomburg, H. Haibt  
Dusseldorf 652031-2 .....  
Cables ..... WHIP, DUSSELDORF
- 75 Paris 8e ..... S. Brown-Joussard  
70 rue de Ponthieu ..... J.-C. Lamoine  
Paris 359 65-77 .....  
Cables ..... UIIP, PARIS 8E
- Tokyo ..... C. T. Sakaguchi  
Room 814, Togin Bldg., Marunouchi .....  
CPO Box No. 1572 ..... Tel: 211-3506-3509  
Cables ..... CLARENESAKA TOKYO

## BUSINESS STAFF

- BERNARD M. GITTELMAN**  
Publisher
- DENNIS J. PERKINS**  
Promotion Manager
- LOUIS L. MARINES**  
Marketing Services Manager
- K. A. MARTINI**  
**B. A. TATUM**  
Advertising Production
- WILLIAM HOWAT**  
Circulation Director
- JOSEPH A. GALVAN**  
Circulation Manager
- JOSEPH P. BABCOCK**  
Reader Service Manager
- JOHN H. KOFRON**  
Chilton Research Services
- C. R. WILHIDE**  
Washington Vice-President

<b>ACDC ELECTRONICS, INC.</b> .....	Inside Back Cover	<b>INTEL CORP.</b> .....	12, 13
Rose Associates		Bonfield Assoc.	
<b>ADAMS &amp; WESTLAKE CO. (Relay Div.)</b> .....	DC-10	<b>INTERSIL</b> .....	DC-2, DC-3
Scofield, Hiery & Malone, Inc.		Jack Herrick Adv., Inc.	
<b>ADVANCED MEMORY SYSTEMS</b> .....	36	<b>INSTRULAB</b> .....	37
Fleig & LeBoeuf Adv., Inc.		R. L. Conhaim/Adv.	
<b>AMP, INC.</b> .....	Inside Front Cover	<b>KEPCO, INC.</b> .....	4
Aitkin-Kynett Co., Inc.		Weiss Adv.	
<b>AMPERITE CO.</b> .....	60	<b>LEIPZIGER MESSEAMT</b> .....	5
H. J. Gold Co.		Interwerbung GmbH	
<b>BECKMAN INSTRUMENTS—Hellipot Div.</b> .....	57	<b>LITTON INDUSTRIES, INC.</b> .....	58
N. W. Ayer/Jorgensen/MacDonald, Inc.		Triad Distributor Div.	
<b>BUSSMANN MFG. DIV, McGraw-Edison Co.</b> .....	DC-7	D'Arcy-MacManus-Intermarco, Inc.	
Henderson Adv. Co.		<b>MARCO-OKA</b> .....	DC-12
<b>CHILTON DIRECT MAIL CO.</b> .....	24, 25	Jansen Assoc., Inc.	
<b>CHOMERICS, INC.</b> .....	69	<b>MICRO SWITCH</b> .....	1
Van Christo Assoc., Inc.		N. W. Ayer & Son, Inc.	
<b>CHRONO-LOG CORP.</b> .....	74	<b>MOTOROLA COMPONENT PRDTS.</b>	
MJS Graphics Co.		Communications & Electronics Div.....	DC-15
<b>CLAIREX CORP.</b> .....	37	Brand Adv., Inc.	
Michel-Cather, Inc.		<b>MURA CORP.</b> .....	71
<b>DALE ELECTRONICS, INC.</b> .....	Back Cover	Kameny Assoc., Inc.	
Swanson, Sinkey, Ellis, Inc.		<b>NATIONAL SEMICONDUCTOR</b> .....	59
<b>DATADYNE CORP.</b> .....	65	Chiat/Day, Inc.	
Currie & Ives Adv., Inc.		<b>PAMOTOR</b> .....	63
<b>DATTEL SYSTEMS, INC.</b> .....	DC-12	Wm. J. Purdy Promotions, Inc.	
John Donlan Adv.		<b>RFL INDUSTRIES</b> .....	DC12-A—DC12-H
<b>DIGITAL EQUIPMENT CORP.</b> .....	23	Josephson, Cuffari & Co.	
Creamer, Trowbridge, Case & Basford, Inc.		<b>SIGNAL GALAXIES</b> .....	28
<b>DIGITRAN CO.</b> .....	2	Larry Courtney Co.	
Jansson Adv., Inc.		<b>S.D.S.A. (Salon International Des</b>	
<b>ELCO CORPORATION</b> .....	34	Composants Electroniques).....	67
Mort Barish Assoc., Inc.		Publi-Service	
<b>FAIRCHILD SEMICONDUCTOR</b> .....	8, 9	<b>SOLITRON DEVICES, INC.</b> .....	55
Carson/Roberts Inc.		Haselmire Pearson Adv., Inc.	
<b>GRAYHILL, INC.</b> .....	74	<b>SOLITRON DEVICES, INC.</b> .....	61
Carr Liggett Advertising, Inc.		Sol Advertising	
<b>GUDEBROD BROS. SILK CO., INC.</b> .....	73	<b>TEKTRONIX, INC.</b> .....	27
Coastline Adv.		Dawson, Inc.	
<b>HEINEMANN ELECTRIC CO.</b> .....	7	<b>TELEDYNE PHILBRICK</b> .....	14, 15
Thomas R. Sundheim, Inc.		Ingalls Assoc., Inc.	
<b>HEWLETT-PACKARD, LOVELAND</b> .....	38	<b>UNITRODE CORP.</b> .....	11
Tallant/Yates Adv., Inc.		Impact Adv., Inc.	
<b>HOTWATT, INC.</b> .....	62	<b>WATKINS-JOHNSON CO.</b> .....	DC-13
Sears Adv., Inc.		Wm. C. Estler	
<b>INDUSTRIAL ELECTRONIC ENGINEERS, INC.</b> .....	26		
Van Der Boom, McCarron, Inc.			



## Talk to Gudebrod about your tying operation this month...

**A**nd about Lacing Tapes, harness rooms and systems. About temperature and vibration . . . speed and rejects! About Nylon, Dacron, Teflon, Nomex, Glass tapes and cords—treated and untreated . . . that meet or exceed military and industrial specifications, about cost comparisons with other methods . . . and all backed up with one hundred years of manufacturing knowledge.

Dacron, Teflon, Nomex—Du Pont Registered Trade Marks

Talk to Gudebrod this month!

Write to this address for prompt return of our  
Product Data Catalog.

*Electronics Division*  
Dept. 531

Gudebrod Bros. Silk Co., Inc. 12 South 12th Street, Philadelphia, Pa. 19107

## Solid-state timers

Here's thorough data on a series of solid-state timers with time delay ranges of 0.2 to 600 s,  $\pm 1\%$  high repeat accuracy with internal spdt to 4 pdt, and 2 to 5 A relay. You'll also receive a timing diagram, a chart that outlines time delay and voltage ranges, and application information. Uniflux Corp., 4th Metropolitan Bldg., No. 286, Takagi-868, Higashi-Yamato, Tokyo, Japan.

**Circle Reader Service #415**

## Telephone exchange of the future

In operation now is a completely solid-state automatic telephone switching system in which all speech paths are carried through ICs with no mechanical or electro-mechanical switches or moving parts. The prototype system uses digital switching under the control of a computer, and uses stored program control techniques. The system, MARTEX, is introduced by Marconi Communication Systems Ltd., Marconi House, Chelmsford, Essex, England.

**Circle Reader Service #416**

## Video data terminals

This series of video data terminals meets needs from simple teleprinter to multipoint polling applications. There's a model for basic timesharing and CCTV applications, and another that adds two-way signalling. A third adds cursor control from keyboard or line, and the fourth adds additional message control and characters to provide two-way communication. Amalgamated Wireless Ltd., Australia.

**Circle Reader Service #417**

## Video cassette recording system

A video cassette recording system and its components are detailed for you in 12 pages of descriptive data. Features and prices are listed for the video cassette recording ensemble and for its components, a recorder and color video monitor. You'll also find details for an additional recorder and a video cassette player. Victor Co. of Japan Ltd., 12, 3-chome, Moriya-cho, Kanagawa-ku, Yokohama, 221 Japan.

**Circle Reader Service #418**

## Video oscillator

For the precision testing of communications apparatus, such as TV video circuits, this instrument covers the frequency range 30 kHz to 30 MHz in six bands. It provides an output of 1 V peak-to-peak across 50  $\Omega$  and a built-in attenuator allows adjustment of the output to any level from -50 to +10 dB. Wayne Kerr Co. Ltd., Roebuck Rd., Chessington, Surrey, England.

**Circle Reader Service #419**

## Data entry system

An optical character recognition system digests printed information at the rate of 540 char./s and directly converts it into a computer-compatible form. A built-in display unit examines and corrects characters before recording on the output tape. And for variety in data processing operations, the system may be modified into a high or low-speed one line character or page reader, or a microfilm page reader. Litton Systems Ltd., Rexdale, Ontario.

**Circle Reader Service #420**

If you need

# TIME CODE EQUIPMENT

look to

## Chrono-log

for

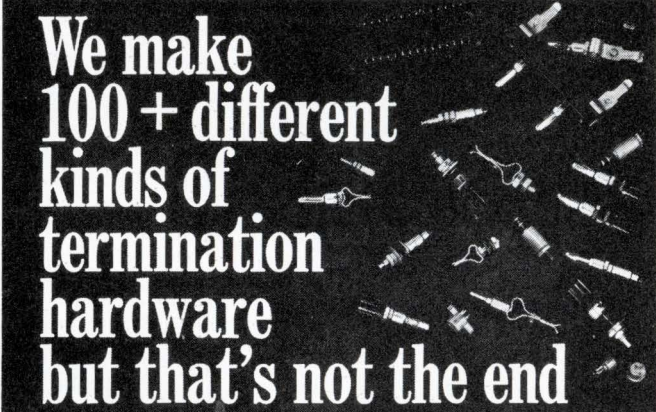
high performance,  
integrated-circuit  
Time Code  
Generators, Time  
Code Readers  
and Automatic  
Tape Search Controls  
used for time correlation  
of data recorded on  
analog tape and oscillographs.

Let our 15 years of experience in time code equipment work for you. Write or call Chrono-log Corp., 2583 West Chester Pike, Broomall, Pa. 19008. Phone: (215) 356-6771.



**CHRONO-LOG**  
CORPORATION

# We make 100+ different kinds of termination hardware but that's not the end



We are in termination hardware because our customers asked us. They had some definite ideas about miniature posts, sockets, plugs or test clips. Binding post caps that don't melt at soldering temperatures, for example.

Most of our termination products were developed for superior insulation, dielectric strength, contact resistance. (Transistor sockets with minimum insulation resistance of 500,000 megohms at 100 VDC.)

But despite the length of our line, it's not the

end. We will develop new hardware for new applications with the same commitment to quality in design, materials and workmanship that has fed the growing demand for our rotary and push button switch lines.

Like to know more? Write or phone for our latest general engineering catalog. Grayhill, Inc., 543 Hillgrove Ave., La Grange, Ill. 60525, (312) 354-1040.

## Grayhill

*pioneers in miniaturization*

# our OEM power supply is very big in computers



About a year ago, we introduced our new OEM power supply, a low-cost, off-the-shelf, 4-32 volt, 0.9-36 amp series. We sold a lot of them, especially for computer applications: 5v supplies for IC logic and  $\pm 12v$  and  $\pm 15v$  dual supplies for associated op amp circuitry. The price was right — starting at \$57 — and they had the features the industry needed: remote sensing, 0.1% regulation, overcurrent and overvoltage protection, remote programmability, UL approval, 50-60 Hz inputs, modular or rack-mounting capability, and ACDC's "guaranteed forever" performance.

Of course, there were some applications that the OEM series just couldn't handle. But it did open the doors for our specials. Specials with overtemperature or under-voltage protection; with locking fault indicators and interface logic signals for absolute protection of stored data; with dc energy storage for memory retention, on-off sequencing, etc. The point? . . . We make a quality line of standard power supplies — and specials too. So, if you're big in computers, why not talk to the company that's big in computer power supplies?

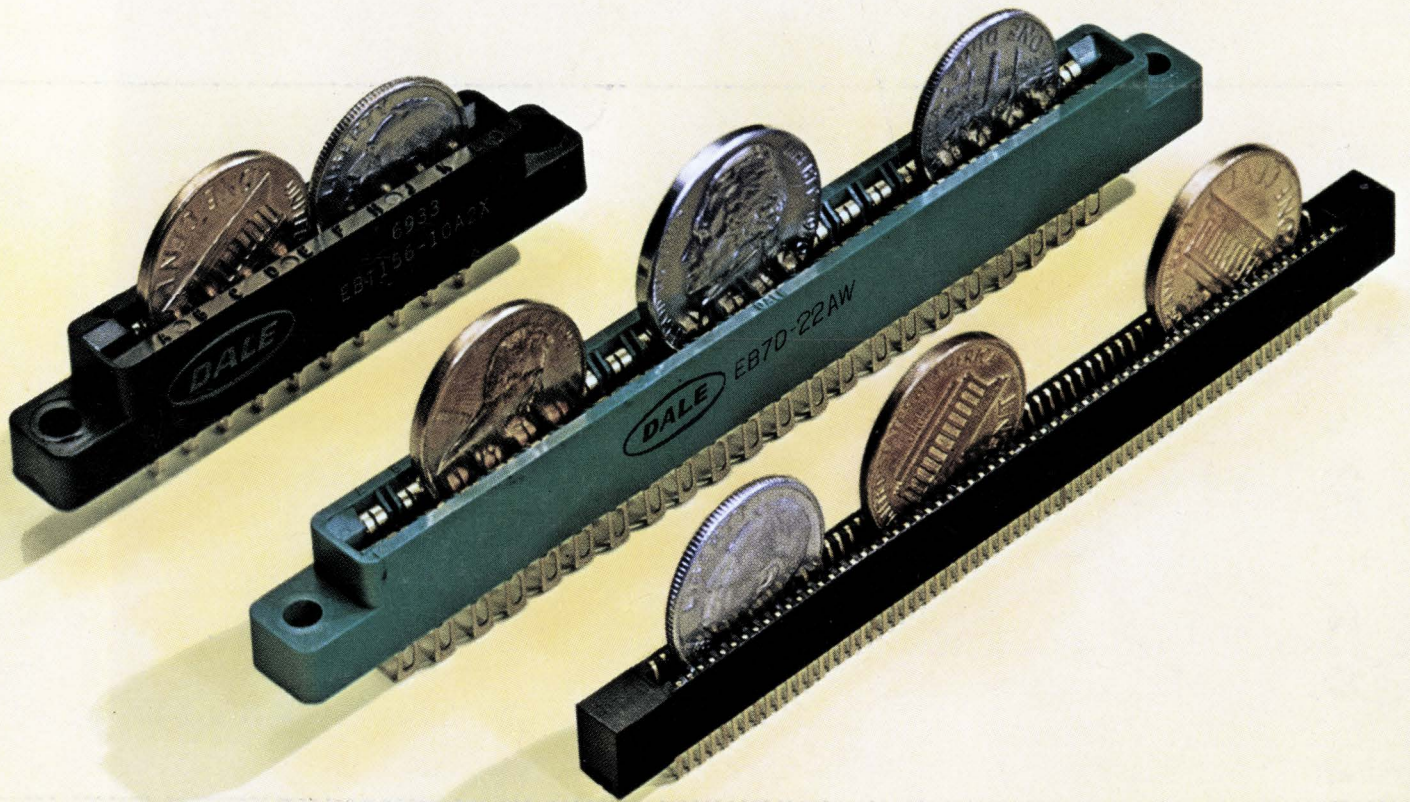
**acdc electronics inc.**

Oceanside Industrial Center, Oceanside, California 92054, (714) 757-1880

Circle Reader Service #39

# Interchange.

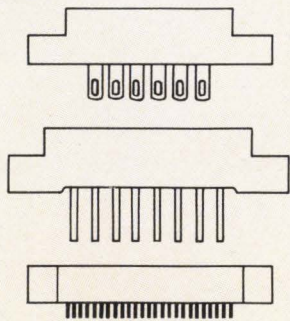
*...and get change!*



## Specify Dale Edgeboards

Dale is ready to deliver your choice of three of the industry's most popular edgeboard connectors...very well made...very interchangeable...very competitively priced. If you're looking for an edge in meeting production schedules and holding the line on costs, contact Dale today.

*Get your edge by  
calling 605-665-9301*



**EB 7** New .156" model with reliable bifurcated bellows contacts. Single row (6, 10, 15, 18, 22 contacts). Double row (12, 20, 30, 36, 44 contacts). Solder eye terminals. For 1/16" board.

**EBT 156** Top-selling .156" model with rugged tuning fork contacts (8, 10, 12, 15, 18, 22). Dip, solder eye or wrap terminals. For 1/16" boards.

**EBTL 050** Industry's thinnest .050" model. Only .158" thick for 1/32" boards; .190" thick for 1/16" boards. Cantilever-style contacts (8, 16, 20, 25, 32, 50, 64 per side).



**DALE ELECTRONICS, INC.**

East Highway 50, Yankton, South Dakota 57078. In Canada: Dale Electronics Canada, Ltd., A subsidiary of The Lionel Corporation

Circle Reader Service #40