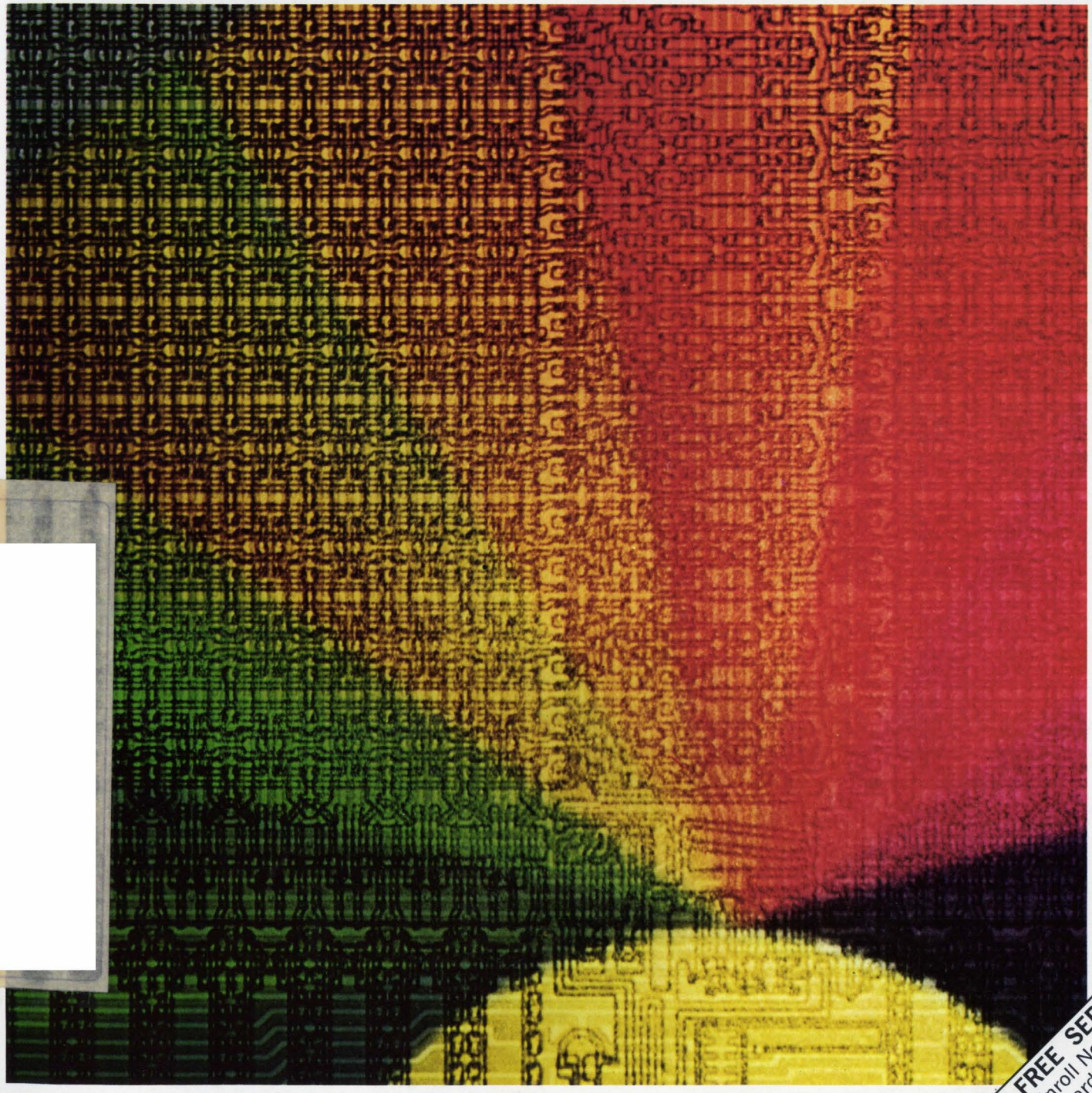
VOL. 20 NO. 2

Electronic Design

FOR ENGINEERS AND ENGINEERING MANAGERS

JAN. 20, 1972

M-bit random access memories are stacking up 1024-bit MOS 1103s against cores. Multiple sources raise confidence level for applications in mini-computer main frame, data transfer from disc or drum and cathode-ray display terminals. For what the memory designer needs to know about the 1103, see page 40.



Are nervous resistors giving your products the jitters?

Stabilize with Metal Glaze™

Stability. The magic word in electronic components. And in resistors, the word for stability is Metal Glaze. And the word is out, because millions are already in field use.

Metal Glaze, noted for its mechanical and electrical ruggedness, is also an extremely stable resistive system. Operated at rated power, and in many cases at twice rated power, Metal Glaze resistors go coolly along, resisting change for thousands of hours. They are truly precision resistors, and we have reams of test printouts to prove our case.

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TRW Metal Glaze resistors are available in quantity from your local TRW industrial distributor. Please contact TRW Electronic Components, IRC Boone Division, Boone, North Carolina 28607. Phone (704) 264-8861.

TRW®
IRC RESISTORS

INFORMATION RETRIEVAL NUMBER 242

Fast relief from connector headaches, ARINC included.

If there's one sure cure for most any connector headache, it's Bendix.

Bendix for ARINC 404 connectors. Bendix for printed circuit board connectors. Bendix for rack and panel connectors, too.

Take our new line of ARINC connectors, for instance. They're the ones available with metal-clip retention, for rear-release crimp contacts. And that can mean fewer headaches in the field for you. Choose from environmental and non-environmental types, in double or single-shell configurations, intermateable with connectors of similar design.

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Consider our rack and panel connectors, also. Standard sizes. Subminiatures. Both available in a wide variety of shell sizes and mounting configurations for most applications.

Bendix connectors. Taken as directed, they bring fast relief for most any connector headache, yours included. The Bendix Corporation, Electrical Components Division, Sidney, New York 13838.

Bendix

INFORMATION RETRIEVAL NUMBER 2

Signetics has the broadest line-up of ROMs in the industry.

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256 Bit Field Programmable ROM (32 x 8) Open Collector Outputs 8223
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2048 Bit Mask Programmable ROM (256 x 8) tri-state Outputs 8204
4096 Bit Mask Programmable ROM (512 x 8) tri-state Outputs 8205

MOS

METAL GATE

1024 Bit Static ROM (256 x 4) Bare Drain or MOS Pull-Down 2410
1024 Bit Static ROM (128 x 8 or 256 x 4) Bare Drain or MOS Pull-Down 2420
2048 Bit Static ROM (256 x 8) Bare Drain or MOS Pull-Down 2430

SILICON GATE

2560 Bit Static Character Generator (64 x 8 x 5) tri-state Outputs 2513
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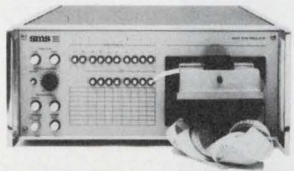
And we make them easy to use.

With our fantastic line-up, we can put you on the air in breadboard and keep you there all the way into production. From design desk to shipping dock your ROM designs will be fully functioning at system operating speeds. In breadboard you'll be using field programmable FROMs or simulators. Through prototype you'll be working on FROMs, ROMs, or simulator. In production you'll be working with FROMs and ROMs—taking advantage of field programming or the Signetics quick turn around ROM mask generation and mask verification capability.

Designs will be de-bugged and into production in weeks or even months less time. And at savings you can measure in thousands of dollars per unit type. No one knows more about ROMs than Signetics. And we help make them easy to use.

In addition to what you've already seen, here's the deal we offer.

5 separate fusers for 3 new FROMs. 3 new FROMs with 5 separate fusers to custom develop your fused ROMs: for laboratory and prototype use or pre-production through mass production.



De-bug your design before you build it. With the fantastic ROM simulator, you can simulate up to sixteen fully operational ROMs simultaneously, each up to 4096 bits either Bipolar or MOS. Each operating completely independent of the others.

Or use our FROMs which are designed for both prototyping and production usage. Your choice.

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TELEDYNE RELAYS

INFORMATION RETRIEVAL NUMBER 4

Electronic Design

VOL. 20 NO. 2

FOR ENGINEERS AND ENGINEERING MANAGERS

JAN. 20, 1972

NEWS

TECHNOLOGY

PRODUCTS

Departments

Cover: Photo courtesy of Intel Corp., Santa Clara, Calif.

ELECTRONIC DESIGN is published biweekly by Hayden Publishing Company, Inc., 50 Essex St., Rochelle Park, N.J. 07662. James S. Mulholland, Jr., President. Printed at Brown Printing Co., Inc., Waseca, Minn. Controlled circulation postage paid at Waseca Minn., and New York, N. Y., postage pending Rochelle Park, N. J.

82501 copies this issue.

The NAKED MINI™
$1450
The bare maximum.

The Computer Automation NAKED MINI™ is naked. But it's not stripped. And that's an important difference.

To us, if a minicomputer is stripped, it's not even a computer. It's only a limited controller. Loose cards and components without even a memory. Sort of a do-it-yourself kit. That's not what you get from us.

The NAKED MINI is a fully-operational, general purpose computer with 4K of expandable memory.

With our NAKED MINI 8-bit and 16-bit computers, the only things missing are the power supply, console, and chassis. That's all.

No, the NAKED MINI is not a stripped computer. Far from it.

It has the complete power of a stand-alone system. It's an integral unit, designed for maximum useability and interfaceability. It's fully tested and warranteed. And it comes with a complete line of standard software.

In fact, you get a lot of features that costlier stand-alone computers don't even have. Standard items like our 145 basic instructions (76 with the 8-bit), the most powerful instruction sets on the market. Three direct memory channels. Vectored priority interrupts. Hardware arithmetic features. And 32K of core. Plus hardware multiply/divide and full byte operations on our 16-bit machines.

Even though our NAKED MINI's have all this horsepower and flexibility, think of them as a component. A component ready to be thoroughly buried inside your OEM product.

Because of its low price tag, the NAKED MINI makes it economically feasible to design your product with a mini-

FJCC Booth 1341

computer, rather than hardwired circuitry. This enhances your system performance, while reducing system costs considerably.

For the systems designer, the NAKED MINI concept means an opportunity to get the full computer power of our packaged machines. But at the price of a component. Take a look at our quantity pricing list. We think you'll agree.

We'll be glad to send you full specification details, including a complete listing of the standard instruction set and software. Just write or call us.

The NAKED MINI has nothing to hide.

Naked Mini Quantity Pricing

	10-19	20-49	50-99	100-199	200 plus
NAKED MINI-16					
4K	$2500.	$2400.	$2300.	$2200.	$1995.
2K	2200.	2100.	2000.	1900.	1725.
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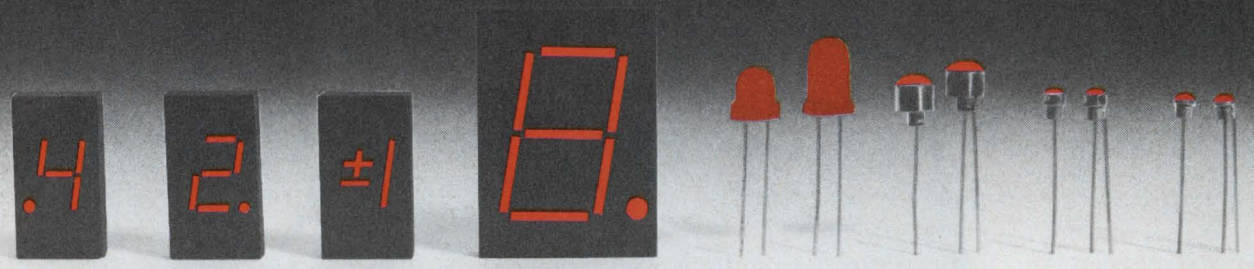
INFORMATION RETRIEVAL NUMBER 5

OPCOA sells LED displays and lamps...

lots of them.



SLA-1 SLA-1R SLA-2 SLA-3 OSL-3,-3L OSL-4,-4S OSL-2,-2S OSL-1,-1S

Lots of displays. All use gallium phosphide, the most efficient visible light emitting semiconductor with 200,000 hours typical half life. All are operable from standard low-voltage IC's. Numerals are red on an opaque black background. Choose from:

SLA-1: A seven-segment numeric display with decimal point featuring a large ⅓-in. character in a standard 14-pin dual-in-line package. Total power is less than ¼ watt. Operates directly from standard TTL decoder/drivers.

SLA-1R: Similar to SLA-1 but with right-hand decimal point.

SLA-2: For use with SLA-1 or -1R seven-segment displays to indicate the overflow numeral one and polarity.

SLA-3: The largest available solid state numeric display with an 0.8-in. character height—readable at distances of over 40 feet. It features a 0.17-in. thin package with 0.100-in. spaced leads for convenient socket mounting or soldering to a p-c board.

Lots of lamps. All use gallium phosphide LED's which emit light in all directions to provide an area light source rather than a pinpoint. All provide typical optical power output of 225 μ watts (4.5 millilumens) at 15 mA. Choose from:

OSL-1 and -1S: Full 0.100-in. sources of light in 0.100-in. diameter packages with good visibility over 180° viewing angle. For coaxial or two-wire hookup.

OSL-2 and -2S: Provide 2.0 millicandelas at 15 mA in 0.100-in. diameter reflector packages. Recommended where high luminosity with more directional viewing is desired. For coaxial or two-wire hookup.

OSL-3 and -3L: Large indicator lamps with 0.200-in. lens diameters offer exceptionally wide viewing angle. Convenient socket or soldered mounting with 0.100-in. lead spacing. Available with short (OSL-3) or long (OSL-3L) dome in either red or clear plastic.

OSL-4 and -4S: Directional 0.175-in. diameter "headlight" type lamps provide 2.7 millicandelas. Particularly useful for panel backlighting. For coaxial or two-wire hookup.

And lots of the model you've chosen. When your design moves from prototype into production, you can count on OPCOA to meet your requirements.

For technical literature or applications assistance, contact OPCOA, Inc., 330 Talmadge Road, Edison, New Jersey 08817; call (201) 287-0355; TWX 710-998-0555.

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Now we offer you the world's first true nonpolar wet tantalum capacitor.

We call it the ANP. And it means protection. *Full* protection from voltage-reversal failures. And from circuit-damaging transients.

Realizing that not every circuit needs full protection, we also came up with the AHS. Type AHS tantalum capacitors are polarized units for operation with a DC bias, including the application of a reverse voltage not exceeding 3 volts.

The new capacitors come in 32 values and 9 case sizes. Stud or PC mounting. Within specified limits, they meet requirements of MIL-C-3965.

So, if you're looking for *true* nonpolarity—or precisely limited polarity—stop looking. We've got both. And bulletin 4-608 explains the details.

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MALLORY CAPACITOR COMPANY
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INFORMATION RETRIEVAL NUMBER 7

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across the desk

Executive sees trend to microprogramming

The article on microprogrammed computers in the Nov. 25 issue ("Suddenly, Everybody is Building Microprogrammed Computers," ED 24, pp. 23-28) was read with much interest here. Indeed, our experience at Memory Systems, Inc., is that the trend to microprogramming and the use of fast control memories is on the upsurge.

In your excellent article we were somewhat disappointed to see no mention of the plated wire EAROM (Electrically Alterable ROM) concept developed by Memory Systems—especially since ELECTRONIC DESIGN broke the story in a cover article on March 1, 1970. We have come far since that time and have now delivered quantities of a wide variety of EAROMs to customers, who are using them in such applications as writable control stores for minicomputers, peripheral controllers, telephone switching equipment, process control computers, N/C robots, machine-tool controllers, to name a few.

While your article stresses the reduced cost of machine hardware with ROM control, our experience indicates that this is often not the major consideration. The ability to reconfigure instructions sets rapidly as the product life unfolds, as engineering improvements or changes are required, as new competitive features are required and added—these all combine to increase product life. A new form of machine, dynamically microprogrammed, is being developed. In this the instruction set may be optimized for each type of job—ideal for time-sharing systems.

Is the writable control store more costly? Not from Memory Systems. We are profitably selling complete systems at prices similar to bipolar pROM chips and far below bipolar ROMs at comparable performance.

Bruce Kaufman,
President

Memory Systems, Inc.,
3341 W. El Segundo Blvd.
Hawthorne, Calif. 90250

Right man, wrong time

In "New electronics to make ICBMs more blastproof and easier to aim," ED 23, Nov. 11, 1971, p. 22-23, we quoted Dr. George C. Messenger, but we failed to point out that the particular quotation was taken from the December issue of the *IEEE Transactions on Nuclear Science*. Our identification of Dr. Messenger, an independent consulting engineer, wasn't particularly up to date, either. We said he was with Northrop Corp. of Newbury Park, Calif., but he hasn't been there for five years. He's now working for North American Rockwell.

A New Year's wish from logic designer

Anno Domini 1972 promises to be a great year for the digital system designer. Fairchild should be in full steam with its Isoplanar process, giving us more bipolar LSI devices with packing densities as high as MOS, and National's announcement of a 54C/74C logic family should bring us all the advantages of MOS in our TTL systems, including truly low power operation—which should just about

Electronic Design welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to Managing Editor, Electronic Design, 50 Essex St., Rochelle Park, N. J. 07662. Try to keep letters under 200 words. Letters must be signed. Names will be withheld on request.

put milliwatt RTL out of business. But there is still one further development I would like to see in 1972—it is the "half-size" logic chip, or "mini-SSI," call it what you like.

Now that the mini-DIP is becoming widely used for linear ICs and a variety of drivers and couplers, it would be great to see a new series of standard TTL in eight-pin mini-DIPs. Triple hex inverters, duals of the most popular quad gates, singles of the best dual packs and eight-pin versions of the 7490 and 7493 counters would help us small-time logic designers get more logic per board and bypass the need for new ICs, like National's DM8090 triple-hex, dual-NAND package.

And, finally, why can't a U.S. manufacturer produce a double (or even a triple) decade counter in a single 16-pin pack? An Australian firm has been doing it successfully for at least a year.

Colin S. L. Keay
Research Associate
Lunar and Planetary Laboratory
University of Arizona
Tucson, Ariz. 85721

More on recorders

"Focus on Industrial Chart Recorders" in the Dec. 9, 1971 issue, pp. 48-53 omitted several important lines—from Leeds & Northrup, North Wales, Pa.; Gould, Inc., Cleveland, and Heath Schlumberger, Benton Harbor, Mich.

Morris Leeds of L&N invented the first null-balance mechanical recorder in 1911, and the company marketed the first electronic balancing recorder in 1933. It now offers several lines of Speedomax recorders.

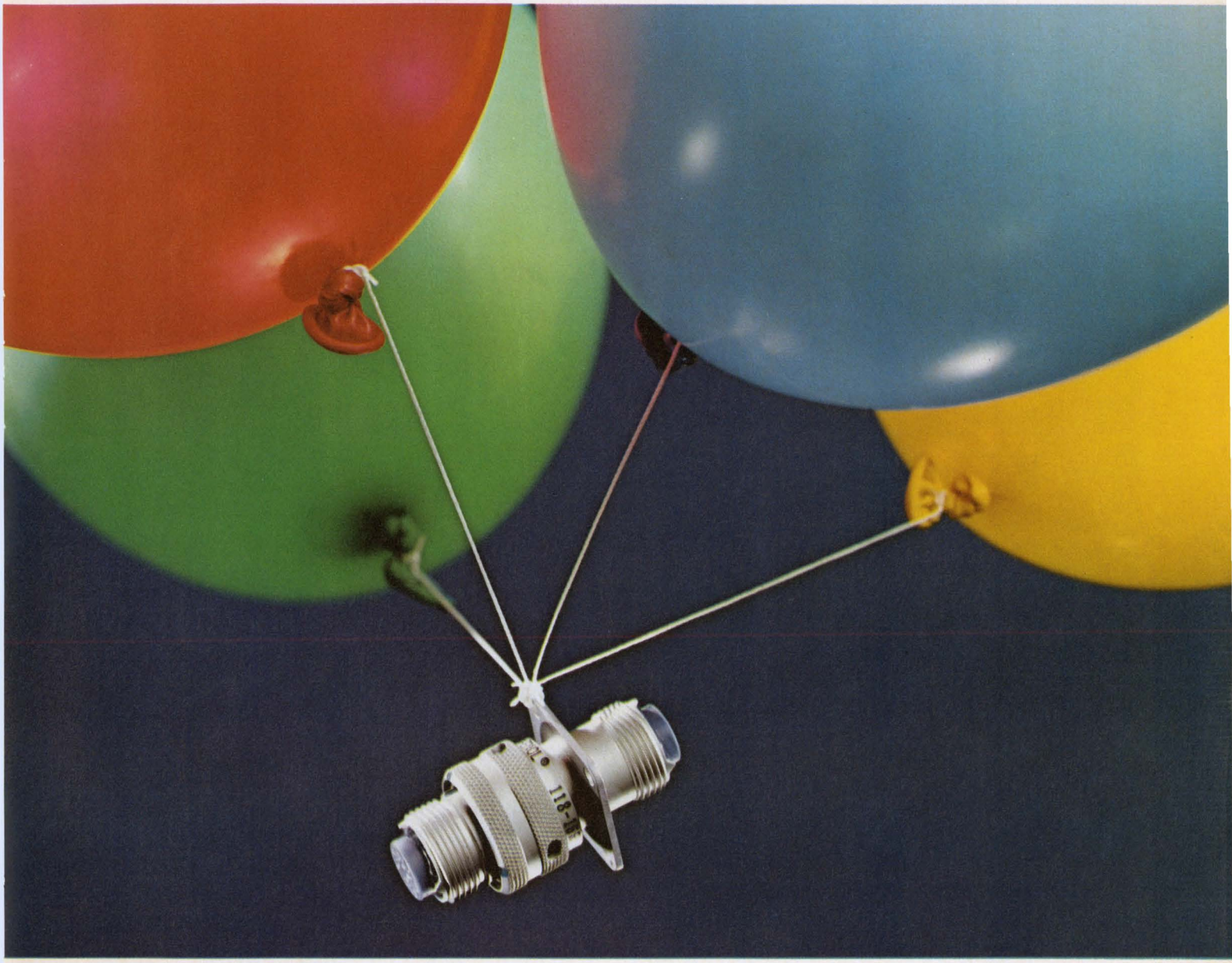
Another leading producer, the Instrument Systems Div. of Gould, Inc., is widely known for the Brush line of recorders.

Heath Schlumberger's Scientific Instrument Div. has a new modular recorder, the EV-205B, with full programmability of all functions.

For more information:

From L&N	Circle No. 451
From Gould	Circle No. 452
From Heath	Circle No. 453

The new Merlin 1® connector.



40% lighter than anybody else's.

Through the magic of Amphenol engineering we now bring you a rear-release, cylindrical, environmental connector that is not only 40% lighter than competition, but ½-inch shorter than most.

A one-piece thermoplastic retention disc, molded of tough Astrel 360* replaces the individual metal retention clips common in heavier connectors. Therefore, a 61-pin Merlin configuration has one retention disc instead of 61 individual metal clips. The result is a lot less useless weight. And, without all those parts, more reliability.

Adds a little magic to cost-cutting, too.

Our new Merlin exceeds all performance requirements of MIL-C-83723, MIL-C-26482 and NAS-1599 and is fully intermateable and intermountable with all three of these types.

Shell sizes are available in the eight most popular configurations with your choice of straight plug and both wall-mounted or jam-nut receptacles.

To get the full story on the new Merlin 1 connectors, just write or call Steve Kelleher, Amphenol Connector Division, Bunker Ramo Corporation, 2801 S. 25th Avenue, Broadview, Ill. 60153, (312) 261-2000.

*Registered Trade Mark 3M Company.

BUNKER RAMO AMPHENOL

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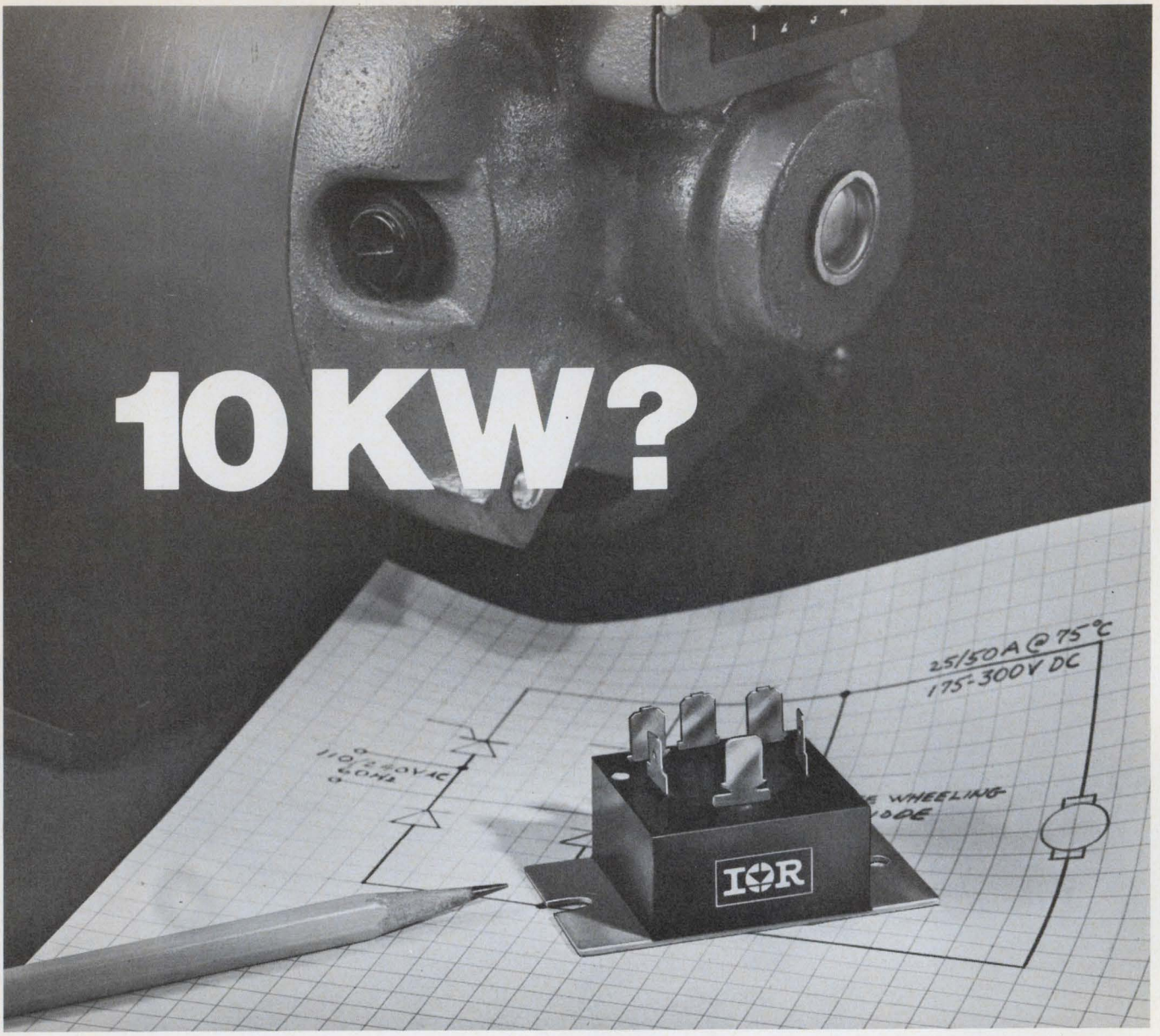


Handle just that, or more, with IR's new PACE/pak™ Passivated Assembled Circuit Elements... first to operate directly from 110-to-240 VAC lines!

Combining long-term know-how in fabricating power semiconductor devices, with advanced passivation methods and the use of proprietary thick-film techniques, IR now introduces a unique series of solid-state encapsulated power circuits. The first such units available, PACE/paks offer a host of benefits for power applications such as: DC motor drives, solid-state circuit breakers, power supplies, generator exciters, welding controls, inverters, chopper drives and heating controls. ■ They provide a number of advantages over conventional power circuits. For example, the savings in assembly and heat-sink costs alone can amount to 50% or more, not to mention as much as a 7-to-1 reduction in piece-part inventories! And, as fewer interconnections are required, their reliability is greatly extended. In addition, their high thermal efficiencies, electrical isolation and compact, convenient packaging make them ideal for any power design requirement where peak-power-performance, low cost, small size and high reliability are prime requisites. ■ They operate directly from 110-130 or 210-240 VAC and can easily handle current loads in the 50-100 Amp range. IR anticipates fabricating PACE/paks with outputs of up to 800 Amps for 440 Volt line application, in single or three-phase configurations. ■ Contact your local IR representative or write to us now . . . and find out how to optimize your own power equipment!

INTERNATIONAL RECTIFIER IOR

Semiconductor Division, 233 Kansas Street, El Segundo, California 90245, Phone (213) 678-6281

INFORMATION RETRIEVAL NUMBER 12

INFORMATION RETRIEVAL NUMBER 13 ►

Unimax lighted pushbutton controls offer you the broadest variety of styles in a wider choice of displays, colors, illuminations and actuations. From simple pilot light applications to the most sophisticated split face switch or circuit breaker, you'll find a Unimax LPB to meet your requirements—with Unimax quality and reliability built-in. At competitive prices.

Series 2: A high-rated (5 amps, 250 volts a-c or 28 volts d-c) lighted or unlighted pushbutton switch, available as momentary or alternate action and offering matching indicators. Small in size and price.

Series 5: A versatile two lamp double pole lighted pushbutton switch, momentary or alternate action, that can either transmit or project color in full or split display. High rating. High candlepower. Choice of front panel snap-in or sub panel hard mount. Low price.

Series 9: Highest quality 4 lamp switch meeting the requirements of MIL-S-22885. Single screw mounting, simple front of panel relamping and wide choice of lamp circuits. One to four pole switching. Features and options not available in any other switch.

Series 9C: All the advantages of the Series 9, with the switching mechanism replaced by a hydraulic-magnetic tripping action circuit breaker.

EAO Series 01, 02, 03: Just introduced, these economical products are available in round, square and rectangular styles. Up to three pole switching in momentary or alternate action or as indicators, key lock or mushroom cap models. Ratings and electrical and mechanical performance are uniformly high.

Dept. ED-10

Unimax Switch
CORPORATION
A Riker-Maxson Subsidiary/Ives Road, Wallingford, Conn. 06492

Gentlemen:

I'm impressed. ☐ Please have your representative contact me for a demonstration. ☐ Please send information on the following LPB lighted pushbutton controls: Series _____

My application: _____

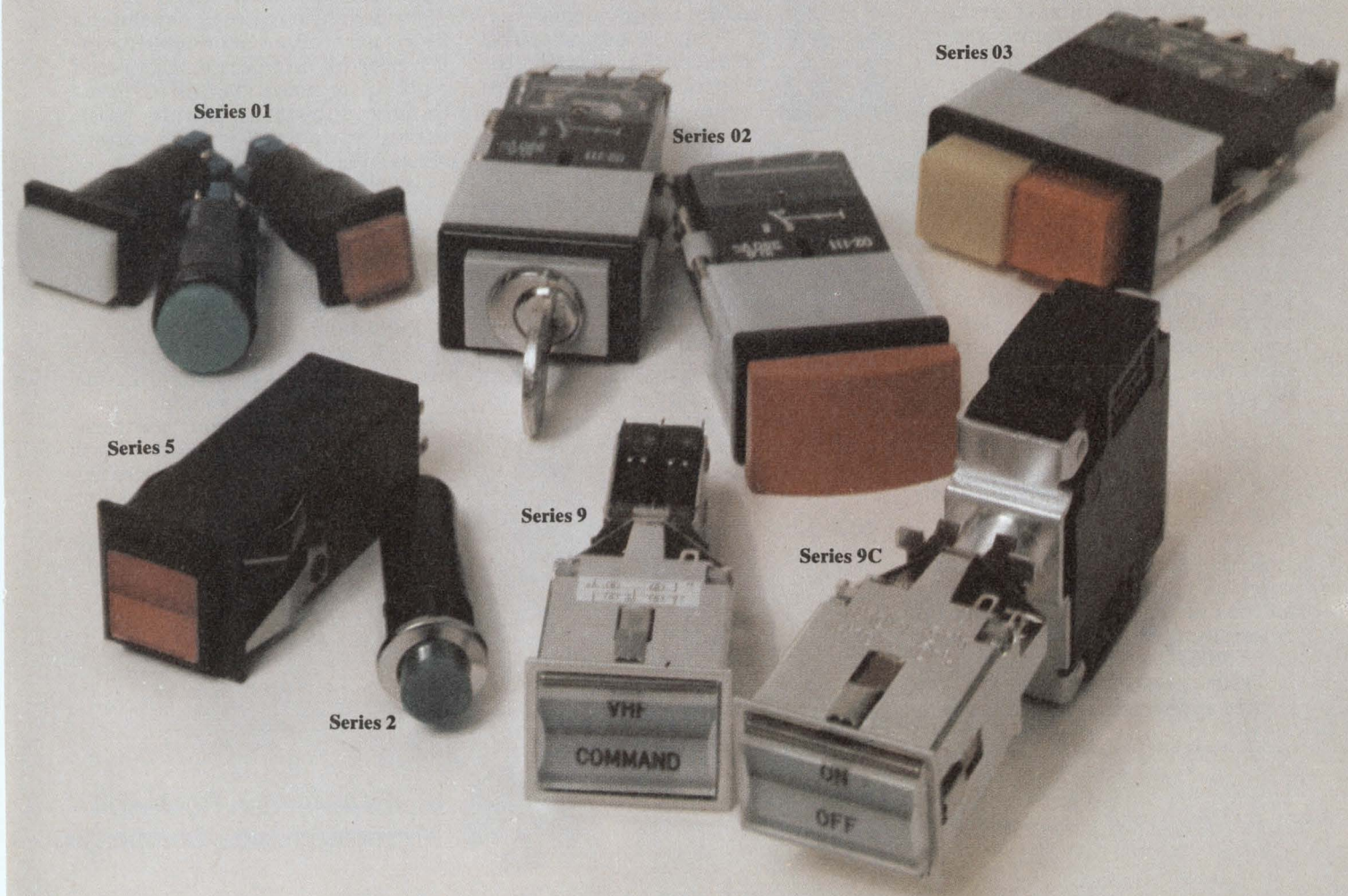
Name _____ Title _____

Company _____

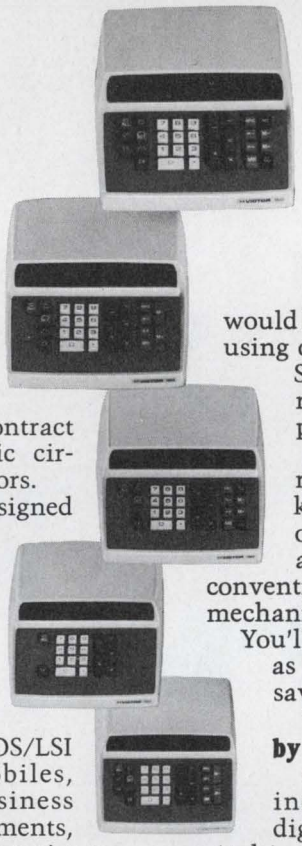
Address _____

City _____ State _____ Zip _____

We have more LPB's going for you than anyone else.



LET MOS/LSI EXPAND YOUR THINKING— AND YOUR MARKETS.



Looking back two short years, we recall the first commercial use of our MOS/LSI electronics —a multimillion dollar contract to supply microelectronic circuits for desk-top calculators.

Since then, we've designed hundreds of other MOS/LSI circuits. With production running in the millions each year.

Today, under contracts with some 20 major companies, we're working on nearly 30 product programs—applications of MOS/LSI technology for automobiles, trucks, appliances, business machines, musical instruments, computer peripherals, cash registers, calculators, data transmission and telecommunication equipment.

A couple of examples.

Right now we're working with Victor Comptometer Corporation on its development of a completely new line of business machines and calculators. And we supply the circuits for the musical computer of the new Allen electronic organ.

MOS/LSI reduces systems costs more than 50%.

Size and weight reductions alone would be sufficient incentive for using our MOS/LSI technology. So would greater product reliability. So would lower power requirements.

But, in business, cost reduction is usually the key consideration. The cost of our MOS/LSI systems is as much as 50% that of conventional electronic or electromechanical systems.

You'll get the other advantages as bonuses, along with the savings.

The state of the art— by its innovators.

Our MOS/LSI technology includes many kinds of digital systems and circuits: switching, arithmetic, counting, driving, multiplexing, digital-analog and analog-digital conversion, frequency generation and discrimination, digital filtering, modulation, demodulation, and memories of different types.

And right now we're developing future generations of microelectronics: new MOS processes, advanced packaging methods, multi-layer ceramic substrates, nitride passivation, silicon on sapphire, liquid crystal displays and more.

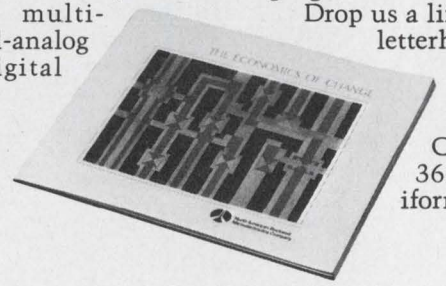
A joint product commitment.

As part of NR's Electronics Group, we're ready to share with you the long-term commitment required for new product design, testing and development.

Even more.

We'll join you in product planning, so that you may share in the progress of current research.

Drop us a line on your company letterhead for a copy of our new brochure, "The Economics of Change." Write: C.D. Chambers, P.O. Box 3669, Anaheim, California 92803.



North American Rockwell Microelectronics Company

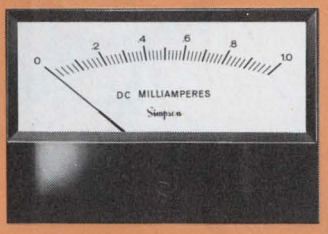
INFORMATION RETRIEVAL NUMBER 14

Simpson® has the world's largest selection of PANEL METERS and METER RELAYS

with famous Simpson STAY-ACCURATE QUALITY

OVER 1500 RANGES, SIZES AND TYPES *IN STOCK* AT ELECTRONIC DISTRIBUTORS NATIONWIDE

WIDE-VUE
1½", 2½", 3½", 4½", 8"

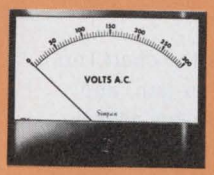


DESIGNER SERIES
3½", 4½"

NEW CENTURY SERIES
1½", 2½", 3½", 4½"

BOLD-VUE
2½", 3½"

RECTANGULAR
2½", 3½"
round style available



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STACKABLE EDGEWISE
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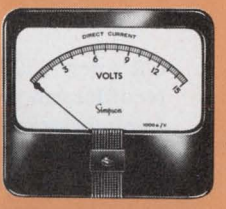

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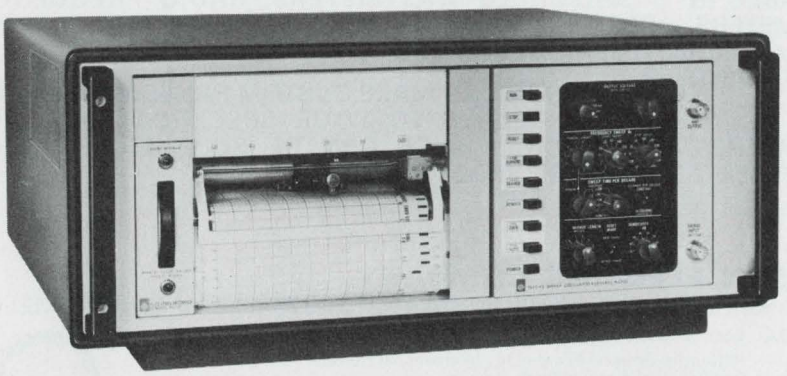

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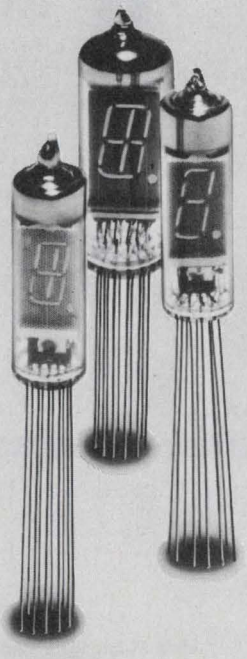

SPECIFICATIONS (pulse operation)

TYPE	Filament Current I_f	Filament Voltage e_f	Phosphor Segment Voltage e_p	Control Grid Voltage e_g	Phosphor Segment Current I_p
DG12M	85	*1 0.8 ± 10%	50	*2 50	4
DG12H	85	*1 0.8 ± 10%	50	*2 50	3
DG19E	95	*1 1.7 ± 10%	55	*2 55	4
Unit	mA	Va. c	Vd.c	Vp-p	mAp-p

TYPE	Control Grid Current I_g	Phosphor Segment Cut-off Voltage $e_{p(co)}$ (MAX.)	Control Grid Cut-off Voltage $e_{g(co)}$ (MIN.)	Brightness
DG12M	19	0	−4	150
DG12H	18	0	−4	150
DG19E	22	0	−4	150
Unit	mAp-p	V	V	Ft-L

*1 Effective Value at 50 or 60 Hz A.C
*2 Pulse condition—Duty Factor 1/16 pulse width 60 μsec.

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INFORMATION RETRIEVAL NUMBER 19

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1900 Series: 8-16 bit, very high speed current switching DAC's and 8-15 bit "glitchless" DAC's for display application. *1800 Series:* Low cost, computer grade 8-12 bit DAC's. *4100 Series:* General purpose, high-level MUX's and low-level, flying capacitor, 4-channel differential MUX's. *270 Series:* Very high speed, high performance S/H. *200 Series:* High level, single ended and buffer amplifiers.

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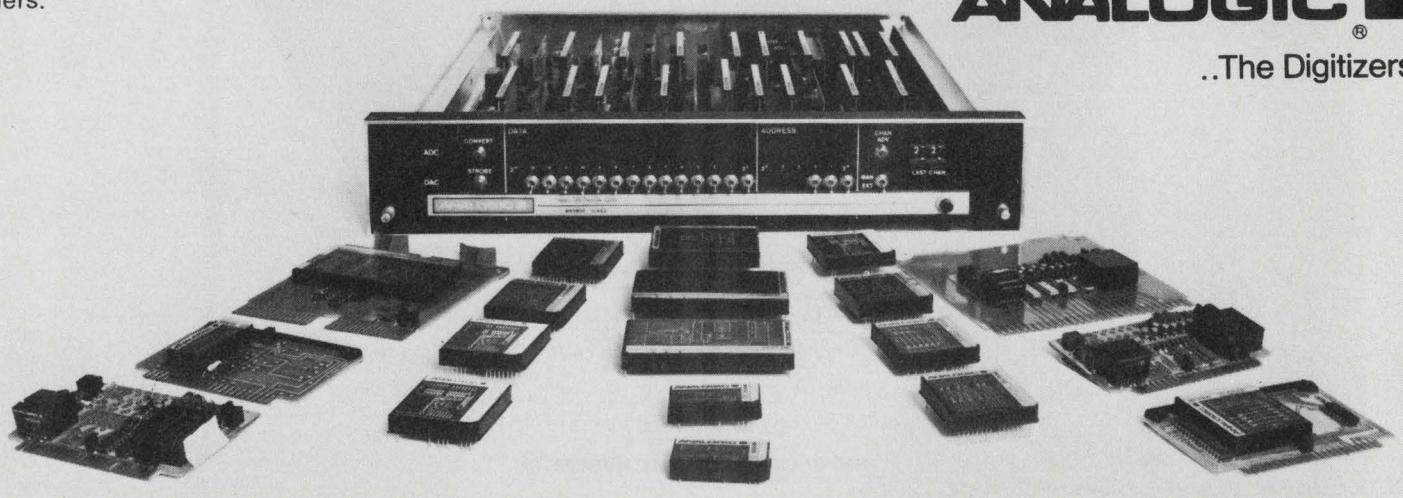


news scope

JANUARY 20, 1972

IEEE strengthening show to boost lagging attendance

The IEEE expects the decline in attendance at its annual International Convention and Exposition to continue this year, but it plans to do all it can to hold the drop to a minimum.

In a preview briefing for the trade press, J. Howard Schumacher Jr., convention manager for the IEEE, said that only about 30,000 engineers were expected this year at the Coliseum Show in New York City, compared with about 37,000 last year and nearly 48,000 in 1970. The show will run from March 20 through March 23.

In an effort to combat declining attendance, this year's show will have a new Science/Technology Center, and the technical program has been strengthened to attract both the high-level specialist and the engineer interested in general knowledge.

The Science/Technology Center will occupy the entire fourth floor of the Coliseum and will contain invited exhibits from leading companies, such as United Aircraft, General Telephone and Electronics, General Electric and, for the first time at an IEEE show, the Ford Motor Co. These exhibits will consist of research projects under development.

United Aircraft will show its Powercell, a fuel cell successfully used in the Apollo program, while GT&E will have an electronic painting exhibition and a magnetic-bubble demonstration. GE's plans are still indecisive.

Ford will show an engine-exhaust sensor, with feedback to the carburetor, for controlling air pollution by cars, and it will demonstrate a sodium sulphur battery that promises higher energy densitites than those available in present auto batteries.

The technical program for the IEEE show will revolve around the theme "New Horizons for Engineering." According to Jack L. Jatlow, chairman of the technical program committee, the aim is to stir interest in areas previously ignored, to a large extent, by engineers. These include the legal aspects of engineering, economics, transportation and the environment, to name a few.

Of the 79 technical sessions planned, 55 will be state-of-the-art reports, to be given in the New York Hilton. The remaining 24 will be "how to" sessions in the Science/Technology Center. The latter sessions will zero in on every-day problems faced by engineers and marketing managers in such areas as the application of minicomputers, MOS user problems, ICs for power and microwave applications, and marketing techniques. In addition there will be a session on "Financing Young Companies."

"An important new feature of each technical session," Jatlow said, "is that the number of papers has been limited to three or four, leaving sufficient time for a panel discussion in each session."

Along with the regular technical program, there will be a four-day seminar on "Engineering in the Hospital," to be held at the Americana Hotel. Organized by Henry S. Littleboy, technical director of medical engineering at Massachusetts General Hospital, the program will cover medical engineering, electronic patient-monitoring techniques and reliability requirements.

Bipolar device enters desk-calculator field

A bipolar integrated circuit is invading MOS country with what its manufacturer believes are a number of advantages over MOS.

Using the CDI process (collector diffusion isolation), the bipolar IC will go into a new desk calculator being built by Sumlock Anita, Ltd., in London.

The CDI process, first pioneered by Bell Laboratories in New Jersey, was later refined by Ferranti, Ltd., in Manchester, England, where the bipolar IC is being manufactured under a $1.25-million order. Ferranti says it's the first breakthrough of bipolar devices in the modern desk-calculator field. Until now, these new, sophisticated machines have been designed with MOS circuits.

The bipolar CDI IC, Ferranti says, has a greater switching speed than its MOS counterparts. Its plastic packaging is simpler and cheaper than the ceramic required by surface-sensitive MOS devices. And the bipolar device will provide the high density of MOS circuits without the corresponding high voltages that an MOS must have, Ferranti says.

The CDI circuit operates with a 1-to-5-V power source, which permits the use of a cheaper, low-voltage battery with a longer operating life.

The Anita calculator will operate with a single chip. And while the company declines to reveal the size of the chip because of proprietary interests, it is known that Ferranti has not made CDI chips smaller than 140 by 140 mils.

"This new bipolar LSI technology," Ferranti says, "could well provide the first high performance 'computer on a slice', or maybe on a single chip."

The cost of the bipolar chip is also secret at this time, but, a company spokesman says, "It compares favorably with the cost of MOS circuits."

9 new minis offered by General Automation

Nine new minicomputers have ben introduced by General Automation, Inc., in the race for position in the flourishing minicomputer market.

The new models of the Anaheim, Calif., company range from "moderate-power computers costing less than $2000 to the most powerful minicomputer available for general use." The big one costs nearly $9000.

Six of the computers are based on the design of General Automation's SPC-16 series, and they can handle conventional minicomputer needs. The three others, based on the SPC-12 model, cover control applications.

The SPC-16/40, 16/60 and 16/80 are equipped with a main memory that is expandable in 4-k increments from a minimum of 4096 16-bit words to 16 k. They have a built-in teleprinter control unit and what the company calls an integral I/O package that enables users to expand the peripheral and controller complement of each system up to data channels. Prices on a single unit are $5550 for the SPC-16/40, $6550 for the 16/60 and $8550 for the 16/80.

Models 16/45, 16-65 and 16/85 are designed for the low and high ends of the market, with prices of $3950, $4950 and $6950, respectively. For the low end, the processors can be bought in small economical modules, so buyers can specify only the capabilities needed for their applications.

The low cost for all three models is made possible, General Automation says, by an external I/O packaging scheme that allows buyers to get a 4-k processor with from one to eight I/O controllers, as required, rather than a minimum number of I/O channels, some of which may not be needed. General Automation believes that "bare bones" systems such as this represent a large portion of the low-end minicomputer market.

The new SPC-12 processors, designated 12/10, 12/20 and 12/30, are described as low-cost control computer with up to 16-k of memory and complete software, interfacing and minicontrollers. The systems are priced at $2980, $3480 and $3980, respectively, in single-unit quantities.

A rising market seen for electrical vehicles

Recent improvements in rechargeable batteries, small dc traction motors and battery chargers, together with increased social pressure for pollution-free equipment, are opening a market for electrical vehicles.

Mark J. Obert, product planning manager of the Automotive Battery Div. of Gould, Inc., Mendota Heights, Minn., sees all kinds of battery-powered vehicles replacing gasoline-driven counterparts. His list includes driver-operated lawn mowers and garden tractors, golf carts, small vans and buses, commercial sweepers and cleaners, and personnel carriers. He predicts that the number of these vehicles in use in the U.S. will increase from 58,000 in 1971 to 293,000 in 1975.

The market for battery chargers will go up, too, Obert says, from $3.2-million in 1971 to more than $13-million by 1975. The total OEM rechargeable battery market will increase from about $6.5-million in 1971 to over $24-million in 1975.

Gene Seider, senior electrical engineer in Gould's research and development group, says that the promise of new markets results from technical progress in the last three years, in which the energy density of lead-acid batteries has been increased from 11 to 11.5 watt hours per pound to 13.5 to 14.5 watt hours. This rise has been obtained from the use of newer, more active oxide compounds in the battery plates and high-strength polpropylene for the cases.

The use of new ceramic permanent magnet materials in motors, instead of wound rotors, has resulted in a 20 to 25 % reduction in weight, Seider points out. This amounts to a decrease of from 24 to 33 pounds for motors in the 10-to-15-hp range.

New metal-vapor laser may compete with he-ne

Metal-vapor lasers—such as the helium-cadmium type—measure several feet in length and are priced well above a thousand dollars. Hence they have been used primarily as laboratory tools for biological and photochemical studies and analyses.

But a Bell Laboratories scientist in Murray Hill, N.J.—W. T. Silfvast—may alter this trend.

He has devised a new helium-cadmium laser—a source of blue and ultraviolet light—that is about 15 inches long, one-fourth the size of conventional metal vapor laser. It has a 2.5-mW output in the ultraviolet range (3250 Å) and emits 12 mW of blue light at 4416 Å. This size and consequent price reduction of about one-fourth, he says, could make it competitive as a source of coherent light with helium-neon, one of the most widely used lasers in science and industry today.

Viewed through beams of metal vapor laser light, Bell Laboratories scientist W. T. Silfvast deflects a coherent blue beam from a new helium-cadmium laser.

The cost of a newly designed he-cd laser should be equivalent to a helium-neon laser of comparable output power, according to Silfvast —$150 to $250.

MOS gyrator replaces conventional inductors

An MOS gyrator has been developed at Marshall Space Flight Center in Huntsville, Ala., by Dr. Erwin Hochmair, a research associate from Vienna.

The gyrator, designed to act as an inductor in an integrated circuit, is capable of providing high inductance in small areas, something not possible with large physical inductors.

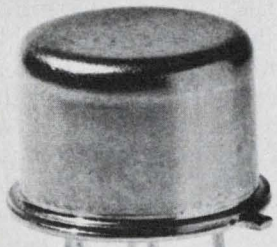
While IC gyrators have been produced before, they have always been of the bipolar variety. Thus, they were more difficult to fabricate and consumed more power than the MOS type.

The new gyrator can be made by using either P/MOS or C/MOS technology. The P/MOS version has already been produced and tested and is capable of providing up to 0.2 H of inductance on a 40-by-30 mil chip.

The C/MOS version of the new gyrator, presently in production, uses a larger 80-by-90 mil chip and will be capable of providing hundreds of henrys of inductance, Hochmair says. While the noise is still a bit of a problem this can be overcome Hochmair feels.

ISOLATION!

3 NEW COUPLERS FROM GENERAL ELECTRIC



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INFORMATION RETRIEVAL NUMBER 21

news

High negative bias sputtering: A revolution for thick films?

A new way to produce a thick film deposit that is dense, uniform and controllable within 5%, could revolutionize the manufacture of thick-film hybrids, according to several leading hybrid manufacturers.

The method, which builds a deposit by applying a high negative bias to a substrate while sputtering, was developed at Sandia Laboratories in Albuquerque, N.M.

The operation would, of course, have to be economically competitive with existing techniques, agree Nick Spann, senior engineer at Motorola's Semiconductor Div. in Phoenix, Ariz. and Henry Fenster, manager of the Hybrid Circuit Subsystems Group in RCA's Solid State Div., Somerville, N.J. "Thick-film resistors produced by the conventional screen-printing process now cost about a tenth of a cent each," Spann says.

John F. Mason
Associate Editor

The cost of mass-producing resistors by Sandia's procedure has not been determined, but its efficiency has, according to Donald M. Mattox, supervisor of Sandia's Surface Physics and Chemistry Div.

Growing deposits by high negative bias would not require trimming, Mattox says, unless very precise resistance values were required. Just how precise has not been determined.

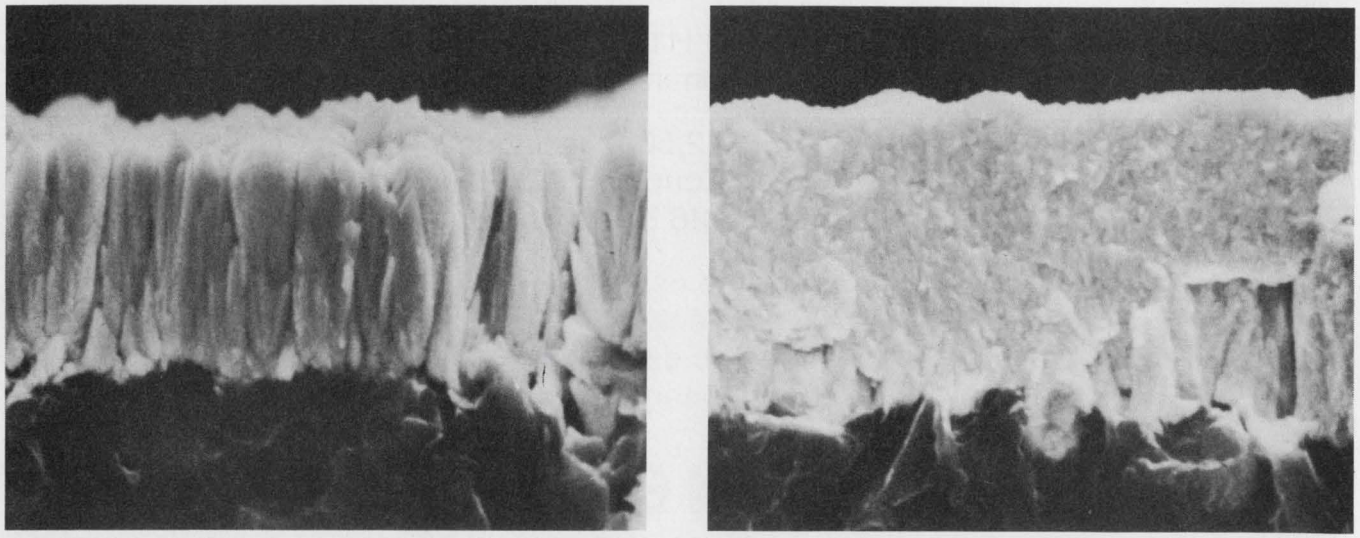
Long used with thin film because of its ability to produce extremely precise thicknesses, sputtering has generally not been successful with thick films because it creates columns rather than the smooth, dense material needed for good structural strength and low electrical resistivity.

But by applying a high negative bias (−500 V) to a substrate while sputtering, scientists at Sandia obtained a dense, fine-grained film 6 μ thick. The potential thickness with a high negative bias, Mattox says, "is a matter of mils."

Usually thicknesses of greater than 1 μ are only sputtered successfully when metals and alloys with low melting points are used. With these, the substrate can be heated during the sputtering operation, causing recrystallization, which in turn produces a smoother, denser deposit.

A new kind of sputtering

Bias sputtering is not new, Mattox explains. "Lower biases—from 50 to 100 V—have been used for a number of purposes by RCA, IBM and other companies. These lower biases increase coverage over steps and surface discontinuities, but they do not modify the physical properties of thick metal films as the higher biases do. To our knowledge, this is the first attempt to



Sputtering thick films normally results in columnar material lacking in density and adequate electrical resistivity (left). By applying a high negative bias (−500 V) to a substrate while sputtering, Sandia Laboratories produced this dense, smooth, fine-grained film 6 μ thick (right). The potential thickness is several mils.

use the higher biases to change the growth of the film and to make it more fine-grained with thicker deposits."

Though Sandia's objective is to build thick-film deposits for their mechanical properties, scientists at the laboratories have also been interested in thick films of refractory metals to cut down their reactions at high temperature.

"If you try to get normal electrode materials, such as platinum, to operate at 400 C or 500 C, it just fuses with the adjacent material and you've lost electrical contact," Mattox says. "Avoiding this is one of our applications."

Sputtering at Sandia is done in a vacuum chamber at a pressure of from 10 to 100 μ of argon.

The holder (incorporating the heated or cooled substrate) is separated from the cathode (containing the metal to be deposited) by a gap measuring from 2 to 10 cm across.

This basic configuration is modified by supplying the substrate with a biasing negative potential of up to 500 V. Application of the bias to the substrate causes argon ions to bombard the growing deposit. The ions dislodge metallic atoms from the deposit surface, causing them to relocate and fill in the "valley" vacancies between the growing columns of materials.

In Sandia experiments, this system produced a highly reflective 6-μ thick film of tantalum on a carbon substrate heated to 300 C. The density was 16.2 g/cm^3, compared with 16.6 g/cm^3 for bulk tantalum and 14 g/cm^3 for Ta sputtered at zero target bias. The deposition rate is about as high as that experienced with unbiased sputtering—about 2 mg/cm^2/hr.

This technique—consisting essentially of ion bombardment during deposition—may be extended to nonmetals and to other deposition techniques, such as chemically vapor-deposited films and electron-beam evaporation, Sandia says. ■■

Laser fax sends newspaper page in 1 min.

A facsimile system that uses a laser beam as a light source can transmit a page of a newspaper in 60 seconds, reportedly with 25 times higher contrast than that of other facsimile systems.

Called Laser Press Fax, the new unit is being offered by Matsushita Graphics Communication Systems, Inc., and Matsushita Research Institute Tokyo, Inc.

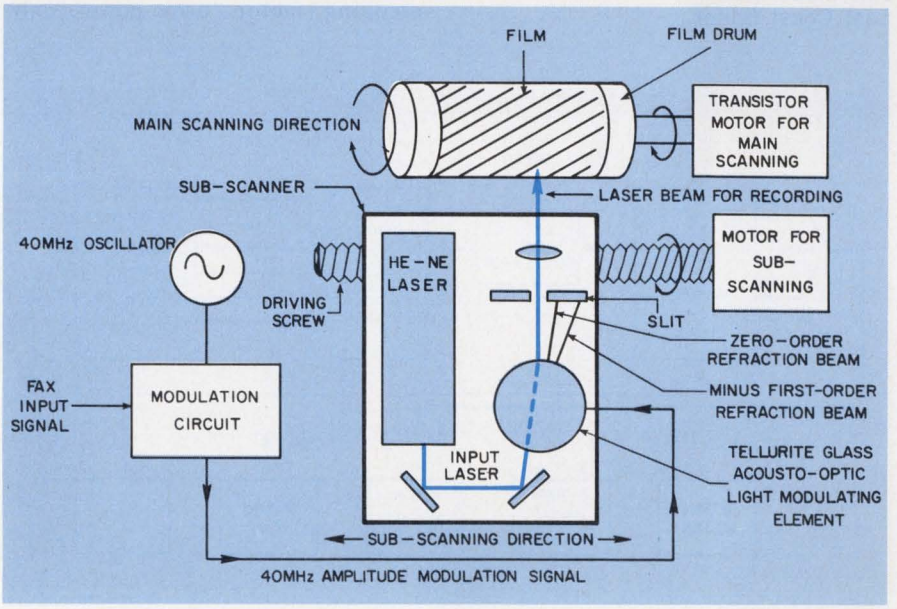
The newspaper page (40-cm wide) is scanned optically and divided into 5,200 to 9,600 lines. Each line is further divided into small dots and transformed into electrical signals. These signals are then transmitted via telephone cable and received at the other end of the line. The receiver changes the signals back into light signals, records these on film, and then makes a copy or master proof.

To increase speed in facsimile transmission, the drum revolution speed must be increased. With currently available facsimile systems, the drum transmits one scanned-line per revolution. To make it faster, a correspondingly higher frequency light source is required at the receiving end (100 to 300 kHz). Further, these high frequencies require large currents, which shorten the life of the discharge tube to about 50 hours. Therefore major facsimile systems used in the U.S. and abroad are limited to about 3600 drum revolutions per minute.

Matsushita's equipment uses a He-Ne gas laser beam light source. It is said to last more than 4000 hours, even at 4500 rpm drum speed.

A key element in the new facsimile system is a special acousto-optic light modulator. It consists of a glass block of tellurite coated with lithium niobate. As shown in the diagram, when a high-frequency signal (40 MHz) is applied, the block's index of refraction varies over a wide range. Therefore the laser beam is intensity-modulated in proportion to the strength of the applied signal.

The tellurite glass is said to have four times greater refraction efficiency—or to pass four times as much light—as the dense flint glass used in conventional facsimile systems. To obtain this brightness, the modulator requires only one-fourth the current that other systems use. ■■



Laser facsimile system contains an acoustic-optic light-beam modulator whose index of refraction varies widely upon application of a modulated high-frequency signal.

Power needs cut dramatically for ocean-floor monitor system

When equipment must go on monitoring duty for a month 18,000 feet below an ocean's surface, low power consumption is not only desirable—it's imperative. Spurred by this requirement, scientists at the University of California of San Diego have designed a seismic monitoring system that cuts the power drain of equipment by orders of magnitude.

The system also has a new seismometer that has higher sensitivity and lower noise than previously attained, according to Dr. William Prothero, research scientist in charge of the project.

The over-all design, developed at the university's Institute of Geophysics and Planetary Physics, has achieved the following dramatic power reductions:

- The standby current needed for the tape recorder is 20 μA, compared with 2 to 3 A for conventional models.
- The operating power for the a/d converter is 15 mW, compared with 2.5 W for the average unit.
- The operating power for the data-acquisition and logging system is less than one percent of that used by comparable bipolar systems.

The conservation of power during both standby and operation was made possible by blending standard and unique designs.

- Complementary MOS (CMOS) was used throughout the sensing, monitoring, control and recording electronics, except for the power amplifiers driving the tape recorder reels.
- A special analog-to-digital converter that uses RCA's COS/MOS was designed to operate from a single 12-V supply. It provides its own −12-V supply and draws power only during the actual conversion cycle.
- The recorder, which has an incremental tape drive, has COS/MOS electronics driving the recording head. Its capstan drive, a stepping motor, uses power only when stepping, and the recording-head current is drawn only when recording. The tape-reel take-up servos are on-off types that use power only when operating.

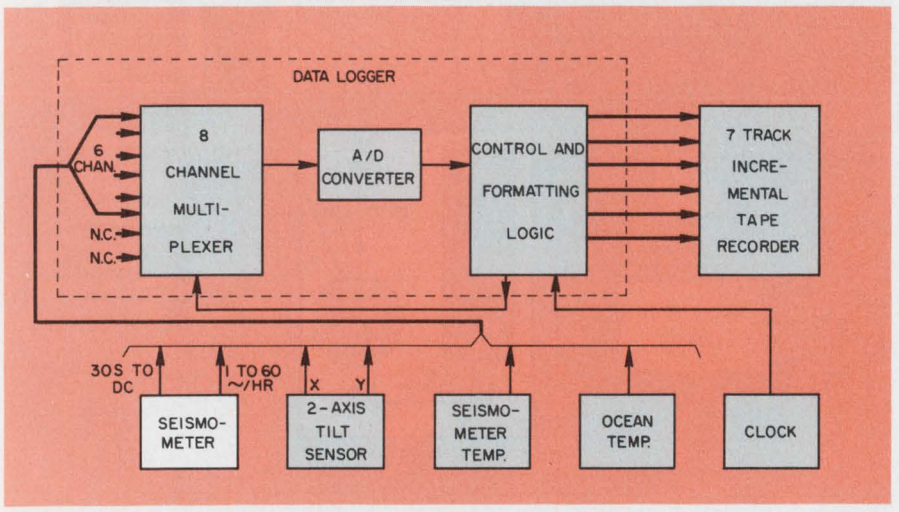
Jim McDermott
East Coast Editor

Sonar provides communication

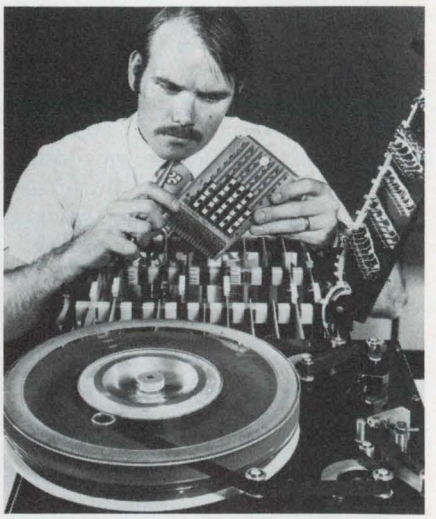
The entire system will measure seismic activity on the floors of oceans, initially in the Pacific. To permit scientists on the surface to turn the system on and off; to monitor the operating condition of the various units of the system, and to recall the system from the bottom after a month's recording has been made, sonar communication—a modified Edo 412 Acoustic Telemetry and Command System—is included in the package.

To perform the various remote-control functions, an 8-kHz, frequency-modulated signal is sent down from the surface. The diagnostic system replies with sonar frequency-shifted signals keyed between 13.5 and 15.5 kHz. The surface readout is in digital form.

The complete sub-sea system is



The data acquisition and logging system of the deep-sea seismic monitor feeds a 7-track incremental tape recorder. The recording system can run continuously for over 30 days on the ocean bottom.



A low-power digital circuit card of the data logging system is checked by James Nick of Honeywell.

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_C (max)	V_{CE} (sus) (min)	V_{CE} (sat) (max)	E_{SB} (min)	t_{ON} (max)	t_{OFF} (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 X , 580 Pleasant Street, Watertown, Mass. 02172.

UNITRODE

packaged in three connected 22-inch aluminum pressure spheres They are set on a frame that also holds ten 12-V lead-acid batteries beneath the capsules to provide system power.

The system is lowered by line, and once on the bottom, the line is cut. The system is equipped to monitor seismic activity, ocean temperature, seismometer temperature and tilt of the package. Data from the sensing instruments is stored on an incremental recorder that has 2400 feet of tape—enough for 33.4 days of continuous use.

During recovery, the spheres disengage from the battery pack on command from the surface and float to the top.

3 elements for monitoring

The seismic-monitoring subsystem is comprised of three principal elements: sensing units, the data-converting and logging system and the tape recorder.

The principal sensor is the seismometer, which has a specially designed vertical accelerometer. The mass of the accelerometer is suspended by a quartz fiber, and all operating elements are enclosed in a vacuum.

The seismometer has a bandwidth of from about 1 cycle for every 20 seconds down to dc. Two seismometer outputs are provided for monitoring, one in the band between 1 cycle per every 30 seconds down to dc and another in the band from 1 to 60 cycles per hour.

At a response of 1 cycle per 20 seconds, the noise level (S/N) is roughly equivalent to 10 to 20 millicrons of ground motion, says Dr. Prothero. This, he points out, is about equivalent to 1 to 2 x 10^{-9} Gs.

To monitor any shift or movement of the stand on the ocean floor—due to large fish bumping the frame or to sediment shift underneath it—a tilt-sensing pendulum is included. A capacitive pickup minimizes power drain and provides high sensitivity and linearity.

Full-scale tilt is 1°, but it can detect as little as 2 x 10^{-4} degrees of shift of the X or Y axes, which are orthogonal to the vertical.

Thermistors are included for monitoring two temperatures—that inside the seismometer and that of the ocean water.

The data-logging system, developed by Honeywell's Marine System's Center in Seattle, is comprised of a multiplexer, which can sample up to eight inputs (only six are used); an a/d converter, which converts the multiplexer outputs to digital form; and control and formatting logic, which converts the digital information to words of two six-bit characters. These characters are fed, together with an added parity bit, to the seven tracks of the incremental recorder.

The total data-sampling cycle takes 64 seconds, with up to eight inputs sampled, one each second for the first eight seconds. For the next 56 seconds, the two inputs from the seismometer are sampled alternately each second.

The a/d converter was designed by Dr. Robert Moore, a University of California staff scientist, in collaboration with James Pastoriza, president of Memodyne Corp., Upper Newton Falls, Mass. Whereas two voltage supplies (+ and −) are usually needed, this converter operates from +12 V dc. However, it generates the −12 Vdc by a special capacitor and clamping-diode circuit. The capacitor provides the −12 V during the 100-μs pulse of the conversion period. During the standby portion of the operating cycle, no current is drawn. ■■

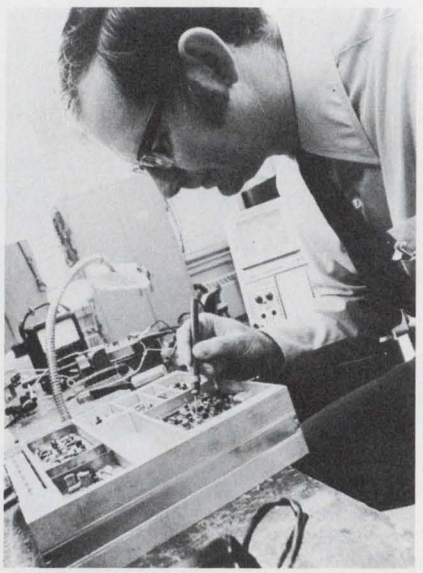
Mobile radio capacity upped 100-fold

A new high-capacity land mobile telephone system being developed by Bell Telephone Laboratories in Whippany, N.J., will be capable of accommodating a half-million mobile units in the same city.

With its present system, Bell is forced to limit its subscribers to several hundred per city to avoid interference.

In the new system a city is divided into a number of small service areas or cells, some as small as two miles in diameter. Each cell is serviced by three low-power transmitter/receiver stations with directional antennas for locating the mobile unit. The mobile units communicate by radio with the stations in their particular cell. These in turn relay the transmissions on by normal telephone lines.

When a mobile unit moves into an adjacent cell a centralized control center activates the directional antenna to locate the unit and then assigns it a voice channel in a new frequency—a change the user is unaware of. In this way the same frequency, or channel, can be used in a number of cells throughout the city, provided they are not close enough to permit interference.



Prototype of mobile telephone unit at Bell Laboratories will be used in a new high-capacity, low-power mobile communication system.

Operating on seven channels between 806 and 881 MHz, the propagation is not line-of-sight but takes place by multi-path reflections. Some problems with terrain obstruction can occur but these shadows are minimized by the multiple antennas in each cell. Also the distances are short, Bell says. Development work will continue for the next five years leading to a mobile service offering. ■■

15 reasons why Monsanto counts with people who count.

Here are 15 Monsanto counters. Their capabilities are as varied as the requirements of you who read this ad. Frequencies range from DC to 12.5 GHz, prices from $250 to $3590.

1.
5 Hz-5 MHz $250

2.
5 Hz-32 MHz $475

3.
5 Hz-20 MHz $350

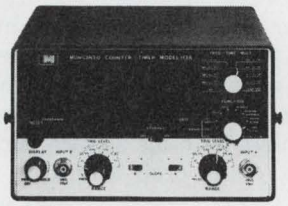
4.
5 Hz-40 MHz $575

5.
5 Hz-50 MHz $695

6.
5 Hz-5 MHz $795

7.
10 Hz-8 MHz $815

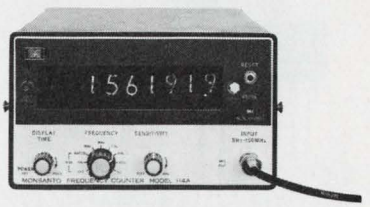
8.
DC-75 MHz $895



9.
DC-2.5 MHz $995

10.
0.1 Hz-20 MHz $995

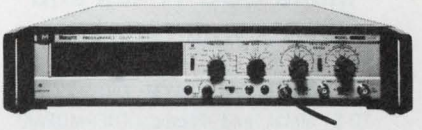
11.
5 Hz-150 MHz $995



12.
5 Hz-512 MHz $1550

13.
DC-150 MHz $1285

14.
DC-512 MHz $1795



15.
DC-12.5 Ghz $3590

According to an independent, nationwide brand preference survey, we're No. 2 (of 67 counter manufacturers mentioned). Not bad. But not good enough. In the year ahead, we plan to give you even more reasons to specify Monsanto for anything you want to count. Meanwhile, one of the 15 shown here will probably do the job. Write for our catalog and see. Monsanto Company, Monsanto Electronic Instruments, West Caldwell, N. J. 07006.

Monsanto

INFORMATION RETRIEVAL NUMBER 23

technology abroad

An intermediate microwave technique has supplanted precision landing radar in a system recently accepted for NATO's portable instrument approach and landing system. The new system, called the Microwave Aircraft Digital Guidance System, was developed by England's MEL Equipment Co., in collaboration with the Royal Aircraft Establishment and the Mullard Research Laboratories. Transmissions from a beacon in the aircraft are received by a pair of spaced, interferometric antenna arrays in the landing area. The interferometer's receiving system produces outputs from which the aircraft's azimuth angular location and its slant range are obtained. These parameters are derived by comparing the phase difference of the individual antenna elements with a reference phase. Azimuth and elevation data are then transmitted to the aircraft interrogation unit over a data link, for integration and cockpit display. The use of microwave frequencies reduces system noise and also antenna size, for portability. The equipment may eventually be developed as an advanced all-weather instrument landing system for both military and civil aircraft.

CIRCLE NO. 441

A high efficiency diffraction grating for extracting colors from white light has been produced with nematic liquid crystals by West Germany's Siemens. The grating consists of two glass plates each coated with transparent tin oxide electrodes. The liquid crystal is contained between the plates that are held from 3 to 10 μm apart with Mylar spacers. As voltage across the plates is increased, the internal structure of the material changes. When this device is sandwiched between crossed-polarizers and white light is shone through it, the crystal produces changes in the color of the transmitted light. The color varies with a change in voltage. Possible applications are in color displays and controllable optical filters.

CIRCLE NO. 442

A low-noise cathode-ray tube with a high brightness-to-voltage ratio has been adapted by England's EMI Electronics for generating signals from color film for television transmission. The cathode-ray tube, the MX69, gains its improved characteristics from a new phosphor coating. The grain size of the coating is 2 to 5 μm, which is much finer than standard phosphor screens. In addition the coating material has been specially processed to minimize grain clustering, which produces noise. EMI says the tube has nearly twice the brightness of conventional tubes used under the same operating conditions. As a result, it can be operated at lower voltages with an accompanying reduction of X-ray radiation. The tube diameter is 125 mm, and has been adapted by EMI for flying-spot scanning of 16 and 35-mm negative color film.

CIRCLE NO. 443

An improved ion-implantation technique for forming high-value linear resistors on silicon substrates has been developed by England's Mullard Research Laboratories. The work, sponsored by the British Defense Ministry, involves the acceleration of neon ions into the region of the silicon resistors on single-chip integrated circuits. Radiation damage from this bombardment reduces carrier mobility and raises resistance. Resistor linearity can be tightly controlled. Mobility reductions of 5 to 1 have been achieved with this technique, and this value remains constant even after annealing at 500 C. Mullard is investigating the application of the technique to both MOS and bipolar circuits.

CIRCLE NO. 444

Try our straightforward method of reducing fixed resistor costs.

Uniform manufacturing process results in consistent quality that lowers your installed cost. And cuts down unnecessary after-purchase expenses. As a result, some of our customers have been able to discontinue incoming inspection. The unique Allen-Bradley hot-molding process minimizes the variations that make ordinary resistors noisy, thermally sensitive, and poor on power handling ability. If you think all resistors are the same, read: "7 ways to tell the difference in fixed resistors." Free from your A-B distributor, or write to: Allen-Bradley Electronics Division, 1201 South Second Street, Milwaukee, Wisconsin 53204. Export: Bloomfield, New Jersey 07003. Canada: Galt, Ontario. United Kingdom: Bletchley, Bucks.

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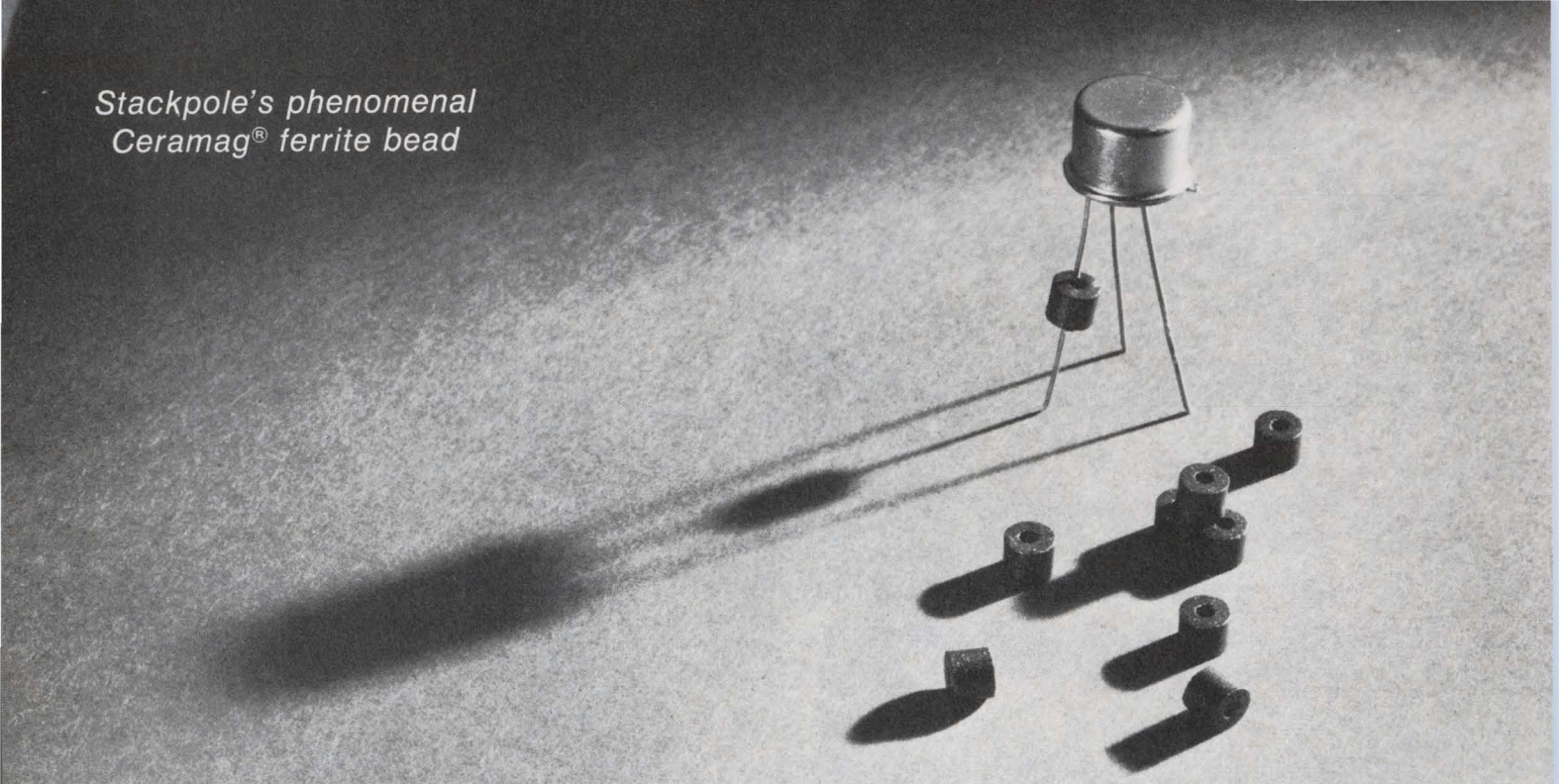
QUALITY ELECTRONIC COMPONENTS

A-B QUALITY

INFORMATION RETRIEVAL NUMBER 25

Stackpole's phenomenal Ceramag® ferrite bead

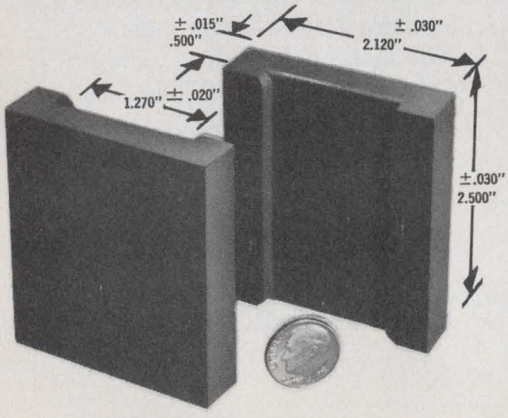


The Silencers

Ceramag® Beads Do Away with Noise

Stackpole ferrite beads offer a simple, yet effective means of suppressing spurious RF signals to prevent them from entering areas susceptible to such "noise." No other filtering method is as inexpensive as a ferrite bead.

How can you use a bead? Consider it as a frequency-sensitive impedance (Z) element. Beads are available in a variety of Stackpole Ceramag® materials. Depending upon the material selected, beads can provide increasing impedances. From 1 MHz to over 200 MHz. Keep in mind, the higher the permeability, the lower the frequency at which the bead becomes effective.



Should a ferrite bead be small? Not necessarily. The unique, giant bead shown below is used by IBM to eliminate the effect of transient noise.

The impedance of Stackpole ferrite beads can be changed by simply varying the length or the O.D.-I.D. ratio.

Installation of Stackpole beads is easy. And inexpensive. Simply slip one (or several) over the appropriate conductor(s) for the desired noise suppression or high frequency isolation.

Additional savings in production time and labor costs are possible by utilizing automatic insertion equipment to install ferrite beads *with leads* in printed circuit boards.

CERAMAG® FERRITE BEAD CHARACTERISTICS

	24	7D	5N	11
Initial Permeability	2500	850	500	125
Volume Resistivity @ 25°C	$1.0x10^2$	$1.4x10^5$	$1.0x10^3$	$2.0x10^7$
Effective Suppression At:	1 MHz.	20 MHz.	50 MHz.	100 MHz.
Curie Temperature	205	140	200	385

Beads are available in sleeve form in a range of sizes starting at .020 I.D., .038 O.D., and .050 long. For special compact filtering applications, beads can be supplied to tight mechanical tolerances.

Sample quantities of beads and beads with leads are available upon request. Send your requirements to: Stackpole Carbon Company, Electronic Components Division, St. Marys, Pa. 15857. Phone: 814-781-8521. TWX: 510-693-4511.

STACKPOLE
ELECTRONIC COMPONENTS DIVISION

INFORMATION RETRIEVAL NUMBER 26

washington report

Don Byrne
Washington Bureau

Defense spending expected to climb $5-billion

The Department of Defense is expected to seek a fiscal 1973 budget which will approach the $81.5-billion spending level, an increase of almost $5-billion over last year's spending request of $76.5-billion. New obligational authority is projected at more than $83-billion. These are the budget figures that Defense Secretary Melvin Laird is expected to present to Congress the last week of this month. Chief items in line for funding are new ships for the Navy—nearly $17-billion—including surface effect ships, high-speed vessels and a fourth nuclear carrier, the CVAN-70, which would cost $299-million. While it is not scheduled to receive production money in the coming year, the Navy's sea-control ship, a 1970's version of the "Jeep" carrier used in World War II to protect convoys, looms large on the horizon. The project is due for $12-million in fiscal 1973 to help carry out tests aboard the amphibious assault ship Guam. The tests are expected to prove the concept over the next year and a half. They will also help to develop procedures for operation with the Light Airborne Multipurpose System (Lamps) helicopters and patrol frigates, a new class of ship. The biggest push in the strategic missile field is for the Undersea Long-range Missile System (Ulms), an advanced version of the Poseidon, which in turn is an improved version of the Polaris. Laird is also supposed to recommend large funds for stepping up the tempo of conversion of the Polaris submarines to accommodate the Poseidon. A massive infusion of funds is expected for the Air Force B-1 bomber—reportedly more than $400-million. On the minus side, the Army will not get the Cheyenne helicopter, the Air Force is not likely to get full authorization for the long-suffering Airborne Early Warning and Control System (Awacs), and the Navy is expected to abandon plans for some of the support and forward combat ships it wanted. Other programs that are in trouble include the Mark-48 torpedo, which DOD feels is costing too much, the C-5A transport plane, the Navy's F-14 fighter and "some shipbuilding programs." Laird is expected to say that his requests for more money are due to the lack of progress in the disarmament talks. Also pay raises will eat up $3-billion of the $5-billion increase he requests.

NASA budget to remain about the same

The fiscal 1973 NASA budget is expected to be around $3.2-billion, just a hair under the current year's financing of $3.34-billion. While the $3.2-billion figure represents something of a victory for NASA since the Bureau of Management and Budget wanted to cut the space agency to $2.8-billion, it really means that the status quo will prevail for the coming year. In addition, it means a serious blow to the reusable space shuttle

program which would have needed about $400-million in the coming fiscal year to keep pace with planned developments. NASA sources indicated that the last two shots in the Apollo series are safe. There will undoubtedly be some personnel cutbacks since NASA employees, like all government workers, will receive a 5.5% pay increase starting this month. Personnel will have to be reduced to make up this extra spending.

Comsat proposes aeronautical satellite system

The Communications Satellite Corporation has proposed a plan to the Federal Aviation Administration to launch and operate for FAA a pre-operational (test) aeronautical satellite system. FAA has been proposing putting up its own system but has run afoul of opposition. In a letter to FAA, Comsat president Joseph V. Charyk pointed out advantages of a nongovernmental system. It would not be the offshoot of "competition among hardware manufacturers," he said, which means having to buy from the lowest bidder. As the United States representative, Comsat said, it would be the facility to negotiate with foreign participants in the system and assume the risks. The service would be offered at a fixed price. The international aspect would, incidentally, obviate the need to "buy-American" regardless of quality or price.

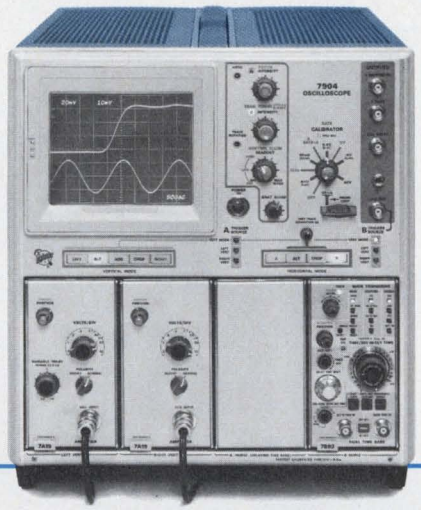
FCC asks AT&T to explain connector tariff

A letter from the Federal Communications Commission's Common Carrier Bureau to AT&T has outlined what it felt to be doubtful practices in the telephone company's sale of connecting devices for customer-owned equipment when used with AT&T's telephone system. The FCC noted that when equipment bought from AT&T's competitors was used AT&T required the user to buy a connecting device, but when AT&T equipment was used a connecting device wasn't required. The FCC asked AT&T, Western Union, General Telephone & Electronics and others for proof of damage caused by user-owned equipment connected to common carrier systems.

Capital Capsules:

The Army says the ABM is working: Twenty-one tests so far have resulted in 17 successes, two partial successes and two failures . . . **Skin flicks being shown on cable TV in the New York area** are causing some concern in the FCC here . . . In a press conference here, **Collins Radio** president Robert C. Wilson said the company **may have to put off long-range plans and concentrate on present customers to reduce losses . . . Tax experts expect President Nixon to ask Congress to approve a "value-added tax" as an alternative to local property taxes.** The value-added tax would be imposed on manufacturers, wholesalers and retailers and presumably would be passed along to customers via higher prices. It is used in several countries in Europe now . . . **Washington attorney John W. Pettit is expected to be named General Counsel of the FCC,** a position vacated earlier this month by Richard E. Wiley who moved up to the position of Commissioner. Both Wiley and Pettit worked on President Nixon's 1968 campaign . . . **The Air Force will seek funds in fiscal year 1973 for a new all-weather, light-weight precision bombing system** called Scana (Self-Contained Adverse Night Attack). The requirement comes from cancellation—for undisclosed reasons—of development of the Pave Lance bombing system.

THE GROWING TEKTRONIX® 7000-Series Oscilloscope Systems



7904 Oscilloscope

From 500 MHz at 10 mV

or: 1 GHz @ <4 V/cm direct access plug-in

For those who have requirements in between 500 MHz and 50 MHz there's the 150-MHz 7704 (R7704 rackmount), 90-MHz 7504 (7514 storage), all with 4 plug-in compartments; 90-MHz 7503 with 3 plug-in compartments.

Exclusive to the 7000 Series is:

CRT READOUT—

Deflection factors and sweep speeds, the DMM and counter outputs, invert and uncalibrated symbols, etc., are automatically displayed on the CRT—where you look for information. CRT Readout can be ordered initially or as a conversion kit that is easily installed. In each case the cost is only $400. And it is available in all scopes except the 7403N.

MULTIPLE-PLUG-IN MAINFRAMES

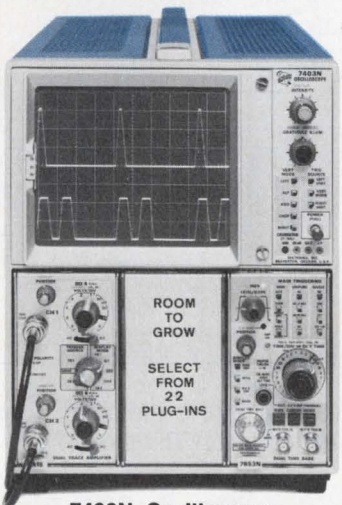
Three or four-plug-in mainframes allow up to twenty combinations of vertical and horizontal operating modes. You can now use plug-ins with widely different features . . . simultaneously. If you wish, start with only one horizontal and one vertical plug-in and add more as your measurement requirements change.

PLUG-IN VERSATILITY

Plug-ins are available to make virtually any measurement desired. Examples are: ● single trace ● dual trace ● combinations for multiple trace ● 10 μV/div differential ● 1 mA/div current amplifier ● differential comparator ● Sampling to 14 GHz ● 45-ps risetime TDR ● 1.8 GHz spectrum analyzer ● curve tracer ● single time bases ● dual time bases with calibrated mixed sweep ● 500-ps dual time base with triggering to 600 MHz ● 525-MHz direct counter ● digital multimeter.

RUGGEDIZED MILITARY VERSION

The AN/USM-281C consisting of mainframe, vertical plug-ins, dual time base and accessory cover is the militarized version of the 7403N Oscilloscope System.



7403N Oscilloscope
(R7403N 5 1/4-inch rackmount)

to 50 MHz at 5 mV

dual-trace, 6½-inch CRT and delaying sweep for only $2200

7000-Series Scopes, complete with plug-ins, start as low as $1670. Call your nearby TEKTRONIX Field Engineer today for a demonstration of the scopes that make *more* measurements *easier* and *quicker* or write: Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97005.

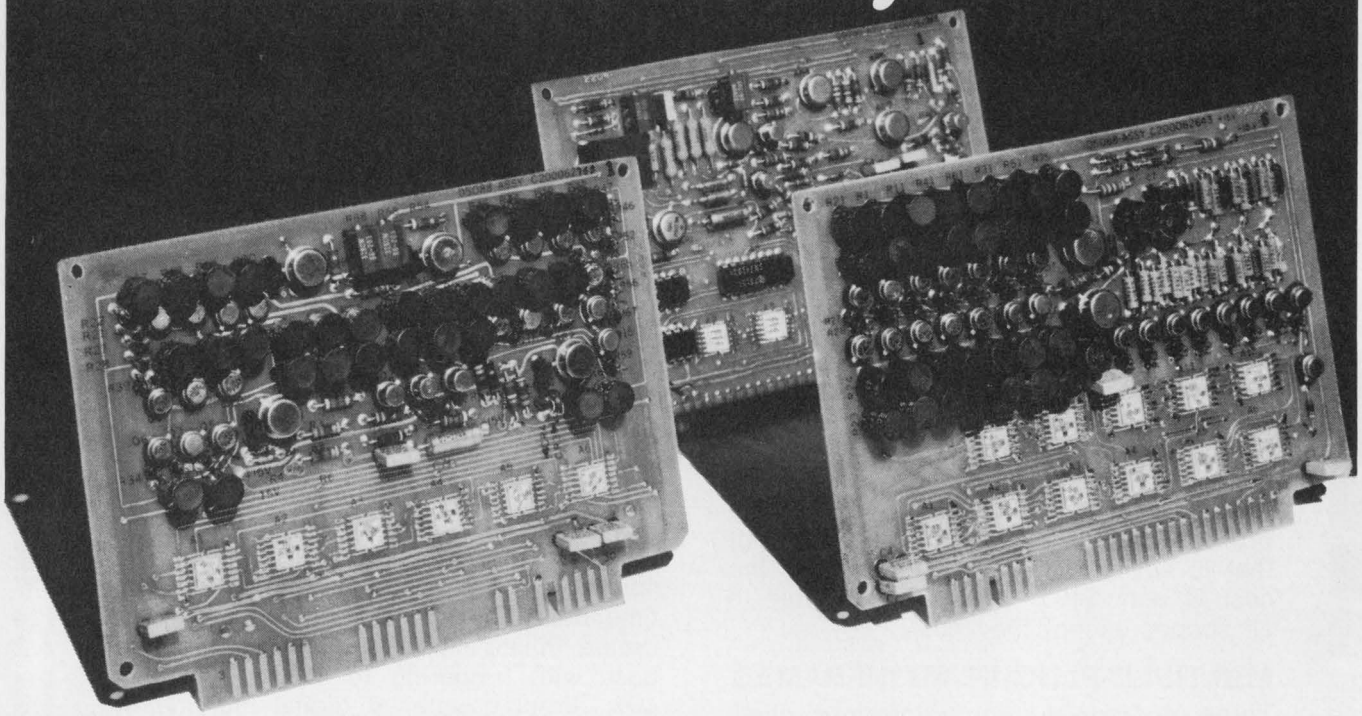
U.S. Sales Prices FOB Beaverton, Oregon

Tektronix lease and rental programs are available in the U.S.

INFORMATION RETRIEVAL NUMBER 27

Mil spec synchro/digital converters:

We've got 'em in cards. Or cased. For off-the-shelf delivery.



Kearfott can solve your synchro-to-digital and digital-to-synchro conversion problems with three production model solid state converters. All three meet MIL-E-5400.*

TRIGAC I—A low cost synchro to digital converter, accurate to 12 minutes.

TRIGAC III—Synchro to digital tracking converter dynamically similar to an electro mechanical follow-up servo.

TRIGAC IV—Digital to synchro converter, accurate to four minutes.

Typical Characteristics

		TRIGAC I		TRIGAC III	TRIGAC IV
Model Number	C70 4773 017	C70 4773 011	C70 4773 019	C70 4773 022	C70 4773 020
Package	2 P C cards	metal enclosure	2 P C cards	3 P C cards	3 P C cards
Input Signal	4 wire resolver	3 wire synchro	4 wire resolver 4 channels	3 wire synchro	12 bit parallel
Output	13 bit BCD			14 bit natural parallel	3 wire 11.8V 400Hz
Resolution	6 minutes of arc				
Accuracy	12 minutes of arc			4 minutes of arc	
Logic Levels	Logic "1"=±5V±10%, Logic "0"=0-0.5V				

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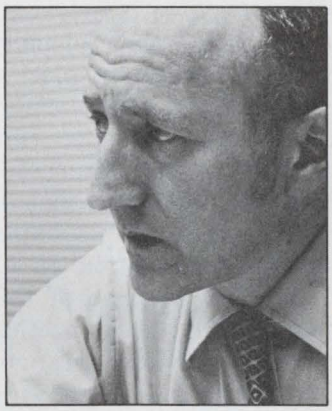
INFORMATION RETRIEVAL NUMBER 28

editorial

The curse of courtesy



We're too damn polite. We cultivate the social art of being inoffensive, even when a sharp jab once in a while can be a high form of true friendship. How many bum designs could we have avoided if someone close had whispered, "Fathead"?

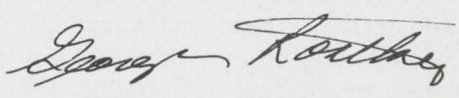
In *Up the Organization,* Robert Townsend argues that an organization should have a vice-president in charge of anti-bureaucratization —a man who can, at appropriate times, shout "Horseshit" at the top of his lungs. That's a really splendid idea—on the personal as well as organizational level.

We all get hung up in our procedures, our traditions, our structures. We tend to substitute "policy" on the organization level, "habit" on the personal level for simple, clear thinking. Many of us do things one way "because we've always done things this way." We keep using solutions to problems that went away because the solutions became policy.

The really sharp engineer keeps challenging himself. He doesn't allow himself to fall prey to structures—even structures he himself created. He doesn't say: "I once designed it this way and it worked so I'll do it this way again." He knows there could be a better way, a simpler way, a cheaper way. The first design might really be best—but he challenges it. The component and the circuit that was great in a piece of 1970 equipment may be too slow, too noisy or too expensive in 1972.

For those of us who haven't yet developed a strong self-challenge reflex, it can prove fruitful to appoint a personal vice-president in charge of anti-bureaucratization. The simplest approach could involve an informal pact: "Look Charlie, let's make a deal. You kick me in the backside when I'm about to pull a big blooper and I'll do the same for you."

Perhaps fortunately, personal goofs don't rate headlines. Corporate goofs do. The pages of the recent history of our industry are splattered with the blood of companies that lacked the man with the authority and guts to shout the right word at the right time.



GEORGE ROSTKY
Editor

technology

The 1103–1024 memory bits on a chip.

With random access, read/write capability and decoding, it's a large-array building block. Here's how to use it.

First of three articles

For large-scale memories, the 1103—a semiconductor building block—is emerging as a real contender to core memories. With 1024 one-bit words on one chip, random-access read/write capability and internal address decoding, the MOS 1103 dynamic memory stacks up into megabit arrays. Multiple sources are delivering it, so designers can build on a standard product.

A block diagram of the 1103 is shown in Fig. 1a, and the pin connections in Fig. 1b. The 1024 memory cells are arranged in a matrix: 32 rows by 32 columns. A_0 through A_4 address inputs are internally decoded to select one row. A_5 through A_9 do the same for the columns.

The basic memory bit is a three-transistor cell (Fig. 2). Data are stored as charge on the parasitic capacitance, C_S, associated with the gate of Q_2 and the connected junction of Q_1.

To read, the RDATA line (with its associated capacitance, C_R) is initially charged HIGH by activating signal ϕ. When line RSEL is activated, the RDATA line discharges if—and only if—the capacitor C_S contains a high. It remains HIGH—if and only if—C_S contains a low. Thus the RDATA line contains the logic complement of the cell data.

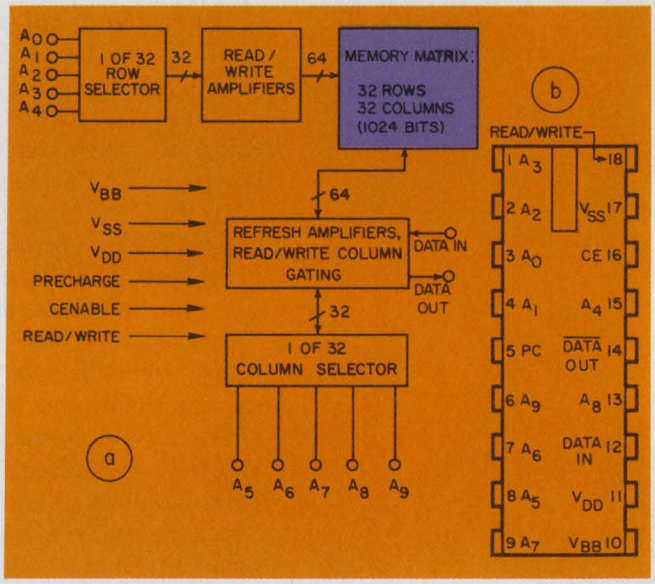
Data are written into C_S via the transmission gate, Q_1. The data are placed on the WDATA line, and the WSEL line is activated.

Three clocks establish timing cycle

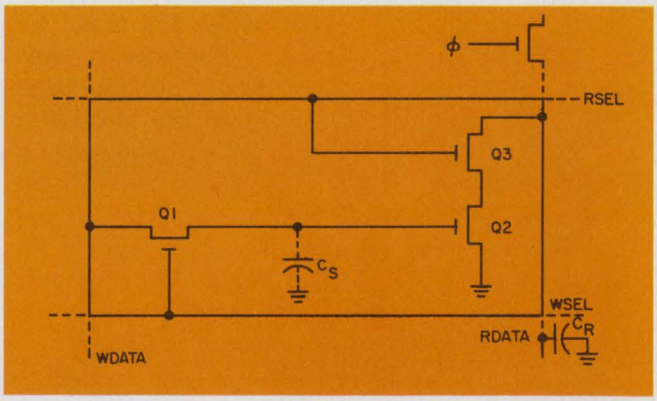
Operation of the 1103 always proceeds through a timing cycle. A read cycle is shown in Fig. 3a and write or read/write in 3b.

Cycle timing is established by three clock signals: precharge, "c" enable (chip enable) and read/write. All start HIGH at the level of V_{SS} approximately. A cycle begins when precharge is brought LOW. The row and column decoders of Fig. 1 are activated and charge all read and write data lines negatively (the ON state for p-channel MOS).

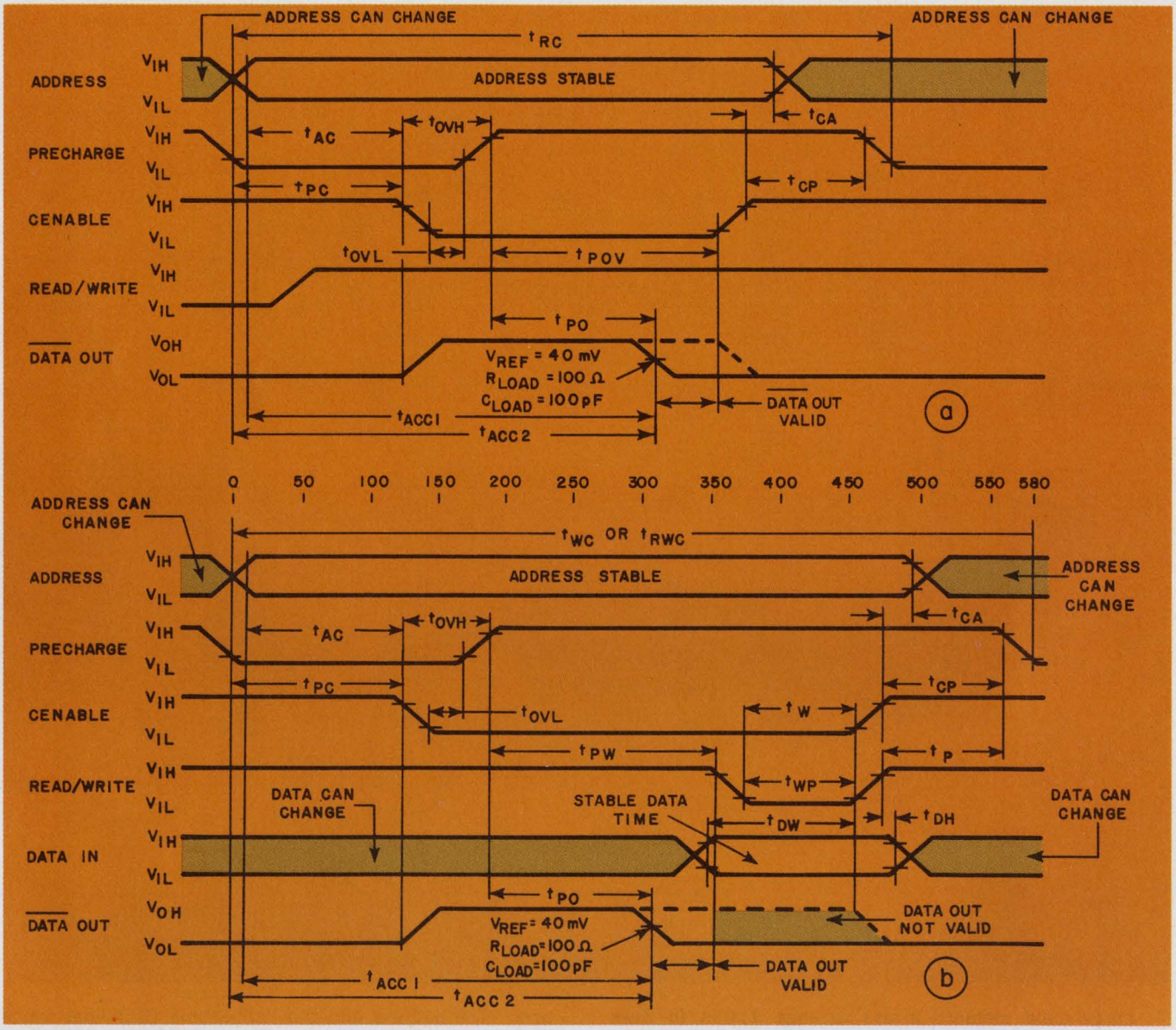
Marcian E. Hoff Jr., Applications Research Manager, Intel Corp., Santa Clara, Calif. 95051



1. **Block diagram of the 1103.** Address bits A_0 through A_4 select one of 32 memory rows and two associated read/write amplifiers (each amplifier drives half a row). The A_5 through A_9 bits select the column. Precharge, "c" enable and read/write lines are timing inputs (See Fig. 3). The data-in line updates the selected-cell contents, and the data-out line carries data from the selected cell. For each read or write cycle, refresh amplifiers regenerate the contents of the selected row (a). Dual-in-line package connections are shown in b.



2. **The memory cell requires three transistors,** with C_S storing the cell data. To read, input signal ϕ first charges C_R high. When the RSEL line activates Q_3, C_R assumes the logic complement of C_S. The selected cell data appears on the output. The data are written onto C_S from the WDATA line when the WSEL line activates Q_1.



3. **Operation of the memory is controlled by timing inputs.** The inputs generate a read cycle (a) or a write or read/write cycle (b). The addressed row data is refreshed in both cycles. The readout access time is 300 ns.

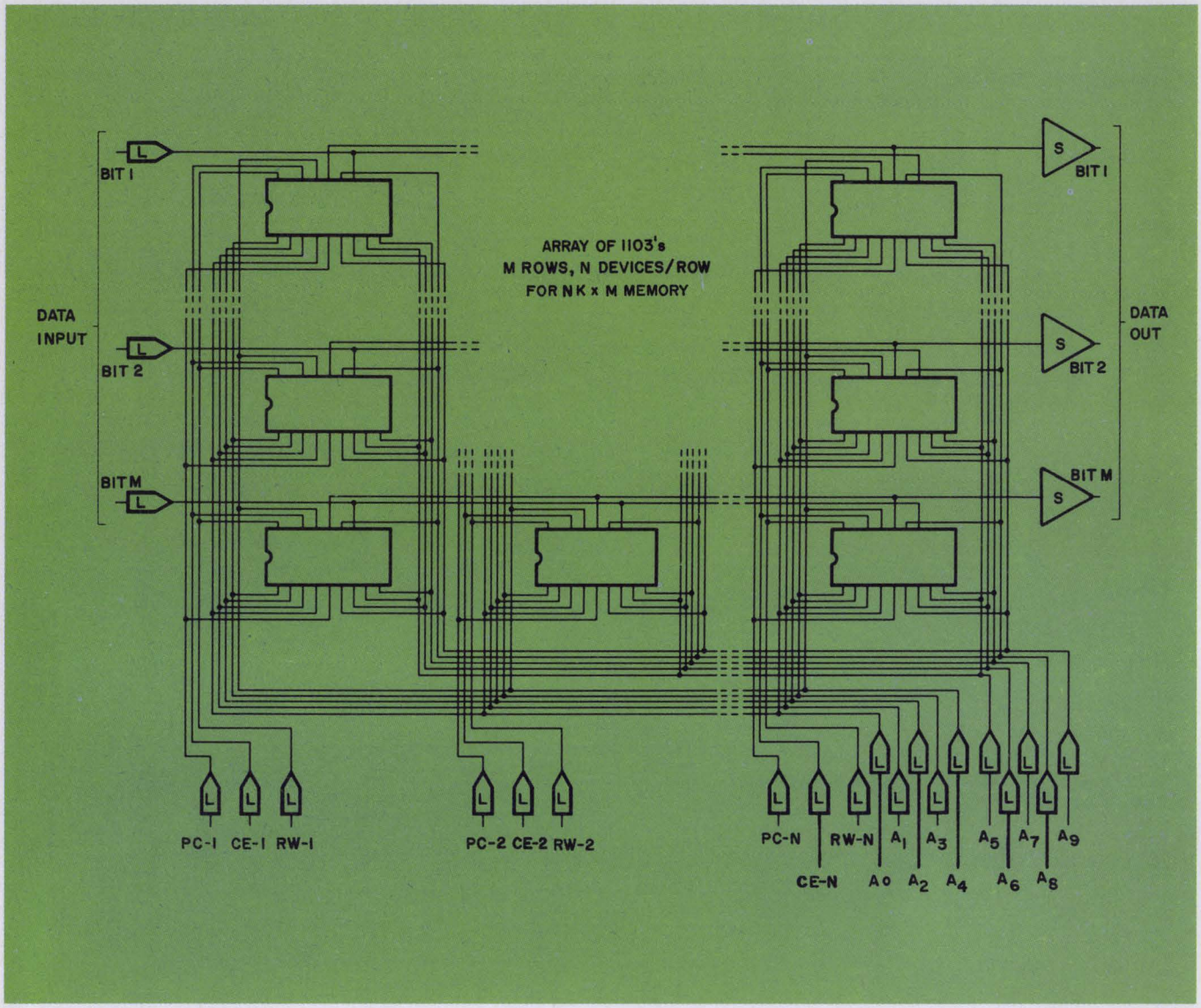
The decoders are faster than the line-charging circuitry. Addresses can therefore stabilize somewhat after precharge is applied without increasing cycle time. This permits use of less expensive (slower) drivers for the address lines than for precharge. The "c" enable line is turned ON next, after precharge and addresses have been present long enough for the data lines to charge and the address decoders to stabilize. "C" enable activates the addressed RSEL line (Fig. 2), and the charging circuits of the RDATA line are disabled. So the data lines discharge and levels approach values corresponding to the complements of the data stored in the selected cell row.

Next, precharge is turned off, removing the charging signals on the WDATA lines and closing the path for discharge. The WSEL line corresponding to the selected RSEL line is also activated, and the data in the selected row cells are refreshed.

Overlap of timing signals affects data

Level on the WDATA line is a function of the overlap time between precharge and "c" enable. For too short an overlap, the RDATA lines will not have discharged sufficiently when the WDATA lines begin discharge, and negative levels in the cells may be reduced. Minimum overlap time is shown as 25 ns when measured at 2 V above V_{DD}.

Overlap time must not be too long either. A weak cell positive level may result in some discharge of the RDATA line before closure of the write-back path, leading to incomplete discharge of the WDATA line. As a result the level written



4. **Large-scale memory arrays arrange 1103s in rows and columns.** As drawn, the number of rows equals the number of bits per word. The number of words equals 1024 times the number of columns. L elements are level shifters from TTL or ECL logic-level inputs to the p-MOS 1103. The address bits A_0 through A_9 drive the entire array. The address and the "c" enable (CE) lines, once energized, select a word for reading or writing. The timing sequence is established by the precharge (PC), the "c" enable (CE) and the read/write (RW) inputs. Data outputs feed current into signal sensors (S) for operating into bipolar-transistor logic-levels.

1. 1103 characteristic capacitances

SYMBOL	TEST	MIN.	TYP.	MAX.	UNIT	CONDITIONS
C_{AD}	ADDRESS CAPACITANCE		5	7	pF	$V_{IN} = V_{SS}$
C_{PR}	PRECHARGE CAPACITANCE		15	18	pF	$V_{IN} = V_{SS}$
C_{CE}	CENABLE CAPACITANCE		15	18	pF	$V_{IN} = V_{SS}$
C_{RW}	READ/WRITE CAPACITANCE		11	15	pF	$V_{IN} = V_{SS}$
C_{IN1}	DATA INPUT CAPACITANCE		4	5	pF	CENABLE = 0V, $V_{IN} = V_{SS}$
C_{IN2}	DATA INPUT CAPACITANCE		2	4	pF	CENABLE = V_{SS}, $V_{IN} = V_{SS}$
C_{OUT}	DATA OUTPUT CAPACITANCE		2	3	pF	V_{OUT} = 0V

f = 1 MHz, All Unused Pins Are At A.C. Ground

back is an even weaker zero. Eventually this results in positive levels changing to negative. For the 1103, the maximum overlap must be less than 75 ns, measured at 2 V above V_{DD}, and 140 ns at 2 V below V_{SS}.

After the end of precharge, and with an additional delay equal to t_{po} on Fig. 3, the contents of the selected cell appear on the output data line and all cell contents are refreshed. For a read-only cycle, "c" enable may be turned OFF after a time t_{pov} from precharge turn-off. Addresses should remain for 20 ns to complete internal operations. A new cycle can begin 85 ns after "c" enable turns OFF. The shortest access time from stable address input until valid output appears is 300 ns. A full read cycle requires at least 480 ns before the next cycle begins.

A write or read/write cycle proceeds the same way, except that "c" enable remains ON for an additional time to enable the write function.

After a time sufficient to stabilize the WDATA lines, the read/write line is activated. The RDATA lines are discharged, disconnecting the refresh amplifiers from the WDATA line. A direct path from the selected cell to the data input line is established, and a signal on this line overwrites the contents of the selected cell.

With restoration of the "c" enable and read/write lines to initial conditions, a new cycle can begin after a 85 ns delay. A full write cycle requires at least 580 ns. In a system both read and write cycle times will increase because of additional delays and tolerances.

Each row of memory cells must be refreshed at least once within any 2 ns-interval. Thus at least 32 memory cycles, one for each state of the five row-address inputs A_0 through A_4, must be executed in each 2-ms interval. In some applications, including those using a sequential access mode, refresh cycles are accomplished as a by-product of normal operation. Otherwise special provision should be made.

Large-scale memories are built by connecting 1103s in rectangular arrays (Fig. 4). M rows establish M bits per word. N columns generate 1024 xN words of memory. Thus for a 12k x 8 memory, 96 1103s are arranged in 8 rows and 12 columns. The "c" enable line selects the column and the 10 address lines the word from the column selected.

In general, timing input signals are generated by TTL or ECL high-speed-logic families. Level shifters are required to convert these logic levels to MOS levels. In Fig. 4 the level shifters are marked L.

Array input lines have high capacity

The signal input lines to an 1103 memory constitute large capacitive loads. Consider a 4096-word, 16-bits-per-word array. Arranged as in Fig. 4, there are four rows and 16 columns. The worst-case input capacitances are:

Each of 10 address lines:	64x7	= 448 pF
Each of 4 precharge lines:	16x18	= 288 pF
Each of 4 "c" enable lines:	16x18	= 288 pF
Each of 4 read/write lines:	16x15	= 240 pF
Each of 16 data-in lines:	4x5	= 20 pF

Stray capacities, including the PC board, increase these values. Charging capacitances draw current from the driver supply. To change the voltage on a capacitor C by E volts in time t requires a charging or discharging current i:

$$i = \frac{CE}{t}.$$

With C in pF, E in volts, t in ns, i is in mA.

About 230 mA, average, is required to charge or discharge each precharge or "c" enable line in this example. The peak charge current may be higher. Thus circuits used to drive 1103 arrays must be capable of providing high peak currents. Table 1 shows the capacitances characteristic of the 1103 signal lines.

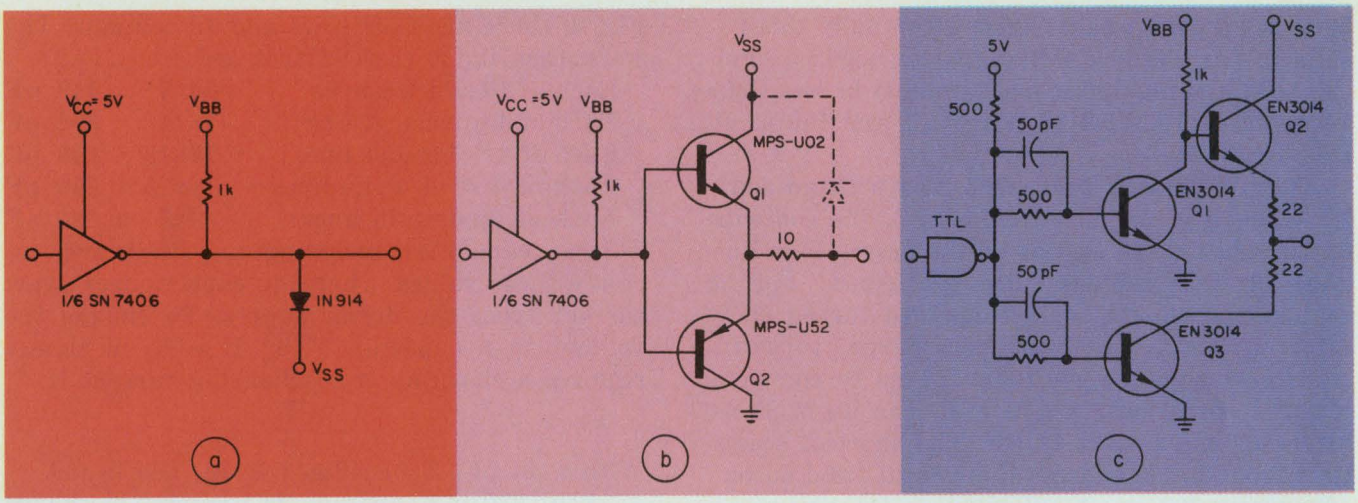
Although a capacitive load dissipates no power, energy is drawn from the driver power supply when the capacitive load is charged. Some energy is dissipated by the driver; the remainder is stored in the capacitor. When the capacitor is discharged, its stored energy is dissipated in the driver. If a capacitor C is first charged to a voltage V and then discharged f times per second, the minimum average current i drawn from the driver power supply will be given by $i=fCV$. With f in MHz, C in pF, and V in volts, i is in mA.

With the power supply also at voltage V, the power dissipated in the driver of the capacitive load is $P=fCV^2$, where P is in mW if the same units are used. Thus worst-case dissipation from this source for a precharge or "c" enable driver in the 4k x 16 memory would be about 120 mW per driver at V=16 V. This must be added to any other dissipation associated with the driver.

The capacitive loading associated with the array may also produce ringing if the leads from the drivers to the array have any significant inductance. The use of series-damping resistors in the level-shifter output is usually necessary. The damping-resistor value is a function of the layout and the number of 1103s driven. A 10 Ω resistor is used in the level shifter of Fig. 5b. Trial and error may result in a different resistor value for the best results in a system.

TTL input levels are shifted to MOS

Figure 5 shows three level shifters with TTL logic input. Table 2 lists significant characteristics. The level shifter of Fig. 5a is used primarily for driving data-input lines. In very small arrays, or arrays where severely degraded performance can be tolerated, the same level shifter



5. **Three types of level shifters** translate TTL logic inputs to interface with the 1103. A low-power unit drives the data input lines (a). A booster output increases capability, but it also introduces negative-level output offset (b). A high-drive unit shifts the level with reduced offset. (b) has better capacitive drive capability but (a) is poorer (c).

2. Level shifter drive characteristics (at 25C)

	Driver (a)	Driver (b)	Driver (c)
I Low Voltage (V_{OL})			
No Load	0.25V	≈0V	0.04V
Sinking 3 mA	–	+0.97V	0.14V
II High Voltage (V_{OH})			
No Load	V_{SS} + 0.65V	V_{SS} ± 0.01V	V_{SS} ± 0.01V
Source - 3 mA	–	V_{SS} – 0.05V	V_{SS} – 0.12V
Sink x 0.5 mA	–	V_{SS} + 0.01(1)	V_{SS} + 0.45V(1)
III Rise time (t_R)(2)			
10 pF	25 ns	25 ns	10 ns
50 pF	90 ns	25 ns	15 ns
100 pF	–	25 ns	20 ns
200 pF	–	25 ns	25 ns
470 pF	–	40 ns	50 ns
IV Fall time (t_F)(2)			
10 pF	12 ns	6 ns	6 ns
50 pF	20 ns	8 ns	9 ns
100 pF	–	10 ns	12 ns
200 pF	–	14 ns	20 ns
470 pF	–	24 ns	35 ns

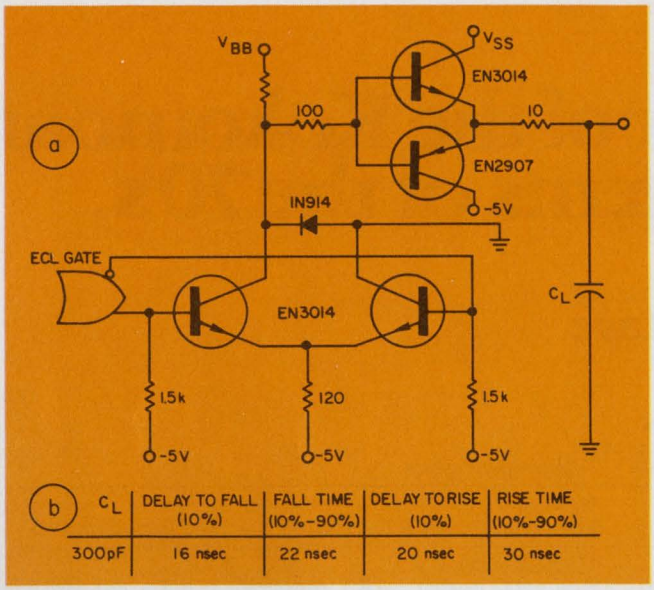
1. This voltage level is a function of transistor reverse gain. A diode clamp to V_{SS} is recommended.
2. These values are measured between the 10% and 90% points.

may also be used for driving address lines. A 1-kΩ load resistor is shown in the figure. Other values may be used. Higher values reduce power dissipation and degrade speed. Lower values increase speed, but also increase power dissipation and may, if too low, exceed the current-sinking capability of the driving gate.

The capacitive-load driving capability of the driver of Fig. 5a is increased by adding a booster stage, as in Fig. 5b. The complementary emitter follower increases capacitive drive capability substantially, as shown in Table 2. However, the emitter-base drop of Q_2 raises the negative output level to about 1 V. If V_{ss} falls to 15.2 V, the negative level applied to the clock input is V_{ss} – 14.2 V, degrading performance, and the voltage may fall out its specified operating range at elevated temperatures.

In using the driver of Fig. 5b, the designer has the following choices:

1. To reduce the allowable range of V_{ss}. This may still result in some speed degradation.
2. To raise V_{ss} and compensate by biasing the V_{dd} return from the array at about +1 V.



6. **ECL logic input levels (ground and −5.2 V) are shifted to match the 1103 input.** The negative level offset is negligible. Positive and negative diode clamps (not shown) on the output hold the line levels within tolerance when transients are induced (a). Speed characteristics with 300 pF load are shown (b).

The driver of Fig. 5b holds the output line very close to V_{ss} when the output level is positive. However, with a layout in which positive transients are capacitively coupled to the driver line, the driver may not hold the line within tolerance because positive transient clamping is a function of the reverse gain of transistor Q_1. To insure a positive output within limits, a clamping diode (dotted in Fig. 5b) is connected from the output line to V_{ss}. The driver of Fig. 5c has less capacitive-load driving capability than that of Fig. 5b (see Table 2) but does not have the offset problem at the negative level. Again, a diode clamp from the output to V_{ss} may be added.

Level shifters for ECL

Figure 6a shows a level shifter from ECL, which is biased between ground and −5.2 V, to MOS levels—V_{dd} at ground, V_{ss}=+16. Figure 6b gives performance characteristics. The circuit output has insignificant negative offset, but it may require a diode clamp to V_{ss} to reduce positive-going, capacitively coupled noise on the output lines. A negative clamp to ground is also desirable to eliminate ringing, which could charge the output line too negatively and reduce the allowable range of overlap between precharge and "c" enable. ■■

The second article on the 1103 memory will continue the discussion.

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The computer prints out:

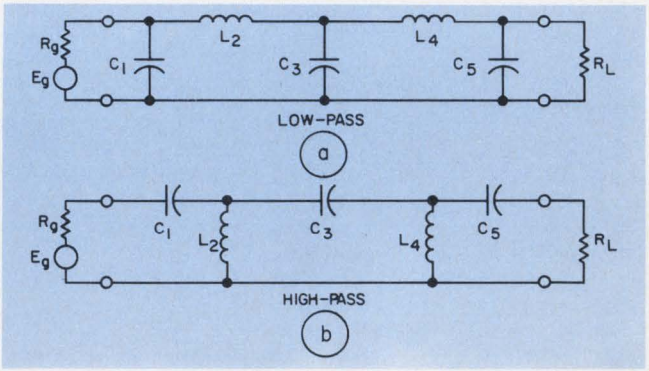
- The actual cut-off frequency.
- Component values.
- The actual maximum pass-band ripple, A_p.

14 designs are stored

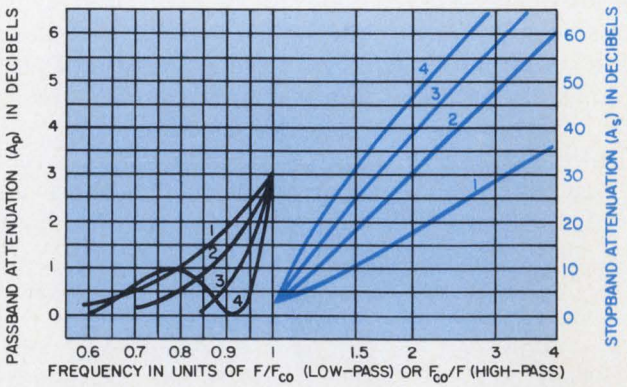
The computer selects a five-element low or high-pass filter (Fig. 1) from the one Butterworth and 13 Chebyshev designs available.[1,2,3,4] Equal source and load termination are specified in the program as most common. The resultant filter symmetry ($L_2=L_4$ and $C_1=C_5$) facilitates construction.

Passband attenuation (A_p) ranges from zero dB for the Butterworth to 1 dB for the curve 4 Chebyshev (Fig. 2). In-between A_p values are interpolated. Attenuation in the first stopband octave increases as A_p increases but component tolerances become more critical with higher values of A_p. The computer selects the design with the lowest A_p below the maximum specified, with f_{co} within ±20% of that requested. If no such design is available, the computer prints out values for a filter with a minimum A_p within the f_{co} tolerance.

Unfortunately VSWR and reflection coefficient (ρ) also increase with A_p, and in applications like a high-frequency transmission line, which must remain flat with frequency, or when the filter is used with other filters, a low VSWR filter should be used. (Filter VSWR is the ratio



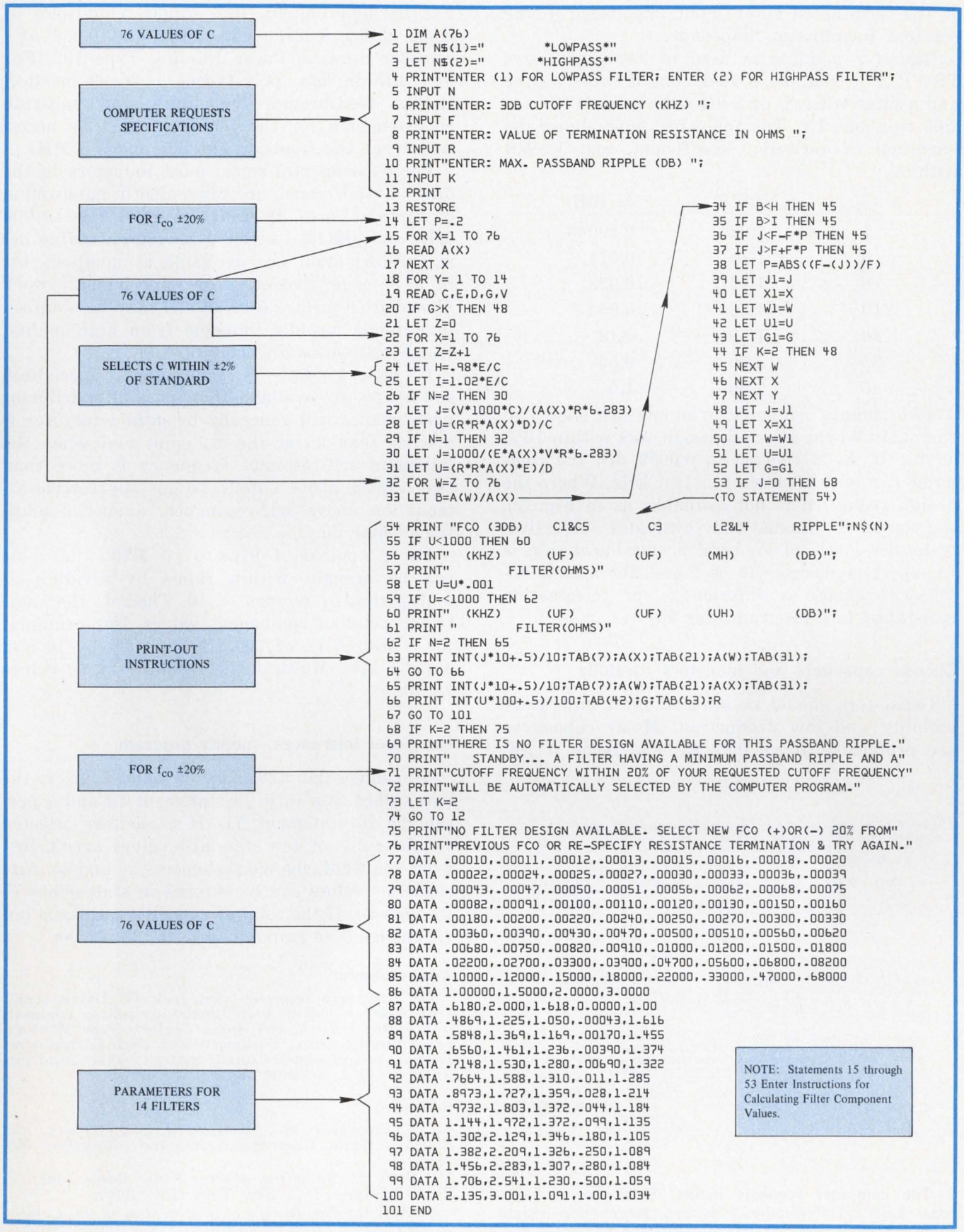
1. **Designs for five-element low-pass (a) and high-pass (b) filters.** The computer selects the best Butterworth or Chebyshev configuration to meet requirements. All designs are symmetrical: $Rg=R_L$, $L_2=L_4$, $C_1=C_5$.



2. **Variation of attenuation in passband and stopband for four filter designs.** The 14 designs available range from passband ripple (A_p) of 0 dB (curve 2) to 1 dB (curve 4). Intermediate values may be interpolated. The five-element Butterworth design with $A_p=0$ dB (curve 2) has superior attenuation performance over the three-element Butterworth (curve 1), shown only for comparison. The passband attenuation and frequency scales are expanded for clarity. The curves are normalized at the 3-dB f_{co} frequency.

Edward E. Wetherhold, Senior Engineer, and **Harry A. Lee Jr.,** Engineering Associate, Honeywell Inc., Test Instruments Div., Annapolis, Md. 21404

BASIC program for L-C filter



This program requires a one-thousand-word memory, minimum, and contains the following: (1.) Request for inputs: Filter type, desired cutoff frequency, termination resistance and maximum passband ripple; (2.) Instructions for calculating components values; (3.) 76 capacitor component values; (4.) Parameters for 14 filter designs; and (5.) Data printout instruction. The program language is in BASIC.

of the terminated filter input impedance to the nominal termination impedance.)

Resistive padding is used to lower excessive VSWR. For example, a 10-dB pad between source and a filter with A_p of 1 dB reduces VSWR from 2.66 to about 1.1. The following table shows the variation of reflection coefficient, and VSWR with A_p:

ρ (%)	VSWR	A_p (dB)
1	1.02	0.00043
5	1.11	0.011
8	1.17	0.028
10	1.22	0.044
20	1.50	0.18
33	2.00	0.50
45	2.66	1.0

Two sample computer printouts are shown in Fig. 3. In 3a the selected design was within 16% on f_{co}. If A_p is relaxed to 0.0039 dB, the computer can offer a closer f_{co}: 19.1 kHz. Where the design requested is not available, as in Fig. 3b, the computer automatically evaluates successively higher levels of A_p until a suitable design is found. If no design can be found, the user is advised to choose a different f_{co} or termination resistance (see program, line 75).

Choose capacitors and inductors carefully

Capacitors should be selected for temperature stability and low dissipation. Mylar capacitors are preferable above 0.01 μF and below 1 μF.

```
ENTER (1) FOR LOWPASS FILTER; ENTER (2) FOR HIGHPASS FILTER!1
ENTER: 3DB CUTOFF FREQUENCY (KHZ) !17
ENTER: VALUE OF TERMINATION RESISTANCE IN OHMS !50
ENTER: MAX. PASSBAND RIPPLE (DB) !0

FCO (3DB)    C1&C5      C3        L2&L4       RIPPLE        *LOWPASS*
  (KHZ)       (UF)      (UF)       (UH)        (DB)       FILTER(OHMS)
   19.7        .1        .33       654.53       0              50
```

(a)

```
ENTER (1) FOR LOWPASS FILTER; ENTER (2) FOR HIGHPASS FILTER!1
ENTER: 3DB CUTOFF FREQUENCY (KHZ) !8
ENTER: VALUE OF TERMINATION RESISTANCE IN OHMS !50
ENTER: MAX. PASSBAND RIPPLE (DB) !0

THERE IS NO FILTER DESIGN AVAILABLE FOR THIS PASSBAND RIPPLE.
   STANDBY... A FILTER HAVING A MINIMUM PASSBAND RIPPLE AND A
CUTOFF FREQUENCY WITHIN 20% OF YOUR REQUESTED CUTOFF FREQUENCY
WILL BE AUTOMATICALLY SELECTED BY THE COMPUTER PROGRAM.

FCO (3DB)    C1&C5      C3        L2&L4       RIPPLE        *LOWPASS*
  (KHZ)       (UF)      (UF)       (MH)        (DB)       FILTER(OHMS)
    6.4        .47        1         2.1      .690000E-02         50
```

(b)

3. **The computer requests inputs:** Enter low or high pass, 3-dB cutoff frequency desired, termination resistance and maximum passband ripple. The computer can meet requirements and prints out component values (a). The computer has no design meeting ripple requirements but automatically selects the minimum ripple design within ±20% of requested f_{co} (b).

For the less-common 10% values (multiples of 0.012, 0.018, 0.027, 0.039, 0.056 and 0.082 μF) consider Sprague Pacer Filmite, Type 192. For 0.01 μF or less, polystyrene is recommended. Button feedthrough capacitors and separate compartments for the inductors may be necessary when the stopband extends above 5 MHz.

For experimental work, most inductors in the 0.1-to-100-μH range are conveniently handwound on toroidal cores. Q curves over 10 kHz to 200 MHz and practical toroidal inductor winding design information are available at nominal cost in a 64-page booklet.[5] For experimental work from 1 to 30 kHz, 2.5 to 88 mH may be obtained in a single toroidal inductor from high-quality, telephone-line loading coils.

If hand-winding is impractical, specialized coil houses are available. Low-pass filter inductor performance will generally be satisfactory for Q greater than 30 at the f_{co} point and when the minimum self-resonant frequency is more than two octaves above cutoff. To get appreciable attenuation above self-resonance, a special additional filter may be necessary.

For f_{co} outside 1 kHz to 10 MHz, the value can be brought within range by dividing or multiplying by powers of 10. Then do the same to the printout component values. For example: for a desired f_{co} of 100 Hz, multiply by 10 and enter 1 kHz. Multiply the resultant L, C, values by 10.

For closer tolerances, modify program

To change the ±20% f_{co} "window," insert the new values as a ratio in statement 14 and a percentage in statement 71. If capacitors selected within ±2% of the standard values aren't just what you want, change statements 24 and 25. Any capacitor values can be entered in statements 77 through 86. If the total of capacitor values is not 76, change it in statements 1, 15, 22, 32. ■■

Acknowledgment

The assistance received from Jack W. Davis, senior EMI engineer, and S. Ivan Rambo, consulting engineer, both of the Defense and Space Center of the Westinghouse Electric Corp., Baltimore, and Carl Tannenbaum, systems programmer, United States Naval Academy, Annapolis, Md., is gratefully acknowledged.

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2. Geffe, P., *Simplified Modern Filter Design*, John F. Rider Publisher, Inc., New York City, 1963.

3. Saal, R., *The Design of Filters Using the Catalog of Normalized Low-Pass Filters*, Telefunken GmbH, Western Germany, 1966.

4. Zverev, A., *Handbook of Filter Synthesis*, John Wiley & Sons, Inc., New York City, 1967.

5. *Q Curves for Iron Powder Toroidal Cores*, Micrometals, 72 E. Montecito Ave., Sierra Madre, Calif.

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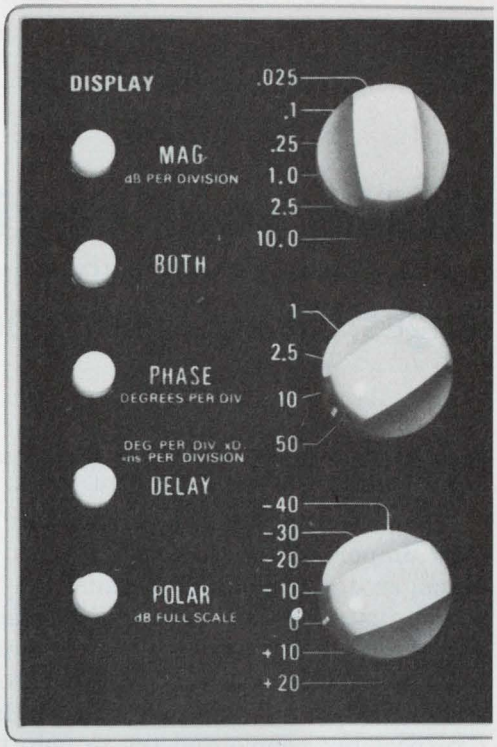

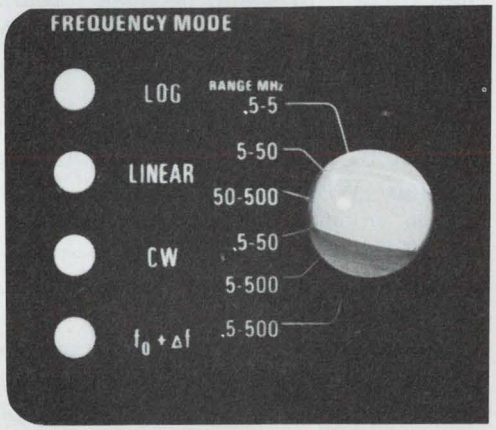

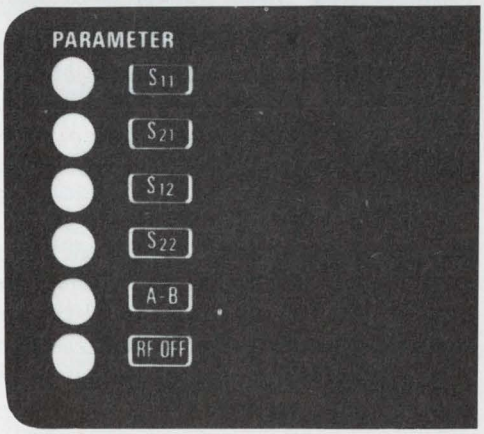

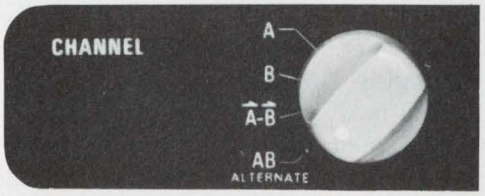

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INFORMATION RETRIEVAL NUMBER 33

Guide your engineers to self-rule, advises this leader, who says subordinate-made decisions help him. His challenges? Hiring, pairing people/assignments, managing creative EEs.

Roger Cady, Manager of PDP-11 Computer Engineering, Digital Equipment Corp., Maynard, Mass.

"People-awareness." I think those are the two most important buzz words for an engineering manager to remember, because he works with people instead of things. Unlike things, however, people are unpredictable; they're going to make irrational decisions; they're going to be temperamental; they're going to respond in human ways. I respect my people and try to help them, rather than dictate to them, because I realize that each has ideas that can help the project. My ability to work with people was probably the most important factor contributing to my promotion.

I developed this ability as an engineer when I learned to interface with technical personnel in the lab. When my job called for me to work with a variety of disciplines outside of engineering, I tried to learn their terminology and thought patterns, so I could communicate with them.

An awareness of people comes down to this: People have their own ideas about how a job should be done. If I can make my people believe that I really care about them and that I really want to hear their ideas, then I'm going to be more effective as a manager.

When you ask engineers for 110% of their capacity and 120% of their knowledge on a project, they realize that they're going to have to learn something new before they can complete the job.

When I want my engineers to do a job a certain way, I don't tell them that this is the way it ought to be done; I want them to decide for themselves, because I'm not always right. If they go through the thought process themselves, they may discover something wrong or they may suggest a better way to do it.

I try to motivate my staff to do a good job the first time, so I don't have to do it myself. Every time I try to do a little engineering myself, the details get lost, because I'm also busy with the managing function.

The most frustrating experience I ever had in this regard was when I supervised system tests for Honeywell's 1200-2200 series machines. I had 45 people on a three-shift basis. It was a good experience for me, because it was a job that I couldn't possibly do by myself. I didn't know the products well enough to test them myself. To be successful I had to work with people.

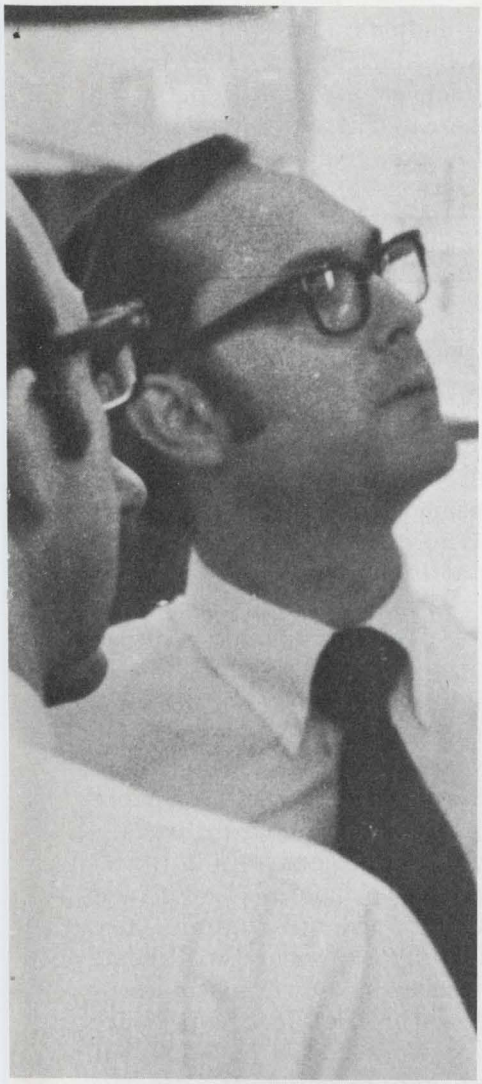
So now I've learned to develop a group that runs with a minimum of supervision, one that is capable of doing the project their way. I build them up, so they can have confidence in themselves. When they realize that I also have confidence in them, they feel qualified to make decisions on their own. This frees me from the petty details of managing, so I can oversee the entire project with more objectivity.

When I give my people a project, I tell them I want 110% of their capacity and 120% of their knowledge. That stretches them, and I tell them so. When I lay out the job, I make it clear that I don't think they're capable of doing the job right now; that they have to learn something to complete it. I say: "It's going to tax you and put a strain on you, but you'll have to learn something new to be successful." My guys like that, and they go after it.

It's very difficult to manage creative people in a world full of schedules, budgets and products that have to be sold. Creative engineers are more concerned with the product design than they are with schedules and costs. I try to get my creative people to stop improving the design and start manufacturing it. The design could be improved forever and never become a product. I instill in these designers the idea that an almost perfect product is better than no product at all. They must understand that although the product isn't perfect, it has met the goals that were set for it.

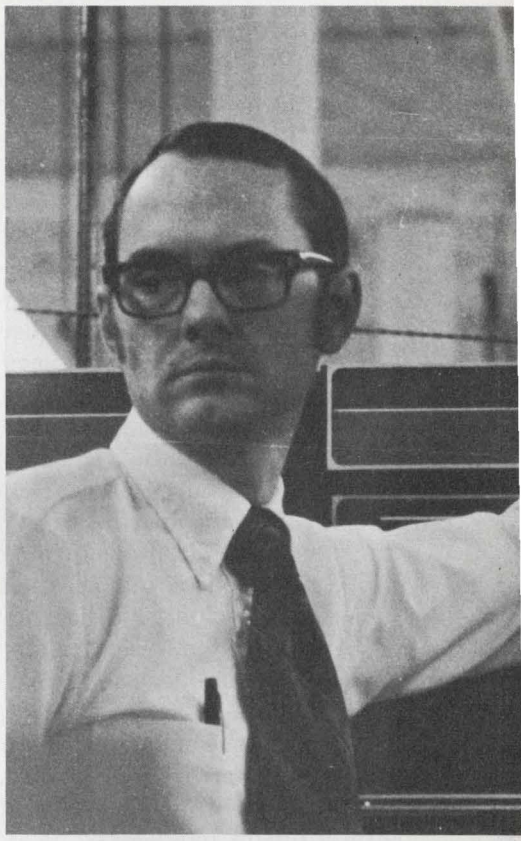
A designer should carry a product from its design through the manufacturing cycle, where he learns about the real world. When he discovers all the other factors that go into producing a product, he'll begin to realize that the extra 2% improvement that he could have made in the product is really negligible in the total picture of its production.

Then, too, there are those creative types who are withdrawn because their ideas have been stepped on. I try to stimulate them to present



ROGER CADY

Education: BSEE, Northwestern.
Experience: Engineering manager; computer test engineering; systems test; instrumentation design; tool and die making; electronic sub-assembly; production, field and operations engineering; and planning.
Best Achievement: Developed the PDP-11 16-bit computer family of digital equipment. Required interface of management with creative design to high-volume manufacturing.
Papers, Symposia: "A New Architecture for Minicomputers—the DEC PDP-11"; Infotec symposium on small computers—London, Sept. 1971.
Personal: Married; three children; interests include antiques; carpentry; photography; sailing.
Employer: Digital Equipment Corp., Maynard, Mass. Founded in 1957 in a converted textile mill by three employees who built/tested manufacturers' computers with a circuit module. Today, with 6800 employees worldwide, and net sales of $146.8-million in fiscal 1971, DEC produces digital test systems, computers, peripherals, and converters, as well as circuit modules.



their ideas and then guide them into a realization of why an idea may be a bad one. "Here's my thinking on it," I tell them. Or: "Let's compare the alternative to it." Often the engineer doesn't have the right approach to the problem. He needs to be guided, not led—and certainly not forced.

Win friends, influence people and hire a select staff by asking each job-hungry engineer: "What makes you think you're so good?"

Hiring people is one of the manager's most difficult responsibilities. I can rationalize shortcomings in personnel when I inherit a crew. But to gather the kind of staff I've been talking about, I have to determine if the prospect can do the job.

I like to hire engineers who are generalists rather than specialists, because my work is rather broadbased and I need guys with flexibility. I like a man who's aware, who walks into the plant and asks questions that are not necessarily engineering oriented. If he comments on the construction of our 100 year old building, for example, he may also be the type who'll be aware of the manufacturer's problems.

I try to ask a job prospect a wide variety of questions, including a half dozen or so one-liners —like, "What makes you think you're so good?" That kind of question gives me a chance to see how he reacts to an abrupt subject change.

"What's the most important thing you've ever done in your life?" is another that's designed to lay open his inner feelings. The trick is getting him a bit off balance, so he starts replying naturally rather than how he thinks I want him to reply. For information on his engineering ability, I find out what his specific project function has been, and why he has or has not been successful.

My most difficult challenge after I've hired my people is assigning them to projects and setting goals for the projects. I tend to pattern things after what I think I can do. The trouble is that some people may not have the experience I have.

So I try to understand each person's capabilities and limitations, so I can align him with an assignment he can complete. When I talk about that 110% of capacity, I have to know if he can grow that extra 10%. I never assign a man to a job he doesn't feel he can do. If he doesn't think he'll be successful, he won't be.

When you first become a manager, I think you have to let your engineers do a lot of goal setting. Then closely monitor them until you find out if they can do more or less than they think they can do. Then adjust their load. First, set some short-term goals. Then set the long-term goals. Initially set the goal for the next three months or less, not for the next year. Goals must be set jointly between manager and engineer.

Complicating the problem of goal-setting is the constantly changing industry I'm in—the computer industry. If a product design takes longer than four weeks to develop, you'll find half a dozen more new integrated circuits available on the market, half of which could be used to improve the design.

A broad experience will give the engineer a breadth of knowledge of a product's function that no engineering spec could ever equal.

Broad experience is another major factor that contributed to my promotion. I was fortunate to attend a cooperative educational program at Northwestern University. I worked for two different companies through that program and got a broad base of experience, a feel for things beyond the textbook. The experience included field work and planning at Commonwealth Edison in Chicago and time in a machine shop, where I got a working knowledge of milling, grinding, injection and die casting.

It's a five-year engineering course for a bachelor's degree under the Northwestern cooperative program. The first year is a normal freshman engineering course. Starting with the sophomore year, I spent school time on a quarterly basis—two quarters in school and two quarters in industry, alternating every three months. I was paid and received credit toward graduation. The course gave me a worldly experience with some control, because I worked my own schedules.

One thing I did to broaden my experience wherever I studied or worked was to figure out how the assembly I had to build fit into the finished product. If it was a photo detector that was to be used on a card reader, for example, I made it my business to find out also how the card reader worked. Then I knew how the item needed to be functionally tested without relying just on the specs. You can rarely write specs that tell you the test that would be optimum from a functional standpoint.

And what is my most difficult problem of the future? As I look ahead, I imagine my function will become less and less technical. I'll get into the business function—marketing, finance, etc.—and that's a problem, because I'm an engineer first. I've got to realize that one day I'll be directing engineering managers, one level back from the design problems. If I can get the engineer to solve his own problems, the better able I'll be to direct him from another level.

Too many people want to become managers when they think they don't have it technically. It's ironic, because a good engineering manager must be a good technical man. He must also have knowledge about all aspects of a project. I've kept abreast of the state of the art and spent time in the field. I'm a firm believer in the idea that the more you learn, the further you'll get. ■■

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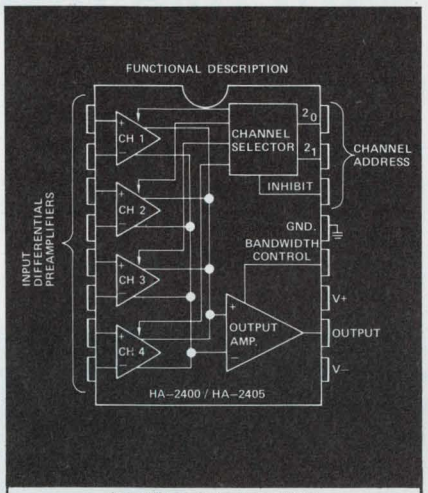

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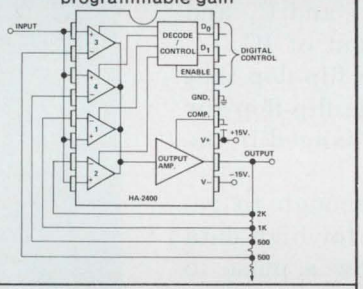
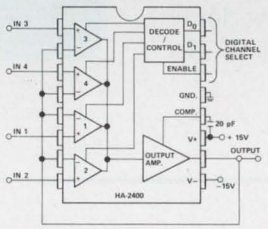
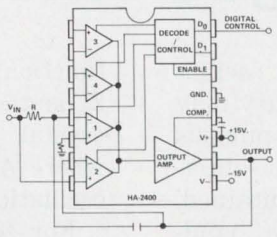


Analog multiplexer with buffered input and output



Integrator/ramp generator with initial condition reset



More challenges:
The foregoing diagrams show just three of many applications we've designed using the PRAM. The following lists other possibilities we haven't had time yet to prove out. Why don't you try your hand at designing them or any other ideas you come up with, and send them to:
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INFORMATION RETRIEVAL NUMBER 34

ideas for design

Transfer data with this flexible circuit

The conversion of many DVM and counter outputs to TTL-compatible levels is generally achieved with circuits that are limited in performance by their source impedances. But this limitation is eliminated when the circuit shown is used. The number of inputs can be extended to N, and only TTL gates and passive components are required.

The operation of each section is identical to that of the first: If the input data is high and CR_1 is reverse-biased by at least 4 V, no pulse passes CR_1 to the input of IC_2 during a data strobe. But if the data input is low and forward biases CR_1 within about 2 V, IC_1 pulls current from the input of IC_2 via C_1, CR_1 and C_2 and causes a pulse to appear at the output of IC_2.

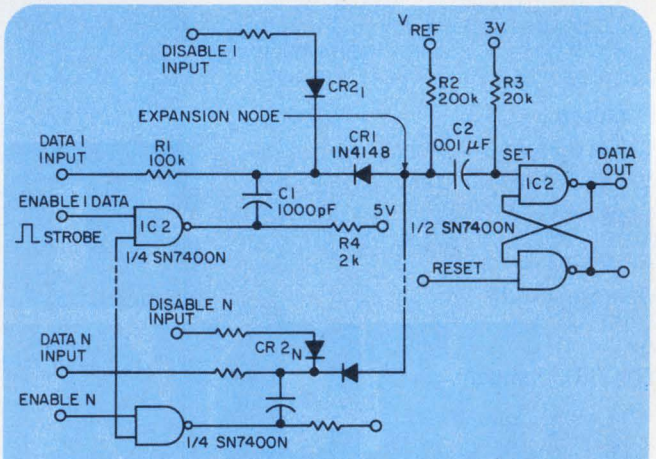
If IC_2 is part of the set input of a flip-flop that has been reset, a data probe sets the flip-flop for data low. The flip-flop remains unchanged if the data input is high.

Voltage V_{REF} must be negative enough to reverse-bias CR_1 during a data strobe for high-data input, while positive enough to allow a pulse to pass to IC_2 during a data strobe with low data input.

As an example, a device can have low logic levels of ≤ -5 V and high levels of ≥ 5 V. In this case, $V_{REF} = 0$. As another example, the low level is ≤ -10 V and high level is ≥ -3 V. Here $V_{REF} = -8$ V.

A. Kuramoto, Lawrence Livermore Laboratory, University of California, Livermore, Calif. 94550

CIRCLE NO. 311



Source impedance is no longer a problem in this conversion circuit for TTL-logic levels. Of course, the usual gain-bandwidth tradeoff still applies, since the input circuit is essentially an integrator.

Clock oscillator guaranteed to start

The problem with most simple crystal oscillators is that under worst-case conditions they may not start, or they may hang up on a spurious mode. But with this circuit (see diagram) start-up is guaranteed and oscillations are maintained.

The μA733, a video amplifier with a bandwidth of about 80 MHz, has an adjustable gain of 10 to 400. Oscillator positive feedback is provided from pins 6 to 12 via the R_2, R_3 voltage divider, the crystal and the tank circuit. The feedback ratio, β, is the network voltage transfer function $\beta = Z_t/[(Z_t+Z_x)(1+R_3/R_2)+R_3]$, where Z_t is the tank impedance and Z_x is that of the crystal. If the product $A\beta$ is greater than unity, where A is the amplifier single-ended gain, then oscillation is guaranteed.

For zero input, the μA733's outputs are both approximately half the positive supply voltage. If oscillation is temporarily absent, the amplifier output hovers in its linear region where the gain is high. Thus starting is assured. When the amplitude becomes sufficient to cause peak satura-

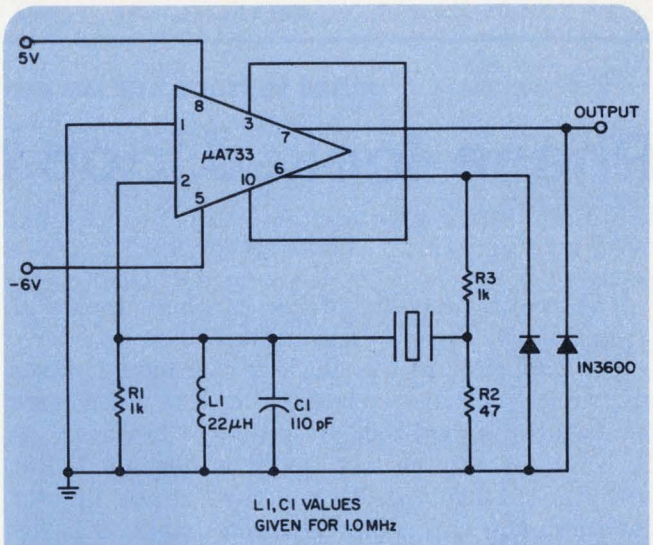
tion, A effectively decreases to automatically limit $A\beta$ to unity.

Most popular crystal cuts exhibit both near and far-frequency spurious responses. Near-frequency is usually defined as responses within ±20% of the main frequency. A typical specification will usually require that any near "spur" have an impedance level two or three times greater than the main mode, with the implicit presumption that far spurs may be equal to the main mode.

The tank circuit is necessary to discriminate only against far spurs. To design the tank, first choose R_1 about 10 times the crystal's maximum main mode resonant resistance. Then $L_1 = R_1/\omega_o Q_t$ and $C_1 = Q_t/\omega_o R_1$, where ω_o is the crystal's series-resonant frequency and Q_t is about 5 to 7.

Richard Mann, TRW Systems Group, One Space Park, R2/1004, Redondo Beach, Calif. 90278.

CIRCLE NO. 312



In this logic clock oscillator start-up is guaranteed by the characteristics of the μA733. The output can drive at least two standard TTL loads.

Use an op amp for simple Schmitt trigger

A Schmitt trigger can be designed around a single op amp to drive DTL and TTL logic devices. A simple choice of component values determines the trigger threshold and hysteresis.

As shown in the figure, the 709 op amp is operated in the open loop mode, with no compensation components added. This produces a fast slew rate and forces the output to remain saturated at ±15 V. The threshold level at which a change of state occurs is determined primarily by R_1 and R_2. A small amount of positive feedback, determined by the voltage drop across R_5, produces the desired hysteresis and prevents the circuit from oscillating.

Design relationships:

$$\frac{R_4 + R_5}{R_3 + R_4 + R_5} = \frac{5.0}{15} \qquad (1)$$

$$V_1 = V_x + (15 - V_x)\ \frac{R_2}{R_1 + R_2}$$

$$\text{where } V_x = 15\ \frac{R_5}{R_3 + R_4 + R_5} \qquad (2)$$

$$\text{and } (R_1 + R_2) >> R_5$$

$$V_2 = 15\ \frac{R_2}{R_1 + R_2} \qquad (3)$$

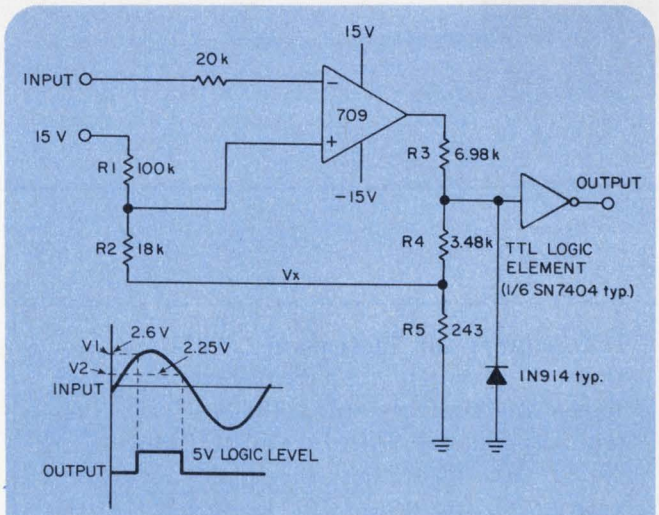
$$R_3 \geq 2\ \text{k}\Omega. \qquad (4)$$

In formulating the equations for the threshold voltages, it was assumed that (a) the 709 output swings from plus V_{cc} to minus V_{cc} (±15 V), and that (b) the 709 has no input offset voltage.

The circuit works well with very slow-moving inputs, making it useful in a variety of level-sensing applications. Adding a capacitor between the inverting input of the op amp and the signal ground converts the circuit into an accurate time delay for long pulses or step function inputs.

John Kramer, Aeronutronic Div., Philco-Ford Corp., Ford Rd., Newport Beach, Calif. 92663

CIRCLE NO. 313



The Schmitt trigger provides an ideal input to TTL logic elements, varying between +5 V and −0.62 V with rise time of 1 μs and fall time of 250 ns.

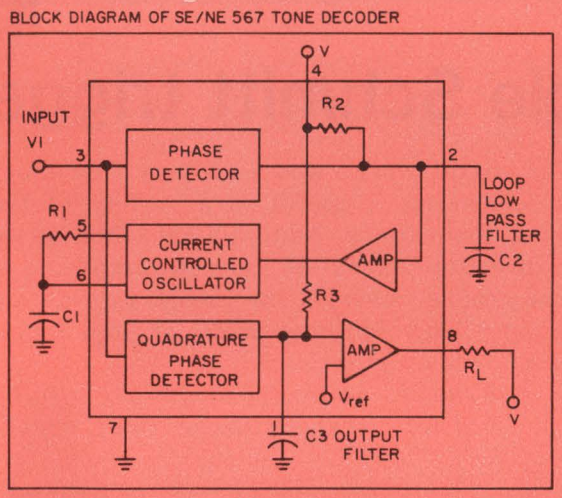
Phase-locked loop decodes narrow bands

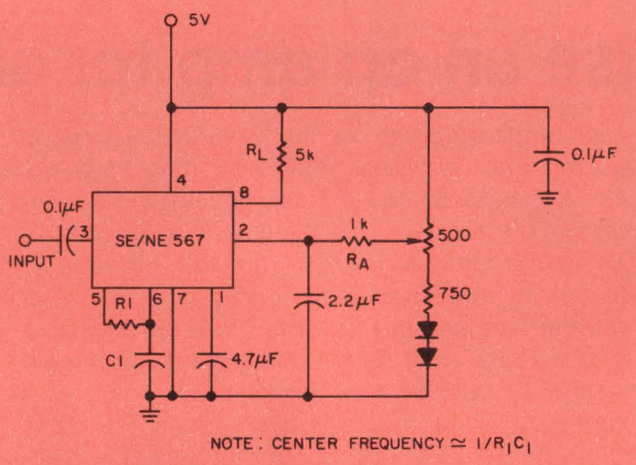
Bandwidth decoding of 1% can be achieved if a phase-locked loop is used with a tone decoder.

The capacitor in the phase-locked loop, C_2 (see diagram), can be increased in size until zero bandwidth is realized. In practice, however, as C_2 is increased, the loop speed is degraded. But with the addition of R_A and the voltage divider network, you can achieve narrow bandwidths by reducing loop gain and still maintain reasonable speed. A value of 1 kΩ for R_A decreases the bandwidth to 4% total, with $C_2 = 2.2\ \mu F$ and $V_{in} = 200$ mV rms. Bandwidth may now be reduced to less than 1% total by reducing the input drive to 50 mV rms.

Jim Wyland, Linear IC Applications Dept., Signetics, 811 E. Arques Ave., Sunnyvale, Calif. 94086.

CIRCLE NO. 314





Narrow-band decoding of less than 1% total bandwidth is realized with the SE/NE 567 tone decoder. Applications include speed calibrators for tape transports and precision speed controllers.

IFD Winner for September 2, 1971
Dale Pippenger, Applications Engineer, Texas Instruments, Inc., 13500 North Central Expressway, P.O. Box 5012, Dallas, Tex. 75222. His idea, "Measure rpm accurately with an optical counter," has been voted the Most Valuable of Issue award.
Vote for the Best Idea in this Issue.

IFD Winner for September 16, 1971
C. A. J. van der Geer, FOM-Inst. Plasmafysika, Jutphaas, Holland. His idea, "Light-pulse generator works on variable supply voltage," has been voted the Most Valuable of Issue award.
Vote for the Best Idea in this Issue.

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851	X		−9 to −21			30
852		X	"			35
803	X		+21 to +32			30
804		X	+20 to +32			35
853	X		−21 to −32			30
854		X	−20 to −32		±0.05%	35
805	X		+3 to +9		±0.1%	30
806		X	"		"	35
855	X		−3 to −9		"	30
856		X	"	Up to 0.5 amp	"	35
807		X	+30 to +60	0.150 amp	±0.05% at −20° to +125°C ±0.1% at −55° to −20°C	30
808		X	+60 to +120	"	"	30
809	X		+5 to +28	0.75 amp	0.003%/mA	8.95
859	X		−5 to −28	"	"	8.95
828A		X	+5 to +30	500 mA	Line: ±0.01%/V Load: ±0.01%	50
838A		X	−5 to −30	"	"	50
844			Dual ±12 to ±20	0.3 amp	Line: ±0.005%/V Load: ±0.005%	20

Low Cost Series 809 and 859 voltage regulators are small (1″ x 0.5″ x 0.170″ high), complete, fully sealed and compatible with flat pack and dual-in-line packaging. The 809 and 859 circuits consist of a series pass stage, an error amplifier with built-in reference, and a precisely adjusted output voltage sense divider. In addition to being complete voltage regulators, the Series 809 and 859 have the following add-on capabilities: current limiting, load capability to over 10 amps, and adjustable output.

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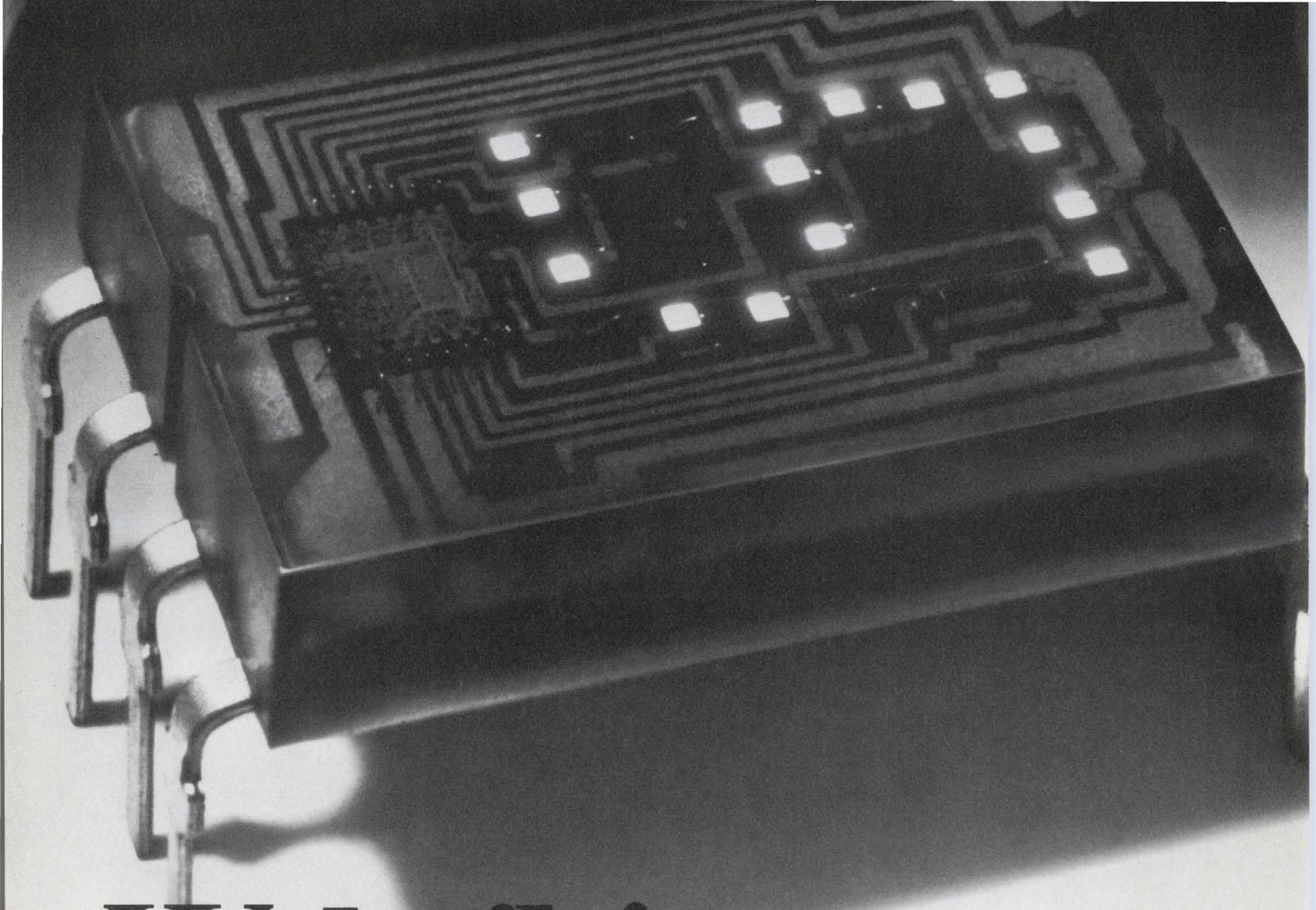
HELIPOT DIVISION

2500 Harbor Blvd., Fullerton, Calif. 92634

INFORMATION RETRIEVAL NUMBER 35



We built in the decoder/driver so you don't have to.

Not only the decoder/driver but the memory too! Now available for *immediate* delivery is the HP 5082-7300 series solid state display.

It's completely TTL compatible. All you do is address it directly with four-line BCD input. The on-board IC allows for either the storage of input data or real-time display. You save design time, space, and money, and get a completely reliable integrated display system.

A bright .290 inch high, shaped character gives excellent readability over a wide viewing angle in a compact .600 inch by .400 inch package.

Best of all is the price: $10.00 each in 1K quantities. So why wait? Order now! For *immediate* delivery on the HP 5082-7300 call your local HP sales office, or Hewlett-Packard, Palo Alto, Calif. 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

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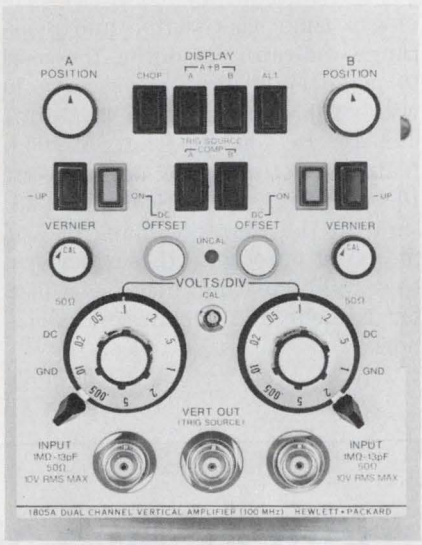
COMPONENTS

INFORMATION RETRIEVAL NUMBER 36

new products

Both high and 50-ohm inputs are given in 100-MHz scope



Hewlett-Packard, 1900 Garden of the Gods Rd., Colorado Springs, Colo. Phone: (303) 636-5111. P&A: $1400; February, 1972.

For precision wideband measurements, a 50-ohm input scope is needed. For probing, high input impedance is generally required. Both impedance levels are now available in one plug-in—the 100-MHz, 3.5-ns-rise-time Model 1805A dual-channel vertical amplifier for the 180 oscilloscope system. Selection is made through a switch on the panel.

The 1-MΩ, high-input impedance is shunted by only 13 pF. The usual rotary-switch, discrete-resistor attenuator contributes 25 pF. H-P halves capacitance with a thick-film approach, depositing resistances and conductors on an alumina substrate, thus improving attenuator rise time by a factor close to two. Resistors are trimmed to 0.5%, providing an over-all attenuator accuracy of better than 2%.

The 50-ohm input has a low VSWR of 1.35 at 100 MHz on the 5 mV/div range, and an even better 1.1 on all others. In the 50-ohm mode, a substantial 2 W can be dissipated. This permits inputs up to 10V RMS to be safely applied.

Additional standard features of the plug-in are ±200 divisions of offset; a vertical signal output with greater than 50 mV/div of display up to 80 MHz, operating into 50 ohms; and pushbutton controls for easy operation. The high-level and low-noise signal output is useful in cascading amplifiers to increase sensitivity for low-level measurements. In this configuration the amplifiers provide a 500 uV/div deflection factor with at least 80 MHz bandwidth.

Offset capability of ±200 divisions allows a nonsymmetrical (biased) logic pulse to be positioned on the screen. ECL logic signals operated with 0.5 V swings and biased several volts from ground are a good example. To maintain dc coupling, offset is required to view this type of signal at high amplitude.

Deflection factor ranges from 5 mV/div to 5V/div in 10 calibrated steps in a 1, 2, 5 sequence for both channels. Operation in a ±A ±B mode is included. The dynamic range is six divisions at 100 MHz. A vernier provides continuous adjustment between ranges and extends the maximum deflection factor to 12.5 V/div. Input signals are delayed sufficiently to permit viewing the leading edge of an input pulse without advancing the trigger.

At the heart of the electronics are three medium-scale integrated circuits with approximately 40 active circuits each.

CIRCLE NO. 250

DVM is insensitive to ac distortion

Dana Laboratories, Inc., 2401 Campus Dr., Irvine, Calif. Phone: (714) 833-1234. P&A: $3150; 30 days.

A new distortion-insensitive AC converter is used in Dana Laboratories Series 5800 digital multimeters. The converter measures the rms values of sine waves with distortion up to 5% with little loss of accuracy. Other 5-digit meters may measure such inputs to only 1%. DC accuracy is 0.003% for 24 hours (0.06% for 90 days). Four dc ranges from 1 V to 1000 V provide 10 μV resolution. Accuracy for AC from 10 Hz to 100 kHz is 0.04%. Resistance ranges have a resolution of 10 μΩ.

CIRCLE NO. 251

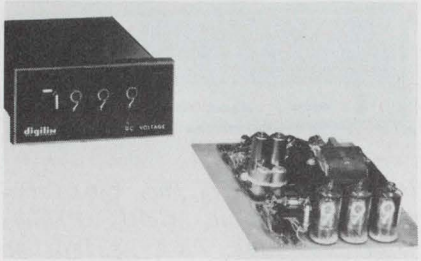
Sweep generators cover 1500 MHz range

Telonic Industries, Inc., Box 277, Laguna Beach, Calif. Phone: (714) 494-9401. P&A: $1095 to $1395; 30 days.

Models 1204 and 1205 sweep generators, designed for "universal" applications, each incorporate a complete sweep oscillator system, an attenuator and up to seven frequency markers in a compact housing measuring 8.75 in. by 6.75 in. by 12 in. overall. Model 1204 bandwidth varies from 200 MHz to a full sweep of 500 MHz. Zero to 1500 MHz in three bands is covered in Model 1205. Attenuator range is 102 dB.

CIRCLE NO. 252

DPM is available on a case-less card

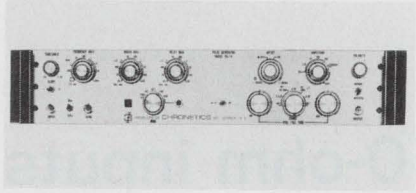


Digilin, Inc., 1007 Air Way, Glendale, Calif. Phone: (213) 240-1200. Price: $125.

Type 1352 DPM features case-less construction, with the electronics and 0.6-in. gas-discharge display tubes on a single card. Type 2352 adds an all-aluminum housing with room for the optional BCD output. Full scale reading is 1.999 V including overrange, with accuracy 0.1% of reading ±1 digit. All integrated circuits undergo active burn-in for long trouble-free life.

CIRCLE NO. 253

Pulse generator has 2 ns rise time



Chronetics, Inc., 500 Nuber Ave., Mt. Vernon, N.Y. Phone (914) 699-4400. P&A: $1450; stock to 30 days.

Rise time is less than 2 ns at 5 V output for Model PG-14 50 MHz pulse generator. With 20 V unloaded output from a 50 Ω source, the rise time is under 2.7 ns. The unit provides a double-pulse output to 75 MHz. In addition to four ranges of voltage output, operation in a current mode provides up to 400 mA from a 1 kΩ minimum source impedance. An output offset of 0 to ±100 mA is provided to vary dc pulse position.

CIRCLE NO. 254

80 MHz counters make 8-digit measurements

Heath/Schlumberger, Scientific Instruments, Benton Harbor, Mich. Phone: (616) 983-3961. Price: $350 and $500.

Models SM-104A and SM-105A 80 MHz frequency counters provide a time base switch and overrange indicator, enabling the user to make eight-digit measurements without prescaling on a five-digit display. In addition the SM-105A features a time base accuracy of 10 ppm. High speed Schottky TTL logic in the counters make one of the first uses of these devices. New light-emitting diodes are used for readout and overrange indication.

CIRCLE NO. 255

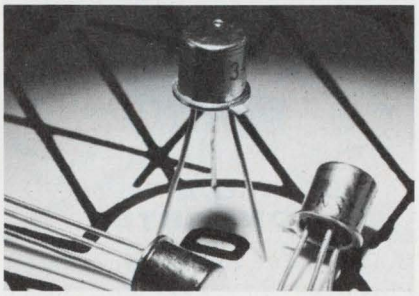
Pulse generator has variable rise time

E-H Research Laboratories Inc., P.O. Box 1289, Oakland, Calif. Phone: (415) 834-3030. P&A: $1595; 90 days.

A pulse generator with output pulse shape completely specified and almost ideal, the 50 MHz Model 135A has rise and fall times variable from 3 ns to greater than 8 ms, pulse width and delay variable from 10 ns to 50 ms and a 10 V output into 50 ohms. A baseline offset of 0 to ±5 V and positive or negative output facilitate interface with different types of logic circuitry. The unit can be triggered by low-level logic.

CIRCLE NO. 256

P-channel FETs halve capacitance

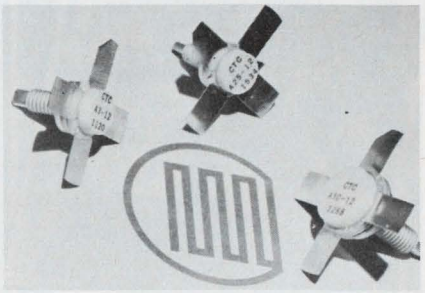


National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif. Phone: (408) 732-5000. Price $1.50 (PF510) $1 (PF511); (100 quantities).

Two new p-channel FETs have C_{ISS} of 12 pF—about half the typical value of similar FETS. The PF510 is a 30-V device while the PF511 is for 20 V. Both have 10-V max $V_{GS(OFF)}$, −2.5-mA min I_{DSS}, 200 Ω typical R_{DS}. I_{GSS} is 10 nA max in the PF510, 100 nA max in the PF511.

CIRCLE NO. 257

12-V power transistors operate to 50 MHz

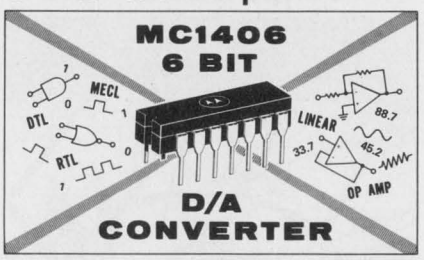


Communications Transistor Corp., 301 Industrial Way, San Carlos, Calif. Phone: (415) 591-8921.

A series of transistors for land mobile applications includes the 3-W A3-12, the 25-W A25-12 and the 50-W A50-12. A chain with one 3-W, one 25-W and four 50-W units can deliver 200 W at 25 to 50 MHz with 200-mW drive. Company performs 100% testing and guarantees devices to withstand infinite VSWR at rated power and voltage.

CIRCLE NO. 258

Monolithic d/a has 6 bits in a 14-pin DIP

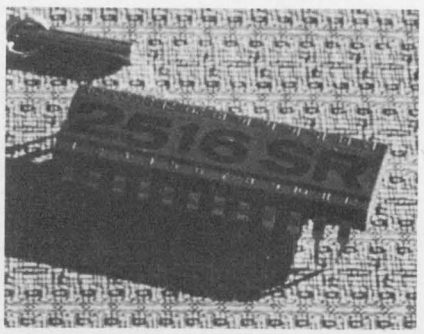


Motorola Inc., Semiconductor Products Div., P.O. Box 20934, Phoenix, Ariz. Phone: (602) 273-6900. Price: $3.95 (100 quantities).

The MC 1406 is a six-bit monolithic multiplying d/a converter in a 14-pin DIP package. The digital inputs are TTL/DTL compatible and settling time is 200 ns. The output is current, 2 mA maximum, with a drift of about 0.002%/C and an accuracy of 0.7% over 0 to 75 C. An external amplifier can convert the output to a voltage. Applying a varying input to the voltage reference terminal results in an output proportional to the product of this analog voltage with the digital input.

CIRCLE NO. 259

3072-bit ROM generates ASCII alphabet font



Signetics, 811 E. Arques Ave., Sunnyvale, Calif. Phone: (408) 739-7700. Price: $19.50 (100 to 249).

The 2516, a 3072-bit static ROM IC, generates the ASCII alphabet font with typical access time of 450 ns. The organization is 64 characters, each of which consists of eight 6-bit columns. Temperature range for normal operation is 0 to 70 C. The 2516 is manufactured in a silicone, dual-in-line 24-pin package.

CIRCLE NO. 260

Voltage comparators boast 40-ns response

Advanced Micro Devices, 901 Thompson Pl., Sunnyvale, Calif. Phone: (408) 732-2400. P&A: See text; stock.

A high gain of 40,000 leaves only bias and offsets as the factors controlling comparator error in the Am106 family, a pin-for-pin replacement for National Semiconductor's line. The family switches 24 V at 100 mA and provides fan-out of 10 with DTL/TTL. Strobe inputs provide output override. High speed and gain give low hysteresis, making for better Schmitt triggers, line receivers, discriminators. Prices in 100-up range from $6.80 to $20, depending on package and temp range.

CIRCLE NO. 261

Spst, spdt pin diodes optimized for power

Aertech, 825 Stewart Drive, Sunnyvale, Calif. Phone: (408) 732-0880. P&A: A9S112 ($55), A9S-212 ($170); stock to 30 days.

High-power pin diodes in spst and spdt configurations handle 70 W peak, 4 W cw. The spst A9S112 has 20 to 45-dB isolation at −100 mA control current while the spdt A9S212 has 50 to 60-dB isolation. Switching times from 100 MHz to 18 GHz are 50 ns for the spst, 200 ns for the spdt.

CIRCLE NO. 262

MNOS DDAs solve diff equations in real time

Collins Radio Co., Dept. 600, Newport Beach, Calif. Phone: (714) 833-0600. P&A: See text; stock.

Three LSI arrays—a quad serial summer (CRC9504), a quad gated shift register (CRC1502) and two full adders with overflow (CRC-9503)—perform complex integration and give real-time solutions of differential equations. Chips are compatible with other MOS devices or DTL/TTL. Logic is low-threshold, dynamic, two phase. In 10-up, summer costs $26.40, shift register $18.60, R-adder $26.55.

CIRCLE NO. 263

IC multiplier operates in four quadrants

RCA Solid State Div., Route 202, Somerville, N.J. Phone: (201) 722-3200. Price: $6.50 (1000 quantities).

Intended basically for multiplication, division, squaring, square-rooting and power-series approximations, the CA3091D is also useful as an automatic level controller, an rms converter, and a frequency discriminator. The unit includes a multiplier, linearity compensator, current converter, current sources for biasing and a voltage reference. Linearity is 4%, 3-dB bandwidth is 4.4 MHz, power drain is 4 mW from ± 6 V, low power-supply sensitivity is typically 64 mV/V. The device is packaged in a 14-pin DIP for −55 to +125 C.

CIRCLE NO. 264

256 × 4-bit TTL ROM gives 50-ns max access

Fairchild Semiconductor Div., 464 Ellis St., Mountain View, Calif. Phone: (415) 962-3816. P&A: see text; 4 to 8 wks.

A new bipolar, 1024-bit ROM, the 93406, has full on-chip decoding. A chip-select feature allows expansion to 1024 four-bit words without adding more gates. Maximum access time is 50 ns from 0 to 75 C. At 100-to-999 level, the ROM costs $16.50 in a 16-pin ceramic DIP plus a $500 one-time mask charge.

CIRCLE NO. 265

MOS/LSI calculator kit forms desk-top computer

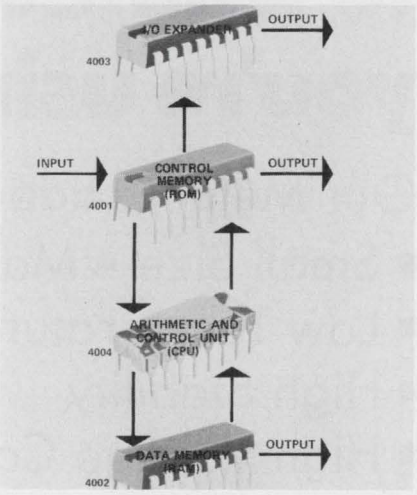
Solitron, 1177 Blue Heron Blvd., Riviera Beach, Fla. Phone: (305) 848-4311.

The latest addition to Solitron's line of calculator products is the 9000 series, an MOS/LSI calculator kit. It contains the entire logic electronics to implement a 10-digit desk-top electronic calculator. Four-function calculations are possible, including constant multiplication and division. The series is also available as a complete system.

CIRCLE NO. 266

ICs & SEMICONDUCTORS

CPU on a chip helps make full computer

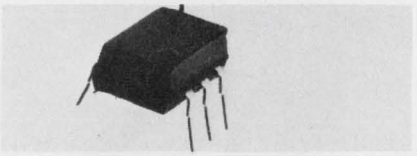


Intel Corp., 3065 Bowers Ave., Santa Clara, Calif., Phone (408) 246-7501. P&A: see text, stock.

A one-chip central-processing unit with a 4-bit parallel adder, 16 4-bit registers, an accumulator and a push-down stack—the 4004—can form the heart of a computer with the 4001, a 256 x 8-bit ROM, the 4002, a 320-bit RAM, and the 4003, a 10-bit serial-to-parallel register. At the 100-piece level, the 4004 costs $30, the 4001 $18, the 4002 $15 and the register $3.

CIRCLE NO. 267

Opto-isolators provide high-V breakdown



Litronix, Inc., 19000 Homestead Rd., Cupertino, Calif. Phone: (408) 257-7910. P&A: Iso-Lit 12, $1.70, Iso-Lit 16, $3.05 in 100-up; stock.

Two optical isolators have high breakdown voltage—1000 V for the Iso-Lit 12, 1500 V for the Iso-Lit 16 with, respectively, 10% and 14% typical current-transfer ratio, and 2 pF and 0.5 pF typical coupling capacitance. In each, a gallium arsenide LED transmits infrared to an npn phototransistor which can directly drive 930 DTL or 7400-series TTL.

CIRCLE NO. 268

DATA PROCESSING

Cartridge transport uses single motor

Astro-Science Corp., 9700 Factorial Way, S. El Monte, Calif. Phone: (213) 443-3211.

A tape transport for audio/instrumentation applications incorporates the recently patented peripheral drive system wherein the two tape packs are driven on their periphery by individual capstans. The Astrodrive transport requires only a single motor, unlike conventional transports that require three motors, to drive the tape reels and capstans. Advantages include: relative immunity to shock, vibration and temperature environments; all parts of the tape move together from one drive source eliminating tape stresses; higher acceleration rates and faster start/stop times; low power consumption.

CIRCLE NO. 269

Cassette recorder replay on X-Y chart recorders

Tetrahedon Associates, Inc., 7605 Convoy Ct., San Diego, Calif. Phone: (714) 277-2820.

An auto-ranging, eight-channel magnetic tape cassette recorder, the Data Manager, expands, contracts, or rescales data in either axis. Using auto-ranging, all incoming and outgoing signals are scaled in digital format over a 3 decade (1000X) range.

CIRCLE NO. 270

Buffered tape transport has 2048 character size

Pertec Peripheral Equipment, 10880 Wilshire Blvd., Los Angeles, Calif. Phone: (213) 475-8464.

A buffered magnetic tape system allows the transfer of blocked NRZI or phase-encoded formats at rates up to 1 million characters per second, asynchronously. Using a dual-buffer option, data can be transferred continuously at rates up to 60,000 characters per second (phase encoded) or 40,000 characters per second (NRZI), with zero data loss. This is achieved by transferring data into one-half of the buffer until that half is full, and then switching data into the second half while data in the first half is being written on tape.

CIRCLE NO. 271

ROM compatible with PDP-14, PDP-16

Datapac Inc., 18872 Redhill Ave., Santa Ana, Calif. Phone: (714) 546-7781. Price: 2¢/bit.

A fully decoded Read-Only-Memory that includes data registers has performance guaranteed with ±5% voltage margins and over the 0 C to +70 C temperature range. The dimensions of the unit are 5.2 by 8.5 by 1.25-in. Running from a single +5.0 V power supply, system access times of 200 ns and cycle times of 500 ns are easily attainable.

CIRCLE NO. 272

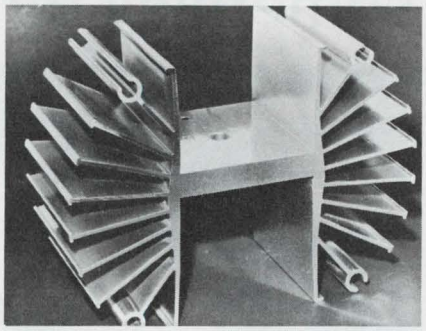
Buffer memory stores 1024 8-bit words

Computer Labs, 1109 S. Chapman St., Greensboro, N.C. Phone: (919) 292-6427. Availability: stock.

The Model CLM 810-1 is a high speed buffer memory which will accept 8-bit words as parallel data at any random or periodic word rate through 10 MHz. It will output these words as a block of data on a first-in, first-out basis at word rates through 2 MHz. It is non-volatile and has a non-destructive readout characteristic.

CIRCLE NO. 273

Uniquely shaped heat sink dissipates 200 W

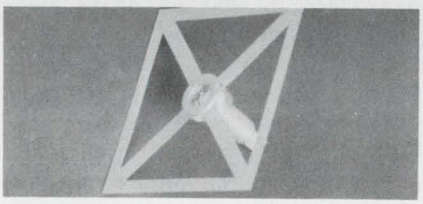


TOR Heat Sink Div., Precision Dipbraze Tor, Inc., 14715 Arminta St., Van Nuys, Calif. Phone: (213) 786-6524.

A large heat sink, Model 1727, has a unique configuration for sinking high power from control circuits, rectifiers and inverters up to 3.5 in. The radial-fin heat sink has 118.3 in.²/in. of heat dissipating surface in natural or forced-air convection use. With two power devices mounted on a six in. length and dissipating 100 W each, the surface temperature rises less then 50 C above ambient.

CIRCLE NO. 274

High reliability power package good at 2 GHz

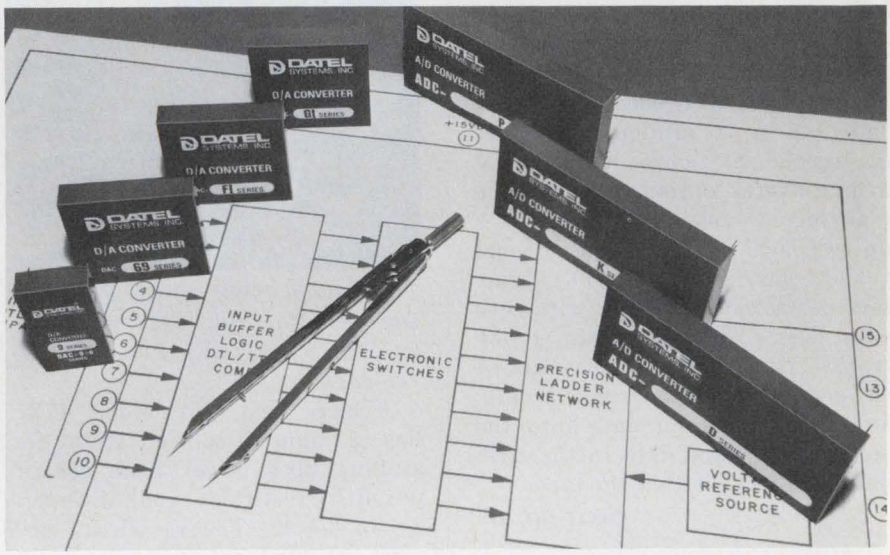


American Lava Corp., Manufacturers Rd., Chattanooga, Tenn. Phone: (615) 265-3411. Availability: 6 wks.

A standard high reliability hermetic power package has superior power dissipation characteristics up to 2.0 GHz and is useful into the microwave region. Exceptionally high reliability results by not using glass. A beryllia ceramic serves as a base and is brazed to a multilayer ceramic component, combining the heat sink capability of beryllia and the strength and bonding capability of alumina. Blueprints, technical data and samples are available.

CIRCLE NO. 275

D/a and a/d line offers something for everyone



Datel Systems, Inc., 1020 Turnpike St., Canton, Mass. Phone: (617) 828-6395. Prices: See text.

Datel System's full line of d/a's and a/d's carries out this theme: A converter to fit almost any application and pocketbook.

Its a/d converters cover the spectrum in accuracy, conversion speed and resolution, with price matching performance. Where cost governs, consider the ADC-59 series at $59, converting to eight binary bits in 200 μs or to two-digit BCD in 100 μs.

Linearity is 0.2% FS with a temperature coefficient of 50 ppm /C over 0 to 70 C. Long-term stability is 0.05% a year. Analog input range can be either unipolar (0 to +10 V) or bipolar (±5 V). For unipolar input, the unit it programmed with a logic zero input, and straight binary, or two-digit, BCD output results. For bipolar inputs, offset binary coding results when the unit is programmed with a logic ONE. The converter module package size is 2 x 3 x 0.4 inches.

At the top of the ADC line are two ultra-high-speed converters: the N12B generates a 12-bit word in 4 μs, and the P10B converts to 10 bits in 2 μs. The cost is the same: $695. The temperature variation is 20 ppm/C over a range of 0 to 70 C. Stability is 0.1% a year. Four analog input full-scale ranges are available: +5 V, +10 V, ±5 V, ±10 V. Input impedance is constant at 2 k. The diallyl phthalate case measures 2 x 4 x 0.8 inches.

Series D, K and EX round out the a/d converter line. The D and K types feature a direct serial digital output for single-channel transmission, in addition to standard parallel output. Output coding is straight or offset binary, or two's complement in word lengths of 8, 10 or 12 bits. Conversion time is 50 μs for type K.

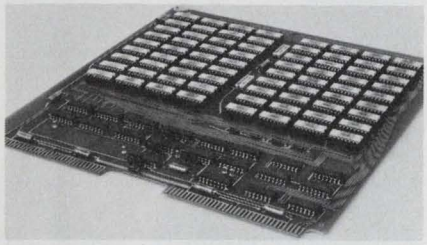
The price for the d/a converter line of 20 models starts at $9.95 for the 8-bit Model DAC-98B with current output. Settling time is 300 ns.

For glitch-free operation (< 10 mV) and 25-ns settling time, computer graphic display designers should consider the DAC-GI series. The 10-bit unit in the GI series costs $139. With 8-bit input and 50-ns settling time, Model F18B in the series costs $99. Linearity is the same for both series: 1/2 LSB. The temperature coefficient is 15 ppm/C, and accuracy is 0.05% FS. Standard output is +5.0 mA unipolar. Bipolar ±2.6 mA is obtained by strapping pins.

All d/a converters require only ±15 V dc power input and are packaged in 2 x 2 x 0.4 inch low-profile modules.

CIRCLE NO. 276

MOS RAM system with 4kx20 bits fits on card

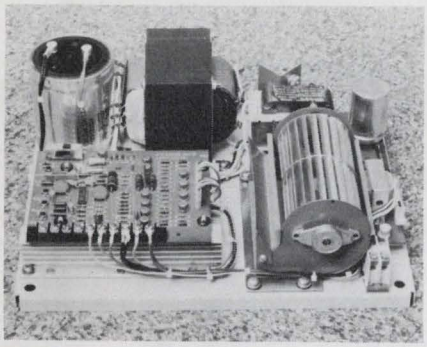


Monolithic Systems Corp., 2700 S. Shoshone, Englewood, Colo. Phone: (303) 761-2275. P&A: 4k x 16 unit $876 (100 quantities); 30 days.

Monostore IV/Planar is a complete MOS random access memory system with up to 4k x 20 capacity on a single PC card 9-3/4 in. by 12 in. System circuitry for timing, control, refreshing and decoding and the address and data output registers are included. Cycle time is 790 ns with access in 490 ns. Inputs and outputs are TTL-compatible. Multiple cards are packaged on 0.5 in. centers.

CIRCLE NO. 277

Servo amplifier has fast response



Westamp, Inc., 1542-15 St., Santa Monica, Calif. Phone: (213) 393-0401. Price: $350.

Model A 5261 servo amplifier will speed a low-inertia motor to 1000 rpm in less than 1 ms, or develop 350 oz-in of continuous torque on a low-speed 40 Frame motor. The amplifier is used in high speed computer-peripheral equipment to position radar antennas or in machine tool axis control. Continuous short-circuit rating is 4.5 A. A power supply is included for operation from 115 and 220 Vac at 50 to 60 Hz.

CIRCLE NO. 278

S/h amplifier has accuracy of 0.01% FS

Zeltex, Inc., 1000 Chalomar Rd., Concord, Calif. Phone: (415) 686-6660. P&A: $39 (100 quantities); stock.

ZD 451 sample and hold amplifier features sampling accuracy of 0.01% FS, 10^{11} Ω input impedance and a settling time of 7 μs for a 0 to 10 V step. The user selects inverting or non-inverting operation and gain from +1 to +100. Aperture is 50 ns. The DC input lines can vary from ±12 V to ±18 V. The low profile plastic case measures 1.96 in. by 1.76 in. by 0.4in. high.

CIRCLE NO. 279

D/a with eight bits sells for $9.90 (1-9)

Hybrid Systems Corp., 95 Terrace Hall Ave., Burlington, Mass. Phone: (617) 272-1522. P&A: $9.90; stock-4 wks.

An 8-bit d/a converter, Model 371-8, with a built in reference, plugs into an IC socket. Full scale current output is 2 mA developing up to 1.25 V across an external resistor. The unit accepts DTL/TTL inputs and settles within 950 ns. Linearity is within ±1/2 LSB and temperature variation is 100 ppm/C. The dc power required is +15 V at 10 mA.

CIRCLE NO. 280

12-bit d/a converter is specified thoroughly

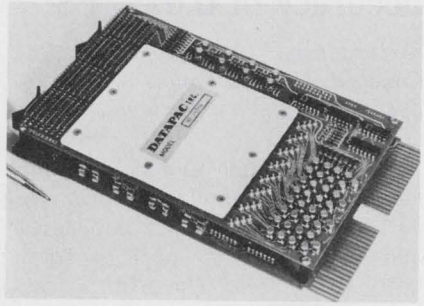
Burr-Brown Research Corp., International Airport Industrial Park, Tucson, Ariz. Phone: (602) 294-1431. P&A: $90-$125; stock to 4 wks.

Performance is spelled out thoroughly on DAC-40 8 to 12-bit high speed d/a converters. Gain drift is 7 ppm/C on the 12 bit unit, linearity 1/2 LSB over 0 to 70 C, offset drift 1 ppm/C and the output settles to 0.01% of final value in 5 μs for a full scale input step, 1.5 μs for a 1 LSB change. Bipolar or unipolar full scale output up to 10 V can be specified.

CIRCLE NO. 281

MODULES & SUBASSEMBLIES

Braided-wire memory is field alterable

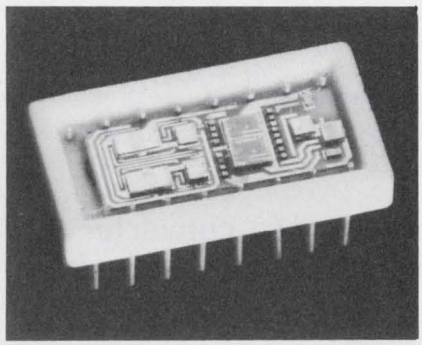


Datapac Inc., 18872 Redhill Ave., Santa Ana, Calif. Phone: (714) 546-7781.

A new braided wire alterable read-only memory system organized as 1,024 words of 16 bits each is furnished on a 5.2-in. by 8.5-in. by 1.25-in. PC card. The self-contained, fully decoded system also contains data registers and is TTL-compatible. Operating from a single +5 V power supply, system access times of 200 ns and cycle times of 500 ns are obtained. Individual bits, words or the entire memory contents can be changed in the field.

CIRCLE NO. 282

Low-cost 8-bit d/a converter costs $59



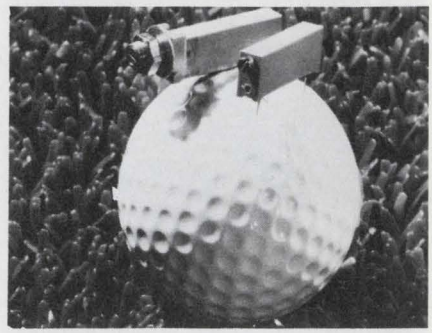
Micro Networks Corp., 5 Barbara Lane, Worcester, Mass. Phone: (617) 756-4635. P&A: $59; stock to 2 wks.

A new low-cost 8-bit d/a converter contains an input storage register, monolithic switches, precision ladder network, internal reference and op amp. The model MN328 is housed in a hermetically sealed 16-pin DIP package and requires only ±15 V and ±5-V supplies to operate.

CIRCLE NO. 283

COMPONENTS

Wirewound trimmer is smallest ever built

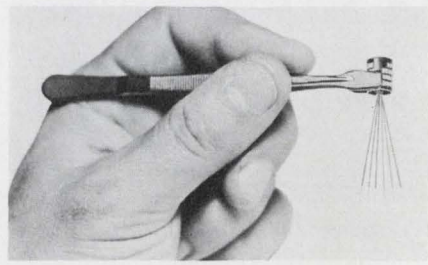


TRW Electronic Components, 2801 72nd St. North, St. Petersburg, Fla. Phone: (813) 347-2181. P&A: $1.68; stock.

The 901 is designed to interchange with all of the popular 1-1/4-in. wirewound trimmers on the market today (RT11P and RT12Y configuration). At 10-Ω, the lowest resistance value, the 901 has unity resolution. A very low 0.15% resolution is available at 20 kΩ This resistor is housed in a flame retardant molded plastic case measuring only one inch long. Offered in a resistance range from 10-Ω to 50-kΩ, it has a power rating of one watt at 70 C with an operating temperature range of −55 C to +150 C.

CIRCLE NO. 284

Transformers are 11/32-in. dia. by 15/32

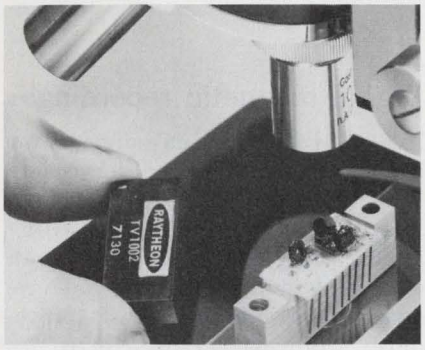


Pico Electronics, Inc., 316 W. 1st St., Mt. Vernon, N.Y. Phone: (914) 699-5514. P&A: $3 to $10; 1 wk.

A standard line of ultraminiature transformers guarantees all units to pass thermal shock requirements of MIL-STD-202D, Method 107, Test Condition A-1 (25 cycles). Primary and secondary impedances are 3 to 250 kΩ; ±3 dB 300 Hz — 100 kHz; 600 mW.

CIRCLE NO. 285

Thin film hybrid rf amps offer 29 dB gain



Raytheon Co., Semiconductor Div., 350 Ellis St., Mountain View, Calif. Phone: (415) 968-9211. P&A: $100, $80 respectively; 14 days.

The TV1001 and TV1003 thin film hybrid rf amplifier power modules occupy a compact package: the electronics portion measures 0.15 cubic inch, the aluminum heat sink 0.26 cubic inch. The TV1001 has a frequency range of 40 to 300 MHz (±0.5 db) and delivers a minimum gain of 29 db. Noise figure is 9 db. The TV1003 has a frequency range of 2 to 130 MHz (±0.5 db). It has a gain of 17 db and a maximum noise figure of 7 db. Both amplifiers operate from a supply voltage of 24 V and have an input/output impedance of 75 Ω. The supply current is 310 A (maximum) for the TV1001 and 200 A (maximum) for the TV-1003.

CIRCLE NO. 286

GaAsP LEDs boast 2600 foot lamberts

Chicago Miniature Lamp Works, 4433 N. Ravenswood Ave., Chicago, Ill., Phone: (312) 784-1020. Availability: stock.

A line of high brightness GaAsP light emitting diodes, dubbed the CMA-20 series, is provided with a choice of a clear (transparent) or diffused (translucent) epoxy lens in either clear or red. Rigid terminals permit the device to be connected in a number of ways, soldered, welded, wire-wrapped or plug-in. IC compatible, the CM4-20 series produces 2600 foot lamberts at 70 mA. At 2-10 mA 50 foot lamberts are produced.

CIRCLE NO. 287

Ceralam capacitors offer volumetric efficiencies

Aerovox Corp., New Bedford, Mass. Phone: (617) 994-9661.

Extended-range axial and radial lead capacitors provide considerable space saving through the use of Ceralam ceramic dielectric. Designated Aerovox Type MC and ML, the units are available in capacitances ranging from 1 pF to 7.5 μF in tolerances from ±1% to 20% and with NPO, X7F and Z7R temperature characteristics. Ceralam volumetric efficiencies make possible units rated at 1 μF @ 50 V in a case size only 0.29-in. square, 0.09-in. thick for a radial lead unit, with the largest of the axial lead units only 0.69 by 0.35-in. for 7.5 μF @ 25 V.

CIRCLE NO. 288

Dual-in-line delay has 50 to 150 ns times

Potter Co., 500 W. Florence Ave., Inglewood, Calif. Phone: (213) 678-2651. P&A: $4; 2 to 6 wks.

The Series 7530 advanced version, dual-in-line delay lines feature a high density package only 0.785-in. long, 0.250-in. high, and 0.240 (or .260) in. wide. Fully encapsulated in epoxy resin, the new delay lines have impedances of 50, 100 and 200 ohms, 10 taps, delay times from 50 to 150 ns, and rise times from 12 to 35 ns. They employ Kovar leads.

CIRCLE NO. 289

Fuseholder series saves PC board space

McGraw-Edison Co., Bussman Mfg. Div., University & Jefferson St., St. Louis, Mo. Phone: (314) 421-1740.

The BUSS HTA series fuseholder is available in three terminal types: symbol HTA has solder terminals; HTA-HH has 1/4-in. quick-connect terminals and HTA-DD has 3/16-in. quick-connect terminals. The HTA series fuseholder measures only 1-25/32 in. over-all. It extends just 1 in. behind the panel and requires only a 1/2-in. mounting hole. The holder takes 1/4 by 1-1/4-in. fuses.

CIRCLE NO. 290

application notes

Digital IC programs

A digital Integrated Circuit Program Library listing all popular digital IC families with associated MSI and special purpose devices is divided into families such as DTL or TTL and is further subdivided into series, for example the 7400 and 9300 series. Each series is separately listed, showing the various manufacturers of the series and their unique designation. Logic gates, flip-flops, adders, decoders, data selectors, etc., require no special programming effort and are grouped as standard programs having a fixed price. More complex programs for MSI and special purpose devices are listed separately with a price for each. Microdyne Instruments, Burlington, Mass.

CIRCLE NO. 291

Measuring popcorn noise

An eight-page booklet, "Measurment of Burst ("Popcorn") Noise in Linear Integrated Circuits," describes random abrupt output voltage pulses in the order of 0.5 ms to several seconds in duration. This application note details the method by which RCA tests its new low-burst-noise devices (such as the recently announced CA6741T operational amplifier). RCA Solid State Div., Somerville, N.J.

CIRCLE NO. 292

Circuit breakers

Heinemann's latest Ideafile, "Control 'tricks' that use circuit breakers," contains numerous schematics and special-circuit descriptions. Various special circuits permitting the passage of control signals in addition to lead current through Heinemann circuit breakers are discussed, and their use in simplifying limit-control systems is demonstrated. Heinemann Electric Co., Trenton, N.J.

CIRCLE NO. 293

Digital magnetic recording

A 32-page design digest for digital magnetic recording covers 1/2-in. IBM-compatible plus 1 and 2-in. heads for digital recording applications. Eight pages of depth design and application factors, five pages detailing test procedures, information on Nortronics new LTC process which extends digital head life by a factor of ten —plus a complete catalog section describing important electrical and mechanical parameters inherent to Nortronics magnetic heads for modern digital applications are included. Nortronics Co., Inc., Minneapolis, Minn.

CIRCLE NO. 294

Analyzing random signals

Use of signal averaging computers in random processes is described in a four-page application note, T-246. The method described permits measurements never before possible in a wide variety of applications areas, such as in boundary layer turbulance measurements in the field of fluid mechanics. Princeton Applied Research Corp., Princeton, N.J.

CIRCLE NO. 295

Graphic recorder interface

An eight-page application note describes a versatile instrument interface for graphic recorders. Strip chart and X-Y recorders are probably the most widely used readout devices for instrumentation. Usually, they are built to display a single type of electrical signal. The MPI note describes over twenty setups of signal processing functions. These include typical tasks such as offset, attenuation, amplification and log ratio recording. Less common jobs include derivative, integration, differential, chopped dual channel, overrange alarm, and current to voltage recording, etc. McKee-Pedersen Instruments, Danville, Calif.

CIRCLE NO. 296

new literature

DEC small computers

A 500-page handbook describes PDP-8/e and PDP-8/m minicomputers and their varied applications. The brochure details how the PDP-8 family computers are manufactured, designed, and used. Digital Equipment Corp., Maynard, Mass.

CIRCLE NO. 297

Linear ICs for industry

A quick-reference produce guide is available on 104 RCA linear integrated circuits for industrial applications. This new guide (Form No. LIC-247) includes functional diagrams on a wide variety of op-amps, arrays, voltage regulators, zero-voltage switches, differential amplifiers, broadband video amplifiers; cross-reference of competitor types; a list of application notes and reprints. RCA Solid-State Div., Somerville, N.J.

CIRCLE NO. 298

Software for the Varian 620

A 12-page brochure detailing the operation of software packages offered with the 620 computer family describes Vortex, a new multi-task real-time operating system for the Varian 620/f. Varian Data Machines, Irvine, Calif.

CIRCLE NO. 299

How to design memories

A 28-page handbook on instructions for building semiconductor memory systems with Type 1103, the 1024-bit dynamic MOS RAM outlines the internal organization and operation of the chip, describes basic system design, and contains instructions for building the required peripheral circuits for level shifting, timing generation, refresh control and power. Also covered are means of protecting the system from damage, methods of reducing power in large systems, a technique of low-power data retention and the layout of PC boards. Intel Corp., Santa Clara, Calif.

CIRCLE NO. 300

Microfilm products

A 32-page illustrated catalog describes all microfilm products available from Kodak. "Kodak Microfilm Products: 1972" gives features and specifications of the company's full microfilm products line from basic micrographic equipment (including the Instamatic microfilm system) through computer-output microfilmers and the new Miracode II information storage and retrieval system. Eastman Kodak Co., Rochester, N.Y.

CIRCLE NO. 301

Core array test system

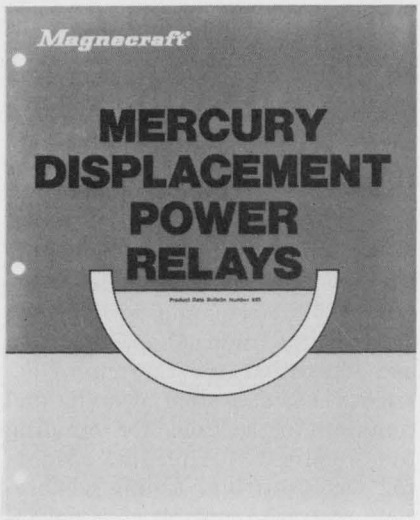
A four-page brochure describes the recently introduced M250 Memory Array Test System for use in production testing or a single type or a limited number of individual types of memory core arrays. Computer Test Corp., Cherry Hill, N.J.

CIRCLE NO. 302

Templates

The 1972 catalog of Templates, a 24-page catalog, illustrates and describes 200 templates. RapiDesign Inc., Burbank, Calif.

CIRCLE NO. 303



Mercury power relays

An eight-page, two-color catalog completely describes applications and principles of operation of mercury displacement power relays offering 20 to 100 ampere switching capability. Included are specifications, dimensions, contact ratings, and pricing information. Magnecraft Electric Co., Chicago.

CIRCLE NO. 304

Peripherals and interfacing

A 294 page handbook on peripherals and interfacing is intended for persons interested in any PDP-11 family system. It describes standard PDP-11 peripherals and options and provides detailed information on interfacing to the PDP-11 Unibus. Digital Equipment Corp., Maynard, Mass.

CIRCLE NO. 305

RF component catalog

A 16-page rf signal processing component catalog describes the selection and operation of a mixer, and defines the terminology of the mixer industry. It also provides application material, specifications and packaging information on Relcom's rf component line. An application section gives details for using mixers as amplitude modulators, phase detectors, switches, bi-phase modulators, current-controlled attenuators and up-down frequency converters. Relcom, Palo Alto, Calif.

CIRCLE NO. 306

Cermet trimming pots

The Series 72 Cermet trimming potentiometers are featured in a new catalog sheet. Models 72 PM, 72 P, 72 PX and 72 XW, designed for application in instrumentation, computers, peripheral equipment, and a broad range of industrial uses are fully described. These 3/8-in. singleturn units under full rated power offer a life expectancy of well over five years of continuous duty. Beckman Instruments, Inc., Helipot Div., Fullerton, Calif.

CIRCLE NO. 307

Digital circuit testers

A four-color booklet describes 720 Series of automatic digital circuit testers. The booklet contents are divided into a product feature section including test patterns each of the test modules is capable of performing, a section illustrating and explaining control and display console features of each tester and a resume of the operation theory behind the series. Microdyne Instruments, Inc., Burlington, Mass.

CIRCLE NO. 308

Log IF amplifiers

An eight-page technical information bulletin describes ultra-precision matched logarithmic IF amplifiers. Known as Log Amp Bulletin LA 201, it details the problems, considerations, circuit concepts, test methods and computer checkout procedure employed to establish the linearity, stability and matching of their precision log IF amplifiers. RHG Electronics Laboratory, Inc., Farmingdale, N.Y.

CIRCLE NO. 309

Interconnection components

A 16-page catalog of computer interconnection components includes illustrations, outline drawings and technical data on EMC's line of dual-in-line packaging systems, panels and sockets, soldertail transistor & IC sockets, component adaptor plugs, interfacing plugs, tools and accessories. Electronic Molding Corp., Woonsocket, R.I.

CIRCLE NO. 310

bulletin board

An expanded **line of silicon npn transistors designated Hometaxial II** including **ten new devices produced by the hometaxial process,** has been announced by the RCA Solid State Div. With the introduction of these ten new types, RCA provides six balanced hometaxial families with three or four JEDEC registered devices per family, allowing the circuit designer to select from a broad range of types to meet his performance and cost requirements. Six new registered premium types extend the capability of the 2N-3054, 2N3441, 2N3442, 2N3772 and 2N3773, increasing voltage breakdown and providing more power-handling capability and increased safe-area-of-operation. Many low-cost applications do not need premium specifications. In response to this demand, RCA has registered four additional types from these same families to provide circuit designers with standard, economical devices to fit their objectives.

CIRCLE NO. 320

Ten more logic functions have been added to Motorola's MECL 10,000 series. The new devices are a quad OR/NOR gate, quad NOR gate, triple OR/NOR gate, triple NOR gate, triple exclusive OR/NOR gate, quad line receiver, dual OR-AND/OR-AND-INVERT, dual OR-AND gate, 4-wide OR-AND/OR-AND-INVERT, dual "D" latch. MECL 10,000 offers high-speed (2 ns typical gate propagation delay), low-power operation (nominal 25 mW/gate dissipation). Looking toward the designer who seeks medium and large scale integration (MSI/LSI) for his circuits, MECL 10,000 offers an on-chip power dissipation of less than 10 mW/gate.

CIRCLE NO. 321

Electronic Design

ELECTRONIC DESIGN's function is:

- To aid progress in the electronics manufacturing industry by promoting good design.
- To give the electronic design engineer concepts and ideas that make his job easier and more productive.
- To provide a central source of timely electronics information.
- To promote communication among members of the electronics engineering community.

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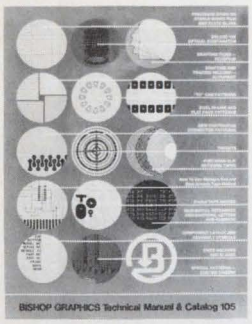

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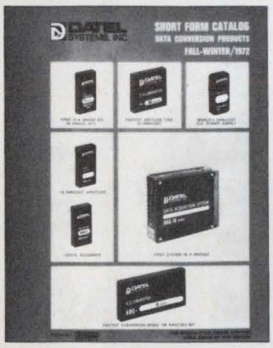

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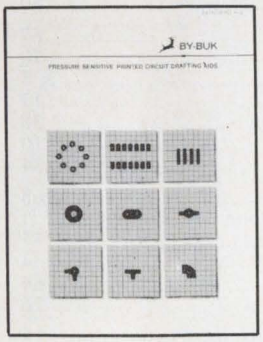

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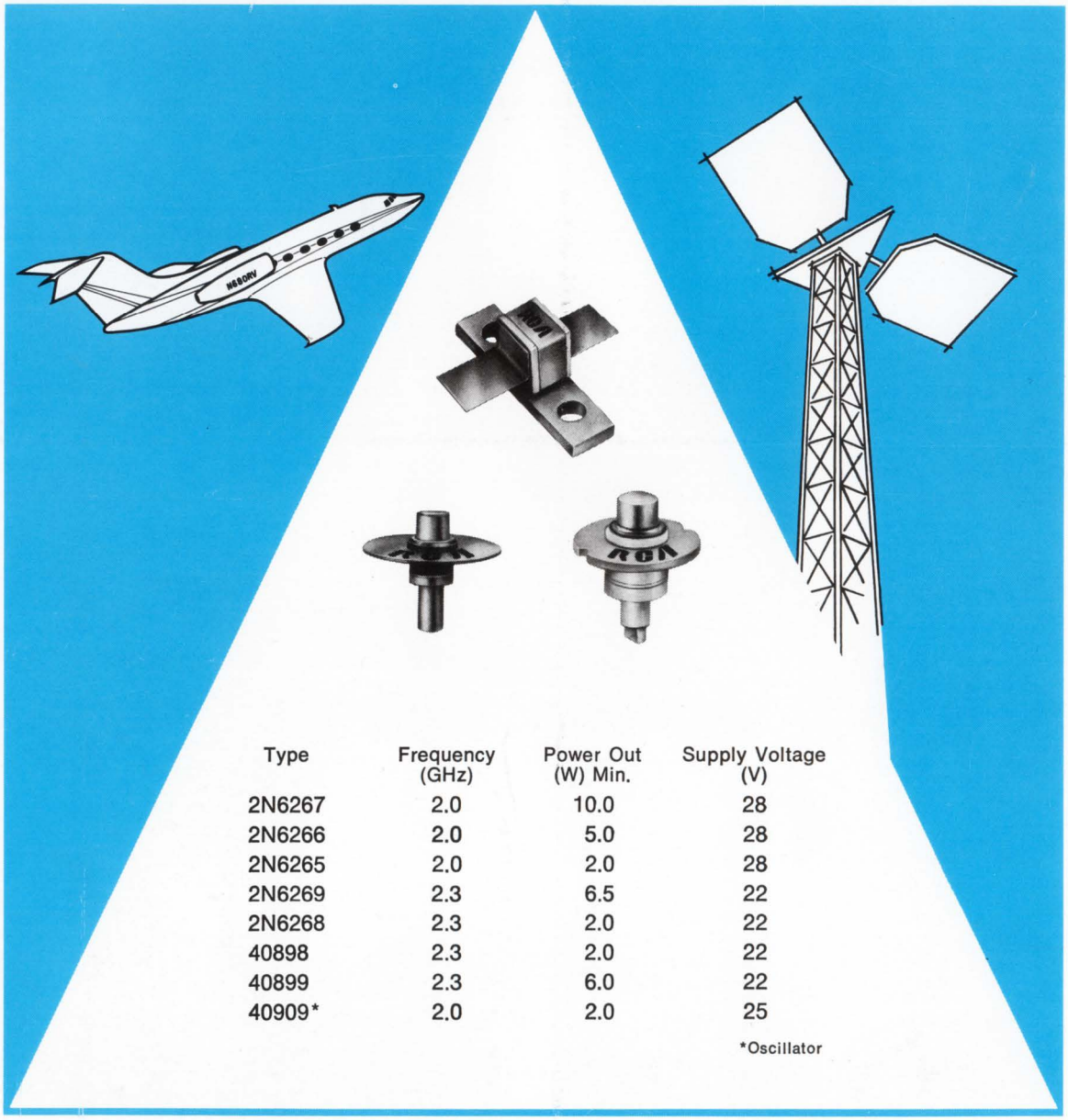

Type	Frequency (GHz)	Power Out (W) Min.	Supply Voltage (V)
2N6267	2.0	10.0	28
2N6266	2.0	5.0	28
2N6265	2.0	2.0	28
2N6269	2.3	6.5	22
2N6268	2.3	2.0	22
40898	2.3	2.0	22
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