FEBRUARY 16, 1978

THE 25TH ISSCC: HIGHER LEVELS OF LSI ON THE WAY/116

After a decade, bubble memories have arrived/75

New kind of tantalum capacitor cuts catastrophic failures/105

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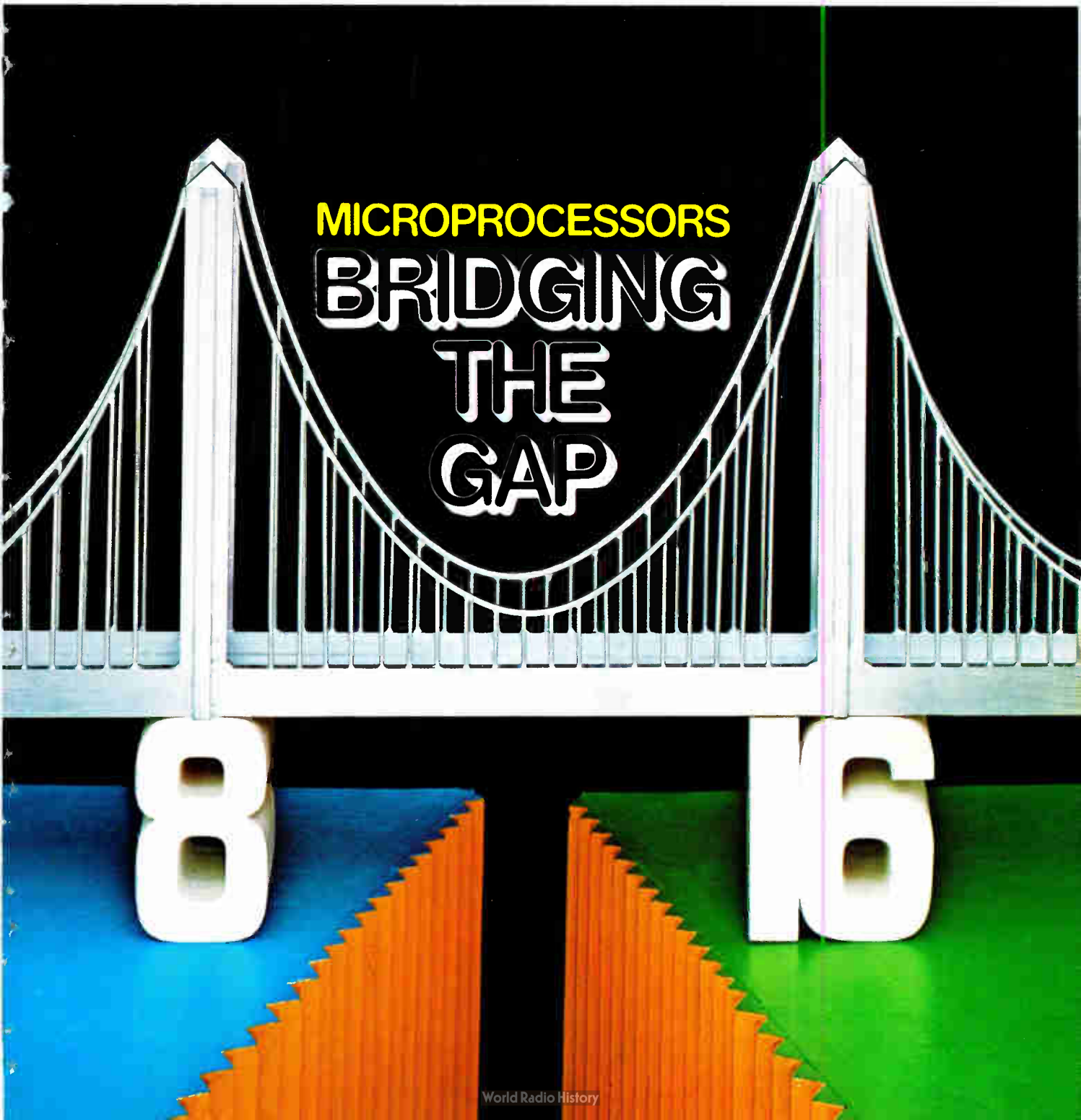
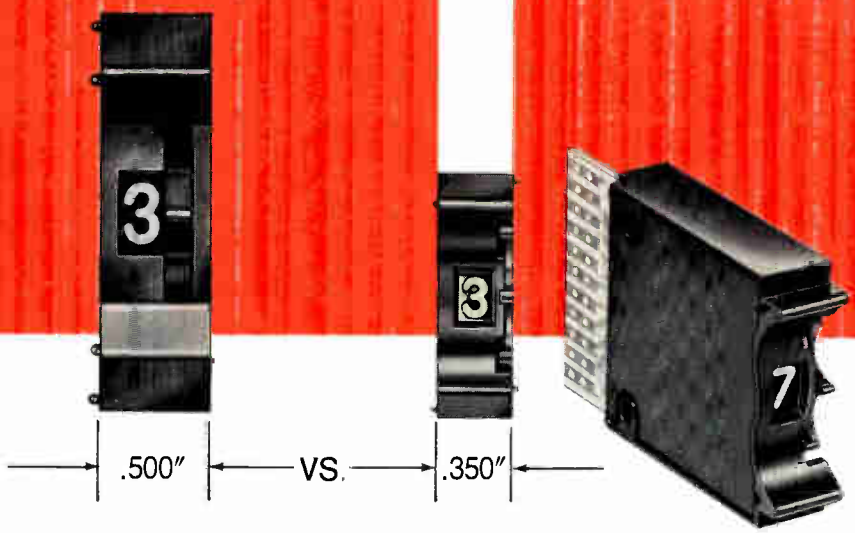
Electronics®

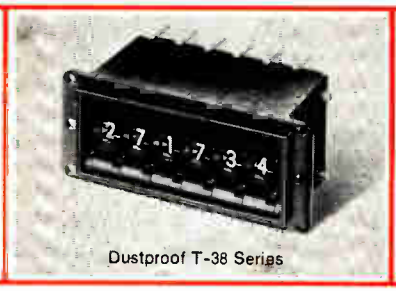


The narrow NEW thumbwheels with wide application

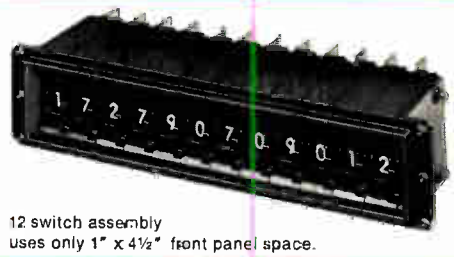


Two new slim thumbwheels...with slim prices, too.

Basic T-35 Series



Dustproof T-38 Series



12 switch assembly
uses only 1" x 4½" front panel space.

Two modestly-priced, slim subminiature thumbwheel switches offering substantial savings in panel space. The more switches you need, the more space you save. Available in two new designs:

The easy and accurate to use Series T-35 Basic Thumbwheel with all the high quality engineering and construction features that establish **Cherry** Thumbwheels as the standard by which you judge **other** thumbwheels.

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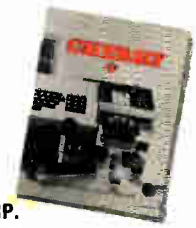

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Cherry switches now available locally from distributors.

Circle 1 on reader service card

Electronics
The International Magazine of Electronics Technology
Vo. 51, No. 4 • February 16, 1978

Highlights

Cover: 8080 family heads for 16 bits, 99
The new 8086 microcomputer executes the 8080 family's 8-bit instructions, as well as its own 16-bit set. Using the high-performance H-MOS process, it enhances the family architecture, thus letting designers use essentially the 8080 software package and development tools.

Cover is by Bob Strimban.

The figures behind EE salaries, 78
When the Institute of Electrical and Electronics Engineers surveyed its members on salaries and fringe benefits, it collected a host of data. Its report breaks down wages by technical and geographic areas and by a number of other categories.

All-tantalum wet-slug capacitor shakes failure, 105
Wet-slug capacitors that use tantalum for the casing, as well as for the anode, avoid the shorts and high leakage that plague silver-cased versions. The new units also have hermetic seals to prevent seepage of the electrolyte.

New designs galore at ISSCC, 117
The International Solid State Circuits Conference is celebrating its 25th anniversary by unveiling many large-scale integrated chips: digital, analog, and combinations for dedicated designs. This special report concentrates on memories (p. 117), analog devices (p. 122), and telecommunications chips (p. 125).

And in the next issue . . .
Testing microprocessors: a special report . . . field-effect transistors move into high-power radio-frequency applications.

GOOD AS GOLD.

Gold keeps the Motorola 1100 Series crystal clock oscillators on frequency longer.

In our 1100 series, the Motorola hybrid crystal clock oscillator is best in its class because it performs better and lasts longer —from 250 KHz to 70 MHz with a tolerance of ±1.0% to 0.0025%.

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Circle 7 on reader service card

Memories for any application:

Fujitsu's RAMs, ROMs, EROMs and PROMs.

Memory and memory-peripheral ICs. They are the most prevalent and critical part of today's digital systems and products—mainframes of all sizes, peripherals of all types, word-processing systems, terminals, point-of-sale units, communications systems and devices, business and scientific calculators. You depend on memory and memory-peripheral ICs. So you should know about Fujitsu's products and capabilities.

Just another 'me too' IC supplier? No way! Fujitsu is quite simply the world's most innovative IC manufacturer. Really? You bet!

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Design and process leadership: in these two critical areas, Fujitsu leads the industry. So-called 'second source' ICs from Fujitsu aren't just pin compatible, copied from licensed masks. They're created from scratch to meet or exceed the original spec, to make them the superior 'first source' choice. Fujitsu innovations in bipolar and MOS technology have delivered the highest performance of any manufacturer, at higher yields, with superior operating reliability.

Reliability that doesn't quit gives you lowest lifetime cost—on top of all the other Fujitsu advantages. Fujitsu's edge in reliability is a matter of record, in millions of sockets in the field worldwide.

Find out the full story. Get Fujitsu's Memory Product Selector Guide and Catalog. They tell you all you need to know about the entire Fujitsu memory and memory-peripheral IC line. Each device is supported with data sheets, applications engineering and a reliability story that will set you straight on the most reliable IC product line in the world.

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- ☐ Please send me the Fujitsu IC Reliability brochure
- ☐ Please send me the 4K dynamic RAM Ap. Note
- ☐ Please send me the 8K EROM Ap. Note
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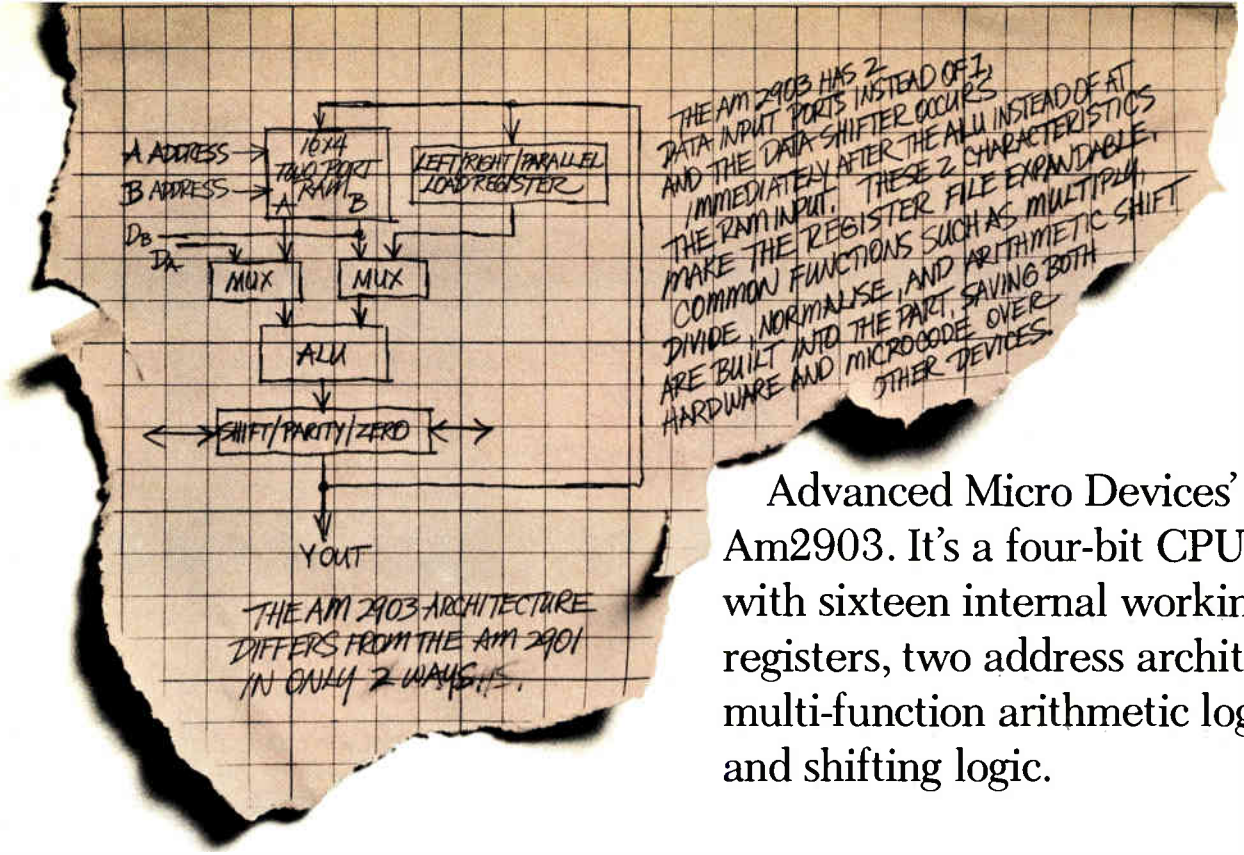
Circle 9 on reader service card 9



Advanced Micro Devices' new Am2903. It's a four-bit CPU slice with sixteen internal working registers, two address architecture, multi-function arithmetic logic unit and shifting logic.

AND NOW, THE SUPERSLICE.™

And if that's not enough, hang on.

The Am2903's register file is expandable. If sixteen registers aren't enough, add as many working registers as you want and still retain the two-address architecture.

For those of you who think two-address architecture isn't enough, we made three-address operation possible in the Am2903. For those of you who hate using SSI and MSI, we put all the extra hardware to do 2's complement multiply and divide right inside the chip.

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Circle 11 on reader service card

Putting the IEEE's salary survey to work

The 1977 survey of salary and fringe benefits conducted by the Institute of Electrical and Electronics Engineers affords an excellent opportunity to focus on the economic aspects of an engineering career. For one thing, EEs can use the survey as a guide in making decisions about job changes, relocations, and the like. It is to be hoped, too, that employers will take notice of it in evaluating their pay scales for engineers.

There also is something the institute should do. It is related to a statistic the survey failed to collect—the number of extra hours that EEs spend on their work, and the amount of spare time devoted to personal and professional improvement through advanced study, IEEE activities, and so on.

In point of fact, how important that word "profession" has become. Professionals are expected to work long hours and sacrifice for the cause, thereby advancing the fortunes of their profession. In the case of EEs, their employers benefit directly from these activities. However, some of them have taken advantage of this spirit to force EEs into uncompensated overtime. What's more, layoffs, age discrimination, and abuse of fringe benefit offerings continue.

On this score, the survey certainly drives home the need for portable pensions. A large majority of IEEE members depends on pensions as a major source of income after retirement. Yet, whether they will even get the benefits is a real question. Vesting on the average takes 10 years, and pensions begin after 30 years of service, according to the survey. How many EEs can fill these requirements?

It has been important both for the advancement of EEs professionally and for the continued vitality of technology for engineers to shift jobs—go where the action is. The regular movement of engineers has been a key factor in making the U. S. the leader in technology, a lead which is now being challenged from overseas. Therefore, it would be unwise to cramp the coming and going of EEs because of pensions. Why should engineers be punished in the pocket book for moving with the shifts in technology?

It's time, then, that the IEEE gets hopping on a portable pension program. There are serious legal difficulties in devising a good portable pension, but they are not insurmountable. Just about everyone agrees on the need for such a program. In other words, the institute need not run yet another survey to find out if members want a portable pension. It is already clear enough that the members want and need this program.

It's also important for the institute to focus on other abuses to members. Many activists in the IEEE accuse the leadership of being tools of management and, therefore, more concerned with the welfare of the industry than of the members when interests conflict. Yet the issue of identifying and reforming the employment practices that take advantage of EEs is not a conflict. It is a step that would help members professionally and upgrade the industry in general.

The institute has taken pains to convince members that it is being responsive. So far most of this activity has been internal, with the exception of the effort against wage busting. Now it is time to convince members that the IEEE is member-oriented by more external efforts. Surveys have to result in more than the collecting and printing of statistics. After all, there are people attached to all those numbers.

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We started out pretty small back in '61. But we were big on product quality and reliability. Had to be. Uncle Sam was our only customer. Over the years we stuck with our own technology. We grew. Became specialists. And we kept on improving our power supplies.

It all paid off. Just look at Abbott today.

Militarized Power Supplies — Our early bread-and-butter line has grown to over 1500 versions. Some we stock. Yet we're equipped to provide fast delivery on any number of high efficiency, hermetically sealed, single or dual output power supplies and switcher modules. That includes our popular 60 and 400Hz and DC versions with outputs from 3VDC to 740VDC, 1 to 250 Watts. And prices go as low as $174 for 2-4 units.

For Catalog Circle Card Number 100

Industrial Power Supplies — Ours isn't a big line yet — only 279 models. But you won't find a better quality of OEM power modules anywhere. (It's just our hi-rel way of thinking.) We provide covered/open frame, AC to DC single, dual and triple output versions, with outputs of 5 to 36VDC, 0.5 to 320 Watts. Plus DC to AC converters with 50 to 60Hz outputs. Competitively priced? You bet. As low as $35 for up to 24 units.

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Transformers — For the do-it-yourself power supply designer who wants our kind of quality for his own military, industrial and pcb application. If you're one of them, we offer over 800 standard transformers, with instructions on how to specify for your custom units. Included are 60 and 400Hz, single phase input versions. Prices start as low as $5.10 for up to 9 pieces.

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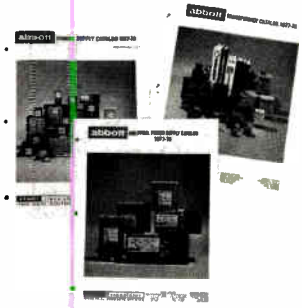
See Power Supply Section 4000, and Transformer Section 5600, Vol. 2, of your EEM catalog; or Power Supply Section 4500, and Transformer Section 0400, Vol. 2, of your GOLD BOOK for complete information on Abbott products.



abbott transistor

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MEASUREMENT COMPUTATION news

product advances from Hewlett-Packard

INTERNATIONAL edition FEBRUARY, 1978

Whether used on the bench or combined with a desktop computer for automatic measurements, this 1500 MHz spectrum analyzer brings new power to frequency-domain measurements.

Microprocessor-based 1.5 GHz spectrum analyzer offers state-of-the-art performance and usability

Ten-hertz resolution at 1500 MHz! That's just one of the major contributions of the new HP 8568A Spectrum Analyzer. This 100 Hz-to-1500 MHz analyzer's measurement range is −137 to +30 dBm, it measures signal frequencies to counter accuracy, it can measure 50-Hz sidebands that are 60 dB down, and its spurious-free dynamic range is ≥85 dB.

As you can see from the illustration, the analyzer's functions and operating state are keyboard selected. The instrument's internal microcomputer administers controls, calculates and manipulates data (including correcting for hardware inaccuracies), and provides new and useful operating features. Among these are tunable markers that greatly speed measurements, automatic peak search, automatic signal track, and complete CRT labeling of all pertinent operating conditions.

(continued on third page)

IN THIS ISSUE

Semiconductor memory at 5¢ a byte • Software libraries for System 45 • Programmable IC tester

Application note tells how to calibrate accelerometers automatically

A new, three-page application note, "Automatic Accelerometer Calibration", from Hewlett-Packard describes how HP's Data Acquisition System is being used to calibrate accelerometers. In tests made by the U.S. Army, accelerometers are used to measure the ground impact force on the cargo and its container package in order to relate the cargo's survivability to the force.

For your complimentary copy of this Application Note 204-1, check W on the HP Reply Card.

Powerful new spectrum analyzer

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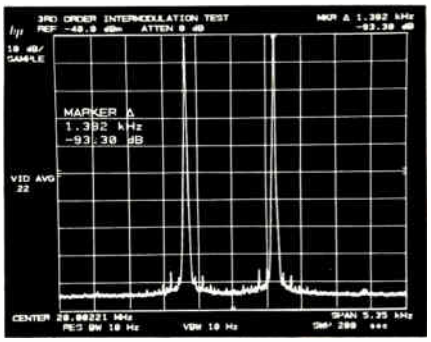
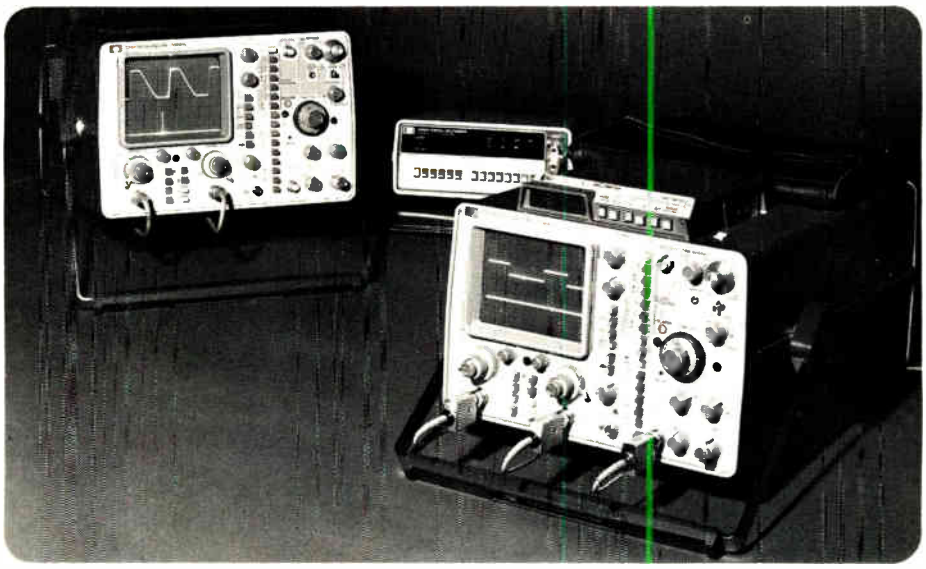


Two-tone test using 8568A shows 3rd-order intermodulation products >85 dB down.

All of the keyboard functions are remotely programmable via the HP Interface Bus such that the 8568A analyzer and HP 9825A desktop computer combine to form a friendly yet powerful automatic system with tremendous measurement capabilities. Challenging applications that can benefit from the spectrum analyzer-computing controller combination include electromagnetic interference (EMI) testing and spectrum surveillance.

To learn more about this revolutionary advancement in spectrum analysis, check A on the HP Reply Card.

Make timing measurements easily and accurately with two new high-frequency scopes



Like all new high-frequency HP oscilloscopes, the 1715A and 1725A have switch selectable 50 Ω or 1 MΩ inputs. And the 1725A with 275 MHz bandwidth, is the fastest 1 MΩ input oscilloscope available which reduces the need for active probes when working with fast logic near maximum fanout.

Now you can choose from two new HP delta time oscilloscopes which make timing measurements easily, with greater repeatability and one percent accuracy—the 1715A with 200 MHz bandwidth, or the 1725A with 275 MHz bandwidth. Both offer an optional, built-in DMM for direct delta time readout, plus autoranging AC/DC volts, amps, and ohms.

A large 8×10-centimeter CRT provides a dual, bright, crisp display on which timing measurements can be made conveniently and accurately, using the Hewlett-Packard developed delta time technique. This technique makes timing measurements such as transition times, propagation delay, clock phasing, and other high-speed digital timing measurements faster and with more repeatability than was previously possible with standard delayed sweep oscilloscopes. For easier percentage measurements, reference lines of 0 and 100% are 5 divisions apart so that each division represents 20% of the reference amplitude. Auto focus and intensity control circuits reduce the need for frequent intensity and focus adjustments, as well as improving CRT life.

Measurement capability is further enhanced by the logically arranged, easy-to-use front panel controls which speed operator familiarization, reduce the possibility of measurement errors and thus improve accuracy. Selectable 1 MΩ and 50 Ω input impedance make it easy to select the best input impedance for your measurement. Sweep speeds from 10 ns/div to 0.5 s/div allow you to expand your signals for maximum resolution and a ×10 magnifier provides one ns/div sweep speed for critical timing measurements.

In addition to faster and more accurate delta time measurements, both new oscilloscopes offer you a selection of channel A or B as the starting point for delta time measurements. This often eliminates the need to move probes and simplifies trace overlap for zeroing. But you can select conventional delayed sweep with the flip of a switch, for simple trace expansion. The optional autoranging 3½-digit DMM can be factory installed. Or, for easy field installation, a kit is available. Another option, HP's "Gold Button", gives you pushbutton selection of either time domain or data domain when the 1715A or 1725A is used with HP's 1607A Logic State Analyzer.

For more details, check E on the HP Reply Card.

Eleven software libraries for HP's new System 45 save costly programming time

System 45, the newest member of the Series 9800 Desktop Computers, combines with our 11 software libraries to save you costly programming time. Depending on your application, System 45 with its CRT and our software provide either a total solution or convenient building blocks for developing your specialized programs. This is what's available:

- **Utility Library**-consisting of two dozen useful, general purpose programs, free with each System 45.
- **Numerical Analysis**-50 powerful routines to handle fourier analysis and differential equations.
- **Regression Analysis**-a comprehensive package of programs for linear, stepwise and polynomial regression.
- **Basic Statistics & Data Manipulation**-programs to perform a wide variety of operations from means and standard deviations to complicated correlation coefficient calculations.
- **Waveform Analysis**-a unique group of programs to analyze large volumes of data based on fast fourier transform routines.
- **Management Science**-four libraries for text processing, linear programming, forecasting and graphics, and network analysis.
- **Business Administration**-libraries for payroll and inventory control.

For more information on System 45, check G on the HP Reply Card. For additional details on each of the software libraries, check H for Numerical Analysis; I for Regression Analysis; J for Basic Statistics & Data Manipulation; K for Waveform Analysis; L for Management Science; and M for Business Administration.

New microwave synthesizer application note

Application Note 218-2, *Obtaining Millihertz Resolution from the 8671A and 8672A*, the second from the Microwave Synthesizer Series, is now available.

The note describes how the HP 8671A and 8672A Microwave Synthesizers can be used in combination with other HP synthesizers to obtain resolution as fine as 1-3 mHz across the 2-18 GHz band. Some sample calculator sub-routines are given to aid programming of the system.

For your complimentary copy of Application Note 218-2, please check X on the HP Reply Card.

New meter makes fiber optic power measurements with ease and accuracy

A new power sensor/power meter combination designed specifically for measurements of signal power in single optical fibers is now available from Hewlett-Packard. By using the well-known detection principle of a thermistor bridge, absolute power is indicated on a meter.

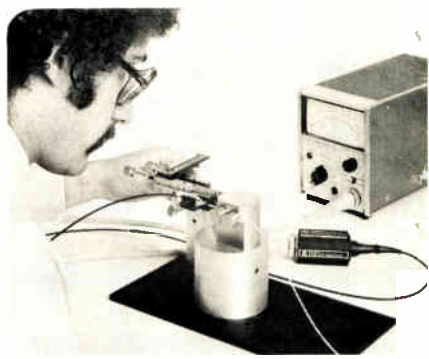
The HP 84801A Power Sensor contains the thermistor elements, one of which is optically coupled to a single fiber pigtail one meter long with a core diameter of 200 μm. (Dupont PFX-S120R, plastic-clad) This large diameter relative to commonly used single fibers permits low loss couplings. Numerical aperature is 0.4, nominal

The HP 432A Power Meter operates the thermistor sensor in a balanced bridge. Since the thermistor is virtually a black body, it efficiently converts the optical power to heat. This tends to unbalance the thermistor bridge and the power necessary to rebalance is metered. Thus, direct, absolute power measurement is obtained with high confidence and convenience.

Absolute accuracies ranging from 7% to 14% are specified over a dynamic power range of 1 μW to 10 mW. The full spectral range is 600 nm to 1200 nm, with four calibration points traceable to the National Bureau of Standards at 650, 820, 1050 and 1150 nm.

If you'd like more information on this first Hewlett-Packard entry into the fiber optic communications field, check F on the HP Reply Card.

Optical power in single fibers can now be measured with HP's 84801A/432A system.



Advances in time interval instrumentation

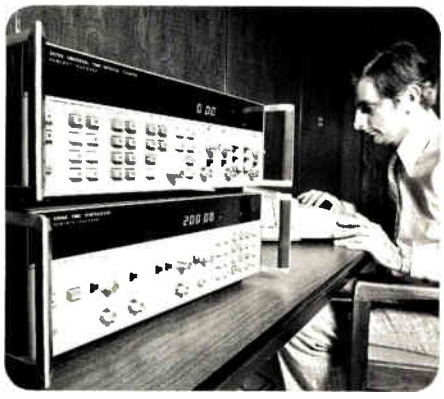
With HP's 5370A Universal Time Counter you can measure time intervals with a resolution of 20 picoseconds—that's five times better than counters did before. It also automatically computes statistical data. And the new HP 5359A Time Synthesizer generates pulses whose time delay and width are adjustable in 50 picosecond steps—that's 20 times better than delay generators did before.

Uses for these advancements are in semiconductor testing, radar and laser ranging, digital communications, computer testing, nuclear studies, and calibration. The 5359A can also generate precise delayed sweeps for oscilloscopes and very accurately time-position the external gates of frequency counters.

Using the 5370A's keyboard, you can quickly set up to compute pulse jitter, minimum and maximum time interval, mean time, and standard deviation. The 5370A is also a full capability universal counter, measuring period and frequency from 0 to 100 MHz with up to eleven digits of information in one second measurement time.

Major specifications for the 5359A Time Synthesizer include: delay range, 0 to 160 ms; pulse width, 5 ns to 160 ms; amplitude adjustable 0.5 to 5 V into 50 ohms; offset adjustable ±1 V. All are controllable by the 5359A front panel keyboard or system commands. Calibration is automatic.

For details on the 5359A, check N on the HP Reply Card. For the 5370A, check O.



Microprocessors make both models easy-to-use and versatile in benchtop or systems use, as in the above VCO tester.

Programmable, 4-color plotters output computer data with fidelity and speed

HP-IB

Two new HP plotters, the 7221A and the 9872A, prepare high quality, four-color plots with unprecedented ease. Controlling these plotters is an HP designed microprocessor which enables dramatically fast, precise, and convenient plotting not available in earlier plotters. Although similar in appearance, the two plotters were designed to fulfill two different needs: 1) direct connection to desktop computers, or other controllers using a standard parallel interface, and 2) connection in a serial communication link to a host computer or terminal.

Both plotters feature user-initiated confidence test to verify their overall mechanical and electrical operation. A built-in self-test allows service personnel to perform a series of tests without the use of external test equipment.

Graphic Plotter for Local Operation

The 9872A interfaces to your controller through the HP-IB interface. Using an easily understood, two-letter mnemonic graphics language, the HP-GL, you can start plotting with only a minimum of programming experience. With 38 graphic instructions, you can select any of four pens, designate any one of five resident character sets, and define any one of seven line types. To enhance the graph, you can change the slant, size, and direction of the characters, program the pen speed, draw arcs with tick marks, and identify traces with symbols. Window plotting permits error-free off-scale data handling.

For further details, check Q on the HP Reply Card.

Remote Terminal Graphic Plotter

The 7221A, with an RS-232C/CCITT V.24 interface, features three modes of operation for efficient use of expensive computer time. These three modes are: direct communication with the terminal, standby, and on-line to the host computer. In addition to sharing many of the graphic functions of the 9872A, the 7221A further reduces communication time through resident arc and circle generation, programmable macroinstructions, definable dashed lines, internal characters, and built-in buffer.

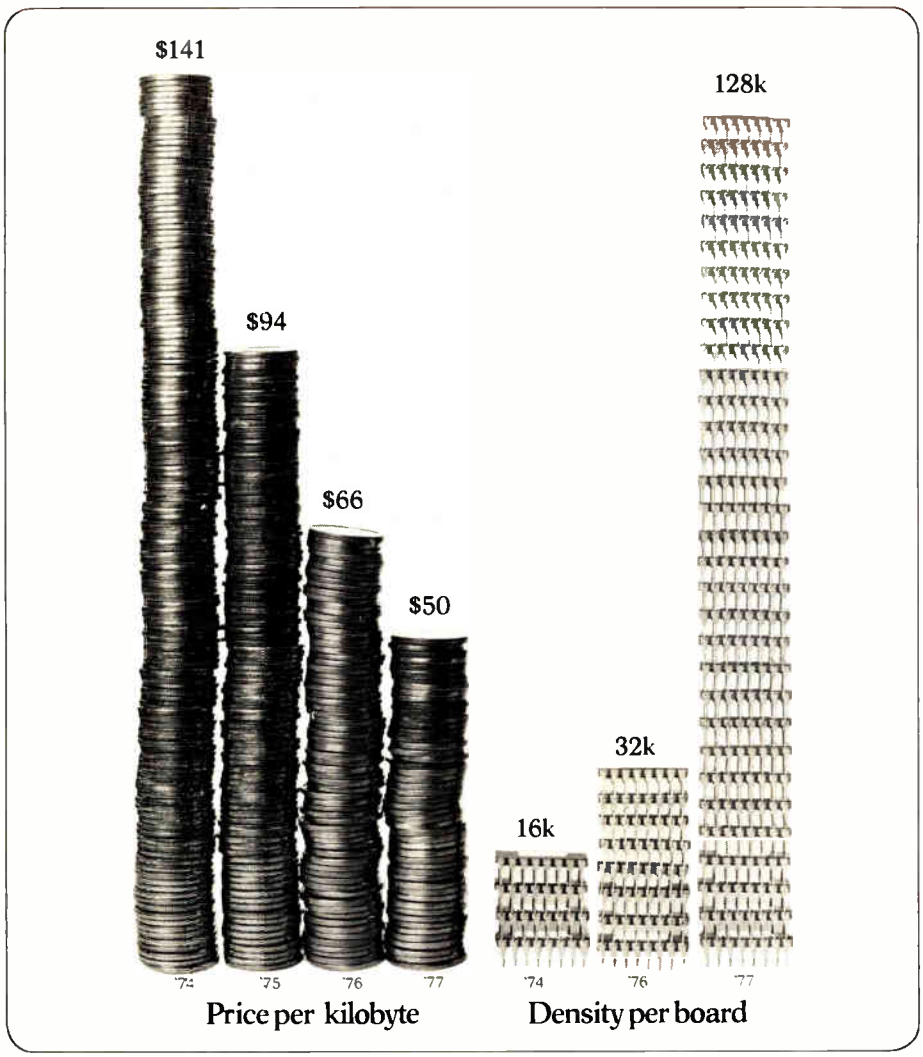
Check P on the HP Reply Card for details.

Convert HP-PLOT/21 for use on your system

A further enhancement of the 7221A is provided by the HP-PLOT/21 software package. Consisting of 86 FORTRAN IV subroutines for HP 3000 Series II, GE MARK III timeshare and TYMESHARE X systems, HP-PLOT/21 makes the advanced capabilities of the 7221A easily accessible. For use with other systems, our Applications Note 229-1 provides information to help the systems programmers determine the feasibility of converting the HP-PLOT/21 to operate on their systems.

For your complimentary copy of AN 229-1, check Y on the HP Reply Card.

Up to 1.8 million bytes of fault-control semiconductor memory—at 5¢ a byte*



Hewlett-Packard's high-capacity memory packs one megabyte of "fault-control memory" in a compact 131 cm (12¼ in) high HP 21MX mainframe—all for only 5 cents a byte.

Hewlett-Packard made an early commitment to semiconductor memory. Since 1974, we have been able to offer memory to our customers at price decreases averaging 30% a year, in part the result of increased memory density.

The newest module, HP 12747, quadruples capacity from 32k to 128k bytes utilizing 16k-bit, N-Channel, MOS/RAM memory chips—the first in use by a major manufacturer of small computers.

Memory for 21MX K, M, and E series computers and HP 1000 computer systems can now be expanded to a maximum of 1.8 megabytes. Upgrading from your present 21MX system to larger memories is also possible.

A new fault-control memory system provides for detection and correction of all single bit memory errors using the standard 21-bit Hamming code. But, because there is always the chance of a double bit error, we added a 22nd parity bit to the Hamming code, enabling us to detect all double errors. Programs will continue running and data will be protected even if a memory chip malfunctions.

Fault control memory is available as an optional controller with its associated check bit arrays.

Density and reliability are not the only advantages of semiconductor memory. Cost savings is another.

*Domestic U.S.A. only

For more information, check R on the HP Reply Card.

New DC power supply catalog from HP

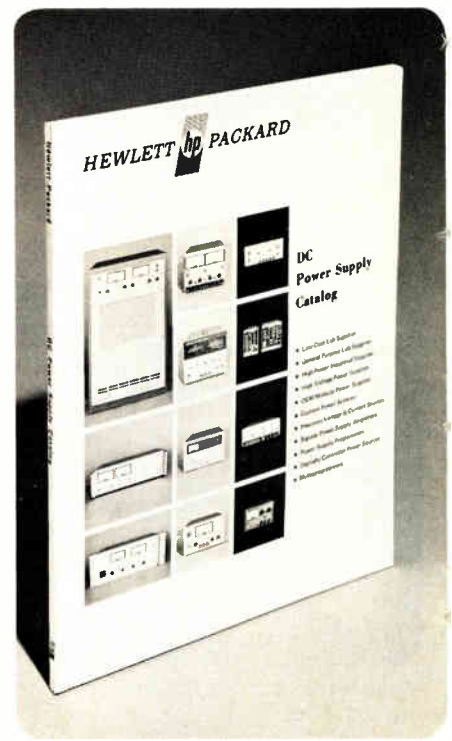
Choosing the right power supply for your application is easy with HP's new *DC Power Supply Catalog*. This 128-page catalog contains product descriptions, photographs, outline drawings, specification, and prices for HP's complete line of power supplies covering the range from 10 W to 11 kW. Products include:

- General-purpose lab and system power supplies
- Precision voltage and current sources
- Digitally programmable power sources

Included is a section detailing several methods to control DC power supplies using the HP Interface Bus. In addition, another section covers power supply ac and load connections.

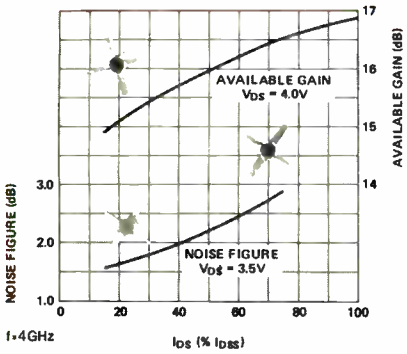
For your free copy, check Z on the HP Reply Card.

HP-IB



HEWLETT-PACKARD COMPONENT NEWS

New packaged GaAs FET offers low noise and moderate power



Linear output power of new 1-micron GaAs FET provides the design engineer with a superior device usable over the broad range of frequencies, 2 to 12 GHz.

HP's new packaged GaAs FET, the HFET-1101, is a cost-effective and rugged transistor which is easy to work with and yields superior performance. It is characterized for low noise and moderate power requirements in the 2 to 12 GHz range, with typical noise figure of 1.6 dB (2.2 dB max) and 11 dB typical associated gain at 4 GHz.

When tuned for maximum output power at +5 dBm input, linear output (1 dB compression) is typically 35 mW at 4 GHz and 25 mW at 8 GHz. The HFET-1101 is useful as a low noise second stage or output stage in the 2 to 8 GHz range for broad and narrow band applications such as land and satellite communications and radar.

The HFET-1101 is packaged in the HPAC-100A, a rugged, hermetic 2.5 mm (0.1 in) square metal/ceramic package. High reliability tested versions of this device can be specified. A chip version, the HFET-1000 is also available.

For performance specifications on both the package and chip versions, check S on the HP Reply Card.

HP increases distribution outlets for semiconductor components

HP component products are now available from 21 additional stocking locations in the U.S. and Canada.

Hamilton/Avnet, the largest electronics distributor in the world, and Pioneer-Standard, Inc., a leading regional distributor in the U.S. have recently been franchised in selected markets.

Customers may now obtain HP components from the following branches of Hamilton/Avnet: Phoenix, Az; Culver City, San Diego and Mountain View, CA; Denver, CO; Chicago, IL; Kansas City, KS; St. Louis, MO; Detroit, MI; Minneapolis, MN; Albuquerque, NM; Salt Lake City, UT; Seattle, WA; Milwaukee, WI; and Toronto, Montreal and Ottawa in Canada. In addition, Pioneer-Standard, Inc. is marketing HP components from its offices in Cleveland and Dayton, OH; Pittsburgh, PA; and Indianapolis, IN.

Both distributors will carry HP's full line of semiconductor components. These include LEDs, infra-red detectors, optically-coupled isolators, solid state numeric and alphanumeric displays, microwave diodes, and RF and general purpose diodes, plus microwave transistors.

Hewlett-Packard began selling its components through distribution in 1972. HP's network of distributors also includes Hall-Mark Electronics Corp., Schweber Electronics Corp., Wyle Distribution Group, Wilshire Electronics Group in the U.S. and Zentronics in Canada. In addition, a number of international distributors make HP components available worldwide.

For a complete listing of HP component product distributors, check U on the HP Reply Card.

HP's Schottky diode—world's first in a DO-35 package

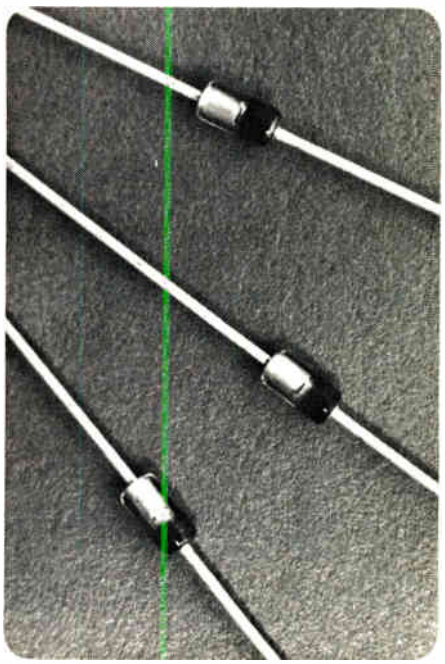
With a low forward voltage of 410 mV, the HSCH-1001 (1N6263) is a functional replacement for many germanium diodes.

It offers switching speed in the picosecond range, a breakdown voltage of 60V, a temperature rating of −65°C to +200°C and is in a hermetic glass package rugged enough for automatic insertion. Applications include waveform clipping, clamping and sampling, transistor speed-up, RF signal detection, and power monitoring.

As the world's first Schottky barrier diode in the industry standard DO-35 package, the HSCH-1001 gives you a reliable, high performance alternative for your general purpose switching needs.

For details, check T on the HP Reply Card.

The HSCH-1001 is offered in the low-cost DO-35 hermetic package. It is rugged enough for automatic insertion equipment and can be supplied in tape or reel.



New HP-IB digital multimeter cuts cost of data gathering

Hewlett-Packard's new 3438A DMM has a built-in HP-IB interface for automatic low cost data collection. This 3½-digit multimeter has five full functions with volt-ohm autoranging. Ten milliohm and 100 μV AC and DC sensitivities make the 3438A excellent for gathering data from various types of transducers.

The 3438A may be used in a talk-only mode with a companion HP 5150A printer to record data on tape. The 5150A recorder includes a clock pacer to control unattended data gathering. Transducer outputs can be normalized or linearized while measurements are made, using a controlling computer such as the HP 9825A. Data may also be stored in the HP 9825A tape cassette for later use.

Whether you use HP's 3438A in manual or autoranging mode, in a system or on the bench, it will always indicate with lighted annunciators, the most commonly understood engineering units. If an improper selection of function and range is chosen, an overload indication on the display informs the operator that a measurement error was made.

For additional information on this item, check V on the HP Reply Card.

Now you can have a 3½-digit multimeter for use in low-cost data acquisition. Used with a controlling computer and scanner, data may be recorded on cassette tape for later use, or analyzed as it is received for process control.

Europe-Central Mailing Dept., P.O. Box 529, Amstelveen-1134, Netherlands. Ph.(020) 47 20 21
Japan-Yokogawa-Hewlett-Packard Ltd., Ohashi Bldg., 1-59-1 Yoyogi, Shibuya-ku, Tokyo 151. Ph. 03-370-2281/92.
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product advances from Hewlett-Packard

January/February 1978
New product information from
HEWLETT-PACKARD
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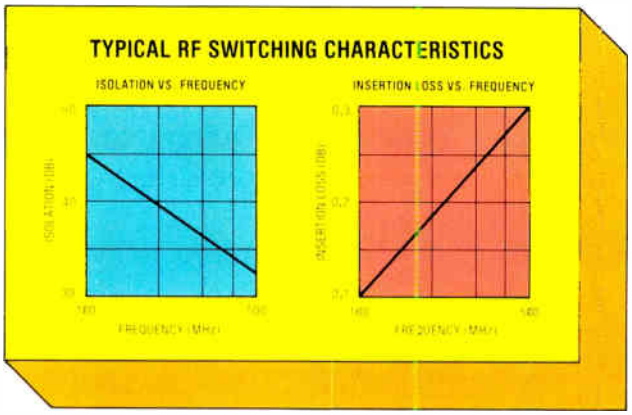
00881

TO-5 RELAY UPDATE

The world's smallest RF relay

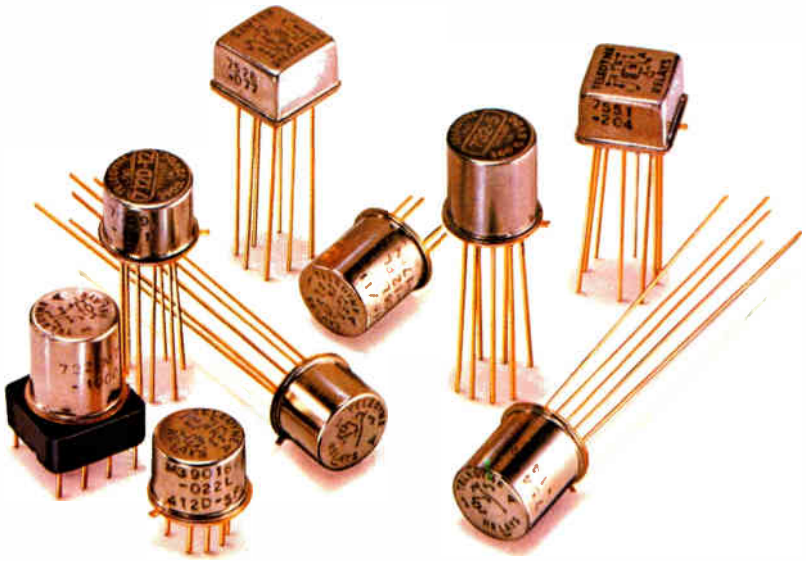


Inherently low inter-contact capacitance and contact circuit losses have established the Teledyne TO-5 relay as an excellent subminiature RF switch for frequencies up through UHF. Typical RF performance: 45db isolation and 0.1db insertion loss at 100MHz.

Added to this, our TO-5 relay requires very low coil power compared to other miniature relays — as much as 75% less than a half crystal can relay.

For hand held radio transceivers, for example, where battery power drain as well as good RF performance are key factors, Teledyne's TO-5 relay is the logical choice for T-R switching.

Our complete line of TO-5 relays includes military and commercial/industrial types, with virtually all military versions qualified to established reliability MIL specs. For complete data, contact Teledyne Relays — the people who pioneered the TO-5 relay.



- **Hybrid "T" Series**
  SPDT & DPDT types with internal transistor driver and suppression diode. Military and commercial/industrial versions.
- **"D" and "DD" Series**
  With internal suppression and steering diodes. Military and commercial/industrial versions.
- **Maglatch Series**
  SPDT, DPDT, and 4PST magnetic latching types. Military and commercial/industrial versions.
- **Centigrid® Series**
  World's smallest relay—only .225" (5.72mm) high x .370" (9.40mm) square. DPDT, with optional internal suppression and steering diodes.
- **Hi-Rel Series**
  Screened versions for space flight applications (NASA qualified)
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Circle 27 on reader service card

Intel delivers the micro components designers

There's no more efficient way to solve your interface and control requirements for microcomputer-based systems than our peripheral components.

They're single-chip solutions to even the most complicated operations, integrating up to 22,000 transistors per chip to replace circuit boards full of discrete logic with a single component. Result: you cut parts cost, reduce package count and board space, and simplify both development and operating software.

We've designed each of these peripheral chips to be an intelligent, programmable component in your system and to perform most functions with minimal cpu supervision. The resulting decrease in cpu overhead provides your system with higher performance and increased throughput.

"I can accomplish almost any I/O function with one chip using Intel's versatile peripheral interfaces and dedicated device controllers."

The dedicated function components below are available now, with more on the way. Here's a brief description of their versatility.

8271 Programmable Floppy Disk Controller. Provides full control of up to four standard or minifloppy drives. (Available early 1978.)

8273 SDLC/HDLC Protocol Controller. For SDLC and HDLC communications.

8275 Programmable CRT Controller. Provides fully buffered interface and control of almost any raster scan CRT display.

8278/8279 Programmable Keyboard/Display Interfaces. Keyboard/sensor array input scan, and output scan for LED, incandescent and other displays. 128-key or 64-key input.

8251A Programmable Communications Interface. Industry standard USART for synchronous or asynchronous serial data transmission, including bisync.

8253 Programmable Interval Timer. Contains three independent 16-bit counters, programmable modes from dc to 2MHz.

8255A Programmable Peripheral Interface. General purpose I/O interface with 24 individually programmable I/O pins.

8257 Programmable DMA Controller. Provides four-channel, high speed direct memory access independent of CPU.

8259 Programmable Interrupt Controller. Handles eight levels of vectored priority interrupt. Expandable to 64 levels.

computer peripheral are talking about.

UPI-41™ is Intel's Universal Peripheral Interface, bringing distributed intelligence to microcomputer systems for the first time.

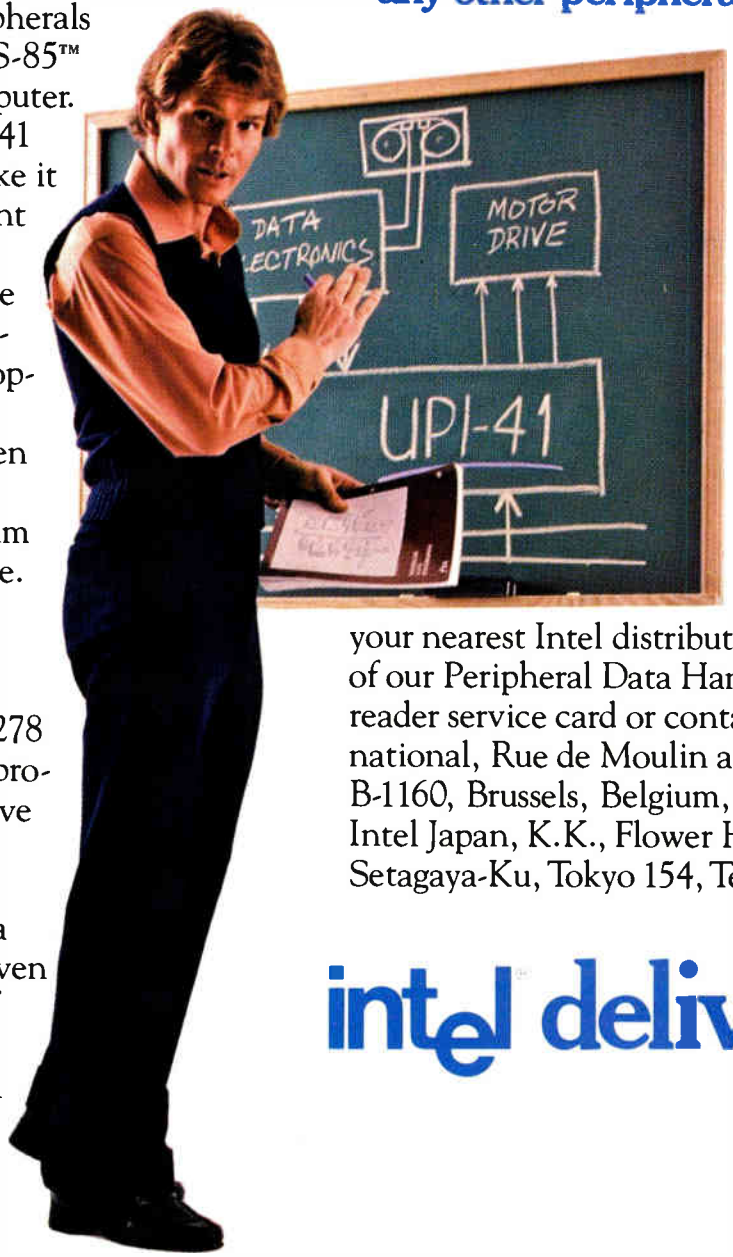
Actually a highly integrated, user-programmable microcomputer, UPI-41 is a new solution that obsoletes custom LSI and specialized discrete designs for interfacing most low and medium speed peripherals with an MCS-80,™ MCS-85™ or MCS-48™ microcomputer.

Intel delivers UPI-41 in two versions that make it easy for you to implement your own designs. The 8741 includes an erasable and reprogrammable 1K-byte EPROM, for development, testing and low volume production. Then the 8041, with masked ROM, provides maximum economy in high volume.

We've taken the UPI-41 concept a step further with the 8278, described at left. The 8278 is the first of several preprogrammed 8041's that we've adapted to specialized applications.

Because UPI-41 is a microcomputer, we've given it the same high level of support we give all our microcomputers. UPI-41 is supported by our Prompt™ 48 Design Aid, the Intellec® microcomputer development system with resident UPI-41/MCS-48 Macro Assembler. Plus applications assistance worldwide, full documentation, training classes, design seminars and a rapidly expanding users' software library.

"And, for my special I/O requirements, Intel's UPI-41 Universal Peripheral Interface is user programmable to control nearly any other peripheral device."



Intel's peripheral components, and the MCS-80, -85 and -48 microcomputers they support, are available through your nearest Intel distributor. For your copy of our Peripheral Data Handbook use the reader service card or contact: Intel International, Rue de Moulin a Pápier, 51-Boite 1, B-1160, Brussels, Belgium, Telex 24814; or Intel Japan, K.K., Flower Hill-Shinmachi, Setagaya-Ku, Tokyo 154, Telex 781-28426.

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Meetings

Compcon Spring, IEEE, Jack Tar Hotel, San Francisco, Calif., Feb. 28–March 2.

Data Communications Interface '78, Datamation magazine, Las Vegas Convention Center, Las Vegas, March 6–9.

IEA 78—12th Instruments, Electronics, and Automation Exhibition, Industrial & Trade Fairs Ltd. (Solihull, West Midlands), National Exhibition Center, Birmingham, England, March 13–17.

11th Annual Simulation Symposium, IEEE *et al.*, Causeway Inn Resort Hotel, Tampa, Fla., March 15–17.

Industrial Applications of Microprocessors, IEEE, Sheraton Hotel, Philadelphia, March 21–23.

International Conference on Physics of SiO_2 and Its Interfaces, American Physical Society, IBM, ONR, and ARPA, IBM Thomas J. Watson Research Center, Yorktown Heights, N. Y., March 22–24.

28th Vehicular Technology Conference, IEEE, Regency Hotel, Denver, Colo., March 22–24.

AAMI Annual Meeting and Exhibit Program, Association for the Advancement of Medical Instrumentation (Arlington, Va.), Washington Hilton Hotel, Washington, D. C., March 29–April 1.

Metric Planning Forum, American National Metric Council (Washington, D. C.), Atlanta Hyatt Regency Hotel, Atlanta, April 2–5.

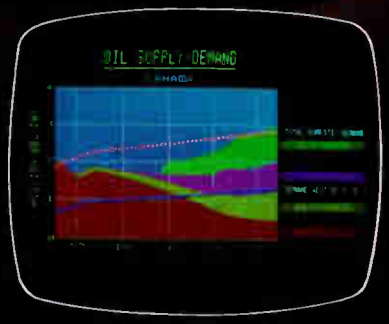
Computer Architecture Symposium, IEEE, Rickey's Hyatt House, Palo Alto, Calif., April 3–5.

21ème Salon International des Composants Electroniques, Société pour la Diffusion des Sciences et des Arts (Paris, France), Paris, April 3–8.

Design Engineering Conference, ASME, McCormick Place, Chicago, April 17–20.

Ramtek has done for imaging and graphics what Kodak did for photography.

Brought you low-cost color.



Most people wouldn't settle for black and white snapshots. There's no reason why you should settle for black and white displays.

The Ramtek 9050 series of Graphic Display Systems slashes the cost of color in half. For imaging. For graphics.

Low cost. Not low quality. Here is the same technology that you've seen delivering ERTS satellite photos, dramatic medical research images, maps, charts, tables and graphics.

We took the most-wanted features of our modular Ramtek 9000 systems and packaged them together in one module. You custom tailor the Ramtek 9050 to your needs with a matching set of off-the-shelf options.

For less than $10,000 the Ramtek 9050 gives you 16 bit image processing, character, vector, plot generation, raster mode, and scrolling. Resolution up to 512 by 512 elements. 256 levels of gray scale. 4096 colors (or 64 colors for under $6,000; black and white for less than $5,500). Video look-up tables. Interactive keyboard and joystick operation. Off-the-shelf interfaces for popular minicomputer lines.

And the Ramtek 9050 is software compatible with its big brother the Ramtek 9000. That's a time-saving plus when your needs shift to real-time applications, ultra-high resolution, expandable customized systems or any of the thousands of possibilities opened up by the Ramtek 9000's modular design.

Call today, or write. We'll fill you in on the whole colorful Ramtek picture.

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Circle 31 on reader service card

powerful floppy-disk system?

AID-80F offers powerful software and versatile hardware for microcomputer applications or Z80 program development. As a complete disk-based computer it provides all the tools required for hardware/software development and debug.

The efficient, straightforward hardware organization of AID-80F includes the powerful Z80 Software Development Board, OEM-80; a memory and I/O expansion board, RAM-80; and the floppy-disk controller board, FLP-80. Optional in-circuit emulation capability is provided by Mostek's Application Interface Module, AIM-80™.

AID-80F Software.

Mostek software is state-of-the-art: efficient, comprehensive, and easy-to-use. It's designed to accelerate your own programming rate, allowing you to concentrate on the application problem, which greatly reduces the overall development cycle.

The power of Mostek software is found in programs like Monitor, Text Editor, Assembler, Relocating Linking Loader, and Debugger. In addition, the Peripheral Interchange Program (PIP) offers the most complete peripheral management system in the industry.

AID-80F Hardware.

OEM-80. It's the heart of Mostek's new AID-80F, providing the power of the Z80 microcomputer plus 16K bytes of on-board RAM.

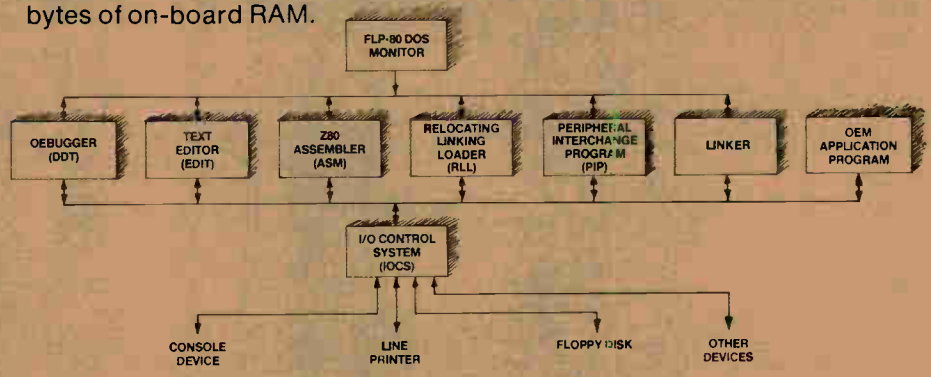
RAM-80. This memory and I/O expansion board includes 16K bytes of RAM (expandable to 64K bytes) and four eight-bit I/O ports.

FLP-80. Mostek's flexible disk-drive controller board interfaces OEM-80 with up to four drives with soft sector format.

AIM-80. This optional board allows real-time, in-circuit emulation with extensive debug, trace and diagnostic capabilities.

AID-80F is priced at just $5995 and each board is also available separately. To get a complete descriptive package on the AID-80F Microcomputer, contact your sales representative or write Mostek Corporation; 1215 W. Crosby Road; Carrollton, Texas 75006; (214) 242-0444. Mostek GmbH; West Germany; Telephone: (0711) 701096

MOSTEK



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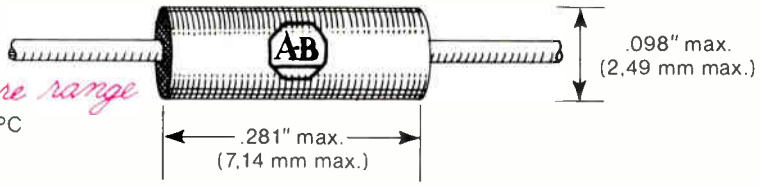
New Type FM resistor. Tight on tolerance. Tight on TC.

Meet the newest member on the board. Allen-Bradley's Type FM. It features the accuracy and stability of metal film technology. It provides you with the tight tolerance, tight temperature coefficient and stable performance you may need for precision applications. Approved to MIL-R-10509, Style RN55, Characteristic E, all tolerances. This high quality metal film resistor adds another dimension to Allen-Bradley's line of hot-molded carbon composition and cermet film fixed resistors of high reliability. We have what you need. Write for Publication EC 54.

Tolerances
±1%, ± 0.5%, ± 0.25%
± 0.1% and ± 0.05%

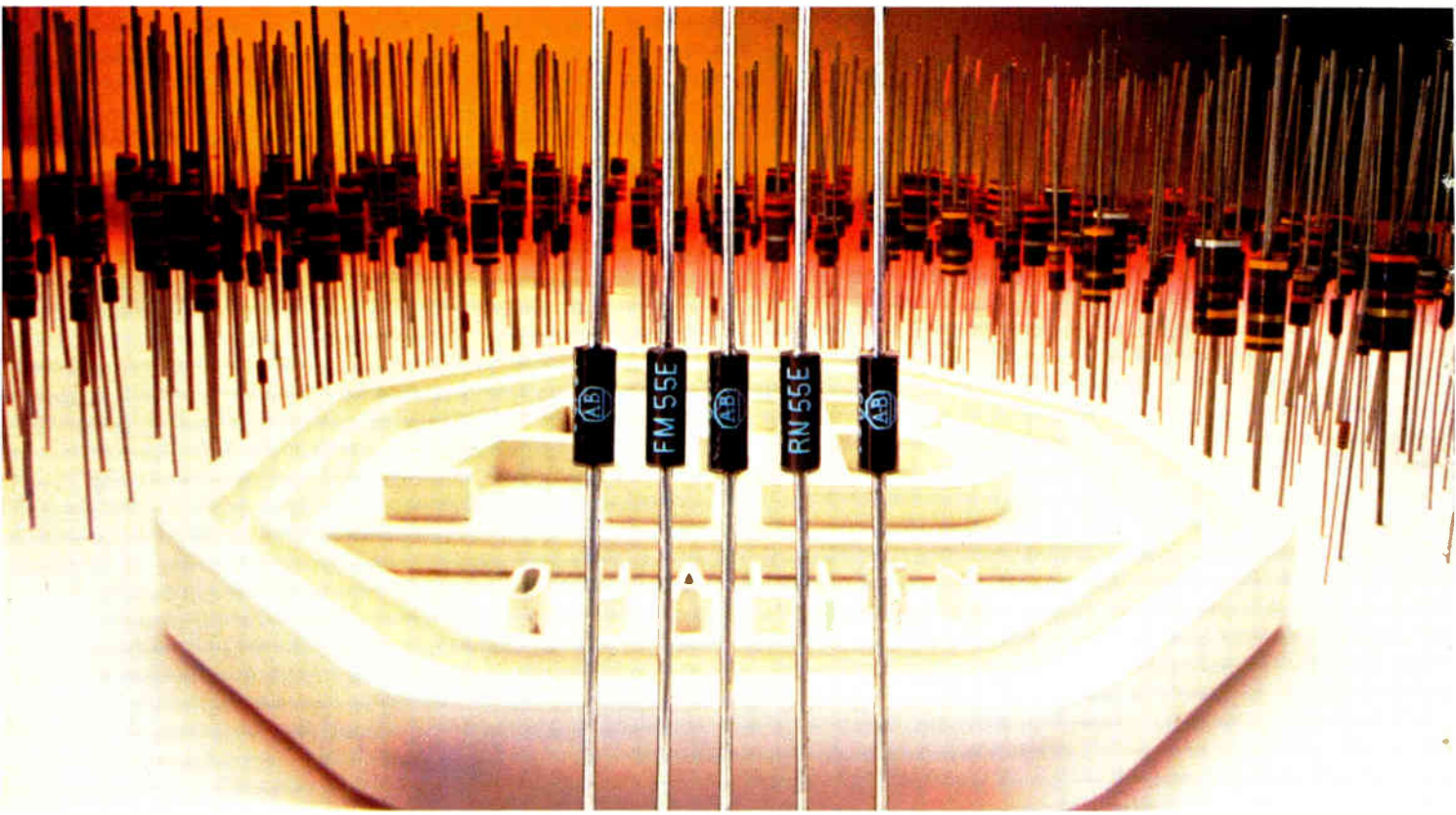
Temperature coefficient
± 25, ± 15, ± 10 PPM/°C

Power rating
0.25 watt at 70°C
0.1 watt at 125°C



Temperature range
−65°C to +175°C

Uniform molded body



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Circle 34 on reader service card

Electronics newsletter

HP ends sales of low-cost devices by distributors

Hewlett-Packard Co. has discontinued its venture into the marketing of low-cost instruments through distributors. The Palo Alto, Calif., firm was selling logic probes, pulsers, and other digital circuit testers through Elmar Electronics, a unit of Wyle Laboratories/Distribution group. But since the returns from such sales were not worth Elmar's efforts, the Mountain View, Calif., distributor proposed it also handle HP counters, digital multimeters, power supplies, and other instruments selling for under $1,000. However, according to Elmar vice president and general manager Larry Pond, "HP notified us that **their business plans don't call for future investments in low-cost instruments,** nor do they think the distribution program we proposed is a wise step for them at this time." As a result, Elmar is terminating the existing program. "It was useless to go on with a program that small," says Pond. Although Elmar accounted for nearly half the sales of those HP instruments sold in its territory, he adds, "it wasn't enough dollars to make a big difference to us."

Hall-effect sensors packaged in film reels

Watch for Texas Instruments Inc. to step up the Hall-effect sensor effort it launched last fall. Next month it will introduce a second version of the magnetically activated switch—**this one supplied in a tiny, epoxy-encapsulated package mounted on reels of Kapton film.** The Dallas firm also has added a fourth pin to the package so that the solid-state switch can be inhibited by strobing, a technique widely used in keyboards to prevent more than one keystroke at a time.

The device is the first standard product from TI to be sold in reels using the film-carrier package developed by General Electric Co. under the Minimod label. It is aimed squarely at high-volume customers that can afford automated assembly equipment.

Analog Devices cuts cost of 8- and 12-bit converters

The complementary-MOS semiconductor operation of Analog Devices, which moved from the West Coast to Limerick, Ireland, just last year, is getting up to speed quickly with a pair of trend-setting digital-to-analog converter chips. This month, the group announced the first one: the lowest-cost monolithic 8-bit d-a converter on the market—a current-output multiplying unit pegged at a low $2 apiece in 1,000-and-up quantities.

Now, the group is about to slash costs in the high-performance area. Very shortly, it will introduce a 12-bit monolithic d-a converter that sells for just $12 in lots of 1,000 or more. To be designated the 7541, the multiplying unit boasts full four-quadrant operation, true 12-bit accuracy, and a current output that typically settles in only 500 nanoseconds.

Motorola forms industrial-control market group

Still another systems division has been formed at Motorola Semiconductor Group in Phoenix. Called the Subsystem Products group, the unit, under the direction of Bruce McDonald, will sell systems and subsystems primarily to industrial original-equipment manufacturers. Now being introduced are two product series: four regulated dc power supplies, and solid-state relays and input/output modules. Both are intended for use with microcomputer-based systems. McDonald says that **OEM panel meters and switching power supplies will be added by mid-year.**

The new systems unit is the third to be formed by Motorola in the last 18 months. The others are the Microcomputer Systems group and Memory Systems.

Electronics newsletter

Fiber cables to be strung from phone poles

Fiber-optic cable is about to come out in the open. Over the past year, cables installed in the U. S. and abroad connecting telephone company central exchanges have always been buried in underground ducts. Now, the Commonwealth Telephone Co. of Dallas, Pa., plans this year to install **the first 45-megabit-per-second fiber-optic link strung from telephone pole to telephone pole.** The 13-mile link, complete with repeaters, was purchased from ITT's Telecommunications Transmission division and will carry 672 circuits between exchange offices in Mansfield and Wellsboro, Pa.

Terminal makers review decision in cataract claim

Video terminal manufacturers are assessing the ramifications of an arbitration's decision in a case pitting The New York Times against New York Newspaper Guild. The issue: do video terminals cause cataracts? The decision likely will affect more than The Times' installation of Harris Corp. equipment and that of the entire newspaper industry, which has an estimated 10,000 video terminals installed. At stake could be the market for terminals in banks, stores, airline terminals, and almost anywhere that data communications terminals and video-screen key entry are used. **Harris' Composition Systems division in Melbourne, Fla., is supplying The Times with terminals with graphic-arts quality,** a better grade than typically found on most terminal screens. According to a Harris spokesman, "Our own studies and those of outside consultants indicate there should be no problem in the area of eye strain, cataracts, and any other problems under normal use." The arbitrator also had studies and measurements made before handing down his decision.

National packs active electronics on audio tape chip

A linear IC that combines all the active electronics necessary to build a tape deck except the bias oscillator is being shipped in sample quantities by National Semiconductor Corp., with production slated for June. The key feature of the LM1818 is electronic switching between the record and playback modes. The single-pole double-throw switch created from a 15-transistor circuit is designed to be more reliable and flexible than the mechanical six-pole, double-throw switches normally found in tape recorders. **National also packed a full complement of amplifier circuitry onto the chip,** including two preamplifiers for playback and microphone, two monitor amplifiers for playback and record, automatic leveling circuitry for equalized voice and background sound levels, and a meter drive. Also included is circuitry to handle audio to dc levels and prevent "pops" when switching between record and playback. The price is expected to be $2.85 in hundreds and $1 in volume.

IEEE drops 'acting' from Emberson's title

Richard H. Emberson, veteran staff member of the Institute of Electrical and Electronics Engineers, has been named permanent general manager after filling the post on an acting basis since last June. He stepped into the job when Herbert Schulke Jr. resigned. Since that time a search committee has attempted in vain to find a replacement who could fill the position for at least 10 years. **However, Emberson is due to retire next spring, so the search is going on.**

MORE BIG TALK ON ECLIPSE SYSTEMS.

First, we brought you AOS, the most intelligent multiprogramming operating system to be found on a small computer. Now we bring you the fastest, largest and most efficient version of PL/I ever implemented on a minicomputer. And that's not just talk. It's available now on all multiprogramming Data General ECLIPSE systems. So now you can take advantage of the sophistication and efficiency of big computer PL/I without having to buy a big computer. PL/I is just one more reason why Data General is the computer company that really talks sense.

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At last. The 2901A, one upped.

Announcing a faster, fully spec'd 2901A 4 Bit microprocessor slice.

It's a unique blend of ECL and Schottky, fully pin-compatible, and faster than any other 2901A in the world.

Here are the numbers.

	Typical	Commercial	Military
Our data:	25° C (5V)	0°-70° C (4.75-5.75V)	−55-+125° C (4.5-5.5V)
A, B Inputs → Y Output	37ns	65ns	80ns
C_n → Y Output	18	30	35
D Input → Y Output	20	40	45
Clock → Y-Output	35	60	65
Minimum Clock Period	45	60	75
Read-Modify-Write Cycle	45	60	75

And if you think those are hot specs, wait'll you see our 2901A-1 coming soon.

Specs like this really shouldn't come as a big surprise to you.

After all, we're the industry leader in bipolar technology. And we invented Bipolar Tri-State™ (which is used with the 2901A).

And another nice thing is all the parts we support the 2901A with.

First off, a family of 16 products, all fully spec'd.

Our family:

IDM2901A	4-Bit Microprocessor Slice
IDM2902	Carry Look-Ahead Generator
IDM2909A	Microsequencer
*IDM2911A	Microsequencer
IDM29702	16 x 4 Bit RAM (open collector)
IDM29703	16 x 4 Bit RAM (Tri-State)
IDM29750	32 x 8 Bit PROM (open collector)
IDM29751	32 x 8 Bit PROM (Tri-State)
IDM29760	256 x 4 Bit PROM (open collector)
IDM29761	256 x 4 Bit PROM (Tri-State)
IDM29803	16 Way Branch Controller
IDM29811	Next Address Controller
*IDM29901	Octal Tri-State
IDM29902	Priority Encoder
IDM29903	16x4 Edge-Triggered Register (Tri-State)
*IDM29908	Quad Gated Flip Flop (flag control)

*Available soon.

Also, we supply a complete line of low-power Schottky MSI, MOS static and dynamic RAM's, as well as all the other parts you need to build a complete, high-performance processor.

So if you need to know who to go to for everything you need, now you know.

E2/16

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☐ Please send more information on your 2901A and its support products.

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National Semiconductor

Field-service tester steps technicians through test paces

At $20,000, Omnicomp unit is expensive but permits more in-field repairs, reducing spare-board inventory

A new kind of portable tester will soon be in the hands of field-service technicians working for NCR Corp., the Dayton, Ohio, computer and data-terminal manufacturer. Perhaps the most sophisticated automated approach to field service to date, the new equipment, called the portable service processor, has been developed for NCR by Omnicomp Inc., a small three-year-old test-equipment maker in Phoenix.

Earlier this month, NCR awarded Omnicomp a $3-million-plus contract that will pay for several hundred testers and costs of their previous development. Initially, they will go into NCR district offices around the world. But this is just the beginning, notes Charles P. Frusterio, manager of field-test systems development for NCR. He is considering the service processor for nearly 1,000 smaller branch offices as well. What's more, Omnicomp already has orders to ship PSPs in quantity at $20,000 for 10 or more to other computer firms. Among them are Sperry Univac in Blue Bell, Pa., and ICL Ltd. in Great Britain.

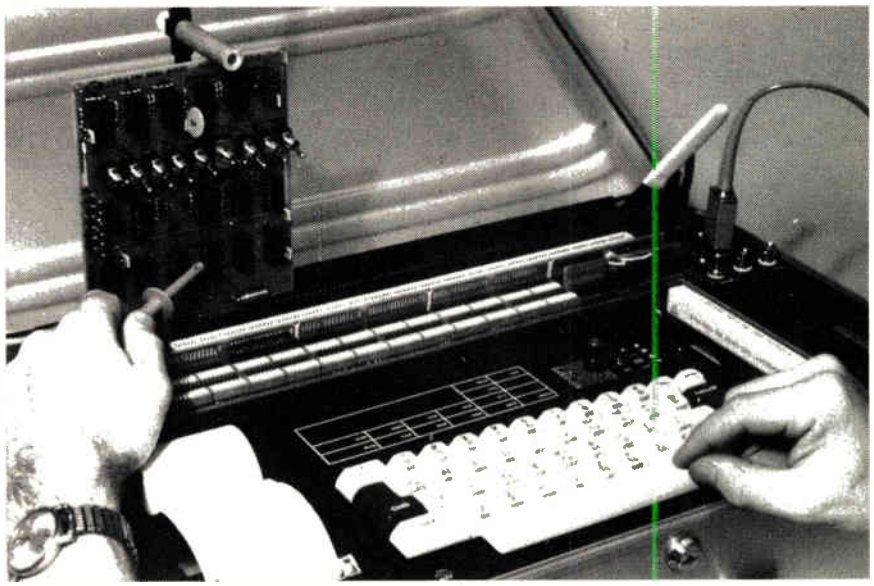
Production tester capacity. What is so sophisticated about the portable service unit? For one thing, it crams "most of the capabilities of large ($100,000-and-up), digital production testing systems used in factories into the volume of a suitcase," says Robert Gaines, vice president of field engineering of NCR's U. S. Data Processing group.

For another, its small size packs a big memory—up to 96 kilobytes, made up of 16-kilobyte dynamic random-access memory chips and 6 kilobytes of programmable read-only memory. This is enough to step the service technician through each test procedure, even for boards containing such large-scale integrated devices as memories and microprocessors. Directions are simply spelled out on a 20-character-per-line printer built into the case. A 3M tape cartridge provides 2.5 megabytes of program storage, adequate for hundreds of test programs.

Relying heavily on LSI circuitry, the portable service processor is built around a custom microprocessor with the power of Digital Equipment Corp.'s LSI-11. Relying on software for guided-probe fault isolation, the field engineer merely touches the test probe to points on the circuit boards according to instructions from the computer. The computer analyzes each reading and prints out the message for the next step. This process continues until the unit pinpoints the bad component.

"The PSP is the first portable or bench-top circuit tester with this guided-probe fault isolation," claims Omnicomp vice president Robert E. Anderson. Test programming is done in an interactive high-level language, called PSP Basic.

Included are 192 fully programmable driver-sensor pins to test boards with multiple logic families, such as transistor-transistor, metal-oxide-semiconductor, and emitter-



At your service. Instructions for probing printed-circuit board and locating faulty components are printed out on 20-character printer, left, in portable, 40-lb tester from Omnicomp Inc. Keyboard is used to call up programs for testing specific circuit boards.

sales of $70, spent $33 on research and development, paid $15 in Federal corporate income taxes, paid $5 in state and local taxes, and generated $15 in personal Federal income tax revenue," Zschau said. Moreover, each of the new companies produced "an incredible $30 of tax revenue in 1976 for every $100 invested."

But Zschau says AEA's survey turned up "a hidden problem" produced by a capital scarcity. It is the increase of debt-to-equity ratios in new companies to a level of more than 2 : 1, compared with the 1 : 1 ratio for companies founded before 1970. "This hidden effect won't be fully experienced until the next economic downturn," Zschau contends, when highly leveraged companies could go bankrupt as a result of their economic instability. □

Memory

Josephson junctions look good at IBM

What's next for computer memory technology, beyond semiconductor and magnetic storage? International Business Machines Corp. is not waiting for others to invent it. Researchers at IBM's laboratories around the world experiment with an assortment of next-generation computer techniques—using optical, amorphous, even organic materials to store tens of billions of memory bits on microscopic-sized circuits. One of these advanced new technologies that appears to be gaining momentum for some applications is the Josephson junction.

A pair of models. A glimpse of what IBM is up to with the Josephson junction, which must operate at cryogenic temperatures, is being given at this week's International Solid State Circuits Conference in San Francisco. Researchers are describing a pair of device models they have built—a 15-nanosecond, 16,384-bit random-access memory and a sub-100-picosecond logic chip. (For a roundup of conference activity, see p. 116.) Though still experimental, both chips illustrate the power of Josephson junctions for computer applications.

The model for the RAM is a 2-kilobit chip. It is filled with nearly 4,500 Josephson junctions fabricated on an insulating substrate (see photograph at top of p. 44). Each junction is made up of a crossed pair of dissimilar but superconducting metals separated by an insulating substrate. Besides the memory array, the chip contains line drivers and decoders that function similarly to corresponding elements on standard semiconductor RAMs.

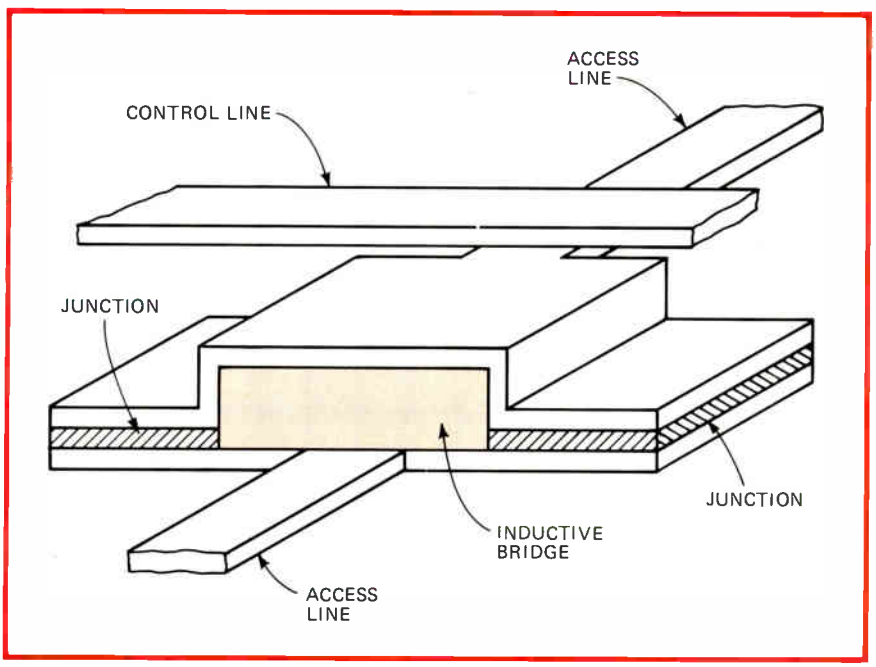
If they could be manufactured at reasonable costs, the Josephson-junction RAMs would be highly desirable as computer storage. They are extremely fast and consume little power: the RAM operates with access times of 15 ns at 10 microwatts, or hundreds of times faster than today's RAMs and consuming a hundredth the power. Indeed, they consume zero power when not operating.

Moreover, the memory is nonvolatile, and when optimized, the cell area can be made several times smaller than today's smallest silicon-gate designs. The one overwhelming drawback of Josephson junctions for most computer environments, however, is the 4.2 K temperature (that of liquid helium) required for superconduction.

Two junctions. The RAM cell is made up of two Josephson junctions coupled by an inductive bridge, as shown in the diagram on the next page. Energized from the control lines, currents flow across the bridge from one junction to the next in much the same way carriers flow from source to drain in a metal-oxide-semiconductor transistor. This current causes a magnetic flux in the Josephson junctions, which can be quantized into distinct states. Bits are stored in the cell as either of two states, differing by one quantum of flux.

The work is being done at the IBM Zurich Laboratory in Switzerland. The researchers there readily concede that their device is still in the experimental stage and was made to test the electrical feasibility of a 16,384-bit chip for a cache memory in a Josephson computer. But the results are encouraging enough to warrant continued investigation, according to IBM.

In a companion project, a team at IBM's Thomas J. Watson Research Center at Yorktown Heights, N. Y., is working on a Josephson-junction logic family using the basic OR, AND, NOR, and INVERT functions. The



Newcomer. Josephson junction memory cell takes up about 1,500 μm^2.

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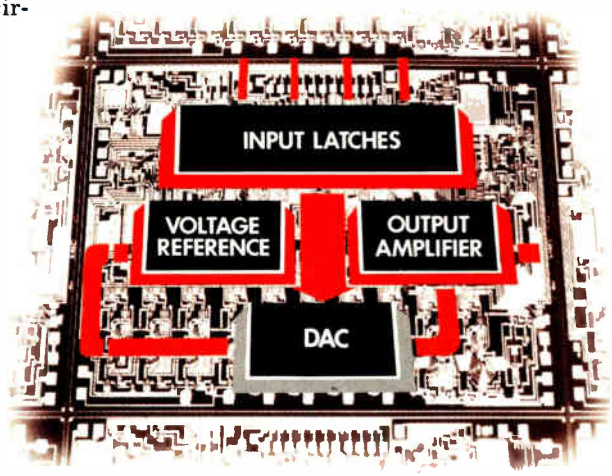

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TI fires first in 32-k erasable PROM battle

It looks as if Texas Instruments Inc. will be the first to market with a 32,768-bit erasable programmable read-only memory, with samples coming this month and volume production following in April or May [*Electronics*, Feb. 2, p. 34]. The device will be TI's first erasable PROM to operate from a single +5-volt supply, although the Dallas firm is expected to introduce companion 8,192-bit and 16,384-bit single-supply parts later this year.

TI's erasable PROM has standard 24 pins, the same number as a 32-k, 5-V unit that Intel Corp. plans for mid-year. TI also is retaining the fully static operation and package of earlier 2708-type erasable PROMs, with a 450-nanosecond maximum speed and 840-milliwatt worst-case power consumption at O°C, though a standby mode reduces power to 55 mW. Intel, on the other hand, is aiming for a speed and power advantage by clocking its part and has shifted a few pins around to match the pinout of its upcoming 32-k and 65-k ROMs (see main story, p. 44).

TI is aggressively pricing its part at $53.60 in lots of 100 or more—less than twice the price of the firm's 16-k erasable PROM.

In designing its new memories, Intel will employ an edge-activation technique similar to one Mostek first used on its 4,096-bit static random-access memories and incorporated into its own 65-k ROM. In this technique, the leading edge of the chip-enable signal activates the dynamic peripheral circuitry. This means that elements like decoders and sense amplifiers remain off except when the chip is selected, saving power.

Jordan says the three new devices, which will have competitive prices, have a maximum standby current of only 15 milliamperes and a maximum average current of 40 mA, meaning that the typical average current is much lower. □

MOS gate array matches ECL speeds

The MOS move into designs traditionally dominated by bipolar technology rolls steadily on with the development of a 920-element metal-oxide-semiconductor gate array capable of operating with gate delays of 3 nanoseconds. It joins the MOS microprocessors that have cut deeply into transistor-transistor-logic designs, the MOS static random-access memories that are vying with

New low-end machines to mean extra $1 billion yearly for IBM

There is more than immediately meets the eye in International Business Machines Corp.'s announcement last month of its 5110 desktop computer. Superficially, it is just an enhancement of IBM's smallest machine, the 5100, introduced more than two years ago. Less obviously, it presages a series of new low-end, accounting-type products that will help boost IBM's sales of small-business systems by about $1 billion annually from now until 1982. Also significant will be a radically new approach to software packaging—programs will be sold, like video games, in read-only memory cartridges.

So says computer industry consultant and IBM watcher Lee Walther, in a study entitled "IBM Strategy for Small Business Systems" that he is preparing for distribution in March. Walther, in Cupertino, Calif., looks for IBM first to close the gap between its 5100 and its System/32, a bigger, more general-purpose machine for small business that, at $42,000, is roughly $30,000 more than the 5100. "There will be either price cuts on the System/32 or a new System/30 to counter the impact of last year's $36,000 System/34, which offers lots more capability for less money," Walther says. "Later, the low end will be fleshed out with a $20,000 or so System/20 closer to the 5110 in performance." IBM needs the /20 and /30 models, he says, to compete with units offered by its major small-business-machine competitors, which include Burroughs, NCR, and Nixdorf Computer.

IBM will also make a major effort in software for the new machines, much as it did for its System/3 machine with the application customizer service and for its System/32 with its industry application programs, according to Walther. He also believes the applications programs, which have become very well defined, will be made available by IBM in the ROM cartridges—an attention-getting innovation. "Besides, patenting a ROM cartridge will yield many advantages over copywriting software—it is much more powerful legally," he says. He expects the ROM cartridges with the System/20 or System/30, and eventually, on the 5100 machine.

According to figures in Walther's report, IBM currently has some 61,000 units installed in the small-business category. With the new models, he is predicting the total could reach 150,000 by 1982, a number that is still dwarfed by IBM's small-business competitors.

IBM will continue to dominate the middle-to-upper small-business-system range with its System/3 and will probably bring out a System/36 or System/38 as well. Its installed business-system base is now worth $4.45 billion and will grow to $8.76 billion by 1982, he says. But IBM's competition at the low end need not be too worried. "Just as in other markets, the presence of IBM will establish credibility and help everyone's sales," Walther concludes. □

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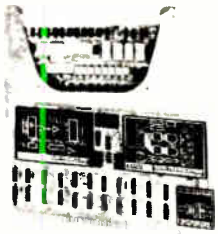

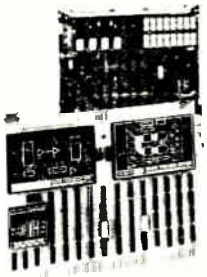

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Analog Inputs																										
16 channels	■					■	■								■				■							
32 channels		■						■								■				■						
64 channels			■						■								■				■					
10mV to 10V range				■						■								■				■				
0 to 10V, ±10V, ±5V ranges	■				■		■				■				■				■				■			
1 to 5V (4 to 20mA) range		■						■				■				■				■				■		
8 bit resolution			■						■				■				■				■				■	
12 bit resolution				■	■	■				■	■	■	■	■				■				■				■
Analog Outputs																										
2 channels					■																					
4 channels						■																				
8 channels																										
0 to 10V, ±10V, ±5V ranges	■						■								■				■				■			
4 to 20mA range		■						■								■				■				■		
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Features																										
programmable gain	■						■								■				■				■			
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program I/O & interrupt			■						■								■				■				■	
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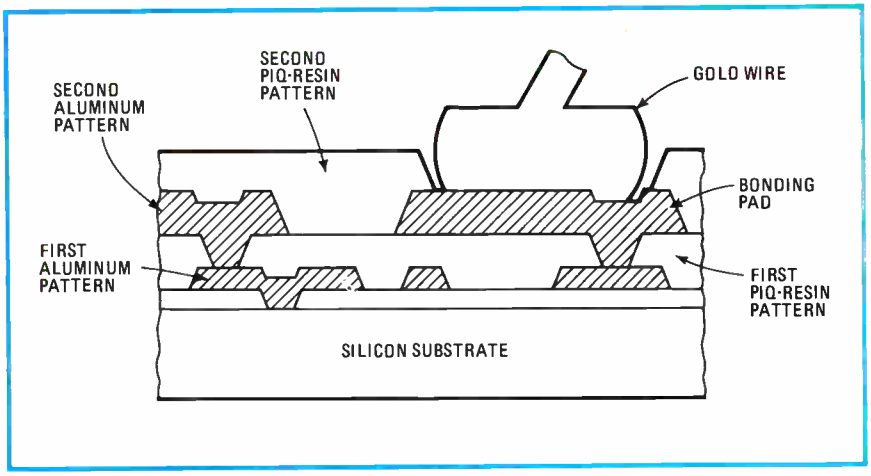
Circle 46 on reader service card

bipolar static devices for cache memories, and other MOS devices now intruding into linear integrated-circuit designs.

But as an illustration of the ability of MOS to grab even the best-performing bipolar applications, there is nothing to beat the master-slice gate-array chip being built by Mitsubishi Electric Corp. for mainframe controllers. Indeed, the chip, which the company developed as part of a major very-large-scale integration program, matches the speed of slices now being built with the fastest emitter-coupled logic. Moreover, it is 25% smaller than ECL versions yet contains 5 times as many gates. Power dissipation of the 920-gate MOS array is down to 3 watts, or about the same as an ECL array containing only 200 gates.

Double-diffused MOS. Mitsubishi designers turned the trick with a double-diffused MOS process that boosts performance and density. Typical speed-power products of 0.05 picojoule at 0.32-ns delays have been measured, or at least 100 times better than ECL versions operating at comparable speeds.

The use of D-MOS techniques (called diffusion self-alignment, or DSA, MOS in Japan) for memory and microcomputer applications is also under way at Mitsubishi, as well as other Japanese chip manufacturers. On the other hand, D-MOS has not yet made much of a hit with U.S. designers, who are using a scaled-down silicon-gate MOS approach to achieve similar performance. □



Layers. Twin layers of polyimide resin provides insulation for two-level aluminum interconnections. Hitachi is applying the resin to bipolar TV chroma chips.

Packaging & production

Resin insulates bipolar IC

Buyers of Hitachi Ltd. color television sets over the past two years may not know it, but they have been in on an entirely new way of fabricating high-density linear integrated circuits. The firm has been using a temperature-resistant resin, of the type often applied as insulation to electric wire, for the insulating layer between two levels of metal interconnections on one of its chroma, or color-control, chips. It is a sharp break with tradition, since insulating layers on ICs are usually polycrystalline versions of the silicon semiconductor itself.

The material is called PIQ, for polyimide isoindroquinazaolinedione, and Hitachi is ready to sell it outside the company. With PIQ, two-level aluminum interconnections can be applied to bipolar devices and not just to metal oxide semiconductors. Till now a reliable insulating layer has been hard to form atop the bottom aluminum layer on bipolar devices. But PIQ is more flexible physically than silicon dioxide, while having about the same dielectric constant. It can be applied in a thicker layer without developing cracks as it covers the underlying pattern.

Smaller chips. The two-level interconnections possible with PIQ make for denser circuitry, because the aluminum lines may run above the active devices instead of down among them or around the periphery of the chip. So the advantage to Hitachi is a 40% reduction in the size of its chip and, hence, an increase in yield.

Hitachi actually uses two layers of its polyimide, as shown in the cross-section above. The second layer protects the top aluminum layer from corrosion. Another size-reducing factor is that the bonding pad, instead of occupying a lot of real estate at the periphery, is right above the chip's active area. Hitachi says that with this technique it has turned out about 410,000 chroma chips that measure 2.34 by 2.36 millimeters.

The new material was developed for semiconductor applications by Hitachi Chemical Co., a subsidiary. It has much higher purity than other polyimides that are used for less critical applications like the wire insulation. Its sodium-ion concentration is less than 0.5 part per million, for instance, because current gain becomes temperature-sensitive with excess sodium concentration in the insulator.

It also operates at higher temperatures than conventional polyimides. Film held at 450°C for five hours shows no loss of thickness. Extrapolated lifetime tests indicate that devices protected by PIQ films should operate more than 100 years at temperatures as high as 300°C.

Application. PIQ is applied to wafers like photoresist—by dropping liquid material onto a wafer and then spinning it. The process can easily be automated and made part of the same automatic process sequence that dispenses resist.

As well as forming a continuous, break-free layer of the desired thickness over the underlying topography, PIQ is also free from stepping that might cause breaks in overlying metalization. Furthermore, vias for interconnection to lower metaliza-

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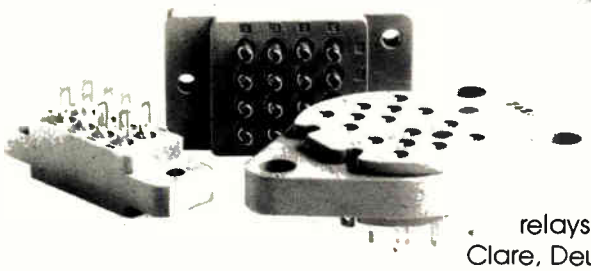

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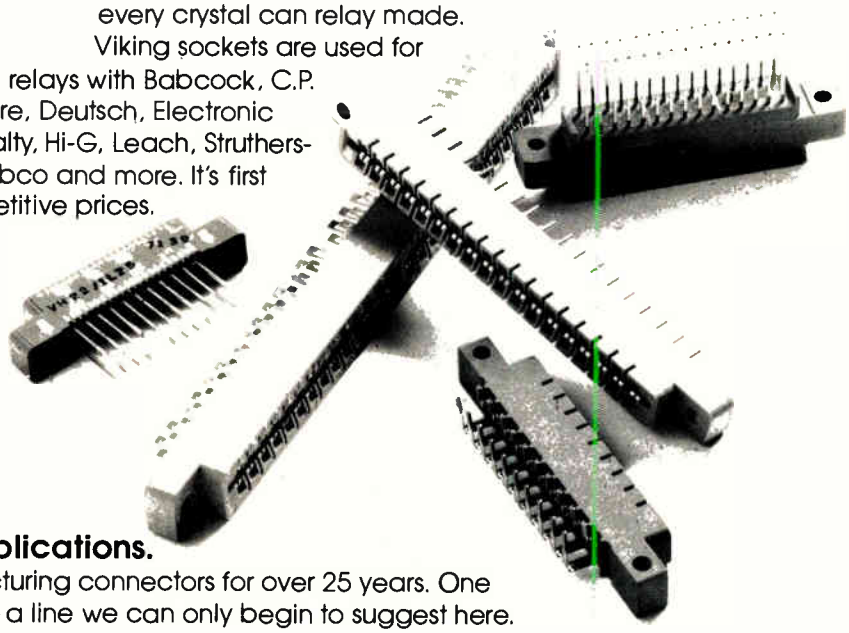

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Electronics review

cost $5 or $6 per conductor meter, last year the price dropped to $3, and now we are quoting a price of $1 per conductor meter for multifiber, full-environment cables," he says.

Moreover, he sees that price dropping to about 10 cents per conductor meter for high-volume orders, which might come in the early 1980s from telephone and telephone-like applications. "What will really make fiber optics take off is long-distance, high-performance applications requiring high data-rate transmission," he observes. □

Consumer

Microprocessors play bigger part in toys

Last Christmas saw microprocessor-based games and toys score such major sales successes that toy makers have been encouraged to introduce still more ambitious products. New functions, particularly in the area of sound synthesis, are to be found in many of the latest items on show this week at the Annual Toy Fair in New York.

Also apparent is that all the major toy companies have now made heavy commitments either to substitute electronics for electromechanical parts in traditional products, including games, or (much more often) to develop altogether new items entirely dependent on electronics for playing features and sound effects.

Chip from TI. For example, Milton Bradley Co. of Springfield, Mass., which brought out Electronic Battleship and Comp IV games last year [*Electronics*, Aug. 18, p. 71], has come up with Simon and Star Bird this year. Simon is a tabletop game based on a Texas Instruments TMS 1000 one-chip processor, plus another chip to drive incandescent lamps and a speaker. The idea is for from one to four players to match sound and color selections generated in random sequences by the processor. The sequence in which they are to be remembered is speeded up as the game progresses.

Star Bird is a rocket ship that makes realistic sounds of engines revving up when the ship is pointed upward and slowing when pointed downward. It also has "laser gun" sounds. The electronics consists of a single custom large-scale integrated circuit and a gravity switch that establishes the ship's attitude as up or down in order to provide the appropriate engine noises.

The Mattel Toys division of Mattel Inc., Hawthorne, Calif., started the trend in hand-held electronic games a year ago with a road race based on a Rockwell microprocessor. It has added several more since then and says demand for its hand-held toys has outrun its manufacturing capacity. And it promises two new categories of games for June, probably non-hand-held video and computer pinball games.

Also in the hand-held category and also built around a TMS 1000 is the Star Wars Electronic Laser Battle game, shown by Kenner Products Co., of Cincinnatti, Ohio. Unlike the other hand-held games, in which one player vies against the computer, it is a reaction game between two players who attack and defend. It has 16 different sounds, three playing speeds, and competitive scoring. The electronics package consists of the TMS 1000 with on-chip 1,024-by-8-bit read-only memory and 64-by-4-bit random-access memory; four switches for the player controls, plus an on-off switch; two rows of six light-emitting diodes with drivers; and speakers.

Few newcomers. Also apparent at the Toy Fair is the fact that the big, traditional game and toy companies have maintained their hold on the market for electronics entries. There are few significant newcomers to the market, as was the case with calculators and digital watches.

"The main reason toy companies have held the market is that developing a good toy is a big expense. A playable product is the name of the game, and everything else, pricing included, is secondary, unlike other electronics products," says Michael Moore, assistant to the vice president of Milton Bradley. □

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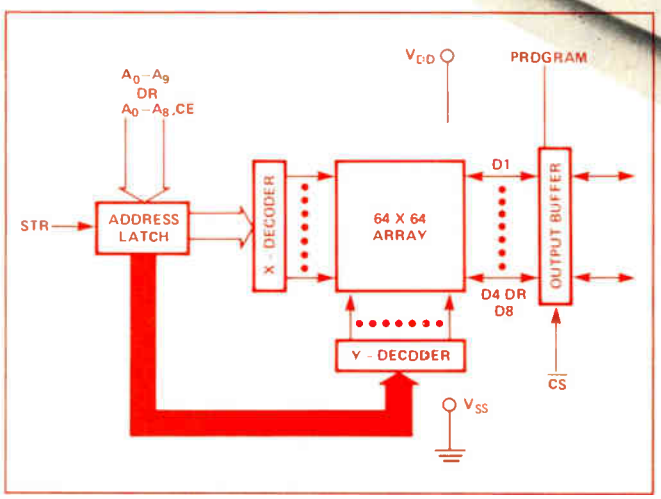

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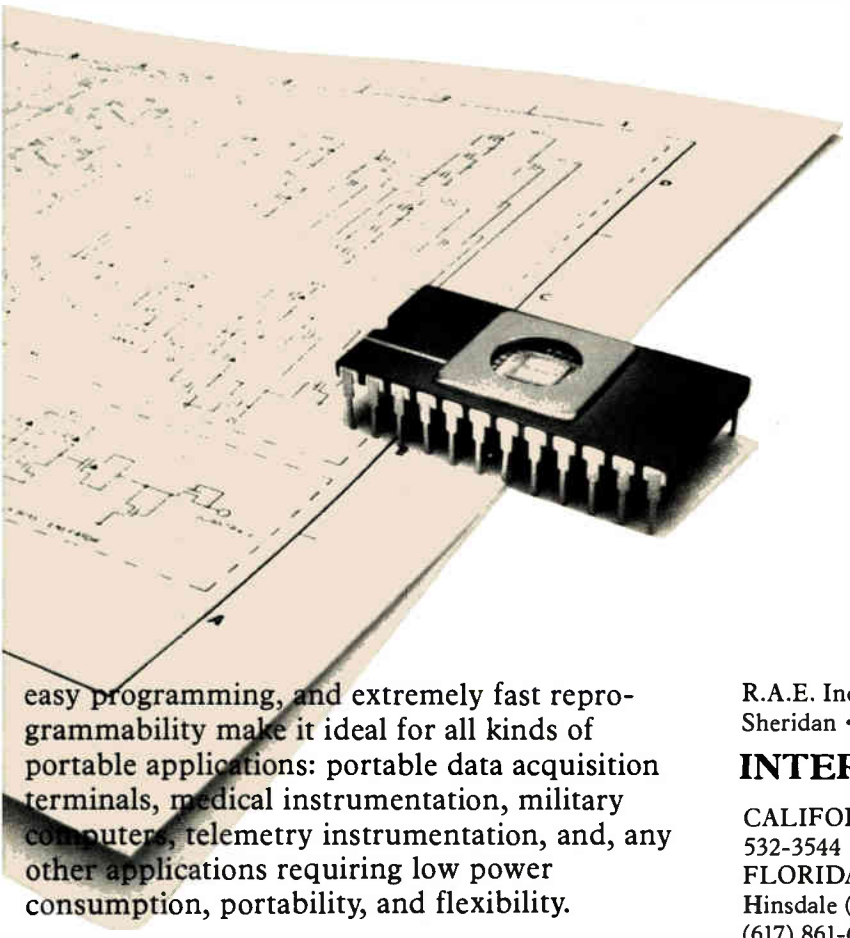

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NEC Newscope

2 Millionth Channel In Carrier Equipment To NTT

NEC marked its 2,000,000th channel delivery to Nippon Telegraph and Telephone Public Corporation (NTT) in the field of carrier transmission equipment with the recent installation of FDM channel translating equipment.

The equipment was installed at NTT's Tokyo Repeater Station and marked the 1,360,000th channel of NEC's FDM systems to be delivered to NTT in addition to 640,000 channels of PCM equipment.

NEC delivered its first FDM equipment to NTT in the 1920's and its first PCM equipment in 1965 marking the 1,000,000th channel in 1972. It took only five years for NEC to reach 2,000,000 channels.

In addition, NEC has exported FDM and PCM systems in a total amount of about 400,000 channels to more than 80 countries.

NTT engineer installs unit marking two-millionth channel of FDM and PCM systems delivered to NTT by NEC.

Austria Orders Complete Earth Station System

The Austrian Federal Ministry of Transport, headquarters of the Postal and Telegraph Administration, has ordered a complete earth station system from NEC for satellite communications.

The earth station will be designed for access to the INTELSAT V communications satellites above the Atlantic Ocean, and provide 108 high-grade international telephone circuits to and from Austria.

The contract, which was signed on a turn-key basis, calls for NEC to implement a complete standard earth station system with a 32-meter diameter dish antenna, while an Austrian-made power supply unit and antenna structure will be used.

This Austrian international gateway is expected to be built near Aflenz located about 150 kilometers southwest of Vienna.

When completed in the later part of 1979, the Austrian earth station will become the fourth international gateway built by NEC in Europe. The NEC-built earth stations in Switzerland, Yugoslavia and Rumania are now serving as international telecommunications centers for these countries.

Highlight of the Fuchu exhibition was the 60-meter long automatic mail processing system made for Brazil.

2,000 Visit Plant Exhibition

To mark completion of an automatic mail processing system for Brazil, NEC invited some 2,000 persons to see the equipment as well as other industrial systems displayed at its Fuchu Plant near Tokyo.

In addition to the 60-meter long complete mail processing system, the first of eight to be shipped to Brazil, there were many kinds of automatic mail processing machinery, the latest NC systems, an environmental pollution monitoring system, microcomputer systems for industrial use, a snow-fall detecting system, a central supervisory/control system for microwave communications networks and other equipment on display.

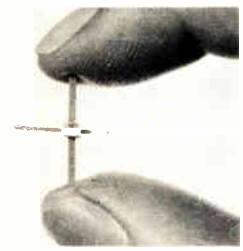
Many new electronic medical devices and systems also attracted the attention of the visitors. Among them were an electrocardiogram telemetry unit, electrocardiography system, ultrasonic tomography system, medical linear accelerator, medical computer system and special X-ray system for infants.

Breakthrough With New Transistors

NEC has successfully developed a remarkable new series of low noise microwave bipolar transistors called the NE644 and NE645, which mark significant breakthroughs in semiconductor technology.

The new transistors use self-alignment technique, a newly developed NEC device structure, to achieve higher consistency, reliability and dynamic range. A very low noise characteristic for a wide collector current range is another interesting and significant feature.

The frequency coverage is from 0.5 to 6 GHz, and the 2 GHz noise figure ranges from 1.6 dB at 7 mA, to 2 dB at 20 mA. The overall gain of 20 dB-plus, associated with a noise figure of 0.8 dB at 500MHz, will make it especially useful for cascade and IF amplifiers.



The NE644 and NE645 are available in chip form or in an 80 mil square hermetically-sealed Kovarceramic package.

This mighty mite is the NE644 low noise microwave bipolar transistor.

Command and Data Acquisition Station For Japan's GMS In Extensive Tests

The NEC-equipped Command and Data Acquisition Station (CDAS) of the Japan Meteorological Agency (JMA) is now undergoing extensive operation tests in conjunction with the Geostationary Meteorological Satellite (GMS), Japan's first successfully-launched application satellite.

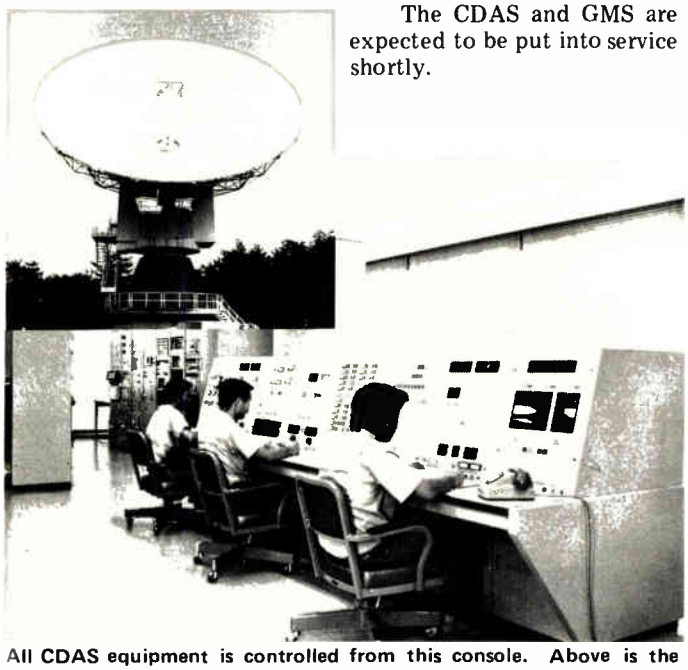
The CDAS, built at Hatoyama, Saitama Prefecture, as part of the Global Meteorological Satellite System, is the gateway to the GMS, and is accordingly designed to receive radio signals sent from the satellite. The signals received by the CDAS are sent over a microwave link to JMA's Data Processing Center in Kiyose, Tokyo, and processed for necessary weather information. The processed data are then sent back to the GMS through the CDAS for distribution to parties in need of such information.

Built atop a hill 100 meters above sea level, the CDAS is provided with an 18-meter diameter parabolic antenna in addition to the equipment for receiving image signals from the GMS, high and low resolution facsimile equipment to distribute weather information and setups to collect meteorological data. Also, those installed in the CDAS include a command transmitter to control the GMS, telemetry equipment and measuring equipment to measure the position of the GMS.

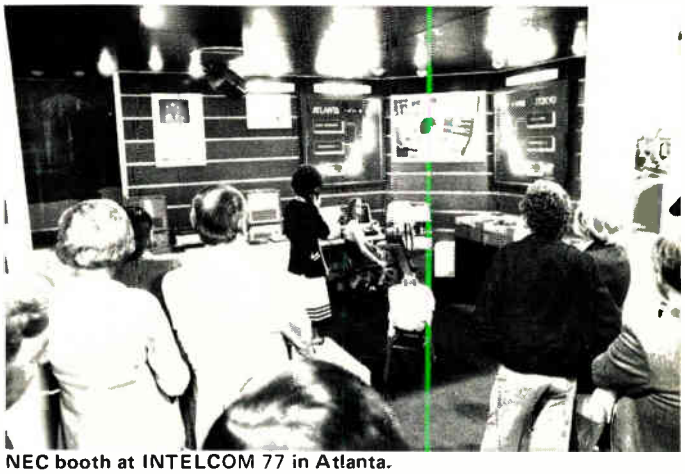
NEC designed and manufactured all the equipment in the CDAS.

The CDAS, in conjunction with the GMS, which was also supplied by NEC, will keep a close watch over the Western Pacific area so as to provide much more accurate weather information than ever before.

The CDAS and GMS are expected to be put into service shortly.



All CDAS equipment is controlled from this console. Above is the 18-meter diameter antenna at the CDAS.

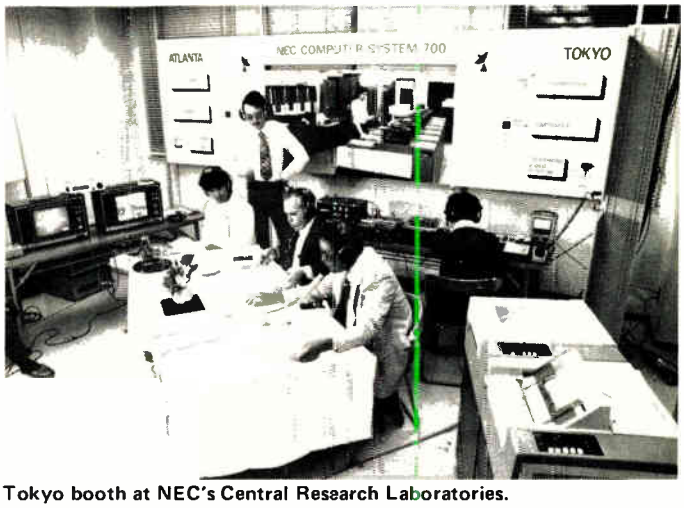


NEC booth at INTELCOM 77 in Atlanta.

NEC's Live Demonstrations Highlight INTELCOM 77

During the INTELCOM 77, the transpacific live demonstrations, conducted by NEC between Tokyo and Atlanta via the INTELSAT IV communications satellite, highlighted the first international telecommunications exposition held in the United States. NEC's transpacific demonstrations opened the door to a new kind of global communications.

The demonstrations were carried out over the ordinary telephone lines between the Tokyo booth specially provided at NEC's Central Research Laboratories and the NEC booth at the World Congress Center in Atlanta. Presided over by the masters of ceremonies at both ends, 80,000 kilometers apart, visitors at NEC's Atlanta booth enjoyed "Computerized Golf Clinic" and other transpacific shows over the special transpacific satellite on-line circuit.



Tokyo booth at NEC's Central Research Laboratories.

Washington newsletter

Two new digital techniques approved for land mobile

Two new techniques for digitizing land mobile communications have been approved by the Federal Communications Commission to become effective March 23. The first, called F3Y emission, scrambles emergency communications by police and fire departments to protect their confidentiality. **If the transmissions are intercepted by the public, they resemble static.** The second technique, called F9Y, is a new high-speed digital method of transmitting nonvoice information in all of the private land-mobile services. Both systems, the FCC says, required development of new interim emission-limitation standards to prevent adjacent channel interference.

SBS picks Harris, Fujitsu to compete for TDMA modems

Satellite Business Systems says it will choose between Harris Corp.'s Satellite Communications division and Fujitsu Ltd. of Japan as suppliers of up to 600 time-division multiple-access burst modems to be used with the SBS domestic satellite-communications system. The system is to go operational in early 1981. **The choice will be made after test and evaluation of five prototype modems** to be competitively developed by each company under two new contracts. SBS refuses to disclose the value of the two contracts, which call for prototype deliveries in 54 weeks. Included in the awards, SBS says, are firm fixed prices for optional quantities of operational TDMA modems.

Production units will be installed at earth stations on customers' premises to digitize voice, data, facsimile, and video communications traffic and transmit it in high-speed bit-stream bursts via a Hughes-built SBS satellite to other earth stations.

Sperry receives contract from Coast Guard

Sperry Rand Corp.'s Sperry division in Great Neck, N. Y., has received a $21.5 million contract to supply integrated electronic systems for the Coast Guard's medium-endurance cutters, a new group of ships designed to patrol the 200-mile offshore fishing limits recently set by Congress. Under the contract, awarded by the Tacoma Boat Building Co., Sperry's Systems Management unit will furnish, install, test, and support the total integrated cutter electronic system for each of four ships.

The system, which is to be on the 27 cutters the Coast Guard plans to buy over the next 10 years, integrates advanced navigation and control equipment to carry out navigation and collision avoidance, steering and propulsion control, and communications, among other functions.

Prospects dim for U. S. aid to counter CB imports

The U. S. citizens' band radio industry is writing off the prospect of higher tariffs on CB imports following the 3-to-3 split by the International Trade Commission on what kind of relief to recommend to the White House for protection of American manufacturers from foreign competition. Following the ITC's initial 5-to-1 ruling that some CB import relief was needed [*Electronics*, Feb. 2, p. 57], half the commissioners recommended a 36% tariff hike next fiscal year to be followed by a 5% reduction in each of the succeeding four years. The remaining three commissioners voted only for trade adjustment assistance to industry—a proposal that was quickly rejected by industry, which derided such payments as "burial assistance." **U. S. CB makers had sought a 50% tariff boost,** above the existing 6% level, that would have been scaled down to 40% over a five-year period. President Carter has until April to rule on what kind of aid, if any, domestic makers shall receive.

Washington commentary

Satellite solar power: Boeing's big new thing

Ever since the end of the manned lunar program, the U. S. aerospace industry has been floundering around with no equivalent program to fully employ its resources. Now the industry, led by Seattle's Boeing Aerospace Co., is moving to change all that by urging the White House, Congress, the Department of Energy, and the National Aeronautics and Space Administration—and anyone else who will listen—to commit the country to a long-term solar-power satellite program, one that could make America independent of foreign energy supplies in the 21st Century.

The SPS concept has come a long way since it was first advanced some 20 years ago by Peter Glaser of Arthur D. Little Inc. Now, after eight years of low-level studies in industry and Government, it appears feasible to assemble in space a rectangular photovoltaic grid 35 miles square. Two microwave transmitters would beam its 10 million kilowatts of power to earth stations, there to be reconverted into electricity and fed into the power grid.

Just plain engineering

Given the recent advances in photovoltaics, which Boeing and other SPS advocates contend will be delivering electricity for close to 4 cents per kilowatt-hour by the early 1990s, power satellites will not require technological breakthroughs. Instead, their challenge is no more than that of "a massive engineering job," smiles Ralph Nansen, Boeing's solar power program manager. He sees the program's greatest stumbling block as psychological, what he calls "concept shock."

Satellites the size of cities and the weight of battleships seem impossible now. So does the idea of four or more daily launches of huge reusable space freighters to transport men and materials into space to assemble an SPS system. It will be a long, hard job convincing unbelievers that SPS is not something straight out of Stanley Kubrick's fantasy "2001." But Boeing is quick to counter that the year 2001 is, after all, less than 25 years away, which is little enough time to turn such an idea into reality.

To get the first SPS sysem operational by 1992—the earliest possible date—industry advocates want the Government to begin an aggressive R&D program right away. Toward that end, Boeing has had introduced into the House a new bill, H.R. 10601, called the "Solar power satellite research, development and demonstration program act of 1978." It calls for the appropriation of $25 million in fiscal 1979 to set up a joint effort by DOE and NASA to accelerate SPS studies so that they yield a space demonstration program by the mid-1980s that will cost an estimated $3 billion.

Prospects for passage of the bill in this session are dim at best, considering that not one House heavyweight as yet supports it. Its principal sponsor is Ronnie G. Flippo, a freshman Democrat from Alabama. Arrayed against Flippo are both DOE and NASA, who must hew to the White House line favoring near-term energy solutions by increased spending on development of existing resources like coal and natural gas.

Nevertheless, Boeing and the other aerospace and electronics companies involved in earlier SPS studies should continue to push the concept for the long term. The roster of involved companies is an impressive one, including such names as Raytheon, Grumman, Westinghouse Electric, McDonnell Douglas, Garrett, General Dynamics, Martin Marietta, General Electric, Hughes, Rockwell International, and Varian Associates.

Present guesstimates are that a single, giant SPS satellite could cost $80 billion over a 14-year period by the time it became operational. That figure turns many people off until they recognize that America spent $45 billion on foreign energy buys in 1977 alone, and the price of oil is still going up. SPS advocates contend that power satellites could last 100 years or more with proper maintenance, with the initial cost being amortized after just 30 years.

The cost of inaction

What happens if SPS is not developed? By Boeing's arithmetic, the national energy bill between 1995 and 2025 will exeed $1 trillion. Thus they reason that "the cost not to develop satellite solar power is greater than the cost to develop it." That argument may seem specious to some listeners, but they cannot reject the fact that SPS would promote domestic economic stability by keeping power dollars and the jobs they create within the U. S. Nor can they overlook the fact that SPS systems have a distinct export potential: a satellite's microwave transmitters could after all be beamed towards ground stations in other nations needing to import energy.

The least that can be said about the SPS program is that it deserves a demonstration before it is turned aside. To reject it out of hand would not only be foolish but contrary to President Carter's promise to exploit America's enormous investment in space technology for domestic uses. Industry's job now is to convince more congressmen than Ronnie Flippo that SPS deserves a chance. **Ray Connolly**

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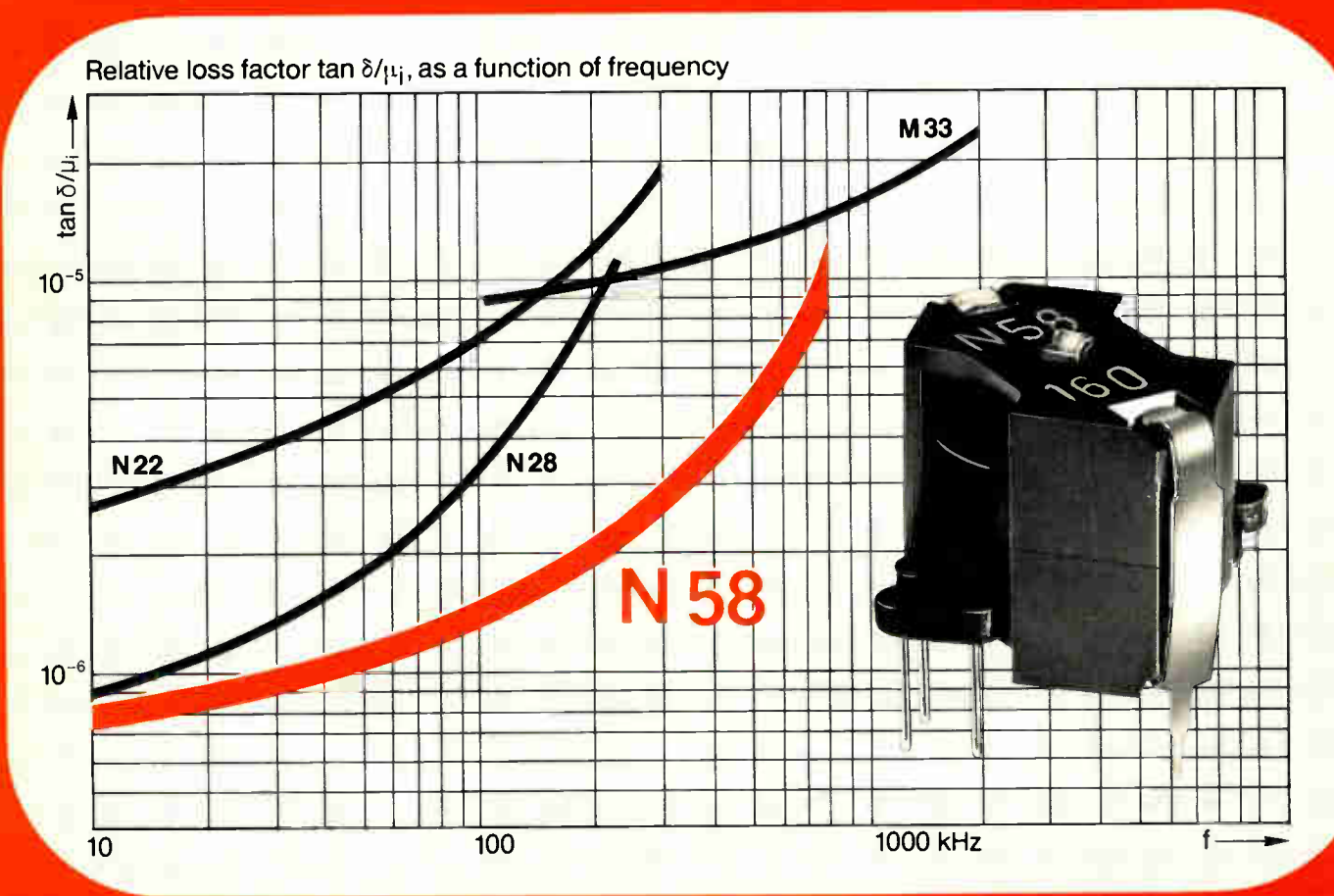

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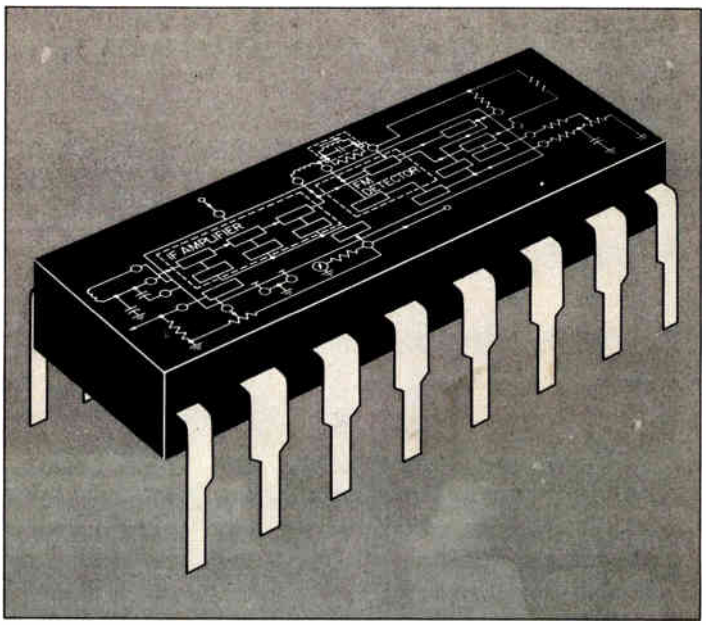

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RCA

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International newsletter

High-speed fax pushes a page to 28 receivers

Matsushita is the latest Japanese company to introduce a versatile high-speed facsimile system. The UF-2200 has a transmission speed of 9,600 bits per second, enabling it to send the standard, 257-by-364 mm, B4 page in 20 seconds. It achieves flexibility by compressing its digital signals for storage in an internal random-access memory before transmission and before writing at the other end. **A page, or several pages, need be read only once before being sent to as many as 28 destinations in sequence.** Also, the receiver can make two extra copies of a page during the 10-second handshake before it starts to receive the next page. Including an automatic document feed that permits transmission at low nighttime rates, the basic UF-2200 sells for $32,500. Rival manufacturer Toshiba also has announced a high-speed fax that also can transmit sequentially to different addresses, but the floppy-disk option that makes this possible adds $29,000 to the $25,000 price of the Copix 9600.

Demand dropping for color TVs, CB transceivers

The restrictions on color TV exports to the U. S. are making a big dent in Japanese exports: down 15.7% to 4,422,599 last year, with a continuing decline expected. The exports of citizens' band transceivers sank even more, by 47.45% to 8,139,609. Again the cause is a diminishing American market, but industry sources think the trend may have bottomed out. **In Sweden, color TV sales will drop 17% this year, to 290,000,** estimates the radio-TV retailers group. The reason, says the group, is that 75% of all households already own or rent color sets.

Low-loss coupler looking for possible makers

A spin-off product from a European Space Agency study of single-fiber data highways for aerospace systems is a Tee coupler with a 2-dB junction loss. The British developer, Cambridge Consultants Ltd. of Barr Hill, near Cambridge, is seeking manufacturers for the device. With a diameter of 7 mm and a length of 1 cm, **it could be a key element in multiterminal systems, as it can launch light energy into, and tap energy from, the fiber highway.** Cheapness, simplicity of construction, and ease of alignment are advantages claimed for the coupler, which uses discrete components such as mirrors and lenses with no tight-tolerance requirements.

France's IC plan awaits details—and election

It appears that the French government's plan for national self-sufficiency in advanced integrated circuits will not be ready before next month's elections. The government has earmarked some $120 million to strengthen the French IC industry over a five-year period. The money will be for development of very-large-scale ICs, a strong position in custom MOS circuits, and a commercial operation in volume MOS circuits like memories and microprocessors. **For the VLSI facet of the program, the government has tapped two French companies**—still not officially named, although one almost certainly will be Thomson-CSF. Most likely candidate for the custom MOS effort is EFCIS, a Grenoble-based company controlled by the French atomic energy agency. For the mass-production MOS operation, the government wants a joint venture between French companies and an American minority partner. Negotiations are under way, but most likely cannot be completed before the mid-March elections, if only because most major French electronics companies are slated for nationalization should the opposition leftist parties win and form a new government.

International newsletter

Varactor diodes have matched capacitance characteristics

Entering volume production at the Philips German subsidiary Valvo is a varactor diode that will be strong competition for other varactors in electronic tuning of TV sets. Using double ion-implanted technology, the BB109G is intended for two-band vhf (42-to-230-MHz) tuners. **Because doping processes by ion implantation can be precisely controlled and thus are highly reproducible,** the capacitance-vs-voltage characteristics in large runs of devices are very similar. This greatly simplifies tuner alignment procedures, says the Hamburg firm. The BB109G will be supplied in matched sets of 120 devices and more. The difference in capacitance between any two varactors in a set is less than ±1.5% over the 0.5-to-28-V tuning range, according to the firm. Quantity price will be about 17¢.

British firms add new wares to PABX market

United Kingdom telecommunications manufacturers are gearing for an assault on IBM's dominant 3750 digital solid-state private automatic branch exchange with a new generation of automated exchanges. Plessey's Private Communications and Data Systems division in Nottingham is first to the market with its PBX. These exchanges, based on the digital exchange design of Rolm Corp., Cupertino, Calif., can have from 80 to 800 extension lines, with 120 public lines. **Further development, part of a $20 million program, will lead to a family of exchanges with a capacity of up to 4,000 extensions.** Plessey already has 13 systems installed or in the works and total orders worth nearly $10 million. Meanwhile ITT Business Systems in Brighton has picked up its first orders, worth $1.25 million, for three of its microprocessor-oriented Unimats. Within eight weeks, GEC Telecommunications in Coventry will launch its anglicized SL1, manufactured under license from Northern Electric of Canada.

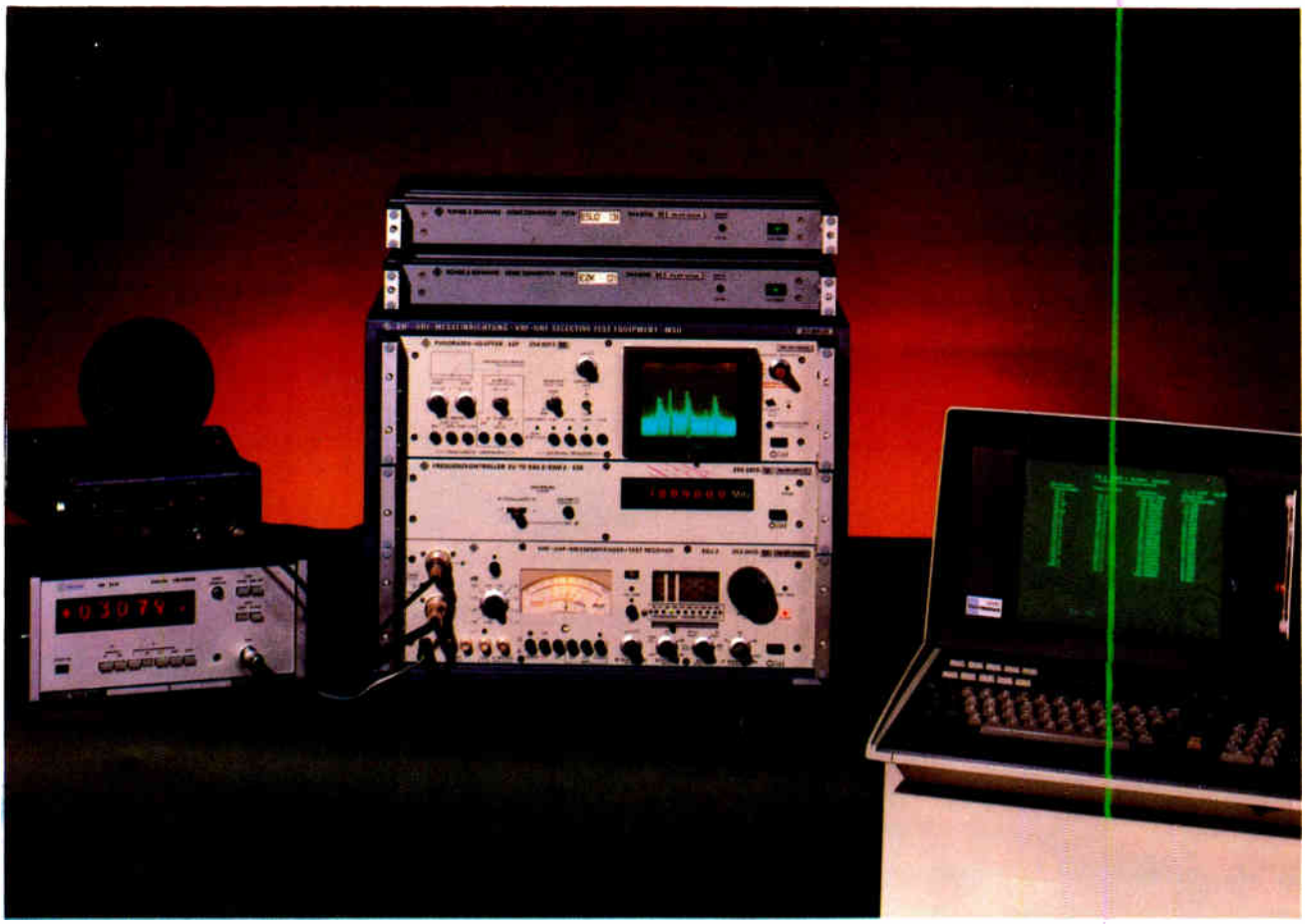
NEC aims minicomputer at industrial control, data networks . . .

Nippon Electric Co. is venturing into new fields with its NEAC MS minicomputer built around 2903-type bipolar 4-bit-slice microprocessors. The Japanese firm is aiming the two new models at distributed-processing, industrial-control, and communications-control applications. The smaller model, costing between $29,000 and $416,700, will have a 700-ns-cycle-time memory that is expandable to 0.5 megabyte. **The larger model, costing between $41,700 and $833,300, will have a 465-ns-cycle-time memory expandable to 2 megabytes.** It will be able to access two 16-bit words at once and will offer 4-kiloword optional cache memories that cut cycle time to 150 ns per word. Shipments of both models will start in May. High-level languages provided include Cobol, Fortran, and Basic. There also is cross software from the firm's ACOS computers, for which the new models may serve as front-end network processors.

. . . as Toshiba unveils big unit for industrial control

Meanwhile, Toshiba has announced the Tosbac series 7/70 industrial-control minicomputer that features 32-bit architecture, a 1-megabyte main memory, and a 16-megabyte directly addressable memory space. **The main memory, which uses 16-k n-MOS random-access memories, has a 2-byte access time of 240 ns.** Register add and subtract time is a speedy 0.36 μs. When deliveries begin in December, system prices will range from a $83,300 to above $4,150,000 for a multiprocessor installation. Although specifications rival those of large computers, operating systems and software have been announced only for industrial control.

Calculator controls measuring of radio signals and interference



Automated VHF-UHF measuring setup for 25 through 1000 MHz controlled over IEC interface bus from Tektronix desktop calculator 4051. Interactive programs for essential applications plus basic software for producing user programs. Numeric and graphic display of results on storage screen.

The **VHF-UHF selective test equipment MSU** with test receiver ESU 2, frequency controller and panoramic adapter meets the needs of automated and manual measurement of radio signals and interference, of lab assignments and monitoring tasks.

The **calculator 4051** governs the operating, measuring and checking routines, makes computations and produces test readouts and diagrams on its screen.

Interactive programs for primary applications:

- radiomonitoring with level measurement and – for the first time – remote frequency measurement (using a frequency counter) acc. to CCIR Report 272-3
- search program for detecting signals
- measuring signal and interfering field strength with results allowing for antenna factors
- measuring interference to MIL specs and VG standards
- measuring radio-interference in line with CISPR and VDE (calculator-controlled for the first time)
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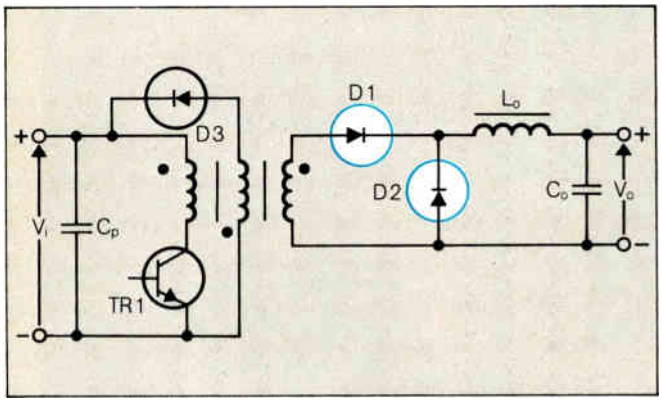
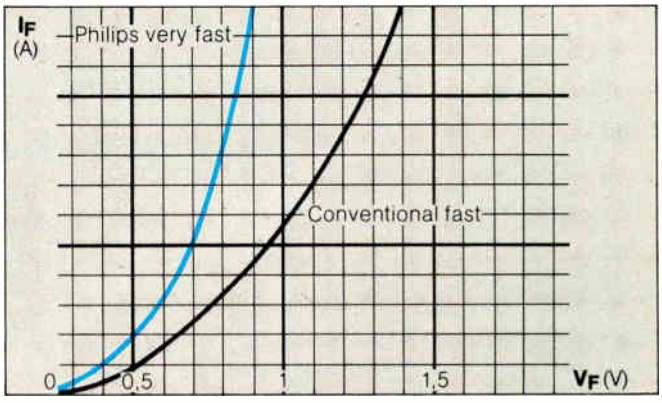
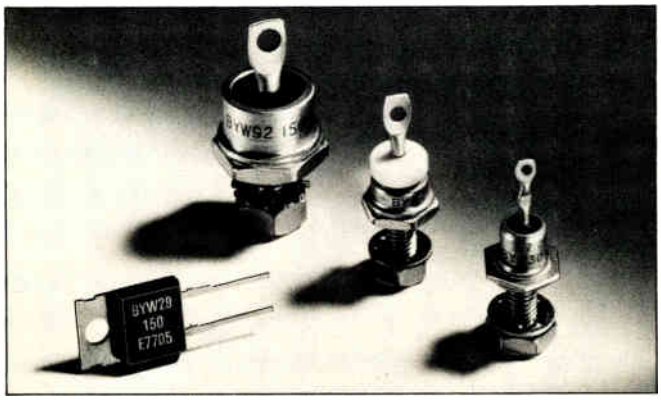


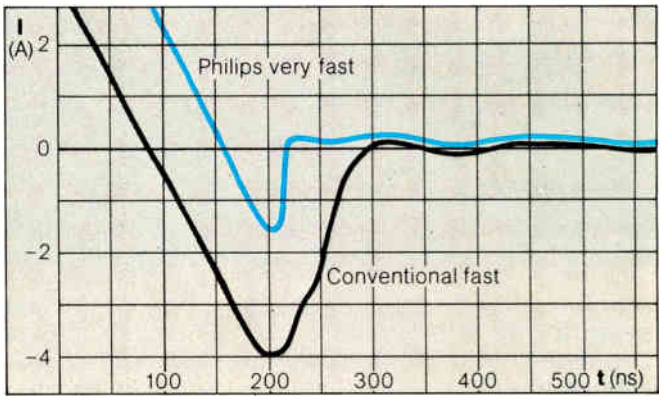
The application: high frequency switched mode power supplies (and inverters)



Benefit one: low forward voltage drop gives high circuit efficiency



The products: four new high efficiency, high reliability diodes in three V_{RRM} ranges



Benefit two: the very fast recovery provides negligible switching losses

Brief data

	BYW29	BYW30	BYW31	BYW92	
$I_{F(AV)}$max	7	12	25	35	A
Q_S	<15	<15	<20	<20	nC
V_{RRM}	50/100/150	50/100/150	50/100/150	50/100/150	V
V_F	<0.85	<0.85	<0.85	<0.95	V
t_{rr}	<35	<35	<50	<50	ns
Encapsulation	TO-220	DO-4	DO-4	DO-5	

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Molybdenum-gate RAM is designed for high speed

Experimental 16-k device has capacitively coupled sense amp, dummy sense circuit, and two multiplexers

A refractory metal out of the solid-state spotlight for a while may shoulder its way back in as development continues on fine-pattern, high-speed memories. Researchers at the Musashino Electrical Communication Laboratory are pushing ahead with molybdenum-gate dynamic random-access memories. The molybdenum has approximately a hundredth the resistivity of polysilicon interconnections.

The newest device from the lab is a 16,384-bit dynamic RAM with an effective gate length of 2 micrometers. It has typical access times of 65 nanoseconds and power dissipation of only 210 milliwatts at a 170-ns cycle time [*Electronics*, Feb. 2, p. 33]. Contributing to the performance are new circuit technologies, including a dummy sense circuit, capacitively coupled sense amplifiers, and double multiplexers, as shown in the drawing.

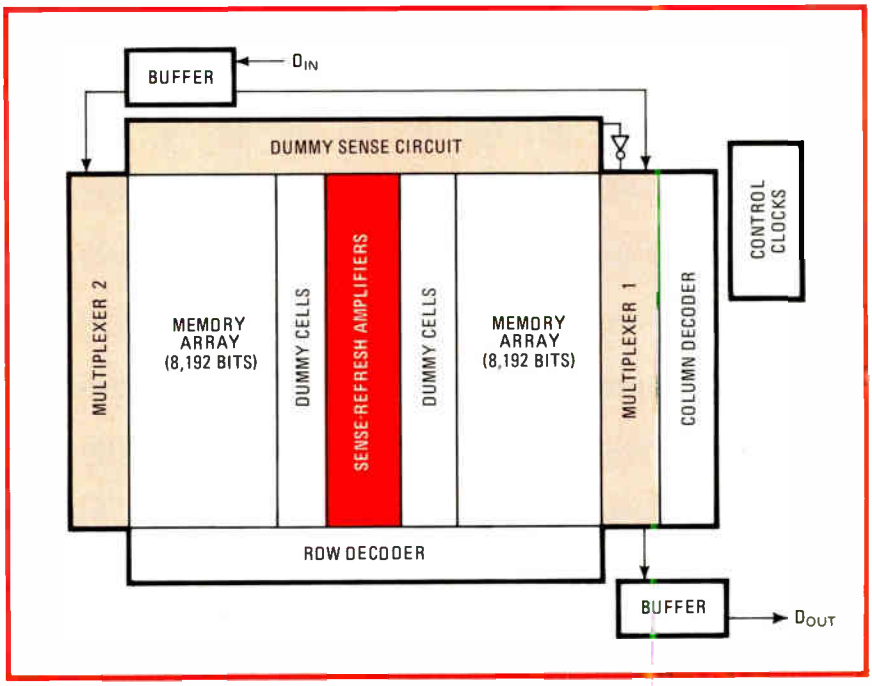
In a 16-k memory, the molybdenum is not essential for high speed: delay in a 2-millimeter-long line is 0.2 ns, compared with 15 ns for silicon. But as memory size grows, the material can play an important role: delay in a 4-mm-long line is about 1 ns, compared with 60 ns for silicon.

Single supply. The higher work function of molybdenum gates, compared to their polysilicon counterparts, makes possible a single power supply. Musashino's experimental device was designed to use two, but with a single +5-volt supply, it has an access time under 90 ns—still a 40-ns improvement over today's fastest parts.

The design is intended as a waypoint on the march towards 65,536-bit and larger RAMs. The lab has already developed a 65-k part [*Electronics*, April 28, 1977, p. 8E], but it has one layer of molybdenum for bit lines and one layer of polysilicon for the gates and word lines. In the 16-k part, both layers are molybdenum, further speeding up operation. Process refinements now make possible the fabrication of molybdenum gates, say researchers at the lab, part of the Nippon Telegraph and Telephone Public Corp.

The RAM has a dummy sense circuit (see drawing) that shortens access time while preventing an incorrect read operation. Other designs use a fixed delay to prevent operation of output circuits for a long enough time to permit the bit lines to reach a stable value. The delay is several times the minimum to compensate for processing variations, power-supply variations, etc., adding 5 to 10 ns to access time.

In the molybdenum device, there is automatic compensation for such variations, thus significantly cutting the delay time and shortening access time by about 10%. Because of the dummy sense circuit's location, it receives the read pulse after the circuits in the sense amplifier. Its output, amplified by an inverter, goes to one input of an AND gate in



Let's get fast. Two-micrometer molybdenum gates, plus dummy sense circuit, capacitively coupled sense-refresh amplifiers, and two multiplexers, give RAM high performance.

the multiplexer. The signal from the bit line is the other input, and it has reached a stable value by the time the dummy's signal arrives.

One cycle. Capacitive coupling in the sense-refresh amplifier permits the combined operation to take place in only one clock cycle, which leads both to a 20-to-30-ns decrease in cycle time, a speedup of about 15%, and to reduced power dissipation. The amp's clock also is capacitively coupled to the two bit lines, one running in each direction from the amp through the array. It raises the potential of the bit lines by equal amounts. Thus the potential of the line that receives the high-level signal from a cell becomes high enough for a refresh.

During a read cycle, only multiplexer 1 is used, because the signal is available to it, regardless of the location of the cell. For write operations, both multiplexers are used, and complementary signals are transferred from the input buffer to the pair of bit lines. Thus the RAM can read/modify/write with low power dissipation. □

France

Three microprocessors for satellite control are better than two, says aerospace firm

Field service for satellites is never likely to flourish, so designers figure on redundancy, adding a backup microprocessor to the one in the control system, for example. Now Engins Matra, the major French aerospace company is going these designers one better, with a three-microprocessor approach to the control system.

The new system, still in development, is designed "to maximize performance, minimize downtime, and allow graceful degradation in the event of failure of any of the processors," says a spokesman.

Sharing. One processor can perform the many satellite-control, diagnostic, and other functions assigned to the control system. However, the system is designed so that all three processors share the tasks, giving improved performance over the standard setup so long as two of the chips are still working.

Matra says the 3μP, for Trimicroprocessor, has a 99.8% chance of operating after seven years, compared with 94.6% for the two-chip redundancy approach. The probability is 0.91 that two of the three processors will be working after seven years.

The Intersil IM 6100 complementary-metal-oxide-semiconductor central processing units each have 4,096 12-bit words of memory, which contain the supervisory programs, the general-purpose routines, and local data.

There are as many as 24,000 words of user memory for applications software, held in 4,000-word blocks of 1,024-bit programmable read-only memories. The 4-k common system memory, composed of 1-k random-access memories and ROMs, holds supervisor tables, system data, and initial values. Both user and common memories are fully redundant. Matra developed the software under a contract with the French space agency, Centre National d'Etudes Spatiales.

As a program runs, each microprocessor works on a portion of it,

Smile, honey, you're on Candid Camera

The time may be drawing nigh when television viewers add a new role: home production of shows. With sales of video cassette recorders growing, the Japanese firms that pioneered these units are beginning to package color TV cameras with portable VCRs [*Electronics*, Feb. 2, p. 63].

The systems are expensive. The new combination from Victor Co. of Japan, shown here in a deluxe version with a 6× zoom-lens camera, costs $2,272 in Japan. For $190 less, Victor will sell its customers a system with a fixed-lens camera but with the same electronic viewfinder. At the moment the only commercial competition is from Sony Corp., whose least expensive VCR-camera combination costs about $3,377 with an electronic viewfinder and fixed lens. But Matsushita Electric Industrial Co. says it will undoubtedly announce a portable VCR-camera combination this year.

Potential buyers are likely to welcome the two-hour recording time of the Victor model, which is an hour more than Sony's present system. If they buy the Victor, they will discover that its camera tubes are less expensive to replace because they are two ordinary vidicons, one for luminance and one for chroma. The Sony camera uses a single tube with integrated phase separation for indexing the three colors.

Neither system is light, with the Sony weighing in at about 1 kilogram less than the Victor's almost 14 kg. Those figures are far above those for an 8-millimeter movie camera, but consumers may well figure that is a small penalty to pay for the instant-picture feature, plus longer playing time.

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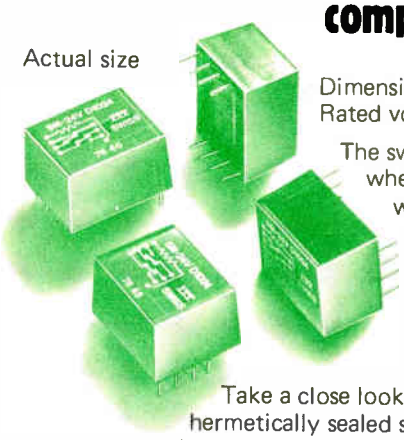

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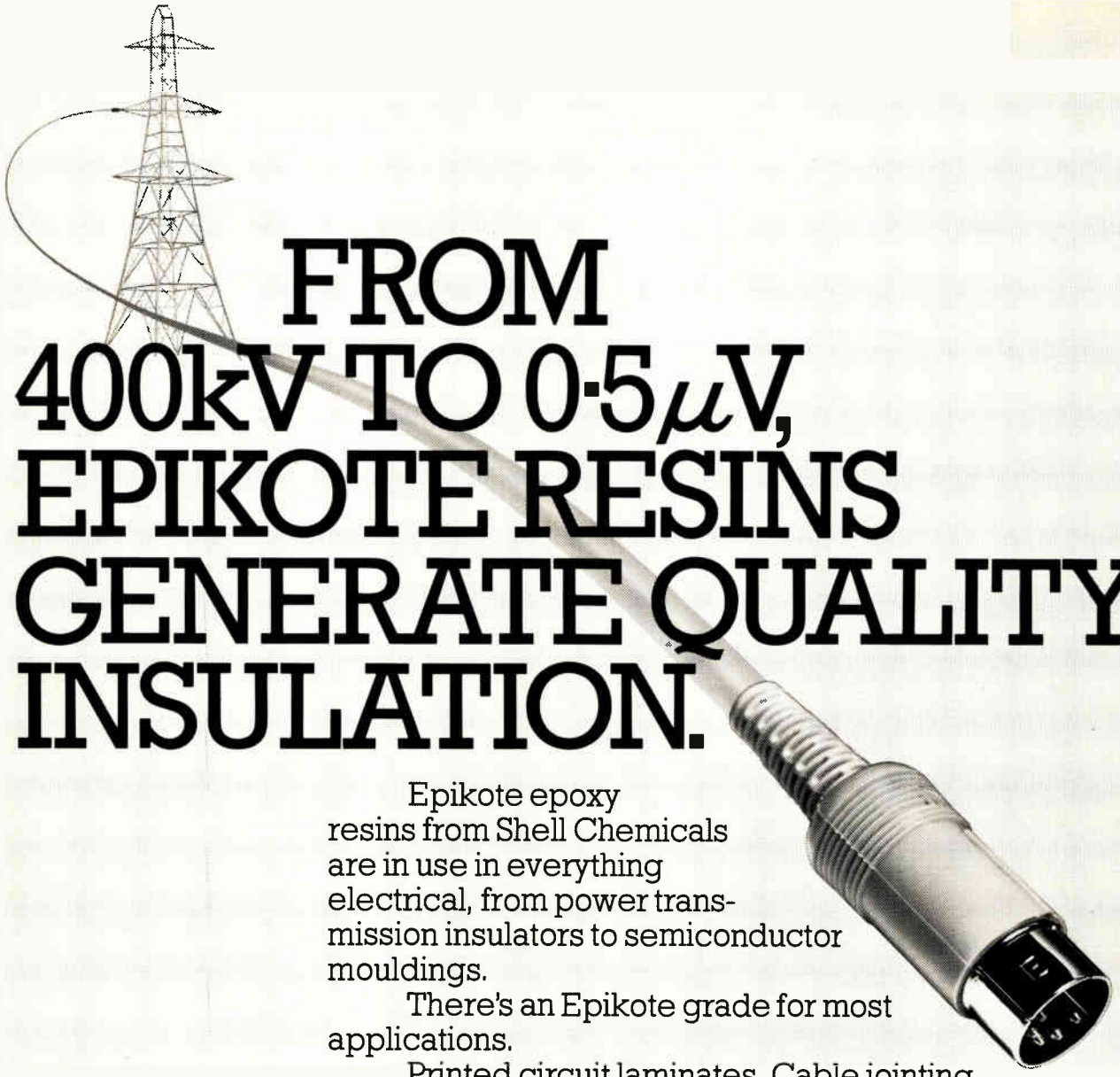

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final antilog stage. Then the coefficients are set up manually in the linearizer with the aid of thumbwheel switches. In the past, this operation could take an hour or more.

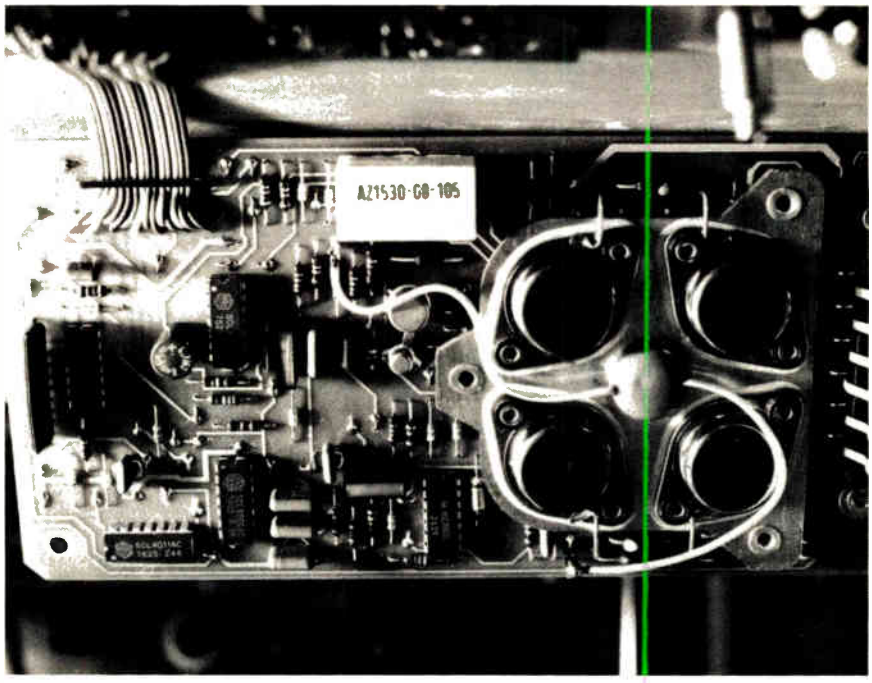
Prosser has reduced the job to a 10-minute operation. As calibration measurements are made, they are keyed directly into the microprocessor, appearing in a display window as they are entered. As many as 99 points can be keyed in, but 10 readings usually are sufficient. When all the plots have been entered, the run button is set, the displays go out, and the 1802 automatically works out the polynomial coefficients and sets up the linearizer module via a digital-to-analog converter that adjusts the multiplier current associated with each log amplifier.

Long-term calibration. Also included in the processor module is a standby battery so that the instrument remains set up from day to day once it has been calibrated by the experimenter. The development of the model 6100 was funded in part by a Department of Trade and Industry import substitution scheme. The department provided half the funds, to be paid back from subsequent sales. In developing the microprocessor program, Prosser teamed with the Electrical Science Department of Essex University. □

West Germany

Electronic cruise control for autos uses electric motor to move accelerator pedal

When drivers of Audi 5000s turn on their electronic cruise controls, they are activating an electric motor that maintains the car's speed and can accelerate it up to the desired speed. Responding to commands from an electronic control unit (see photograph), the motor works the gas pedal. In the usual electromechanical setup, which may or may not be electronically directed, the control unit's signals drive a vacuum unit



Remembering. Audi electronic cruise control stores driver-programmed speed in RAM and uses an electric motor to control movement of the accelerator pedal.

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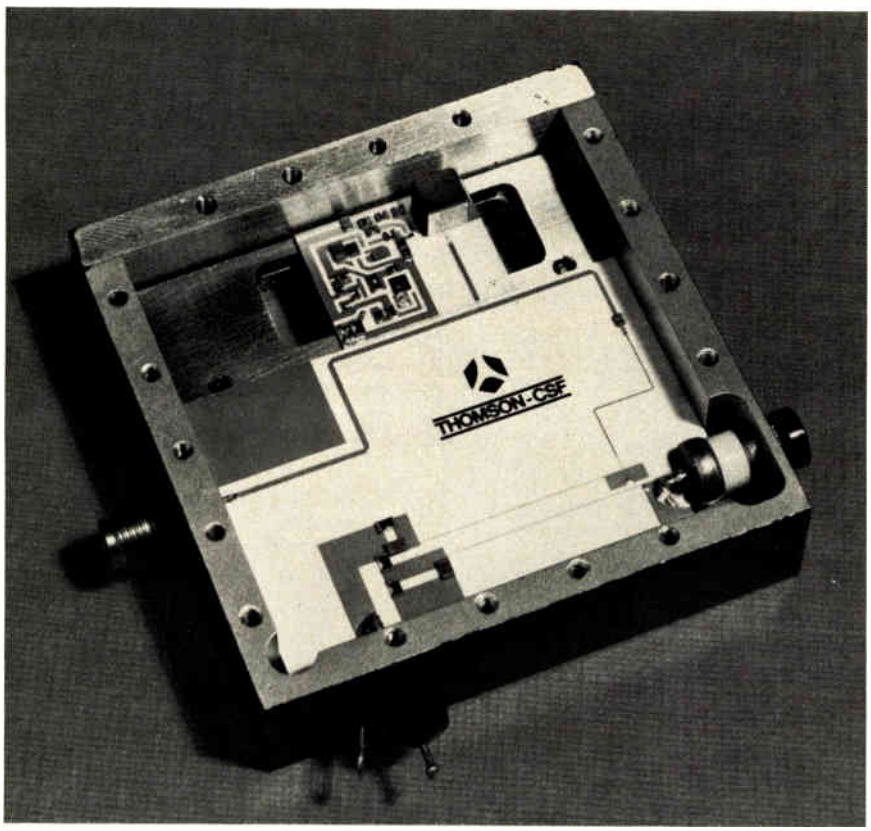
Stable bulk-wave source delivers 1 W at up to 3 GHz

by Arthur Erikson, Managing Editor, International

Heart of device is a thermostatted bulk-wave quartz delay line with a lithium-niobate transducer

Designers of microwave equipment have generally been unable to take a straightforward approach when they have needed stable solid-state sources at frequencies of 1 GHz or higher. What they have had to do, most often, is use a frequency multiplier paired with a highly stable pilot oscillator operating below the desired frequency. It works, but the harmonics that accompany frequency multiplication are a bother to get rid of.

So Thomson-CSF's Electron Tubes division should find a welcome for its samples of a stable bulk-wave oscillator microwave source that can go as high as 3 GHz. The device's medium-term stability is an excellent 20 ppm over a wide temperature range, and its power output a respectable 1 W. All these characteristics are much better than those of the surface-acoustic-wave oscillators that Thomson-CSF also makes for applications up to 800 MHz.

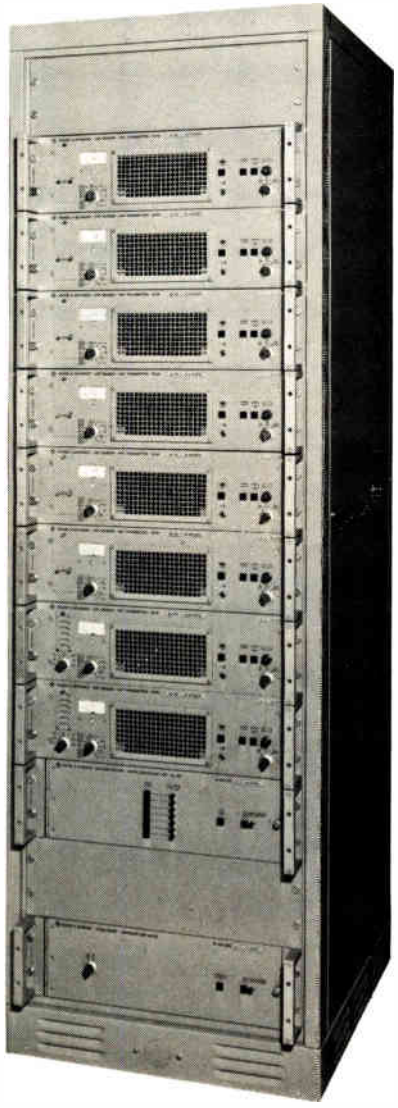


"You can use bulk-wave oscillators directly anywhere you need a source between 1 and 3 GHz," says André Schaer, who is in charge of microwave developments for the division. Thomson-CSF has priced the bulk-wave oscillator at "around $2,500 in small quantities. That's about the same price as an oscillator-multiplier combination, but there are no harmonics," he says. Frequencies higher than 3 gigahertz, of course, can be had by using multipliers with the harmonics problems reduced rather than eliminated.

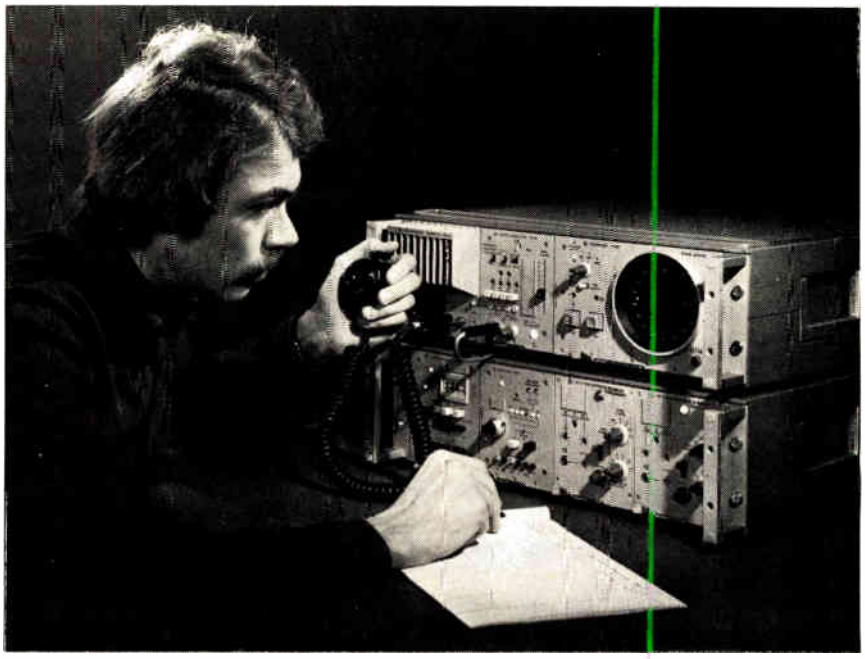
Essentially, Thomson's new bulk-wave oscillator is a free-running Miller-effect transistor oscillator that is phase-locked to an acoustic cavity—a thermostatted bulk-wave delay line. The frequency of the oscillator tends to decrease as the phase angle of its load increases. At the same time, the impedance of the cavity varies with the oscillator frequency. For these two effects together, then, there is a precise frequency at which the oscillator will lock on to the cavity. Locked on, the oscillator has a short-term drift of 1 part in 10^9 per second and a medium-term stability of 20 ppm from $-40°C$ to $+60°$ C. The medium-term stability of a SAW oscillator, in contrast, is 30 ppm over a narrower temperature range.

The free-running oscillator itself is nothing unusual, Schaer explains, but the bulk-wave delay line is something special. It consists of a slab of quartz crystal, AT cut and with a very thin lithium-niobate transducer soldered to one face. The fundamental frequency at which the delay line operates is set basically by the thickness of the transducer—for

Electronic aids for air-traffic control



VHF 6-channel transmitting system NU 156 (50 W, 118 to 144 MHz). Extremely high up-time of all channels through a special automatic reserve device.



The VHF direction finder PA 008 is a reliable and good-value compact system, and also highly suitable for mobile use.

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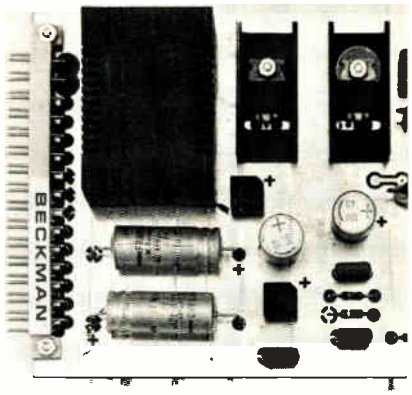
Circle 263 on reader service card

1 GHz, for example, the transducer is 1.7 μm thick. But a fine adjustment can be made by removing a few angstroms of material from the back of the quartz crystal by ion etching.

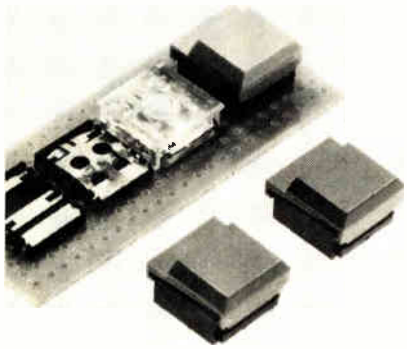
Operating in bulk wave, Schaer explains, the new oscillators are 10 times more efficient than the company's SAW oscillators, drawing only 10 w from a 12-v supply for 1 w of output power. The transistor oscillator draws between 3 and 5 w; most of the rest of the power is consumed by the crystal heater and its control circuit.

Thomson-CSF, Electron Tube Division, 38 Rue Vauthier, 92100 Boulogne-Billancourt, France [441]

Logic probe JAER can detect pulses as narrow as 50 ns. Versions for use with RTL, TTL, DTL, C-MOS, and low-speed logic are available. The units use four light-emitting diodes to indicate logic levels and switching states. Kreiseder, 8200 Rosenheim, Tillystr. 10, West Germany [445]



A servo amplifier on a 100-by-172-millimeter Euro-format plug-in card contains a 220-V power supply, two power amplifiers, a gain-adjusting trimmer, and current-limiting circuitry. Beckman Components GmbH, Frankfurter Ring 115, 8000 Munich 40, West Germany [448]

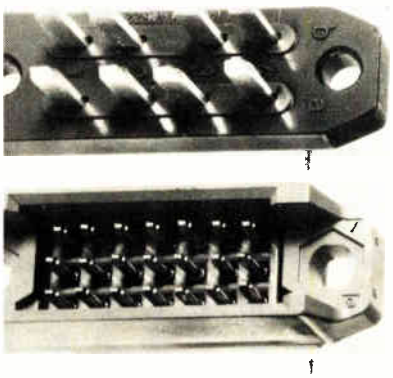


The type REK push-button switch is intended for ultrasonic remote-control units for TV sets and other entertainment equipment. It can handle maximums of 250 mW, 25 mA, and 25 V dc. The switch can be soldered directly to pc boards. SEL (ITT), 8500 Nuernberg, Box 2340, West Germany [443]

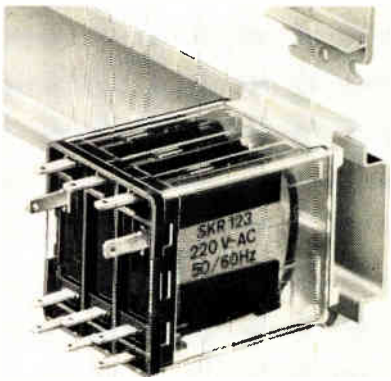
The UZ46 is a six-digit 15-MHz universal counter-timer that measures frequency, period, pulse width, time intervals, and events. It has a miniature quartz-crystal-controlled oscillator, which serves as its time base. H&B, 6 Frankfurt 90, P. O. Box 900507, West Germany [446]

The type 1002 quartz oscillator is a temperature-compensated device that delivers 1 V rms at 10 MHz. It is supplied as a 50-by-70-by-35-mm module that can be soldered directly to a printed-circuit board. Dietechnik, 8041 Weng, Am Kirchfeld 2, West Germany [449]

Digital multimeter DM33 measures ac and dc voltages and currents as well as resistance. Resolutions are 100 μV, 1 μA, and 100 mΩ, respectively. The 21-range instrument has automatic zeroing and overload protection. Grundig AG, 8510 Fuerth, Kurgartenstr. 37, West Germany [444]



Connectors in the DIN-Highdensity series come with 21 to 72 pins and conform to DIN41618 and DIN41622 standards. The 21-pin unit, for example, has the same dimensions as a DIN41622 8-pin device. Amphenol-Tuchel Electronics GmbH, 8024 Oberhaching, West Germany [447]

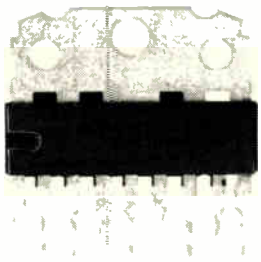


Measuring 35 by 35 by 47 millimeters, the SKR123 industrial relay can handle 10 A at 220 V ac (50 Hz or 60 Hz). The component is supplied with attachments for wall and panel mounting. Its contact springs have a 5-mm air gap. Elesta AG, 7310 Bad Ragaz, Switzerland [450]

News from Philips

Integrated circuits ● Semiconductors ● Electron tubes ● Components ● Assemblies ● Materials

MANY MOUNTING OPTIONS FOR AUDIO POWER ICs IN SIL-9 PACKAGE



The TDA1010 and TDA2611A integrated audio power amplifiers in the new single in-line 9-pin SOT-110A encapsulation with a cooling tab provide the designer with a wide choice of mounting methods. In most applications, the cooling tab can be clamped or screwed easily to an external heatsink to prevent excessive temperature rise.

The TDA1010 combines the functions of pre-amplifier (gain = 24 dB) and power amplifier (gain = 30 dB), but with separated circuits. This gives the designer more freedom in frequency response and gain variation. Thermal protection with linear reduction of pre-amplifier gain is integrated on the chip. Due to the absence of overall feedback, the stability is good and gain reduction can be obtained between both amplifiers without feedback variation. The TDA1010 has a nominal supply voltage of 14,4 V and delivers 6 W output power into a 4 Ω load, or 8 W into a 2 Ω load. This device is ideal for automobile radios, as well as mains operated equipment such as record players, table radios and recorders.

The TDA2611A, with a gain of 37 dB without external components and a supply voltage range from 6 to 35 V, is intended for use in mains powered equipment such as TV sets. It delivers 5 W into a 15 Ω load at 25 V supply voltage, or 4,5 W into an 8 Ω load at a supply voltage of 18 V, and is thermally protected. The TDA2611A has a nominal input impedance of 45 kΩ. This can be increased by bootstrapping the input with an external resistor and capacitor in series to as much as 1 MΩ, depending on component values.

Both devices require a minimum of external components, and the few which are needed can be smaller or cheaper.

CIRCLE 104 ON READER SERVICE CARD

AUDIO SWITCHING WITH BIPOLAR ICs

The TDA1028 and TDA1029 bipolar integrated circuits perform the functions of d.c. controlled audio switches. The TDA1028 behaves as two isolated 2-way, 2-pole switches, and the TDA1029 behaves as a single 4-way, 2-pole switch. Basically, the devices consist of operational amplifiers connected as impedance converters; their overall gain is unity. Control inputs for switching only need a connection to ground. Most important technical features of the new circuits are the large input signal handling capability of 5 V r.m.s., low distortion of only 0,02% at 1 kHz and 0,04% at 20 kHz, low cross-talk of − 75 dB at 1 kHz and 47 kΩ source resistance between a switched-on and a switched-off input, or − 90 dB between two switched-on inputs, and low noise of only 5 μV from 20 to 20000 Hz with a 47 kΩ source resistance. Input impedance is up to 470 kΩ.

Intended initially for hi-fi applications, the new circuits can be used for input selection (pick-up, radio a.m./f.m., tape, auxiliary), monitor switch, rumble filter, noise filter, mono/stereo switch, contour, and muting. An unscreened control wire is all that is needed to operate a switch; the end of the wire has to be grounded. This enables controls to be placed where ergonomic considerations dictate. Another important feature is that screened cable does not need to be brought to the front panel. D.C. control of audio functions enables easy application of remote control to hi-fi equipment; in automobiles, the tape playback unit can be mounted anywhere in the car with simple buttons only on the dashboard.

CIRCLE 105 ON READER SERVICE CARD

STABISTORS FOR LOW VOLTAGE CIRCUITS

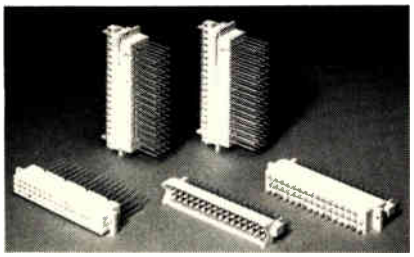
Where a zener diode would be ideal, but the voltage is too low, our low voltage stabistors BZV46-C1V5 and C2V0 are the answer. Consisting of two (or three) series-connected base-emitter junctions on one planar chip, the new devices are the latest additions to our range of whiskerless diodes. They are intended for low-power clipping, level shifting, voltage stabilization, and temperature stabilization of transistor base-emitter biasing networks.

Low cost is the most important feature of the stabistors which have a guaranteed reverse blocking voltage capability of 4 V, and low differential resistance. The BZV46-C1V5 has a forward voltage from 1,35 to 1,55 V and a differential resistance less than 20 Ω. For the BZV46-C2V0, the forward voltage is from 2,00 to 2,30 V and the differential resistance less than 30 Ω.

The new diodes, which are encapsulated in a rugged SOD-27 (DO-35) package, have a total power dissipation of 250 mW up to an ambient temperature of 45 °C.

CIRCLE 106 ON READER SERVICE CARD

HEAVY DUTY EUROCARD CONNECTORS



Heavy duty Eurocard connectors F068-II have been designed for applications where high current ratings and/or wide clearances and creepage distances are necessary.

Conforming to DIN41612 and the proposed IEC standard, the F068-II series is rated at 5,5 A at 20°C. They are designed for 19-inch single and double Eurocard formats and employ a 5,08 mm (0,2 inch) contact pitch. The F068-II series is available in DIN "Style F" with 32 and 48 contacts and "Style G" with 64 contacts.

Complementing the small-signal series of printed circuit connectors F068-I, the heavy duty series employs contact pins of brass for the male, and phosphor bronze springs for the female, with gold on nickel plate for the contact faces. The springs of the female are reinforced with a steel spring to eliminate fatigue and maintain constant contact pressure under severe industrial operating conditions such as vibration. Extended length initial ground contact pins for the male parts are standard.

The female parts are terminated with 1 mm square pins for wire wrapping or dip soldering. The male part has 90° dip solder pins specially shaped for easy mounting. Versions with other forms of terminations will become available in due course.

The combination of the F068-I for small-signal circuits and the F068-II for heavy duty applications is ideal for a wide range of instrumentation and control systems in severe environmental conditions. The connectors conform to the US flammability standard UL94 - Cat V1.

CIRCLE 107 ON READER SERVICE CARD

ELCOMA WINS CONTRACT WORTH OVER 10 MILLION GUILDERS

We have recently secured a contract worth over 10 million guilders from the European Organisation for Nuclear Research (CERN) in Geneva for the supply and installation of four 500 kW, 200 MHz power amplifiers for their Super Proton Synchrotron. These additional amplifiers will provide enough extra radio frequency power to double the present capacity of the existing synchrotron for high energy physics experiments.

The Super Proton Synchrotron, which is built in a circular tunnel 7 km in circumference at an average depth of about 40 m, currently operates at a level of 400 GeV (400 thousand million electron volts). The new amplifiers, which will be delivered during 1979, will enable the Super Proton Synchrotron to be used more efficiently.

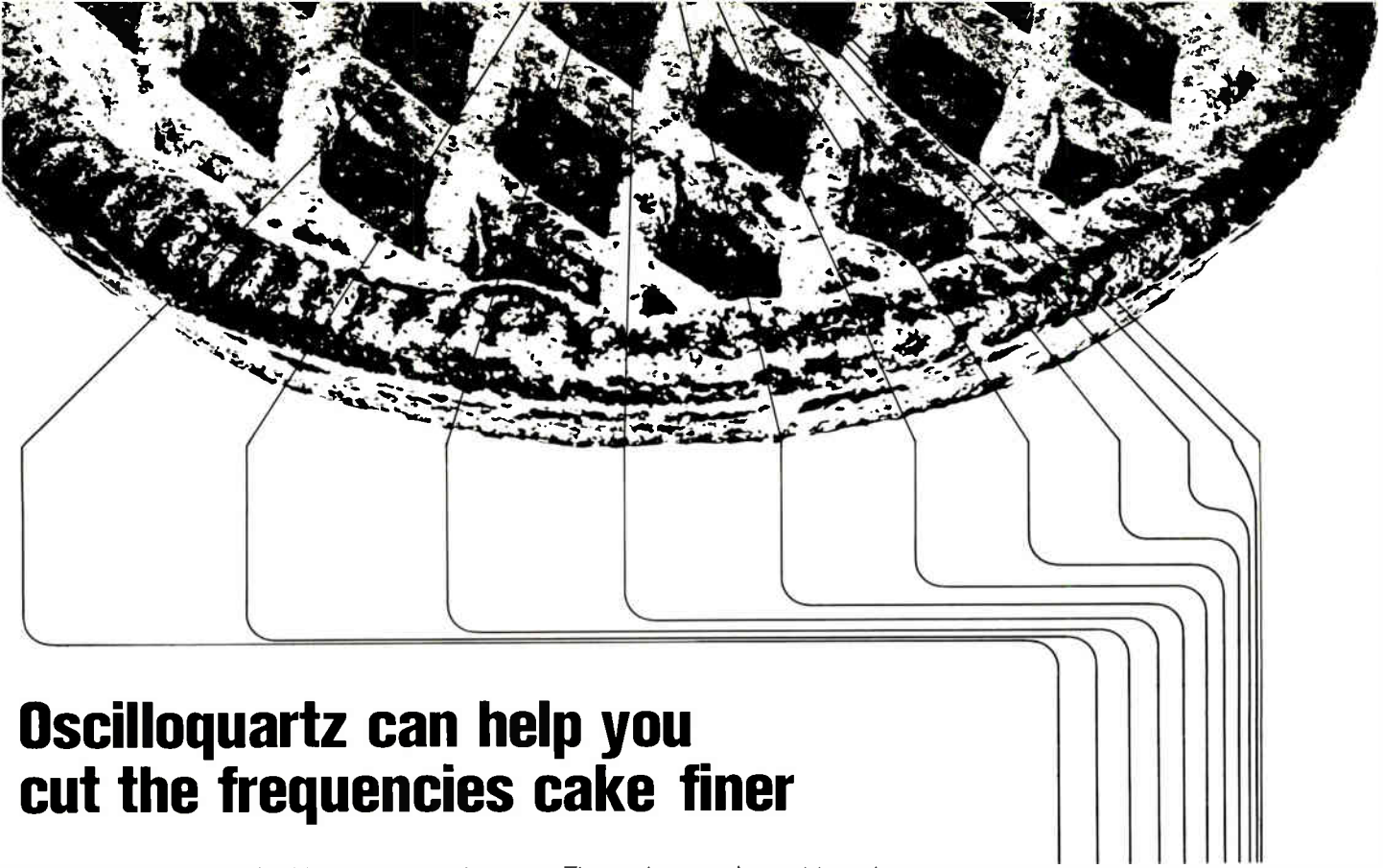
Each of the 500 kW power amplifiers will employ 17 tubes of the YL1530 type. These tubes are air-cooled coaxial power tetrodes of metal ceramic construction and develop approximately 37,5 kW each. ELCOMA, who is the main contractor, will supply the tubes and cavities. The anode and auxiliary power supplies which provide up to 4 MW of electrical power, as well as the control, protection and signalling systems, will be supplied by the Power Electronics Division of the Dutch company Hazemeyer B.V., Hengelo. The power amplifiers will be built and installed by Philips Telecommunication Industries in the Netherlands. R.F. couplers and connectors will be supplied by the German firm of Spinner GmbH, Munich.

The contract also provides for the supply of spare tubes by ELCOMA for a period of 10 years.

Philips Industries
Electronic Components and Material Division
Eindhoven - The Netherlands

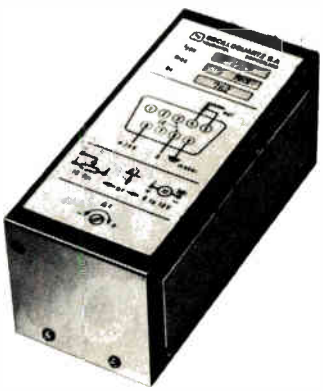
PHILIPS Electronic Components and Materials

PHILIPS



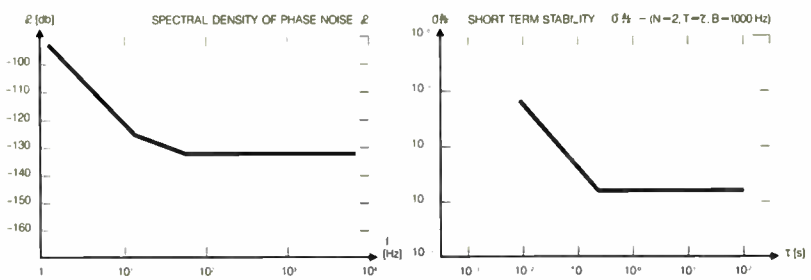
Oscilloquartz can help you cut the frequencies cake finer

Times are changing. And in more ways than one. These days you've got to get more and thinner slices out of that frequencies cake.
That's where Oscilloquartz can help with their B-1325 (24 VDC) and B-1326 (12 VDC) oven-controlled crystal oscillators. They offer the best in price for performance in OCXOs to provide a fixed frequency source.
They are your economical route to spot-on performance in communications and navigation systems, applications where signal multiplication to higher frequencies is required, in synthesizers, time-code generators, counters and spectrum analyzers.
Take a look at the specification. You're getting the sort of short-term stability, spectral purity and long-term aging performance formerly available only in oscillators produced for laboratory work. Yet the cost of the B-1325 and B-1326 is comfortably within the industrial-type oscillator range.
But that's not all. If you're in the communications field, you get more economic mileage out of these OCXOs. You'll need a lot fewer calibrations to stay within the increasingly stringent requirements demanded by the FCC, CCITT and government communications agencies around the world.



This is what you get for less money than you thought:

Output frequency: 5 MHz or other close frequency
Frequency stability:
  Aging 5x10^{-10}/day; 1.5x10^{-7}/year
  Over temperature range <6x10^{-9} from -40°C to +60°C
Short term stability: $\tau = 1$–10 s, $\sigma = 1 \times 10^{-11}$
Environmental:
  Temperature -40°C to +60°C
  Altitude 7,600 metres (25,000 feet)
  Humidity 95% relative at 60°C
  Vibration 1.5 to 0.5 mm peak to peak: 8 to 50 Hz
  Shock 50 G/9 ms (all axis)
Dimensions: 50x51x116.5 mm (2x2x4.6 ins)



Then there is the rest of the Oscilloquartz range. It doesn't matter whether you are looking for a clock oscillator, TCXO, OCXO or a 1x10^{-11} cesium frequency standard, we can supply you with the frequency source best adapted to your particular application.

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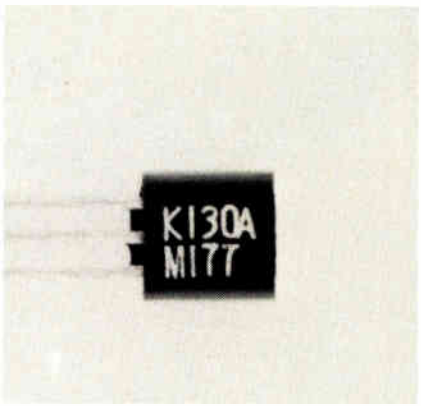
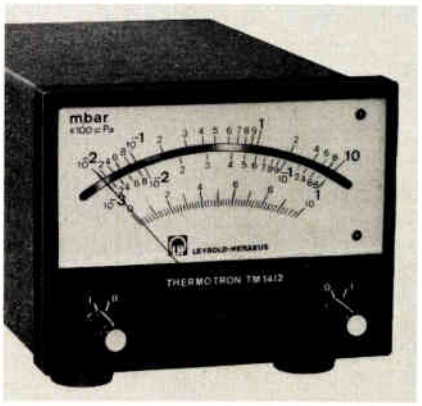


A low-frequency, low-noise, n-channel junction field-effect transistor, the 2SK130A, can be used in what is called an input-capacitorless (ICL) circuit, which can be connected directly to a moving-coil pick-up. Nippon Electric Co., 5-33-1 Shiba, Minato-ku, Tokyo 108, Japan [460]



The Thermotron TM14/2 is a vacuum-measuring instrument designed for use in semiconductor production facilities. It makes measurements from 10^{-3} millibar to 10 mbar. The unit has two recorder outputs. Leybold-Heraeus GmbH, 5 Cologne 51, P. O. Box 510760, West Germany [463]

The AS30 signal generator delivers a stable output of 200 mW from 125 kHz to 32 MHz. The unit has an 80-dB attenuator and includes a 1-kHz generator for internal modulation. Output impedance is 75 ohms. Nordmende, 2800 Bremen 44, P. O. Box 448360, West Germany [464]

Interactive VAX-11/780: A new computer system with exceptional performance...

VAX-11/780™ is a new, virtual memory, multi-user, multi-language, multi-programming, interactive computer system with extensive batch and real time response capabilities.

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digital
VAX11
780

..unmatched reliability, availability, maintainability...

By design, the interactive VAX-11/780 is the most reliable, available, and maintainable computer system of its general class that has ever been built. It is another standard against which others must be measured.

Reliability, availability, and maintainability features are found in the hardware architecture, the software architecture, the individual component and board designs, and in the cabinetry – all supported by new and improved diagnostic aids.

Objective: keep the system running. If it fails, find the fault quickly, fix it, get the machine up and running again. Protect that data.

Four hierarchical access modes protect the system information. A diagnostic console contains an LSI-11 microcomputer. Automatic consistency and error checking detect abnormal instruction uses or illegal arithmetic conditions. Integral fault detection and maintenance features detect errors on memory, on disks, keep a history of recent bus activity, detect hung machine conditions, and allow automatic restart recovery.

Parity checking for the integrity of the data is performed on the synchronous backplane interconnect, the MASSBUS and UNIBUS adaptors, memory cache, address translation buffer, microcode, and writable diagnostic control store. There are fault tolerance features. There are remote diagnosis capabilities. There are system verification test packages. There are functional and fault isolation diagnostics.

There are operating system consistency checks, redundant recording of critical information, uniform exception handling, on-line error logging, unattended automatic restart capabilities.

There are power loss, temperature and air flow sensors, cabling located away from the modules, a modular power supply with malfunction indicators...

digital
VAX11
780

Circle 69 on reader service card

Major Features of the VAX-11/780 system

CPU 32-bit word length • Can directly address 4 billion bytes of virtual memory • User program can be up to 32 million bytes • Powerful instruction set includes integral floating point and context switching instructions • Instruction set supports 9 fundamental addressing modes with single instructions simulating entire high level language constructs • 8K byte write-through memory cache results in effective 290 nsec memory access time • Supports state-of-the-art paging memory management with 4 hierarchical protection modes each with read-write access control • 16 32-bit general-purpose registers • 32 interrupt priority levels, 16 for hardware and 16 for software • 2 standard clocks, programmable real-time and time-of-year with battery backup for automatic system restart operations • 12K bytes of writable diagnostic control store.

The Console Subsystem Intelligent microcomputer LSI-11 with 16K bytes of read-write memory and 8K bytes of ROM, floppy disk, and terminal • Optional port for remote diagnostics • Fast diagnosis, both remote and local, simplified bootstrapping, improved distribution of software updates.

Main Memory Subsystem ECC MOS memory built using 4K MOS RAM chips • Memory controller includes request buffer, increasing system throughput, eliminating most need for interleaving • Minimum memory configuration 128K bytes – maximum up to 1 million bytes per controller, two controllers allowed per system, for total of 2 million bytes physical memory.

Input/Output Subsystems Synchronous Backplane Interconnect (SBI) is main control and data transfer path. SBI capable of aggregate throughput rate of 13.3 million bytes per second • Error and parity checking every cycle for data integrity • SBI protocol uses 30 bits for address, allows both 32-bit plus parity and 64-bit plus parity data transfers • UNIBUS connected to SBI permits interfacing of general-purpose peripherals and user devices • Buffered UNIBUS adapter pathway between UNIBUS and SBI has throughput of 1.5 million bytes per second • MASSBUS connects to SBI via buffered adapter, permits interfacing high performance mass storage peripherals with parity checking • MASSBUS adapter throughput rate is 2 million bytes per second • Four MASSBUS adapters permitted per system.

Software System Designed for many applications including scientific, time-critical, computational, data processing, batch, general-purpose timesharing • Process-oriented paging for execution of programs larger than physical memory, transparently to the programmer • Memory management facilities controlled by user – can lock pages into working set, never to be paged out, or lock into physical memory, never to be swapped out • Sharing and protection at page level (512 bytes) • Four hierarchical access modes • Interprocess communication through files, shared address space, or mailboxes • System management facilities • DIGITAL command language and MCR command language provided • File and record management facility includes sequential and relative file organization, sequential and random record access • Supports Files-11 on disk structure level 2 • Program development capability includes an editor, language processors, symbolic debugger • Support provided for FORTRAN IV-PLUS/VAX and MACRO/VAX in native 32-bit mode, COBOL-11 (V3) and BASIC-PLUS-2 (V1) in compatibility mode • Scheduler is priority-ordered, round-robin/time-slicing, event driven • 32 levels of software process priority for fast scheduling • Networking capabilities are supported through DECnet for process-to-process, file access and transfer, and down-line loading • Batch facilities include job control, multi-stream, spooled input and output, operator control, conditional command branching and accounting • Command procedures are supported by command languages.

PDP-11 Compatibility Provides system-wide compatibility supporting execution of the PDP-11 instruction set (with exception of privileged and floating point instructions) in compatibility mode • Applications Migration Executive allows RSX-11M/S non-privileged tasks to run with minimal or no modification • Host Development Package allows creation and testing of RSX-11M tasks • Same data format • Same source-level programs • High level languages • Files-11 on disk structure, level 1 • RMS file access methods including ISAM • DIGITAL Command Language and the RSX-11 MCR command language.

Reliability, Availability, Maintainability Remote diagnostics by means of integrated diagnostic console permits diagnostics, examination of memory locations from remote terminal • Automatic on-line error logging • Automatic restart capabilities after power failure or fatal software error • Users continue to use system with failed hardware components • Consistency and error checking detects abnormal instruction uses or illegal arithmetic conditions • Improved packaging and cabinetry increase hardware reliability and ease of maintenance • On-line diagnostics available and run under operating system.

digital

VAX 11 780

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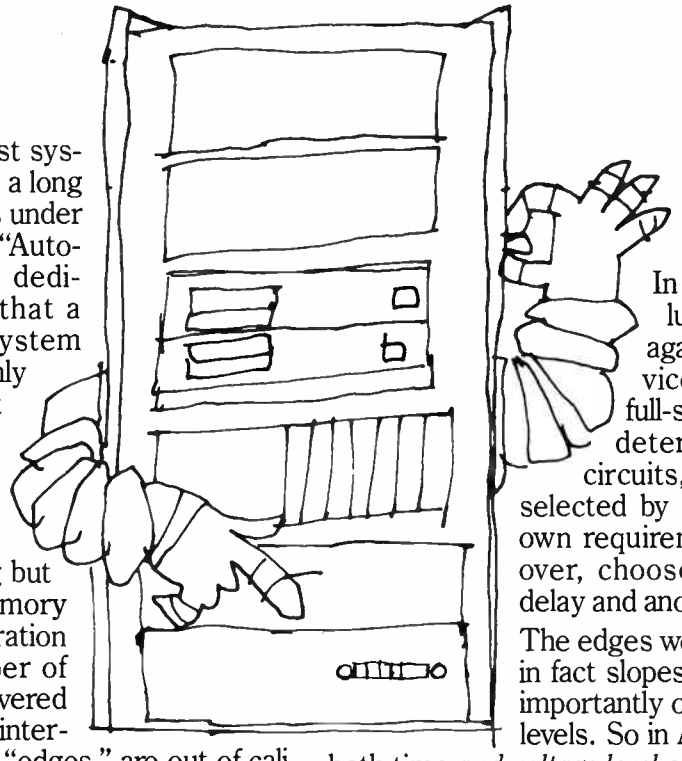
E16

Circle 71 on reader service card

Teradyne finds the practical solution.
No. 2 in a series.

Automatic Edge Control

If God wanted man to calibrate, He'd have given him screwdrivers for hands.



One of the most valuable test system capabilities to turn up in a long while is something that goes under the unpretentious name of "Automatic Edge Control." It is dedicated to the proposition that a computer-operated test system ought to be called on not only to test, to manipulate test results, and so forth, but to handle its own overhead burdens to the greatest extent possible.

These burdens are anything but trivial in semiconductor-memory testing, a time-sorting operation that requires a large number of fast voltage transitions delivered at precisely calibrated time intervals. If these transitions, or "edges," are out of calibration by even a few nanoseconds, good memories will end up in the bad bin or, heaven forbid, bad devices will end up in the good bin. To a memory producer or a high-volume user of memories, the stakes are thus high enough to justify spending considerable energy to calibrate all those edges.

Until fairly recently, edge calibration meant bringing the test system down for the six or eight hours needed to hand-tweak several dozen adjustments, usually with the aid of a fast oscilloscope. This posed a dilemma: It was costly to calibrate often, but risky (in terms of test results) not to.

To solve the problem, Teradyne engineers endowed their J387 Memory Test System with the ability to calibrate its own edges automatically. The concept is simple enough: The accuracy of a built-in crystal calibrator is transferred to a comparator, and each edge to be used in the program is then automatically calibrated against the comparator. As implemented in the J387, the calibration is performed to a resolution of 1 part in 4096, which on a 100-nanosecond range yields very fine intervals indeed.

In any measurement, resolution must be traded off against full-scale range and vice versa. In the J387, full-scale timing ranges are determined by plug-in RC circuits, with the R's and C's selected by the user to satisfy his own requirements. He may, moreover, choose one range for pulse delay and another for pulse width.

The edges we are talking about being in fact slopes, time intervals depend importantly on start and stop voltage levels. So in Automatic Edge Control both time *and voltage level* are programmed, the latter to a resolution of 10 millivolts. The necessity for calibrating time with respect to given voltage levels would appear to be beyond debate (especially since device specs are written that way), yet for some reason many memory test systems do not include provision for precise voltage calibration.

Since the Automatic Edge Control program is carried out at a rate of about a second per edge, the 100 or more edges one might encounter with a 16-K page-mode part take only a couple of minutes to calibrate. Thus it is entirely feasible to start each day with a freshly calibrated system.

As we said, the whole idea here is to make the test system responsible for its own overhead. With Automatic Edge Control, the memory test system takes over one of the most critical and time-consuming of all overhead operations. The benefits—tighter guard bands, increased system uptime, elimination of human error—find their way to the bottom line pretty quickly.

TERADYNE

Memory makers brace for bubble battle

American and Japanese firms to pour out products this year as competitors for CCDs and floppy disks

by William F. Arnold, San Francisco bureau manager

Competitors in the market for magnetic-bubble memories are preparing for what looks like a real international horserace beginning in 1980. A pack of companies are preparing to challenge the early favorites, Rockwell International Corp. and Texas Instruments Inc. in the U. S. and Hitachi Ltd. in Japan. In the parade to the post are: Fujitsu Ltd. and Nippon Electric Co. in Japan [*Electronics*, April 29, 1976, p. 73]; the Plessey Co. in Britain; and Intel Corp., National Semiconductor Corp., and Signetics Corp. in the U. S. Signetics says it is coordinating a product development effort with parent Philips Gloeilampenfabrieken in the Netherlands.

This year should see a slew of products breaking from the starting gate as those semiconductor companies look for an early lead in this type of microcomputer memory. In terms of price per bit, access time, and density, magnetic-bubble memories challenge both charge-coupled-device memories, which may not turn out to be as economical as many thought, and floppy-disk systems, which are too large and too expensive for many microcomputer applications. Bubbles are "jazzy, nonvolatile, and a hell of a lot cheaper," observes James Cunningham, who heads National's new effort [*Electronics*, Feb. 2, p. 14].

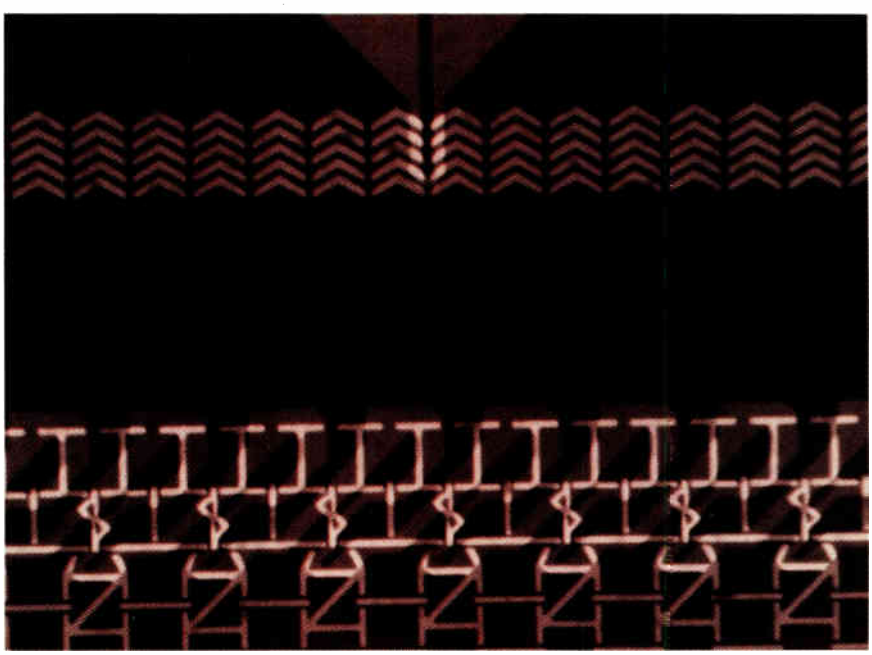
Memory sizes of the emerging products range from 64,000-bit chips from Hitachi, to 1-megabit board systems from Plessey, to the 2-megabit system due out from Rockwell. Most employ serial-loop addressing on conventional materials based on gadolinium-gallium-garnet substrates. But companies expect to follow these memories with more exotic variations built on new configurations and possibly new materials after they crank up to high-volume production.

Although magnetic bubbles are expected to capture about 50% of the business now done by CCDs, John L. Archer, head of Rockwell's bubble program (see p. 14), thinks they will easily grab more than that. "It's questionable whether CCDs can achieve the economics necessary to compete," he says, especially "when you're looking at RAMs on one side and bubbles on the other."

National's Cunningham points out that "CCDs have to compete with other semiconductors," whereas "magnetic bubbles compete with rotating memories." And against rotating memories, the total price of a system will be less with magnetic bubbles because there will be less memory, he declares, noting that most microcomputer systems do not need a lot of memory.

What's more, the growing number of suppliers only strengthens the market, according to Archer. "There's enough interest in bubbles that it'll be a suppliers' market, at least for the next three years," he says. Archer explains that market size can be determined by the number of suppliers. If there are many suppliers, "then it gives people a warmer feeling about using that product," he says. Considering design-in time, Archer expects high volume to begin in 1980.

In terms of product introduction,



From Texas. TI sees bubble memories such as this as ideal for data terminals, industrial process controls, point-of-sale terminals, data recorders, and portable data storage.

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IEEE salary survey, which shows averages by type of job, age, product, and degree, indicates highest pay is in those areas

by Gerald M. Walker, Senior Editor

To make the highest salary, you should be an engineering manager or designer of electronic devices, living in the northeast or west and working for a company employing 100 people or less that manufactures office or business machines.

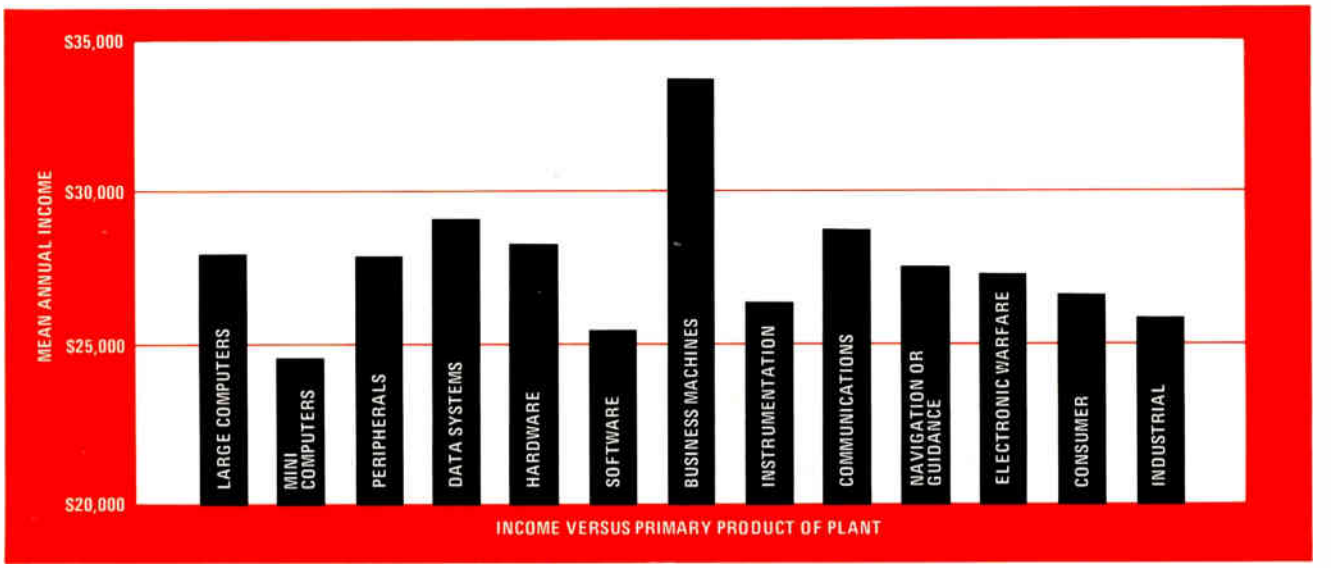
Sounds like a difficult job to find? It should be, because it exists only statistically in the newly released results of the Institute of Electrical and Electronics Engineers' 1977 salary and fringe benefits survey of its U. S. members. This survey, IEEE's third such, indicates that electrical and electronic engineers' paychecks have increased about 16.8% during the 28-month period since the last survey in 1975. In that period, the Consumer Price Index increased 15.6%, so that, on the average, the engineer is somewhat ahead of the rise in the cost of living [*Electronics*, Feb. 2, p. 48].

Covering the period from July 1976 through June 1977, the study represents usable returns from 9,277 IEEE members in the U. S. resulting from questionnaires mailed to every fifth name on the institute's membership rolls. Aside from salary and fringe benefit information, the poll reveals that only 0.8% are unemployed involuntarily. In addition, more than three quarters of the respondents are employed full time in their area of primary technical competence.

No significant difference in incomes was found between members employed in their primary technical competence and those not so employed but not interested in a job change. But those not working in their areas of technical competence and available for a job change average $4,300 to $4,500 less than the other two groups.

Although the average annual income for all participants was $27,496, there are a number of ways to analyze the results and get much different averages. For example, take the "ideal" job mentioned earlier. There, the engineering manager or designer of electronic devices would make an average of $34,628 and $32,613, respectively. EEs in the Northeast average $29,161, followed by $28,535 in the Western states (IEEE's Regions 1 and 6, respectively). And engineers employed by small companies enjoy a salary advantage, having mean annual incomes of $30,284 as against an average of $25,847 for those in firms with 500 to 999 employees.

Where and what. The survey breaks out incomes in two major ways: by primary end products of the plant in which the respondent works, and by the specific product on which the respondent works. Thus, engineers at plants that produce office or business machines, even though they do not work directly on those products, make $33,895 on average; EEs whose primary end products



Memories

65-k RAMs won't slight performance

Mostek, a leader in dynamic memories, is quietly planning speed, size and power specs that could surprise its competitors

by Laurence Altman, Solid State Editor

The talk of the semiconductor industry is the 65,536-bit dynamic random-access memory. Some examples of the dialogue:

- Nippon Telegraph and Telephone Public Corp., with three Japanese semiconductor manufacturers, is disclosing a 65-k design at the International Solid State Circuits Conference (see p. 116).
- Siemens AG of West Germany and American Microsystems Inc. are publicizing their plans to leapfrog the industry with V-MOS approaches.
- Texas Instruments Inc. more than 18 months ago revealed its related, double-level silicon-gate program.

The acknowledged leader in dynamic-RAM design has yet to speak. However, Mostek Corp., which captured the initiative two years ago with its now much-copied 4,096-bit 4027 and 16,384-bit 4116, has not been resting on its laurels. Under the direction of Paul R. Schroeder, director of its highly successful memory-design programs, the Carrollton, Texas, integrated-circuit manufacturer is well into an aggressive 65-k design program that could yield a chip that offers, not only four times the density of today's 16-k designs, but also much higher performance and better system characteristics.

According to Schroeder, the trick is not to come out prematurely with a prototype chip from an oversized die that falls short in performance, nor is it to rely on designs made with untried processing that never get into high-volume production. "Today's dynamic-RAM users are too sophisticated to buy that," he maintains. "They want higher performance, lower bit costs, and proven production before they commit to a next-level design. We learned that with our 4027 4-k design, which came to market two years after the first 4-k parts came out. Being first is no longer as important as being best."

Standards. If Schroeder's 65-k program is successful, the industry may be surprised by the standards set by his design team (see table). Specifications that he is aiming at are well above those so far made public for 65-k RAMs.

MOSTEK'S PROPOSED 65-k DYNAMIC RAM VS 16-k

	65-k	16-k
Technology	"scaled" silicon gate	standard silicon gate
Cell design	2-level, on-chip biasing	2-level, no chip biasing
Channel length (μm)	2 to 3	5
Gate oxide thickness (angstroms)	500	1,000
Supply voltage (V)	+5	+12, ±5
Access time (ns)	50 – 150	150 – 300
Power dissipation (mW)	300	300
Chip size (mil²)	30,000	25,000 – 30,000
Pinout configurations	300-mil, 16-pin multiplex	700-mil, 16-pin multiplex

Source: Electronics

Take speed. He predicts that the new 65-k devices will have access times typically much shorter than today's 150-nanosecond parts. "The 65-k data sheets may initially specify maximum access times of 150 ns, but even on the very first samples, I wouldn't be surprised if we saw access times typically under 100 ns, and many parts will range down to 50 ns," he says. "If you consider a product life cycle of four years, with the first parts entering production in 1979, then at the peak of 65-k RAM production (in the 1980–81 time frame), we should routinely be manufacturing parts at the 50-ns level."

Another item is chip size and its effect on memory costs. Schroeder sees his 65-k dynamic parts filling dice measuring approximately 30,000 square mils, or about the size of most of the industry's 16-k parts (Mostek's own 16-k die measures 22,000 mil²). That means costs and yields of the new 65-k dice should be about the same as for 16-k parts. Once high-volume production is achieved (and Schroeder agrees with everyone else that it will happen late next year), dynamic-memory bit costs will be cut by at least a factor of two or three.

Supply voltage could be another tough Mostek target for the industry to hit. "Our 65-k RAM, may well be designed for 5-volt operation, compared to the multiple positive and negative 12 and 5 v required for 16-k devices," Schroeder says. This means using on-chip substrate bias generation to eliminate the negative supply now needed for this purpose. Clearly, that makes the device much easier to use. It also frees at least one

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Microprocessors

16-bit wave gathering speed

With users looking for more throughput and greater accuracy, Intel, Zilog, and Motorola are poised to jump in

by Larry Armstrong, Midwest bureau manager

If the wave of the future is the 16-bit microprocessor, preparing to ride the crest are Intel Corp., Zilog Corp., and Motorola Semiconductor. The two that owe their reputations to microprocessors—Intel and Zilog—are racing to market with 16-bit machines offering the higher throughput and greater accuracy that users are beginning to demand. But both firms are steering a tricky course: device performance must be traded off for compatibility with 8-bit processors to capitalize on the ocean of 8080 software that users have developed.

The 16-bit wave almost beached some earlier efforts. Texas Instruments Inc. has been disappointed in the penetration of its two-year-old TMS9900, a 16-bit processor that had the distinct advantage of software shared with the firm's minicomputer line. Only lately, with pared-down, yet software-compatible, 8-bit versions and upward-integrated 9900 boards, has TI seen its units start to win broader acceptance. General Instrument Corp. has carved out a niche for its standard CP1600 only by developing custom peripheral circuits for high-volume customers.

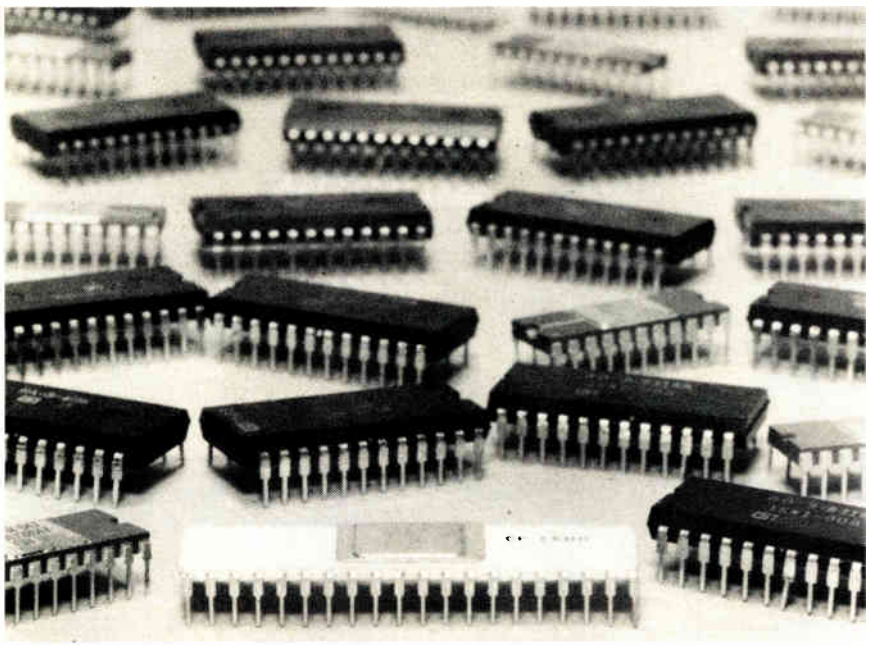
Coming together. Price has been a stumbling block, although TI points out that, on the system level, its 9900 boards sell for less than Intel's 8080 boards. But now the price gap between 8- and 16-bit processor chips is starting to narrow, and the lure of higher throughput is becoming appealing. "The 16-bit devices will penetrate in two phases," believes Bernard Peuto, manager of computer architecture of Zilog, in Cupertino, Calif. First will come "customers who need the speed of a PDP-11/45 but can't afford a minicomputer." The second phase will be "today's 8-bit processor market."

"Once users understand what they can do with the 16-bit machine, they will want to have its greater power, more memory, and faster speed," agrees Frank Jelenko, who is microprocessor marketing manager at GI's Hicksville, N. Y., Microelectronics division.

Intel's 8086 (see p. 99), now available in sample quantities, and Zilog's Z8000, expected by midyear, are 16-bit processors, but designed so that 8-bit software can be preserved. The compatible software provides "an easier path to the 8086," says Jeffrey Katz, manager of midrange processor marketing at Intel, in Santa Clara, Calif. "A customer won't get all the benefits of a 16-bit processor, but it's a faster way to get there," he admits.

Translating. Compatibility is at the assembly-language level: 8080 source codes must be run through a new translator and assembler, a process that makes some competitors leary. "I seriously question whether it can be done efficiently without hand coding," says one.

Motorola is taking a different, perhaps more cautious, tack toward 16-bit microprocessors. It is bridging the gap between the 8- and 16-bit machines with its MC6809, planned for later this year. The device takes advantage of 16-bit internal architecture while using the 8-bit data bus common to the rest of the firm's



Adding momentum. As if to dramatize the building wave of 16-bit microprocessors, these CP1600s from General Instrument are ready for what the firm sees as a rapid switchover.

6800 processor and peripheral family. "Most of the bucks in the next three years will go for 8-bit machines," says Gary Summers, microprocessor marketing manager at Motorola's Austin, Texas, MOS facility. "We want to retain our 8-bit identity, but the 6809 will improve our throughput and support higher-level languages." Operating codes are not compatible with the 8-bit processors, but source codes are.

The MACS. Motorola also has a true 16-bit microprocessor called MACS, for Motorola advanced computer system. It is a family of 16-bit devices optimized for different applications. "We hope to dribble out a minimum of five different chips during 1979," Summers says. The MACS microprocessors will be built with a short-channel process to get a throughput 10 times that of the 6800, he adds.

Its address bus will be 24 bits, allowing MACS to directly address up to 16 megabytes of memory. In contrast, the 9900's address space is 32 kilobytes, Intel's new 8086 will directly address 1 megabyte, and Zilog is planning 64-kilobyte and 8-megabyte versions.

National Semiconductor Corp., also in Santa Clara, which now builds both 8- and 16-bit devices, is readying a high-performance 16-bit processor apparently similar to Motorola's MACS. National, however, will divulge no details, except to say the device employs a third-generaton metal-oxide-semiconductor process that the firm calls X-MOS.

Early-bird TI's response to the newcomers will be "to upgrade the 9900 to compete with the Z8000 and 8086," says Edwin S. Huber, marketing manager for the firm's 9900 family in Houston. TI's first move will come in 60 to 90 days, when it starts sampling a smaller version that boosts the 9900's performance some 30%, to about 4.5 megahertz. Huber counts the device's history among its strengths: "We've been shipping for more than two years."

He has his eye on another class of competition as well. "The closest performance equivalent to the 9900 is the [Digital Equipment Corp.] LSI-11," he says, "and I think DEC will be one of the stiffest competitors for microprocessor makers." □

Electronics abroad

Outlook in Scandinavia mostly gloomy

Sweden and Denmark look for only minuscule growth, but oil-rich Norway expects 6% rise in its GNP

by Arthur Erikson, Managing Editor, International

In Scandinavia at the moment, the more are not necessarily the merrier. For Sweden, largest of the Nordic nations, the economic outlook for the year is as gloomy as an Ingmar Bergman film. The projection for Denmark, too, is definitely somber. Norway, smallest of the three, is something else; its bunkers brimming with North Sea oil, the country figures to have the fastest-growing economy in Western Europe in the coming year.

Electronics markets, to be sure, generally grow faster than the overall economy. But with growth in Sweden and Denmark likely to run next to nil, sales of electronics equipment in Scandinavia this year certainly cannot climb a lot. After surveying the markets in the three countries last fall, *Electronics* forecasts factory sales of equipment of $1.995 billion, up from $1.880 billion in 1977. Since the survey tallies markets in current terms, the nominal rise of 6.1% has to be discounted for the effects of inflation, of course, and that downgrades the prospects from barely satisfactory to poor.

A quick look at the markets chart for affluent Scandinavia shows what is pulling the totals down: most of the people who want things like color television sets and hi-fi gear have them by now. As a result, the crucial consumer electronics market started to wane last year and will edge down a little more this year to some $756 million, according to *Electronics*' survey. Happily, computers and communications equipment, the other two major markets, should wind up with respectable gains this year.

As for the components market, it will expand 6.9%, the survey estimates. As one would suspect, sales of color-TV tubes are headed down. Semiconductor suppliers, in contrast, can count on a reasonable gain of just under 14%. That would carry the market to $131 million.

Sweden. Although economists may quibble over tenths of percentage points, there is general agreement in Sweden that there will be little if any growth this year. The list of economic ills that plague the country includes a slump of 10% to 20% in capital investment, a small drop in consumer buying power, a deficit in the balance of trade, an acute energy problem, a high inflation rate, and unemployment. As a result, anyone predicting more than a 1% hike in the country's output of goods and services is considered a candidate for a Nobel Prize in optimism.

Sweden's electronics equipment market reflects the overall pattern. It will edge up some 4% to a little over $1 billion, according to the forecast. Set makers face the sorriest situation. The slimming down of consumers' wallets is coming at a time when the color TV market is saturated, and there is nothing new in sight at the moment that figures to pull customers into showrooms the way TV in living color once did. Sales of consumer electronics, then, are predicted to drop $402 million this year from the estimated 1977 figure of $410 million.

Communications equipment makers figure to do the best. Their home market should climb a solid 12% to $184 million. As it said it would, the state telecommunications agency Televerket has ordered the first batch of hardware—$100 million

SCANDINAVIAN ELECTRONICS MARKETS FORECAST
(IN MILLIONS OF DOLLARS)

	1976	1977	1978
Total assembled equipment	1,803	1,880	1,995
Consumer electronics	782	760	756
Communications equipment	349	375	418
Computers and related hardware	423	475	527
Industrial electronics	124	132	142
Medical electronics	61	65	70
Test and measurement equipment	43	48	54
Power supplies	21	25	28
Total components	433	461	493
Passives	262	279	296
Semiconductors	102	115	131
Tubes	69	67	66

(Exchange rates: Denmark, $1 = 6.1 kroner; Norway, $1 = 5.49 kroner; Sweden, $1 = 4.79 krona)

Note: Estimates in this chart are consensus estimates of consumption of electronic equipment obtained from an *Electronics* survey made in September and October 1977. Domestic hardware is valued at factory sales, prices and imports at landed costs.

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7550 BD (A/D)	13-bits	N/A	40msec	$24.90
7522 JN (D/A)	10-bits	8-bit	500nsec	$13.90
7522 KN (D/A)	10-bits	9-bit	current	$16.95
7522 LN (D/A)	10-bits	10-bit	settling time	$26.10

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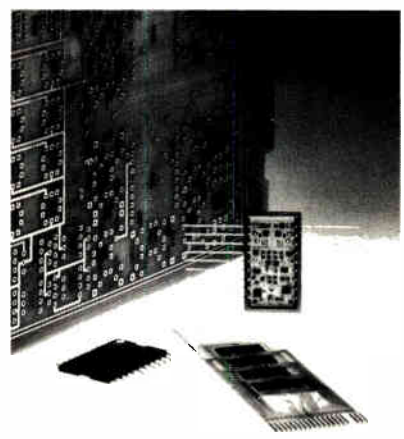

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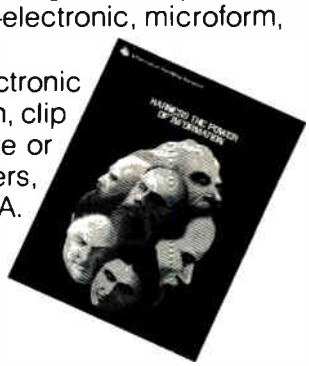

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8086 microcomputer bridges the gap between 8- and 16-bit designs

by B. Jeffrey Katz, Stephen P. Morse, William B. Pohlman, and Bruce W. Revenel, *Intel Corp., Santa Clara, Calif.*

☐ The Intel 8086, a new microcomputer, extends the mid-range 8080 family into the 16-bit arena. The chip has attributes of both 8- and 16-bit processors. By executing the full set of 8080A/8085 8-bit instructions plus a powerful new set of 16-bit instructions, it enables a system designer familiar with existing 8080 devices to boost performance by a factor of as much as 10 while using essentially the same 8080 software package and development tools (Fig. 1).

The goals of the 8086 architectural design were to extend existing 8080 features symmetrically, across the board, and to add processing capabilities not to be found in the 8080. The added features include 16-bit arithmetic, signed 8- and 16-bit arithmetic (including multiply and divide), efficient interruptible byte-string operations, and improved bit manipulation. Significantly, they also include mechanisms for such minicomputer-type operations as reentrant code, position-independent code, and dynamically relocatable programs. In addition, the processor may directly address up to 1 megabyte of memory and has been designed to support multiple-processor configurations.

How it is done

The 8086's improved performance stems from a combination of process and architectural enhancements. It is the first microcomputer to be fabricated with the newly developed silicon-gate H-MOS process [*Electronics*, Aug. 18, 1977, p. 91], which gives the device 4-micrometer scaled-down metal-oxide-semiconductor

SUMMARY OF THE 8086'S GENERAL CHARACTERISTICS		
Process	H-MOS, scaled n-channel depletion-load silicon-gate (same as 2147 RAM)	
Transistors	29,000	
Package	40-lead Cerdip	
Supplies	5-volt, ground	
	Standard	Selected
Clock frequency	5 MHz	8 MHz
Memory cycle time (4 clocks/cycle)	800 ns	500 ns
Access time at pins (address to data-in valid)	460 ns	295 ns

bits of a segment's address are 0s. At any given moment, therefore, the contents of four of these segments are immediately addressable.

The four addressable memory segments are called the current code segment, the current data segment, the current stack segment, and the current extra segment. These segments need not be unique and indeed may overlap. The high-order 16 bits of the address of each current segment, called the segment address, is held in one of the four dedicated 16-bit segment registers (see Fig. 2). Bytes or words within a segment are addressed using 16-bit offset addresses within the 65-kilobyte segment (Fig. 5). A 20-bit physical address is constructed by adding the 16-bit offset address to the 16-bit segment address, complete with its four low-order zero bits.

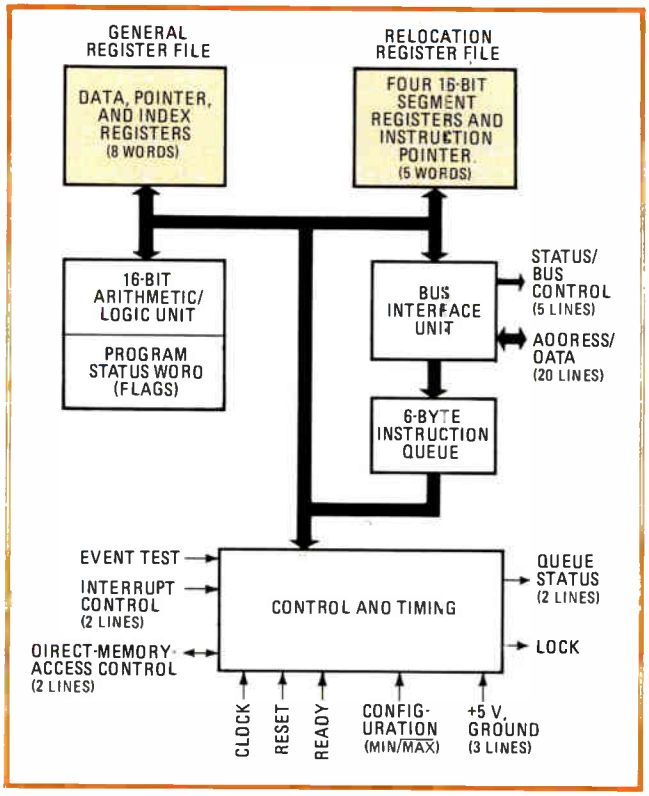
Of course, some programs may be designed not to load or manipulate the segment registers, and they are said to be dynamically relocatable. Such a program may be interrupted, moved in memory to a new location, and restarted with new segment register values.

The instruction set

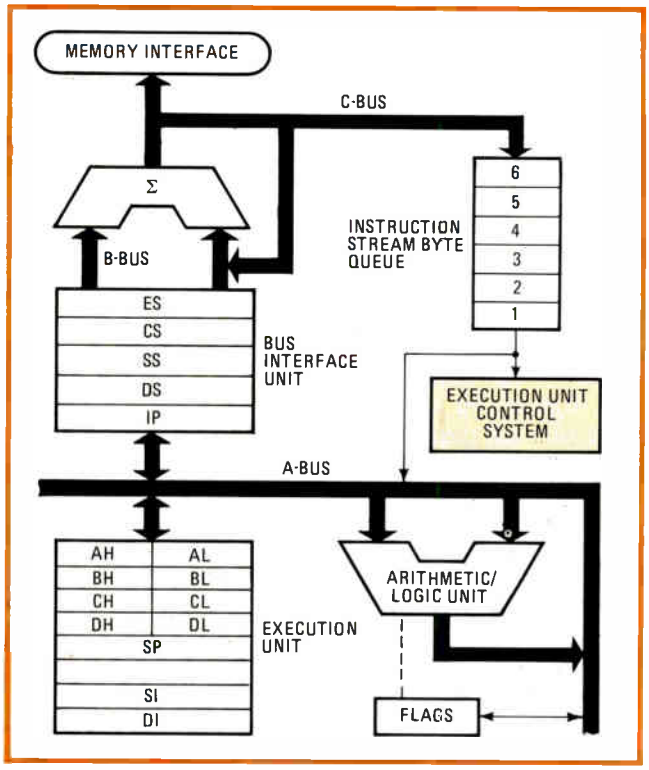
Several 8086 instructions may manipulate the four segment registers that make up the relocation register file. Most of the rest of the 8086's instruction set operates with the general register file, which contains two main sets of four 16-bit registers, as well as the 16-bit instruction pointer and the pair of 8-bit status flag registers (Fig. 6). The accumulator, base, counter, and data registers make up one set of general registers, the pointers and index registers the other set. The 8080 register set (shown tinted) is a subset of this structure.

The 8086 instruction set can address operands in several different ways. In general, operands in memory may be addressed either directly, with the 16-bit offset address, or indirectly, with base (BX or BP) and/or index (SI or DI) registers added to an optional 8- or 16-bit displacement constant. Here, if BX is used as the general-purpose data-base pointer, then the BP register may be used as a stack frame marker for efficiently supporting stack management in block-structured high-level languages like PLM-86. PLM-86 is an extension of the high-level PLM languages developed for the earlier 8080 and 8085 devices.

This two-operand technique allows memory or any



2. More processing power. The 8086 register structure is 16 bits wide internally. Additional pin functions can be supplied by time-multiplexing some pins (such as the address and data pins) and by strapping others to change the signal meaning.



3. Processing data. The 8086 has two independently controlled units: the bus-interface unit (BIU) maintains a fetch-ahead queue of instructions, which the execution unit (EU) performs. Throughput is enhanced because the BIU keeps the memory as busy as possible.

How the string-manipulation primitives operate

A typical data-format translation is a good illustration of how the 8086 microcomputer iterates with primitive, one-byte operation to produce a complex string operation. The procedure is highly efficient, as the example will show.

Suppose an input driver must translate a buffer of EBCDIC characters into ASCII and continue transferring characters until one of several different EBCDIC control characters is encountered. Suppose also that the transferred ASCII string is to be terminated with an end-of-transmission (EOT) character.

To do this, source index register SI (see Fig. 6 in text) is initialized to point to the beginning of the EBCDIC buffer. Destination index register DI is then initialized to point to the beginning of the buffer for the reception of the ASCII characters. Next, base register BX is made to point to an EBCDIC-into-ASCII translation data table residing in memory, and count register CX is initialized to contain the length of the EBCDIC buffer (which might possibly be empty). The translation table, incidentally, should contain the ASCII equivalent for each EBCDIC character plus perhaps ASCII nulls for illegal characters. The EOT code is then inserted among those entries in the table, wherever it corresponds to the desired EBCDIC stop character.

The table shows the 8086 instruction sequence that will implement these events. It makes the efficiency of the 8086 in performing such complex operations quite obvious: the entire body of this loop requires only seven bytes of code.

```
        JCXZ    Empty       ;skip if input buffer empty
Next:   LODB    Ebcbuf      ;fetch next EBCDIC character
        XLAT    Table       ;translate it to ASCII
        CMP     AL, EOT     ;test for the EOT
        STOB    Ascbuf      ;transfer ASCII character
        LOOPNE  Next        ;continue if not EOT

Empty:
```

register to serve as one operand and either a register or a constant within an instruction to serve as the other operand. In these cases, the results of the two-operand operation may be directed to either of the source operands, unless one is an in-line (immediate) constant. On the other hand, single-operand operations are applicable uniformly to any operand in register or memory, with the same exception for immediate constants.

Within this instruction technique, the 8086 supplies several variations of the four basic arithmetical operations (add, subtract, multiply, and divide). Both 8- and 16-bit arithmetical operations and both signed and unsigned arithmetic are provided, standard 2's complement representation being used to distinguish signed values. In this context, addition and subtraction can be both signed and unsigned, with flag settings to distinguish between the signed and unsigned operations.

With the aid of its correction operations, the 8086 can do this arithmetic directly on unpacked binary-coded representations of decimal digits or on packed decimal representations. Standard logical operations, shift, move data, etc., are available to both 8- and 16-bit operands. Other instructions support the movement of 32-bit address objects called pointers, which consist of a 16-bit offset address and segment base address.

Also provided is a group of one-byte instructions that, besides performing various primitive operations to manipulate byte and word strings, can each be performed repeatedly when provided with a special prefix. The single-operation forms are then combined to form complex strings of operations, with their repetition controlled by special iterative operations. The effect is to create tight, efficient loops for performing subroutines (see "How the string-manipulation primitives operate," above).

For handling program flow, two basic varieties of calls, jumps, and returns are provided—one that transfers control within the current code segment, and one that transfers control to an arbitrary code segment, which then becomes the current code segment. The 8086 supports direct and indirect transfers, both of which make use of the standard addressing modes. Intra-segment calls and jumps specify a self-relative displacement, thus allowing position-independent code.

In all, 16 conditional jumps are provided to support all common program-controlled interrupt structures. Both signed and unsigned relationships can be tested, as well as parity, overflow, and sign conditions.

Many interrupt types

In an interrupt sequence, an interrupt signal prompts the transfer of processor control to a new location in a new code segment. The 8086 memory structure supplies a 256-element table that contains pointers to these interrupt service code locations. Each element is four bytes in size, containing an offset address and a segment address for the service code location. Each element of this table corresponds to an interrupt type, and there are 256 interrupt types, or enough for even the most heavily interrupt-driven applications.

The 8086 has the ability to detect program inconsistencies, such as errors in division or overflow conditions, by means of a one-byte instruction that causes an interrupt if the condition occurs. The internal interrupt

instructions transfer the program's execution control to a checking sequence by means of operations like those done during external interrupts. Both the internal and external interrupts perform a program transfer by pushing the flag register onto the stack and then making an indirect call (of the intersegment variety) to the service routine.

Multiprocessing mechanisms

Besides handling a large variety of interrupts, the 8086 CPU has mechanisms for sharing resources and controlling access to those resources in multiprocessor applications. Such mechanisms are mostly provided by software operating systems but do require some hardware assistance. This is where the bus-locked output comes into use.

Labeled lock in Fig. 2, the output works like this. The 8086 has a special one-byte prefix that can be attached to the front of any instruction. This prefix then compels the processor to assert a bus-lock signal for the duration of the operation caused by that instruction. Meanwhile, external hardware, upon receipt of that same signal, is prohibiting other bus masters from bus access during the period of its assertion.

The instruction most likely to have such a prefix attached to it is "exchange register with memory." A simple software lock may be implemented with the following code sequence:

```
Check:  MOV   AL,1        ;set AL to 1
                            (implies locked)
LOCK    XCHG  Sema, AL    ;test and set lock
        TEST  AL, AL      ;set flags based on AL
        JNZ   Check       ;retry if lock already set
                          ;critical region
        MOV   Sema,0      ;clear the lock when done
```

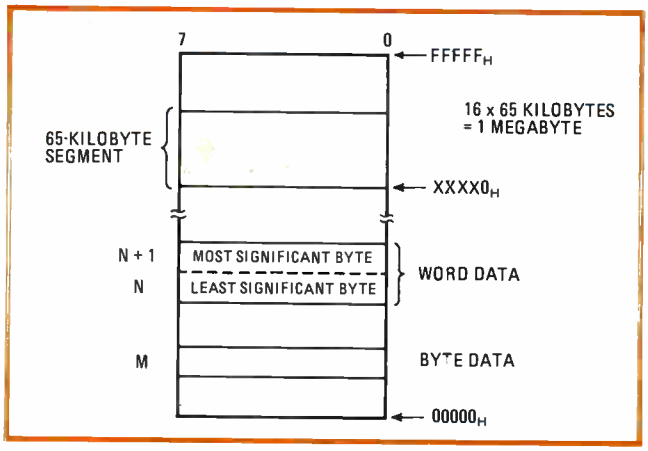
System configurations

A wide variety of system configurations can be built around the 8086 CPU. For small systems, where minimal external circuitry is needed, the 8086 may be strapped into a minimum mode, in which the microprocessor itself provides all bus control signals. In larger or Multibus systems, the strap pin may be set to the maximum mode, and the same control-signal pins take on the functions required to operate the 8288 bus controller.

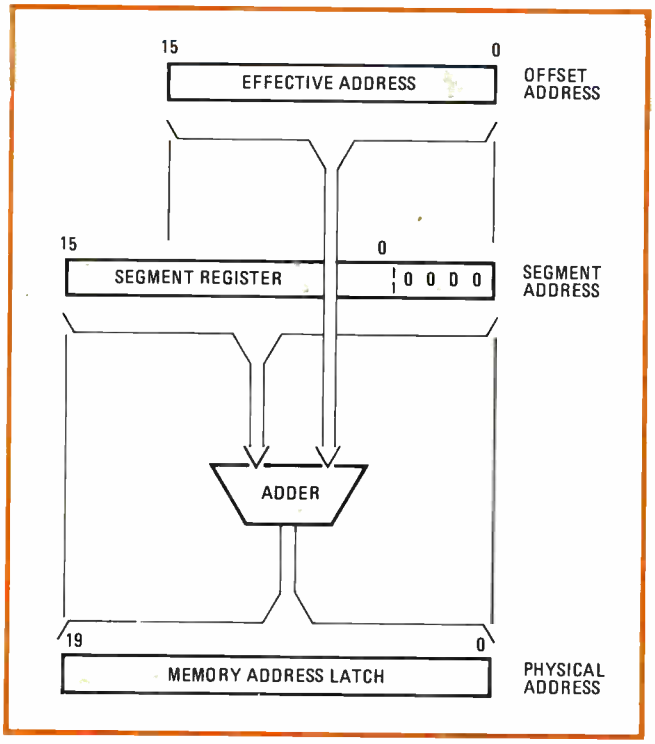
For really big systems, the MCS 86 family of components includes several new Schottky bipolar support components that maximize the CPU's ability to control many external memory and peripheral chips. There are inverting and noninverting octal latches and octal bus transceivers, a clock controller/ready synchronizer, and a bus controller that makes the 8086 compatible with the 8080 family's Multibus timing and control protocols.

The latches and transceivers have three-state controls and separate strobe or direction signals. To ease system design, they are packaged in 20-pin packages with a uniform pinout. The bus side of the parts is capable of sinking 32 milliamperes of output current for driving a wide assortment of peripheral equipment.

The clock chip includes an oscillator circuit, a Schmitt-trigger-reset detector/driver, and a ready-



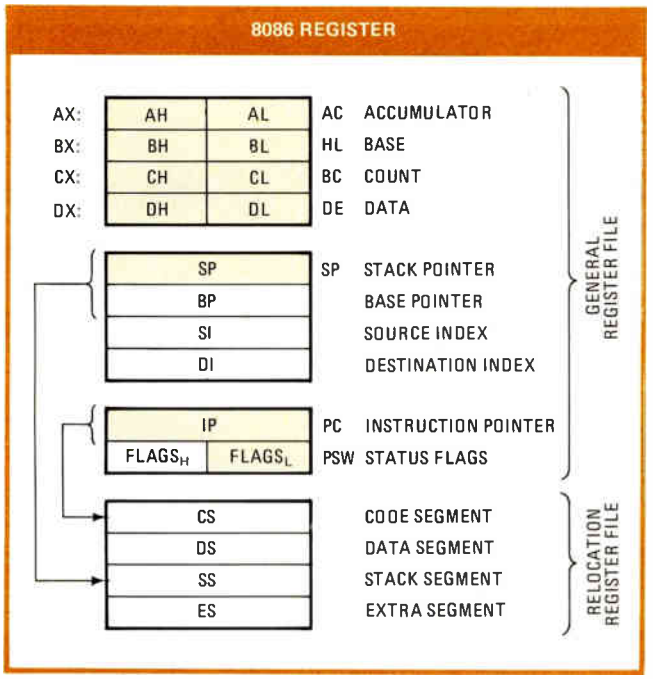
4. Memory organization. While the 8086 is made up of a sequence of 8-bit bytes, any two consecutive bytes may be paired to form a 16-bit word. Such words are grouped in four immediately addressable memory segments totalling 1 megabyte.



5. Addressing it. The 8086 memory can be thought of as an arbitrary number of segments. A byte or word within a segment is addressed with a 16-bit offset address. Adding the offset address to the 16-bit segment address creates a 20-bit physical address.

synchronizer circuit. The chip's latch, which captures the asynchronous ready signal from the system or Multibus, prevents output glitches or metastable conditions in presenting the signal to the CPU within the required timing constraints. The bus controller, used when the CPU is strapped to maximum mode, generates Multibus command signals as well as control signals for the address latches and data transceivers that are used in buffered systems.

The multiplexing technique used by the 8086 CPU for address and data resembles the one used on the 8085. Each processor bus cycle consists of at least four clock



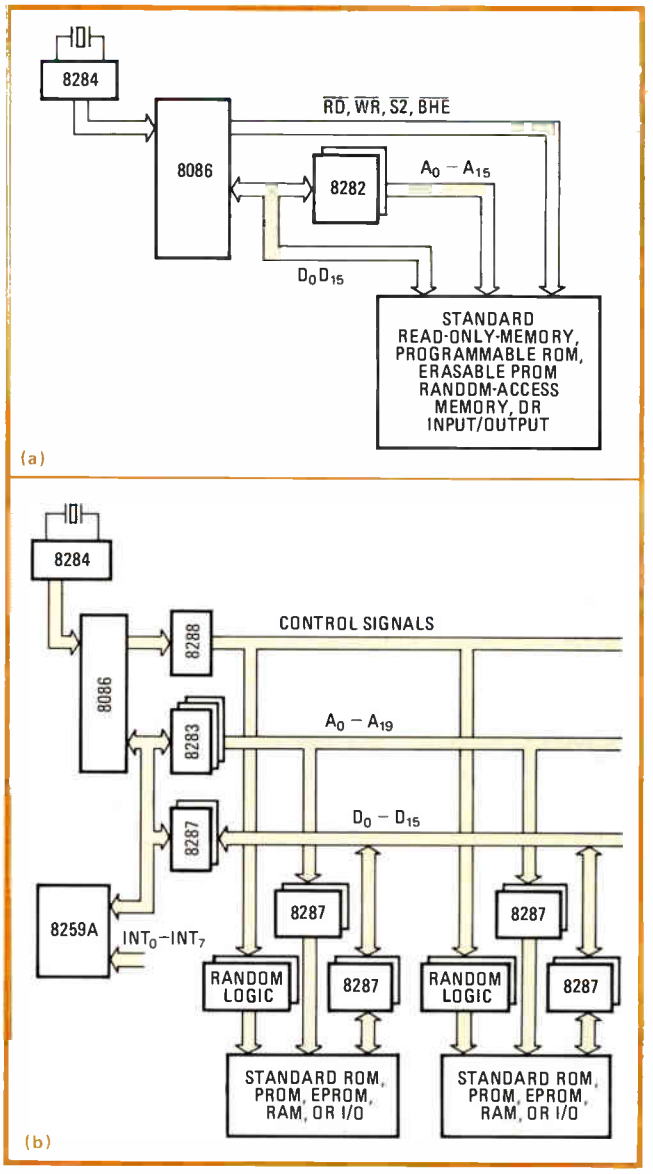
6. The registers. The 8086 register model consists of two main sets of four 16-bit registers, as well as the 16-bit instruction pointer and the pair of 8-bit status flag registers. Tinted areas indicate the subset of the registers that are to be found on the 8080 microprocessor.

cycles—T_1, T_2, T_3, and T_4. The address signals emerge from the processor during T_1, while data is transferred on the bus during T_2, T_3, and T_4. During the read operations, T_2 is used primarily for changing the direction of the multiplexed bus, and T_4 is used for terminating the present bus cycle and preparing for the start of the next bus cycle. If the addressed device gives a not-ready indication, wait states (TW) are inserted between T_3 and T_4. Each inserted wait state has the same duration as a clock cycle.

Some sample systems

In a minimum mode system of the kind shown in Fig. 7a, the 8086 generates the control signals used by the memory and I/O devices for interacting with the address and data buses, as well as a timing signal for latching the addresses emitted during T_1. In this configuration, as noted earlier, the access times required of memory and I/O devices for the 5-MHz 8086 are roughly 430 ns from receipt of address and 205 ns from receipt of read or write enable. These times are about 265 ns and 130 ns respectively for 8-MHz CPU operation. The difference between these figures and those in the table takes the addition of the address latch into account.

In the larger buffered configuration (Fig. 7b), the 8086, in its maximum mode, generates coded status information during T_1 on only some of the pins needed for producing minimum-mode control signals. Here, all that is needed is enough coded information to push an 8288 bus controller into generating Multibus-compatible control signals and timing signals for addressing latches and data transceivers. The minimum-mode control-signal pins can now take on additional functions, such as extra direct-memory-access control and bus-locking



7. Systems. When operating in the minimum mode, the 8086 needs only 11 components to form a complete system, including clock, 2 kilobytes of RAM, and 4 kilobytes of ROM (a). By adding support components, very large systems (b) can be configured.

capabilities for use in multiprocessor operations.

In buffered systems the required memory and I/O access times for 5-MHz CPU operation are 395 ns from receipt of address and 290 ns from receipt of read command. These times are respectively about 230 ns and 150 ns for 8-MHz CPU operation.

The bottom line of all system design is performance. Initial studies have indicated that on average an 8086-based system will perform about an order of magnitude better than an 8080A-based one. Depending on program type, execution speeds 7 to 12 times faster than 8080A speeds can be expected. At the same time, the program is typically 10% to 25% shorter. However, while there exists an 8086 instruction mapping for every 8080 instruction, and while 8080 programs may be easily transferred to the 8086, maximum 8086 efficiency does require the rewriting of certain routines. □

All-tantalum wet-slug capacitor overcomes catastrophic failure

Use of a tantalum case instead of a silver one eliminates shorts and high leakage caused by silver whiskering; hermetic seal prevents electrolyte seepage

by A. M. Holladay, *Marshall Space Flight Center, Ala.*

☐ The all-tantalum wet-slug capacitor is bidding to replace the conventional wet-slug tantalum capacitor in a variety of aerospace, military, and commercial applications. Its reliability and its eventual decline in price should make it decidedly the more popular for filtering out ac components like hum in dc power supplies, storing energy in photoflash units, and generally coupling and decoupling signals.

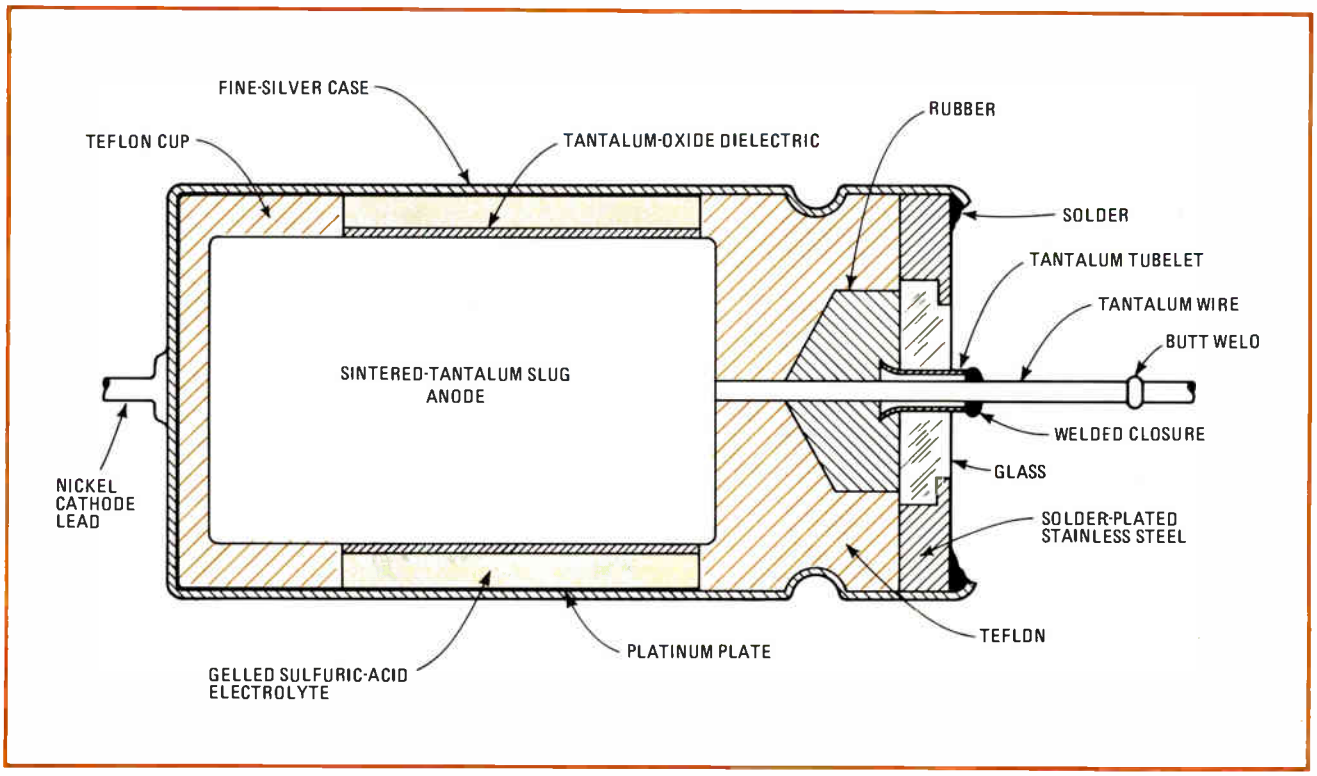
Named after their liquid or gelled electrolyte, the devices have the highest ratio of capacitance-voltage product to volume of any capacitor. Their dc leakage is low, their dissipation factor is low, and their equivalent series resistance is low for an electrolyte device. Also, their characteristics remain relatively stable over a broad temperature range.

Despite these virtues, the conventional wet-slug capacitor suffers from weaknesses bad enough to have caused quite frequent catastrophic failures. Its silver case is the problem. So the newer version, which has emerged in the last year or so, uses a tantalum case instead.

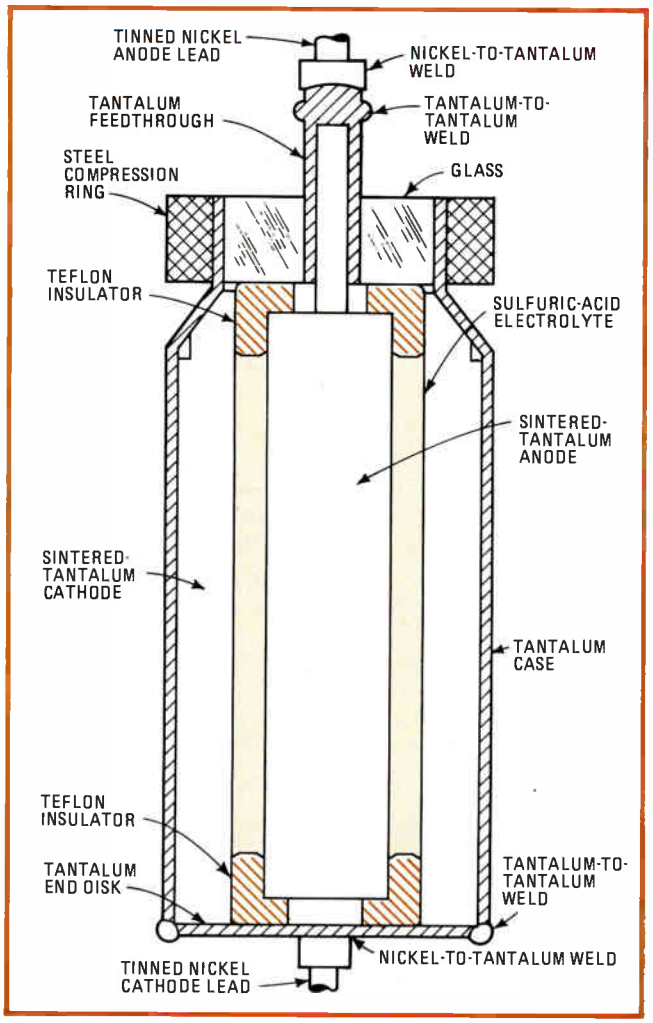
The conventional design

To all appearances, the silver-case wet-slug capacitor is soundly designed. As shown in Fig. 1, it has a sintered-tantalum slug as its anode and a fine-silver case as its cathode. The electrolyte between these is a liquid or gel of either lithium chloride or sulfuric acid in water, sometimes containing additives.

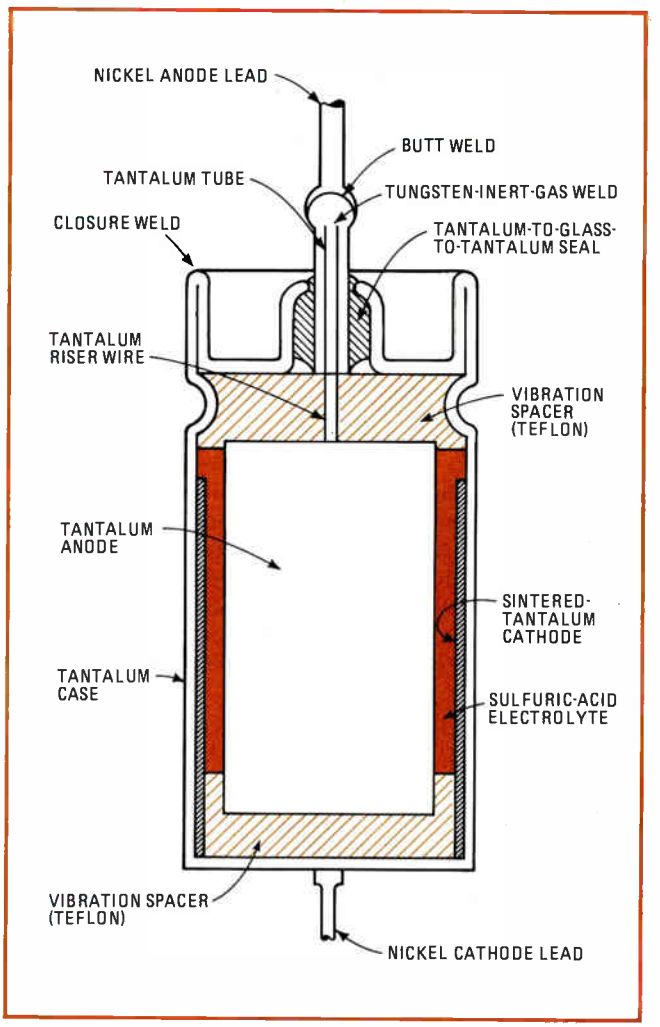
The unit's high capacitance per unit volume is due to both the anode and the cathode. The anode owes its high capacitance to two factors: the very large surface area of the rough tantalum grains that make up the porous



1. Standard design. Despite its excellent electrical characteristics, the conventional wet-slug tantalum capacitor all too frequently suffers from silver whiskering, which leads to shorts or high dc leakage. Even a few millivolts of reverse bias can deplate the silver case, sulfuric acid in the electrolyte can dissolve the silver, and inadequate seals can permit the electrolyte to seep out.



2. From Transitor. With its tantalum case and hermetic seals, the new all-tantalum wet-slug capacitor solves the reliability problems of the conventional silver-case unit. This Tansitor device has welded seals on both the anode end and the cathode end.



3. From Sprague. In contrast to the Transitor design, the Sprague all-tantalum capacitor offers a double seal on the anode end, made up of a tantalum welded seal and a Teflon swaged seal. The internal Teflon spacer, though, does somewhat reduce capacitance.

anode slug, and the relatively high dielectric constant of the thin layer of tantalum oxide that forms all along the slug surface. Equally important is the cathode capacitance, created by the large surface areas of the silver and its rough plating of platinum.

The highly conductive sulfuric-acid electrolyte helps to keep both equivalent series resistance and dissipation factor low over wide variations in temperature. Fortunately, this acid does not corrode the dielectric, so that dc leakage is low even at 125°C. In general, capacitance ranges from 1.7 to 1,200 microfarads over a working-voltage range of 6 to 125 volts dc.

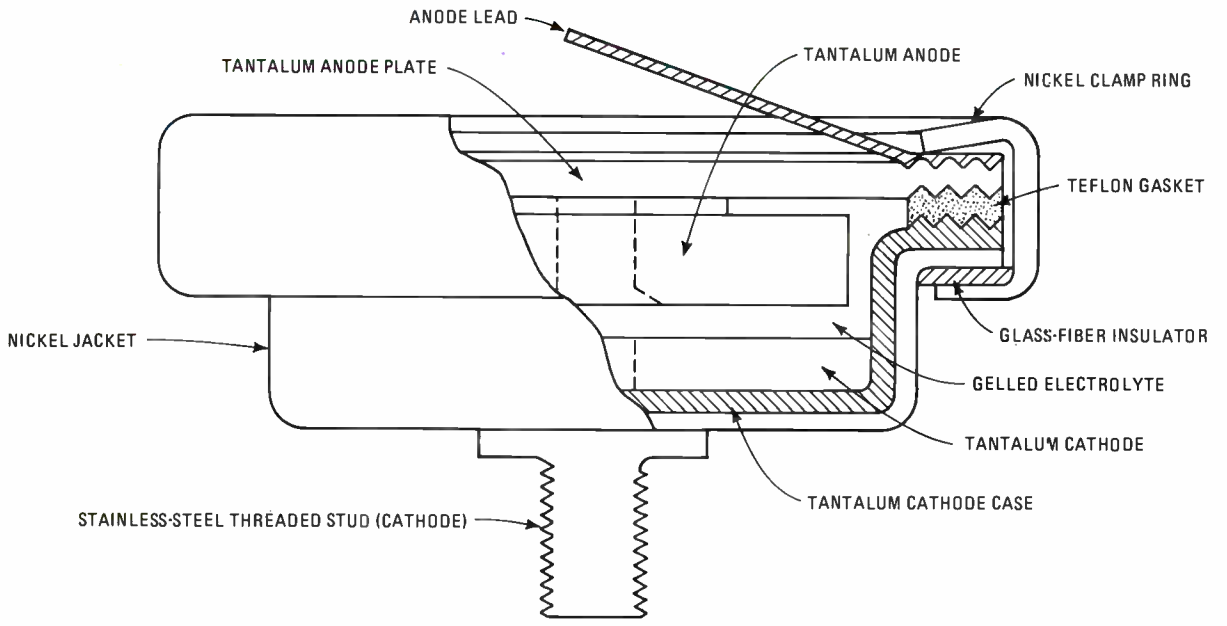
The causes of failure

Nevertheless, the silver-case wet-slug capacitor is liable to short out or permit excessive dc leakage because of three major weaknesses. Under reverse bias, the silver case deplates, forming silver whiskers, or dendrites, that penetrate the tantalum anode slug. Then, despite the platinum coating on the case, the sulfuric acid in the electrolyte can eat its way through and dissolve the silver—ironically, a problem that is aggravated by the ac ripple the unit is designed to handle. Finally, the electrolyte can seep out through the seal.

Over the past decade, these problems have led to a number of expensive retrofits for electronic hardware in space, military, and commercial equipment. For instance, in 1970, erratic electronic behavior of the control signal processor and the flight control computer of the Saturn vehicle for Apollo 14 was traced to silver whiskers in the wet-slug capacitors.

Similarly, failures of the input wet-slug filter capacitors caused trouble in the charger battery regulator modules of the Skylab in 1972, and the erratic behavior of the power circuits in the Apollo telescope mount was found to be due to silvering of their wet-slug capacitors. Just as serious was the trouble, in 1974, in the Saturn flight control computer for the Apollo-Soyuz mission. Here the capacitors were nearly 10 years old, and the sulfuric-acid electrolyte had corroded the silver so badly as to create pinholes through which it ran out of the case onto the circuit boards.

Lamentably, failures like these are not due to excessive stress or misuse. On the contrary, because the tanta-



4. From Plessey. Button-like all-tantalum capacitor made by Plessey is not compatible with the tubular U. S.-manufactured units, and the device's pressure seal with a Teflon gasket is not truly hermetic. At this time, too little test data is available for proper evaluation.

lum-oxide dielectric is extremely thin—just 1,000 angstroms or so thick—a few millivolts of reverse bias will cause enough whiskering to induce shorts or excessive leakage. Indeed, if a silver-case unit never encounters any reverse bias, it may still undergo massive silvering in response to ac ripple that should be well within its specifications. Even normal on-off switching accelerates silver deplating by producing high di/dt. Unused devices are not immune, either, for silvering may occur in them as a result of screening and burn-in tests at the factory.

The seal of silver-case units, too, though markedly improved in recent years, is still not really hermetic. On most tubular devices, the final seal is made with solder, and no foolproof way has been found to prevent the sulfuric acid from occasionally oozing through the internal Teflon seal and onto the solder. Once in contact with the solder, the acid gradually corrodes it till the capacitor springs a slow leak.

Problem solver: the all-tantalum electrolytic

The new all-tantalum wet-slug capacitor virtually does away with these problems. Because of its tantalum case, silver whiskering is eliminated, and the unit has a reverse-bias capability of at least 3 v at 85°C. Seepage, too, is held in check, since the device has a hermetic seal that is compatible with the sulfuric-acid electrolyte. Also, the only metal contacting the electrolyte is tantalum, so that unlike solid-tantalum and silver-case capacitors, the all-tantalum wet-slug unit produces no electromotive force—a possibly significant factor in applications involving coupling. Most important, the tubular all-tantalum design meets the requirements of MIL-C-39006/22: it qualifies as style CLR79, a direct replacement for the silver-case CLR65 style.

Currently, there are the three manufacturers making all-tantalum devices. They are the Tansitor division of Aerotron Inc. in Bennington, Vt., Sprague Electric Co. of North Adams, Mass., and the Plessey Co. of England. Others are expected to follow suit shortly.

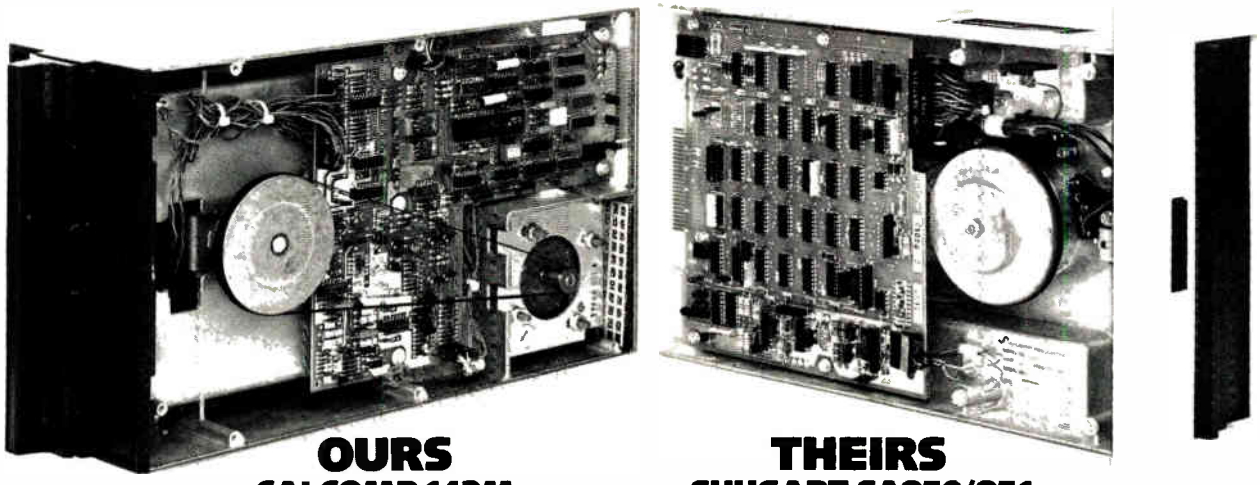
Looking at three versions

The Tansitor unit (Fig. 2) is intended as a direct substitute for the CLR65 devices with their T2 case size. A conventional slug of pressed sintered tantalum forms the anode, while the cathode is a sleeve of the same material welded to the inside of the tantalum case. Teflon spacers hold the slug apart from the sleeve, the gap being filled by the sulfuric-acid electrolyte. The seal at the anode end is glass to tantalum, the glass being compressed around a tantalum tubelet and within the tantalum case by an outer steel ring; between the tubelet and the nickel lead there is a tantalum-to-tantalum weld, as well as a nickel-to-tantalum weld. The seal at the cathode end—the final one—is a tantalum disk welded to the tantalum case.

Aimed at the T1, T3, and T4 as well as the T2 case sizes, the Sprague unit (Fig. 3) is also tubular and employs conventionally processed slugs, nickel lead wires, Teflon spacers, and liquid or gelled sulfuric acid as the electrolyte. But structurally it is rather different from the Tansitor unit. Most obviously, the seal at the cathode end is integral with the case, and the final seal is at the anode end—one of glass to tantalum carefully matched for thermal coefficient of expansion. Both Tansitor and Sprague capacitors exhibit a leakage rate of less than 10^{-8} cubic centimeters per inch.

The Plessey unit is altogether different (Fig. 4). It is shaped like a button and employs a gasketed pressure seal rather than a welded seal. It meets the requirements

THERE ARE TWO SIDES TO EVERY STORY.



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- industry standard format
- 50-pin compatible interface
- *switch-selectable* variable functions
- hard *and* soft sectored
- *write current switching* in drive
- write precompensation *not required*
- one head fixed: *minimal* media wear

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- two-sided and double density
- industry standard format
- 50-pin compatible interface
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- hard *or* soft sectored
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- write precompensation *required in controller*
- both heads move: *greater* media wear

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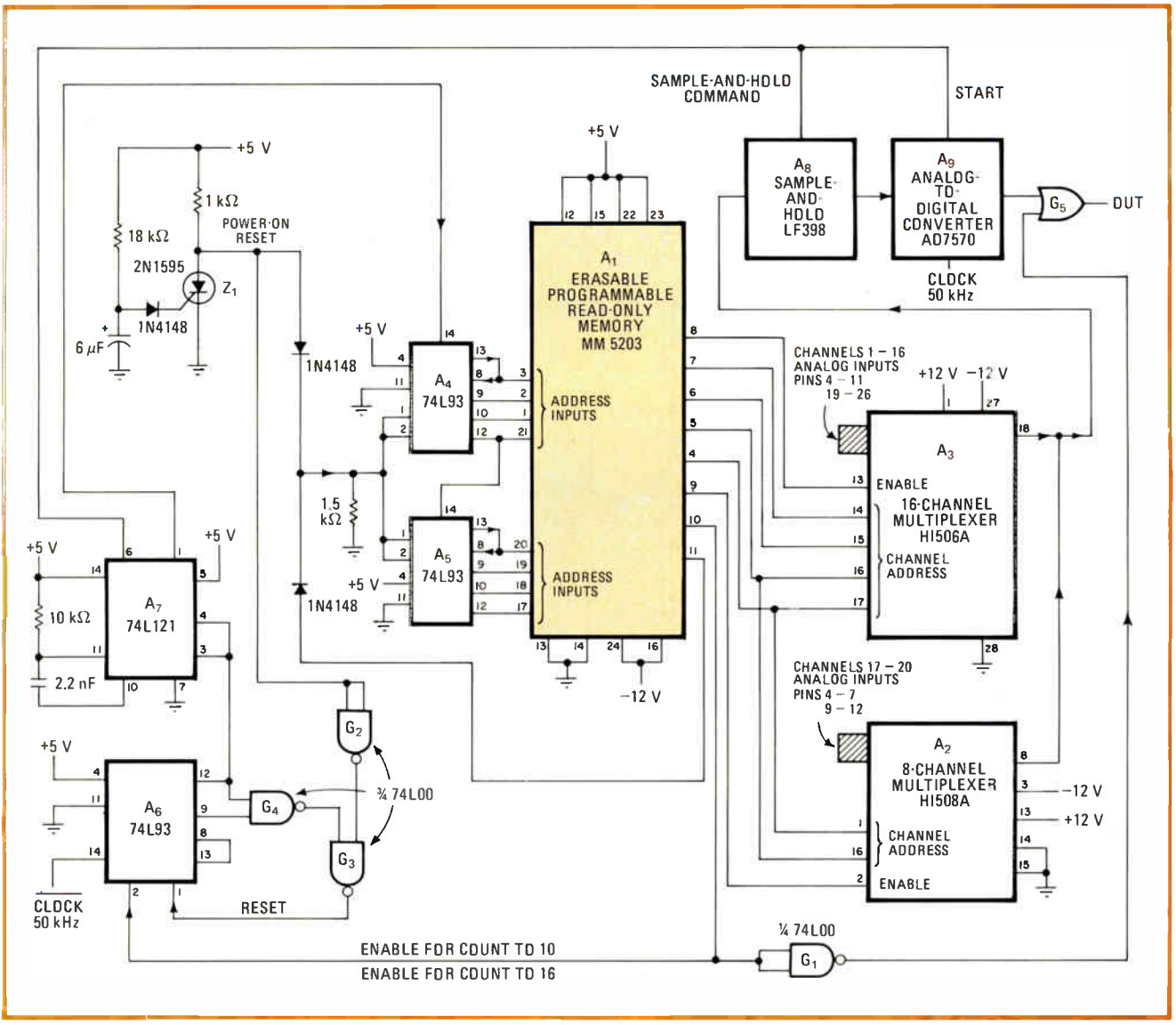

2. Data sampler. Circuit ensures that the rate at which all channels are sampled is proportional to the bandwidth of each, in accordance with the requirements of sampling theory. The erasable PROM can be programmed so that any desired channel sequence can be transmitted via the 16-channel multiplexer; the transmission rate for each channel will in this way be easily controlled.

On power up, thyristor Z_1 resets counters A_4 through A_6, thereby selecting the first PROM location. A_4 and A_5 will be placed in the standby mode and A_6 will be placed in the count-to-16 mode, because the PROM is programmed to generate a logic 0 at pin 10 of A_1. When Z_1's anode voltage drops to zero, A_6 begins to count, and this initiates the master sync cycle.

After 16 counts, the one-shot (A_7) fires and increments A_4, and therefore the second memory location of the PROM is selected. The second location is programmed so that its contents are identical to that of location 1, and consequently, 16 counts later, the third memory location is selected. This location contains the address of the first multiplexer channel.

Pin 10 of A_1 has moved high, thereby enabling G_5, and setting A_6 into its count-to-10 mode. Note that the multiplexers are addressed by 6 bits of A_1, not 8; the remaining 2 bits are required for the system sync-control circuit comprising G_1, G_5, and pin 10 of A_6.

Meanwhile the one-shot initiates the sample-and-hold command and resets A_9. The contents of channel 1 then appear at the input of A_9. At the second positive clock edge after the cessation of the pulse emanating from A_7, the most significant bit of data appears at the output of A_9 and thus at the circuit output. A_3 is now in the count-to-10 mode (caused by pin 11 being high). A_4 and A_5 are again incremented by A_7 after the monostable is triggered by pulse 10 of A_1. A_5 and A_6 select the next PROM address, which is 2 in this case. This process is repeated until all seven channels have been selected.

At the next memory location, the PROM must be programmed so that a 0 once again emanates from pin 10, to set A_6 into the count-to-16 mode once more and to generate a logic 1 at the system output by means of G_1 and G_5. Triggering A in this way sets the stage for the generation of a subframe sync pulse and the selection of the first channel in the second subframe after 16 pulses have been counted by A_1. The selection process continues

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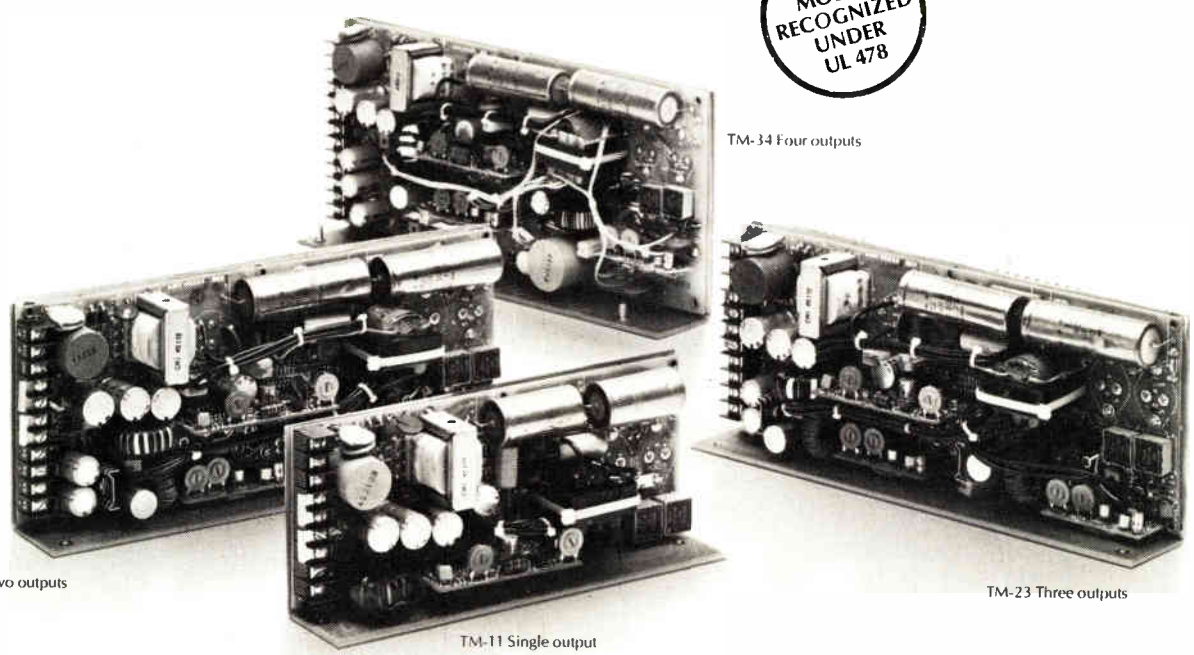

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until all the subframes have been scanned.

The location representing subframe 12 should be programmed so that a logic 1 appears at pin 11. This resets the counters and selects the first memory location in A_1, as before. The system generates the main-frame sync pulse again and the entire process is repeated. □

Phase-locked generator converts, filters most inputs

by Peter Reintjes
Research and Design Ltd., Morehead City, N. C.

Replacing the voltage-controlled oscillator in the RCA 4046 phase-locked loop with the popular Intersil 8038 waveform generator forms a circuit that produces sine, square, and triangular wave voltages capable of tracking almost any input signal. Besides performing its prime function of waveform conversion, the circuit serves as a high-Q filter. With a harmonic distortion of only 0.5%, it finds the fundamental frequency of any signal.

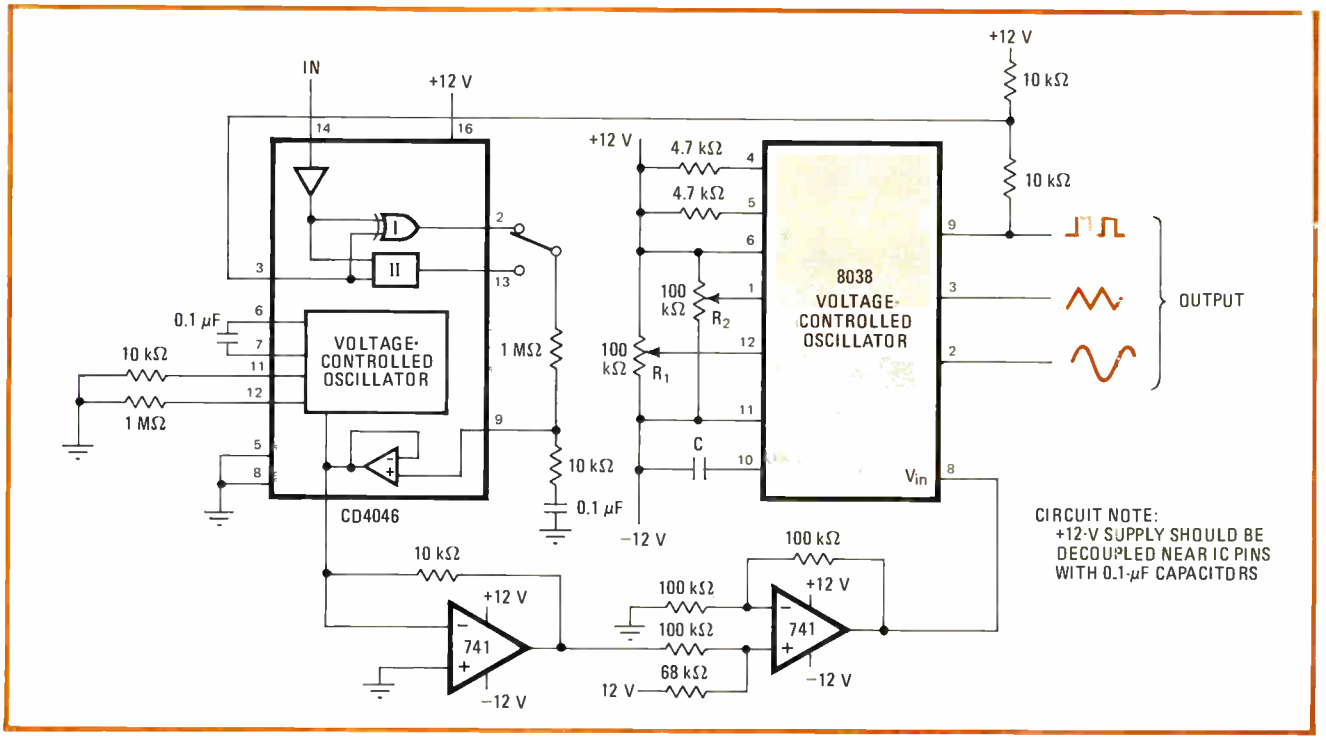
The performance of this circuit far exceeds that of a conventional filter, which always adds a phase shift to the incoming signal. Also, traditional filtering methods are often of little use when the fundamental frequency must be recovered from an unpredictable input signal.

Connecting the 8038, which is itself a voltage-controlled oscillator, to the 4046 as shown in the figure does not affect the normal operation of the phase-locked loop. The only difference in the basic PLL circuit is that the 8038 generates sine, triangular, and square waves and drives the 4046 in place of the loop's internal VCO. The output waveshapes are unaffected by the harmonic distortion present on the input signal. Capacitor C sets the center frequency of the 8038 (a value of 0.047 microfarad corresponds to a frequency in the audio range). The frequency-capture range of the circuit, which is determined by the 4046, remains 1,000 to 1. The generator's maximum operating frequency is about 700 kilohertz.

To secure precise locking, the comparators in the 4046 should be driven by the square-wave output of the 8038. If the input waveform is a pulse, phase comparator I should be used. For unpredictable or high-noise signals, phase comparator II is more suitable.

Any phase difference between the square-wave output of the 8038 and the input signal is amplified by two 741 operational amplifiers and then fed back to the VCO to increase or decrease its frequency, as the case may be. Although the internal VCO of the 4046 is not used, it must be enabled by grounding pin 5 of the device so that its voltage-follower will be active. If matched resistors are used at pin 4 and 5 of the 8038, the sine-wave output distortion can be reduced to 0.5%. Potentiometers R_1 and R_2 aid in minimizing the distortion. □

Designer's casebook is a regular feature in *Electronics*. We invite readers to submit original and unpublished circuit ideas and solutions to design problems. Explain briefly but thoroughly the circuit's operating principle and purpose. We'll pay $50 for each item published.



Tracking waveforms. ICL 8038 and two op amps replace internal VCO in 4046 to form phase-locked-loop waveform generator that can be used to recover fundamental frequency of any input signal or to convert the control signal to sine, square, and triangular waves. The generator's maximum output frequency is about 700 kHz. R_1 and R_2 are adjusted for minimum output distortion.

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MATCHING CHARACTERISTICS			OP-10AY			OP-10Y			
These specifications apply for $V_s = \pm 15V$, $T_A = 25°C$, unless otherwise noted.									
Parameter	Symbol	Test Conditions	Min	Typ	Max	Min	Typ	Max	Units
Input Offset Voltage Match	ΔV_{os}		—	0.07	0.18	—	0.12	0.5	mV
Average Non-Inverting Bias Current	$I_B +$		—	±1.0	±3.0	—	±1.3	±4.5	nA
Non-Inverting Offset Current	$I_{os} +$		—	0.8	2.8	—	1.1	4.5	nA
Inverting Offset Current	$I_{os} -$		—	0.8	2.8	—	1.1	4.5	nA
Common Mode Rejection Ratio Match	Δ CMRR	$V_{CM} = \pm$CMVR	114	123	—	106	120	—	dB
Power Supply Rejection Ratio Match	Δ PSRR	$V_s = \pm 3V$ to $\pm 18V$	100	112	—	94	110	—	dB
Channel Separation			126	140	—	126	140	—	dB

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Digital design: scaling new heights

by Laurence Altman
Solid State Editor

☐ This year's conference shows that chip makers are ready to take the next step in digital design. They are readying denser and faster memories for mainframe, cache, and microcomputer system designs; 16-bit microprocessors that execute instructions at minicomputer speeds; and random-logic gate arrays that feature subnanosecond delays for mainframe controllers in next-generation computers. Here is what the state of the art for devices, as reflected by ISSCC papers (Table 1), will look like for users over the next 12 months:

In dynamic random-access memories, the technology is definitely established for reaching the 65,536-bit level. Prototype chips (probably from Japan) are expected late this year, and sample production from several U. S. and Japanese manufacturers should follow in 1979. That is earlier than many observers thought possible for implementing 65-k RAMs, yet to judge from the ISSCC papers in this area, the parts will be built using fairly conventional one- and two-level polysilicon-gate cell structures and fairly standard (2- to 4-micrometer) photolithographic fabricating methods. This says that, once designed, 65-k devices should get into production quickly, and that costs per bit should again halve as these four-times-denser RAMs come on stream in 1980.

Static RAMs are moving in two directions. N-channel metal-oxide-semiconductor types are now moving to the 8,192-bit level, in 1,024-word-by-8-bit configurations that make them extremely attractive for byte-oriented microcomputer system designs. Meanwhile, transistor-transistor-logic static RAMs are being extended to 4,096 bits with no sacrifice in performance (24- to 40-nanosecond access time, 350-milliwatt power dissipation). These parts strike back at the newly developed 50-ns, 4-k MOS static devices built with scaled-down processes, such as high-performance MOS, or H-MOS [*Electronics*, Aug. 18, 1977, p. 91], in the struggle in cache designs.

Read-only-memory designers are aiming at 65-kilobit chips—some, in fact, are already in production. This means that a user can immediately replace four 16,384-bit devices, making cheaper hardware available for storing microcode in all types of computer designs, as well as in large systems for storing fixed data such as look-up tables. Moreover, some suppliers, like Mostek Corp., can select for speeds below 100 ns, so that designers can use these chips as high-capacity replacements for smaller bipolar parts in real-time applications.

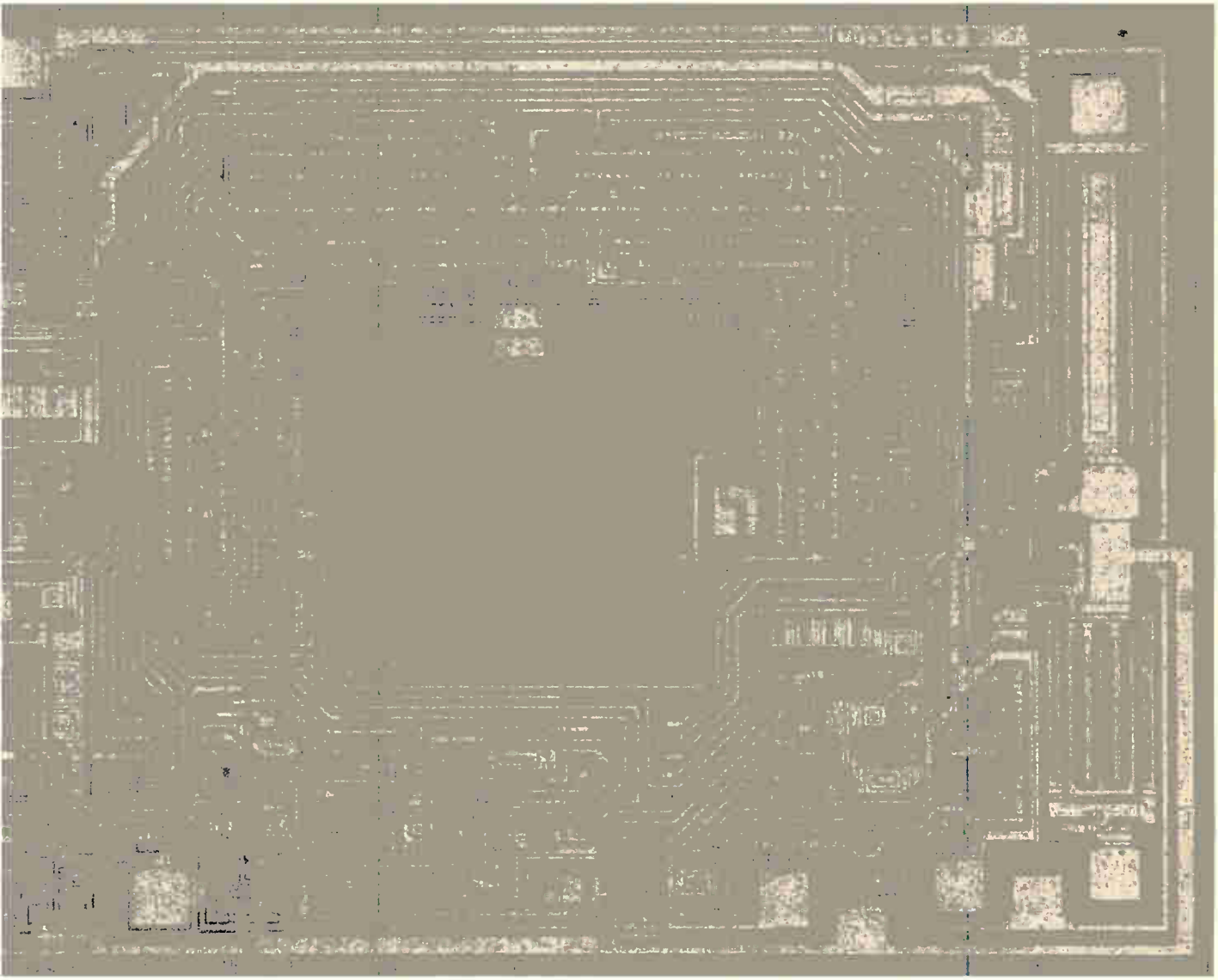
Charge-coupled memories are already reaching the 65-kilobit level for block-storage applications. Here, users will want to evaluate carefully the cost-performance tradeoffs between RAMs and charge-coupled devices to determine where the CCD chips fit in. Since CCDs are serially accessible and slower than RAMs, they are more difficult to use. Most system designers will require at least a two-to-one price advantage of CCDs over RAMs to reconfigure their memory hierarchy; otherwise, it will probably not be worthwhile to accommodate them.

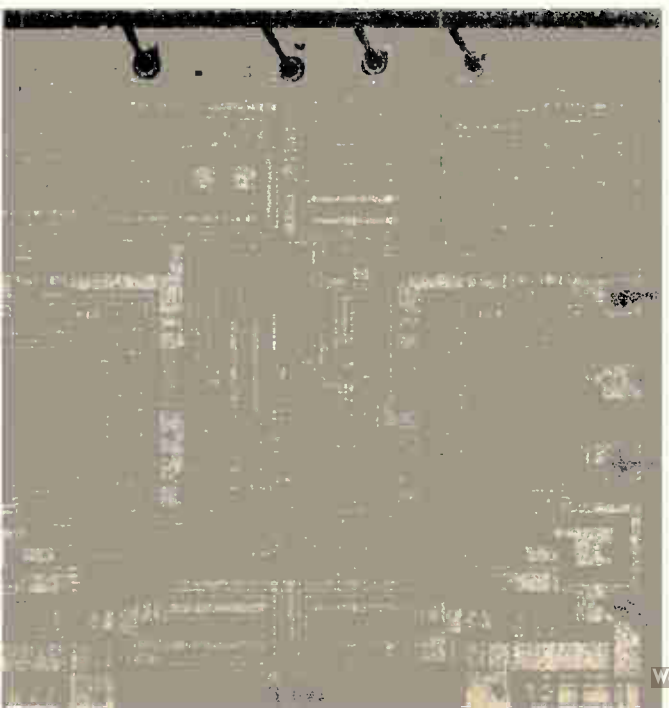
In logic, too, the move is to faster, denser chips. Man-

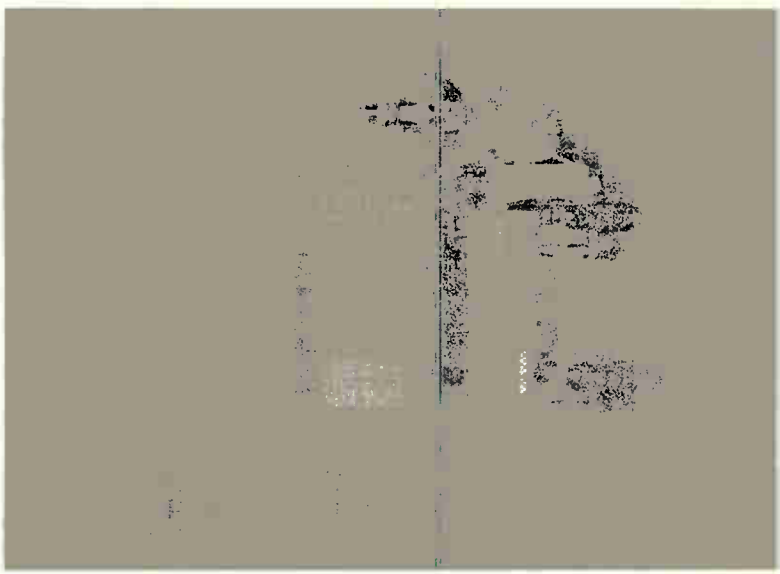
TABLE 1: DEVICE TYPE AND PERFORMANCE

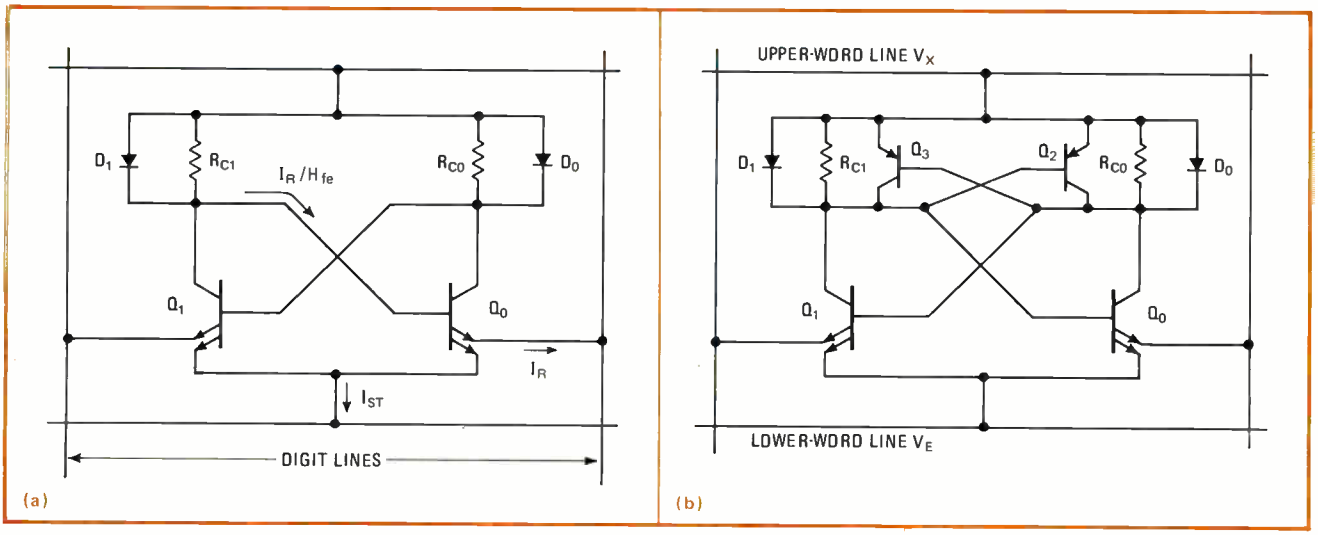
Device type	1977 Production Device			1978 ISSCC Device				
	Density/ capability (bits)	Speed (ns)	Process	Density/ capability (bits)	Speed (ns)	Process	Manufacturer	Session number
Dynamic RAMs	4-k 16-k	150 150 – 300	n-MOS n-MOS	16-k 65-k 65-k	<100 150 – 300 150	I^3L n-MOS V-MOS	Fairchild NTT Siemens, AMI	12 12 –
Static RAMs	4-k 4-k 4-k 1-k, 4-k	150 50 50 30 – 50	n-MOS H-MOS V-MOS TTL	8-k 8-k 256 bits (nonvolatile) 4-k 4-k	200 150 1,000 25 40	n-MOS n-MOS C-MOS TTL TTL	Semi Mostek Hughes Hitachi NEC	9 9 9 9 9
ROMs	16-k, 32-k 16-k	250 80	n-MOS TTL	64-k	100	n-MOS	Mostek	12
CCDs	16-k	~1 μs		64-k	200 – 500		Fairchild	12
Erasable PROMs	16-k	500	n-channel Famos	4-k	500	complementary Famos	Intersil	9
Microprocessors	8 or 16	1 μs	n-MOS	16 bits	600	C-MOS/n-MOS	NEC	15
Gate arrays	200 gates	3 (delay)	TTL/ECL	920 gates	3 (delay)	MOS	Mitsubishi	6
Experimental memory	–	–	–	16-k (RAM)	15	Josephson junction	IBM	6
Logic				–	40 – 120 ps	Josephson junction	IBM	6
				–	82 ps	GaAs	Rockwell	6

Source: Electronics









1. Modified diode cell. Increased density and speed are achieved by adding to the conventional diode cell (a) two bipolar transistors, Q_3 and Q_4 (b). This modification reduces base-current conduction and leads to lower power dissipation, but with no increase in cell area.

to match the size of the 5-μm V-MOS chip.)

Unlike 65-k dynamic RAMs, both the CCD and the ROM chips have already entered production. In the CCD design from Fairchild Semiconductor, Mountain View, Calif., an interlaced data-entry and multiplex-like data-shifting method results in a chip size of only 4.4 by 5.8 mm^2, allowing the part to be packaged in a standard 16-pin package 300 mils wide. Moreover, the memory can be operated at a respectable speed range of 1 to 5 megahertz at typical active power dissipations of 200 mw. The high data rate is achieved by shifting data in each array in parallel by means of eight-phase ripple clocks generated on the chip.

The chip is laid out with a standard serial-parallel-serial configuration comprising 16 randomly accessible blocks of 4,096 bits each. The architecture is a little tricky, requiring four MOS-level clocks. Two main high-frequency clocks, ϕ_1 and ϕ_2, run at a frequency equal to the data rate and are used both for shifting data within the input and output serial registers of each 4,096-bit block and for controlling all the peripheral MOS circuits. Two low-frequency transfer clocks, ϕ_{T1} and ϕ_{T2}, are irregular and run at a frequency equal to $1/32$ of the main clock. They are used to transfer charge from serial-to-parallel and parallel-to-serial registers of each block. This design, however, requires that the clocks be skewed to achieve correct bit storage in each block.

Besides reaching 65-kilobit chip complexity, Mostek Corp.'s ROM also breaks new ground in performance—and does it with standard silicon-gate MOS processing. Thanks to dynamic peripheral circuitry, which reduces power and increases signal throughput, and a cell design that saves space by sharing not only the outputs from each cell but also the virtual grounds between them, the Carrollton, Texas, firm's design achieves a typical access time of 80 ns on a chip measuring only 4.65 by 4.83 mm. As an added bonus, chip power dissipation averages a mere 150 mw. What this means is that users will be able to get the speeds associated with bipolar ROMs at lower power dissipations and at much lower costs.

Static RAMs are moving faster and faster

A static bipolar RAM entry from Japan reaches the 4-k chip level while increasing the speeds of this device type into the bargain. Indeed, the 4-k TTL design from Hitachi Electronics Co. has a typical access time of 25 ns—the fastest speed yet reported for any 4-k device. Moreover, a power dissipation of only 250 mw gives the device the best speed-power product yet reported.

Hitachi designers did it by modifying the standard parallel diode cell (Fig. 1a) used in this type of RAM by adding two bypass pnp transistors, Q_2 and Q_3 (Fig. 1b). Thus, when the cell is selected, the voltage drop caused by base-current conduction at the cell's output is reduced dramatically, since much of the current is drained off by either of the bypass elements.

Finally, the industry's first single 5-v 8-kilobit static RAM will soon be offered by Semi Inc., Phoenix, in a 1,024-word-by-8-bit configuration that will facilitate byte-oriented microcomputer applications. Moreover, the chip's timing characteristics match the most popular 2-MHz microprocessor requirements.

Semi's part has good state-of-the-art specifications: access time, 300 ns; cycle time, 450 ns; and deselected current drain, only 6 mA. The chip, which is being packaged to be socket-compatible with popular 8-k and 16-k erasable programmable ROMs, PROMs, and ROMs, will be available in a 22- and 24-pin configurations.

To achieve the combination of high packing density and good speed and power characteristics, Semi designers used several circuit and processing innovations. Clocked peripheral-chip circuitry reduces power, increases speed, and prevents race problems, high-value polysilicon resistors decrease memory-cell size and power. Finally, a high-performance silicon-gate process further increases density and performance.

Linears: a mixed bag of controllers, opto, converters

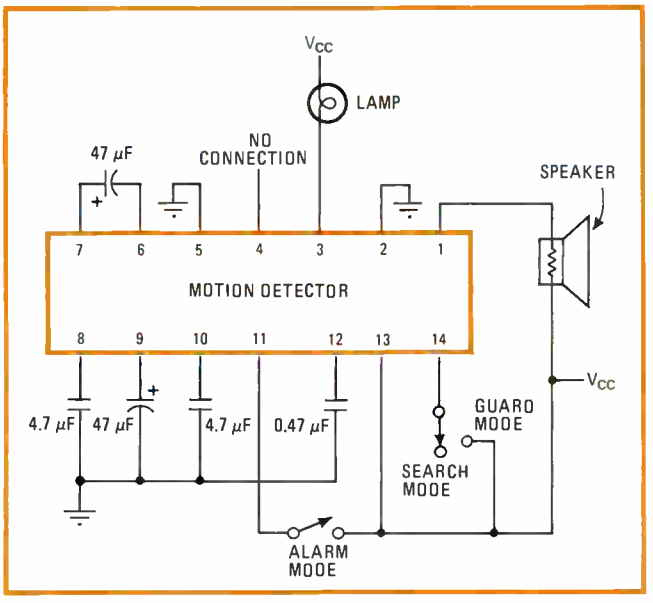
by Lucinda Mattera
Components Editor

☐ Large-scale integration is very much in evidence at this year's ISSCC, which brings a record number of major disclosures in the linear area. Among the highlights are: special-purpose linears for power control as well as optical applications, data-converter chips that are actually miniature microprocessor-compatible subsystems, and new monolithic amplifiers able to operate at microwave frequencies.

Power supplies, the prime movers in any electronics application, are getting a big hand from linear LSI technology. Within the last year, about a half-dozen controller chips for switching-regulated supplies have swept onto the market. Fabricated with linear bipolar technology, these devices considerably simplify the design of switching supplies.

For higher noise immunity and better speed-power performance, however, Rockwell International Corp., Anaheim, Calif., has turned to complementary metal-oxide-semiconductor circuitry on a sapphire substrate. The resulting chip contains all the control functions required for power conditioning and servicing of pulse-width-modulated switching regulators.

In all, the device has five on-chip operational amplifiers, three of which perform error amplification, pulse-width modulation, and overload detection. The other two serve as voltage comparators for detecting overvoltages and undervoltages. Five master-slave flip-flops and their associated logic provide timing control, as well as mode and sequence control. Mode control permits selection of either single- or two-phase modulation outputs, while sequence control provides the interlocking logic for predetermined sequential turn-on–turn-off of individual regulators in a multiple-voltage power subsystem.



1. Optolinear. Initially intended for electronic toys, integrated motion detector from Sprague may be at the heart of low-cost intrusion alarm systems in the near future. Combining digital I²L circuitry with linear bipolar circuitry, the device includes an on-chip photodiode.

Both inputs to the error amplifier are brought out, so the device may be used in either a positive or a negative regulator. The overload-detector amplifier differs from the error amplifier in that its input source-followers allow common-mode operation below ground. Both of the chip's output drive signals are immediately terminated upon detection of an overload signal, but are reinitiated on the next clock pulse for automatic restart.

Other LSI linears for general power-control applications are beginning to appear, too. For example, the Central Research Laboratory of Hitachi Ltd. in Japan has found a way to increase the breakdown voltage of integrated injection logic for analog functions. Lab researchers are using a double-epitaxial technique to build a temperature controller having high-voltage output drivers. Suitable for use in a home appliance such as a room air conditioner, the new device boasts output drivers capable of sinking up to 200 milliamperes and providing a breakdown voltage of 40 volts.

To get the high breakdown voltage without sacrificing switching speed and current gain, Hitachi's designers tailor the thickness of the epitaxial layers under the bases of the I²L and normal npn transistors. A wide epitaxial layer for the normal driver transistors raises their breakdown voltage, while a reduced epitaxial layer for the I²L devices increases injection efficiency and thus current gain. Furthermore, switching delay for the I²L devices is cut because the number of hole carriers injected into the epitaxial layer is decreased.

A relatively new and upcoming area is optolinears—monolithic chips that combine a photosensor with linear circuitry. Initially developed for automatic cameras, optolinears are now beginning to penetrate a far broader range of light-sensing applications.

Prospects bright for optolinears

To that end, one of the pioneers in this area, National Semiconductor Corp., Santa Clara, Calif., has come up with a general-purpose device suitable for use as a building-block element in either analog or digital circuitry. Besides a linear light-to-current converter, the chip includes a voltage reference and an adaptively biased voltage comparator. Its sensors are ion-implanted photodiodes offering enhanced visible-light response over conventional diffused photodiodes because of their shallow junction depth.

In addition to their normal sensory function, the photodiodes serve as active elements, taking part in biasing and loading the circuit. To hold input bias current as low as possible, the entire chip actually operates on photocurrents. This extreme form of

adaptive biasing tailors the input bias current and circuit speed to the incident light level, trading speed for bias current at low light levels. To ensure minimum loading of the amplified photocurrent output, the comparator is also adaptively biased with light-derived currents. In this way, input bias current is typically held to 1% of the photocurrent output, independent of the illumination.

Meanwhile, special-purpose optolinears are moving into consumer applications other than cameras. Sprague Electric Co. in Worcester, Mass., has designed a fully integrated motion detector for electronic toys that looks very promising for use in a low-cost, high-volume alarm system. This bipolar chip is capable of sensing motion at a minimum distance of 8 feet over a 2-ft surveillance diameter. Made up of both I^2L digital circuitry and linear bipolar circuitry, the device (Fig. 1) contains an on-chip photodiode and high-current output drivers.

Upon sensing motion, it sounds a whooping alarm (via an external speaker) for a given time, after which it automatically resets. The device also offers a search mode of operation, flashing an external lamp at a rate of approximately 2.5 hertz while simultaneously sounding a random sequence of audible notes. When it detects its own reflection, the unit triggers the alarm and increases the lamp flash rate to about 25 Hz.

Even at micropower levels, bipolar linear ICs generally require a supply of several volts for proper operation. However, under contract to National Semiconductor Corp., Robert Widlar, the father of the integrated general-purpose op amp and now an independent contractor in Puerto Vallarta, Mexico, has developed simple circuit techniques for fabricating low-voltage bipolar linears, like op amps, comparators, voltage regulators, and even voltage references. The new devices, says Widlar, will work from a voltage as low as that supplied by a single nickel-cadmium cell—approximately 1.1 v. Moreover, he adds, such low-voltage operation is possible without compromising device performance or even operation at higher voltages.

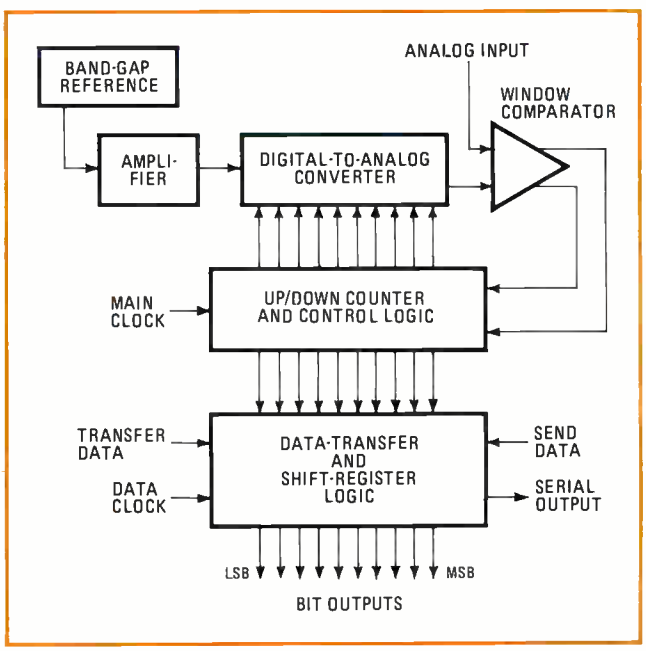
A burst of converter chips

As might be expected, this year's ISSCC reflects the changing nature of monolithic data converters, which are bringing more address, control, and multiplexing circuitry right on the chip for simpler hookup to a microcomputer. A prime example of this growing complexity is the new data-acquisition chip being unveiled by the Semiconductor division of Japan's Tokyo Shibaura Electric Co. Implemented in what its developers call clocked C-MOS circuitry, the chip is the first 12-bit unit of its kind. On the chip are: an eight-channel analog multiplexer, a 12-bit integrating analog-to-digital converter, channel-address-decoding logic, read/write interface logic, and three-state output buffers for directly interfacing with a microprocessor data bus. Yet the device is powered by a single 5-v supply.

For high accuracy, the chip employs an unusual conversion technique that is useful for both unipolar and ratiometric applications. Rather than the traditional two-phase dual-slope integration, the technique involves five phases, one of which automatically compensates for the offset voltage of the integrator. Since the threshold voltage of the internal comparator is supplied by on-chip dividing resistors, the absolute accuracy of this voltage has no influence on the conversion as long as the ratio of the dividing resistors remains stable within a conversion cycle. Because of its clocked C-MOS logic, the chip is able to operate at a fairly high internal clock frequency, typically 3 megahertz, resulting in a reasonable conversion time of 3.6 milliseconds. Overall accuracy is to within 0.05% of full scale.

Like such monolithic converter subsystems, individual converter chips are becoming increasingly self-contained, as well as offering higher accuracy and resolution at faster speed. Take, for instance, the latest bipolar a-d chip from Analog Devices Inc., Norwood, Mass. It is a fully self-contained 10-bit successive-approximation a-d converter that offers a maximum error of 0.1% and a conversion time of 25 microseconds. Built with a combination of I^2L and linear bipolar processing, the device includes a comparator, a temperature-compensated buried-zener voltage reference, a 10-bit digital-to-analog converter, a clock, control logic, and three-state output buffers for direct microprocessor hookup. One of the keys to the unit's high performance is the inclusion of on-chip thin-film resistors that are laser-trimmed at the wafer stage.

In contrast, some converter manufacturers are looking to dispense with trimming altogether yet produce high-resolution parts. To that end, England's Ferranti Ltd. is using its bipolar collector-diffusion-isolation technology



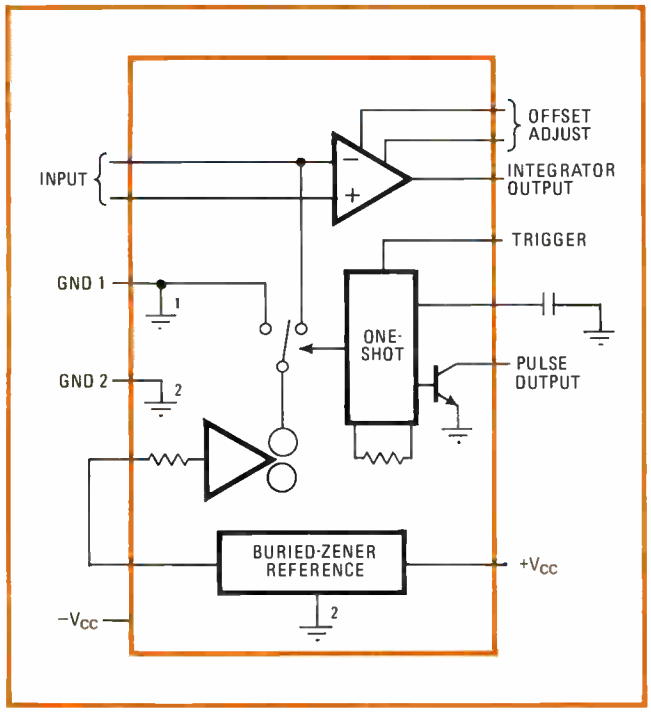
2. Untrimmed yet accurate. This tracking a-d converter made by Ferranti with its collector-diffusion-isolation technology employs diffused resistors carefully matched for minimal error. As a result, the chip needs no trimming, yet it provides 10-bit performance.

to build a 10-bit tracking a-d converter (Fig. 2) that requires no trimming at all.

Rather than thin-film resistors, Ferranti employs diffused resistors, carefully matched for minimal error. An on-chip band-gap voltage reference supplies the current reference amplifier, and the reference source currents are derived in a closed-loop system, so that thermal effects in the current-source array are nulled. As a result, the output temperature coefficient is essentially that of the reference voltage. For a smooth transition between codes with a minimum of jitter and hysteresis, the chip employs a window comparator, as opposed to the more usual single-threshold type of comparator. The output from the d-a converter is compared with the incoming analog signal in the window comparator, which directs the counter to count up or down or to hold. On the transfer command, the data in the counter loads into the shift register.

Another breakthrough in individual converter chips comes from Advanced Micro Devices Inc. in Sunnyvale, Calif. AMD has developed a high-speed microprocessor-compatible 8-bit d-a converter that offers a choice of eight coding formats as well as output-range selection via a current-mode multiplexer. Providing multiplying performance, the unit holds nonlinearity to ±0.1% maximum over its full operating temperature range. Settling time is a fast 160 nanoseconds.

Voltage-to-frequency converters offer a simple and inexpensive way to make high-resolution a-d conversions. The first generation of chips of this kind of converter, though, provided only limited accuracy and moderate full-scale frequency. Now, the second generation, offering considerably improved performance, is here. Raytheon Co.'s Semiconductor division in Mountain View, Calif., has a bipolar chip (Fig. 3) that holds nonlinearity to 0.025% of full scale at 100 kilohertz and to 0.015% of full scale at 1 kHz. The device, which includes its own ion-implanted buried-zener reference, also contains a stable one-shot multivibrator, a precision voltage-to-current converter, a current switch, and an op amp. The one-shot, in turn, is made up of an R-S latch, a ramp generator, and a voltage comparator. In response to a 10-v step input, the chip settles in 10 μs for an output frequency of 100 kHz.



3. High performance. Containing a buried-zener voltage reference, monolithic voltage-to-frequency converter from Raytheon offers precision performance. It holds nonlinearity to 0.025% of full scale at 100 kHz and to only 0.015% of full scale at 1 kHz.

For accurate data acquisition, a sample-and-hold circuit is often needed to minimize error. As a rule, though, the performance of monolithic devices has not been good enough for high-accuracy applications. But by implementing a novel circuit technique with standard bipolar linear processing, Precision Monolithics Inc., Santa Clara, Calif., has put together a sample-and-hold circuit that meets the accuracy requirements of 10-bit applications. Droop rate is a remarkably low 5 microvolts per millisecond typically and only 120 μv/ms over the temperature range of −55°C to +125°C. To get this kind of performance, PMI uses superbeta input transistors for both the input and the output amplifiers, a diode bridge for switching, and a unique current booster that serves as a supercharger for the hold capacitor. Acquisition time is a fairly fast 3.5 μs and accuracy is to within 0.1%.

New devices for microwave applications

Linear integration is even moving up to microwave frequencies. For the most part, microwave ICs are really hybrid-like assemblies of discrete parts. But Hewlett-Packard Co. of Santa Rosa, Calif., has put gallium-arsenide technology to work, building monolithic voltage amplifiers that may be easily cascaded to form a dc-coupled three-stage amplifier delivering a maximum gain of 28 decibels at 2 gigahertz. A single stage develops 7 dB of gain from dc to 4 GHz and 12 dB of gain from dc to 2.5 GHz. Moreover, HP says, incorporation of a variable feedback network permits adjustable peaking of frequency response.

Meanwhile, the search continues for better ways to build GaAs power field-effect transistors—and the Central Research Laboratories of Japan's Nippon Electric Co. Ltd. has found one. The result is a new microwave power FET that offers high drain-to-source breakdown voltage yet has a simple structure for easy reproducibility and good yield. By simply increasing the thickness of the active epitaxial layer at the drain region, Nippon has created a recess structure that exhibits no burnout during tuning and operation. At zero gate bias, dc drain breakdown voltage is greater than 16 v. At 6 GHz and 4-dB gain, a single chip delivers more than 2 watts; two chips in parallel give better than 3 w; and four chips, more than 6 w.

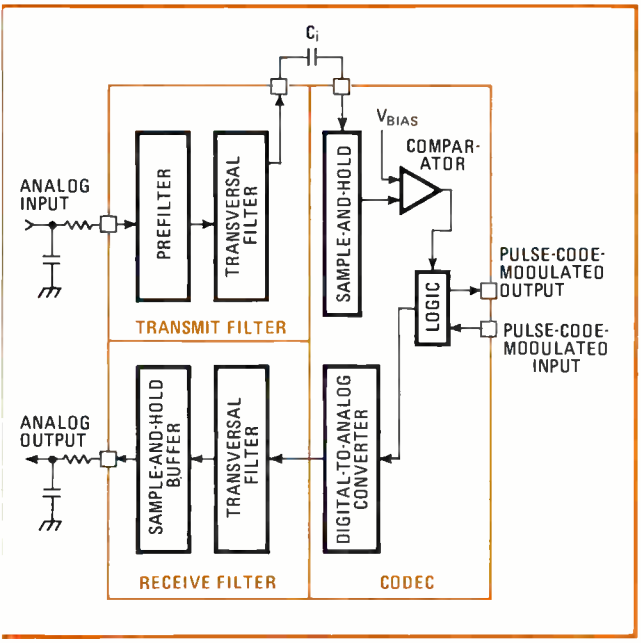
Dedicated LSI chips aim at communications

by Richard Gundlach
Communications Editor

☐ The advent of large-scale integration is creating a technological revolution in the telecommunications industry. Spurred on by the growing sophistication in today's communications technology and the increased activity in digital switching (itself a result of LSI advances), semiconductor manufacturers are busily developing dedicated-function chips to meet the growing needs of communications companies. Now, after several years' work, a flood of new chips is surfacing—codecs, tone dialers and decoders, fiber-optic transmitter and receiver interface chips, and the like.

One of the hottest areas right now is low-cost codecs, which are triggering a rapid conversion to digital switching in telephone networks. Designed to meet the many rigid specifications imposed by the telephone industry, these coder-decoder chips perform sampling and analog-to-digital conversion using special nonlinear coding (companding) laws in conjunction with sophisticated digital control, fast digital buffering, and nonlinear digital-to-analog conversion.

LSI codec chips are well represented in this year's ISSCC. There is an entire session devoted to per-line codecs, as well as a panel session that will explore the present status and the future evolution of codec circuits. Six papers cover the different approaches used by semiconductor manufacturers and telephone companies to fabricate such devices.



1. Space saver. Bell-Northern Research's one-chip PCM codec performs all the necessary functions, including filtering. The digital circuitry is implemented with four-phase dynamic principles and uses polysilicon for the active gates and interconnections.

Opting for a single-chip codec are Bell-Northern Research, Ottawa, and Intel Corp., Santa Clara, Calif. Both have developed n-channel metal-oxide-semiconductor chips, but the BNR codec includes charge-coupled, transversal, minimum-phase filters on chip. Siliconix Inc., National Semiconductor Corp., and Siemens AG have two-chip codecs. Siliconix uses complementary-MOS technology for both chips, whereas National and Siemens use C-MOS for the digital circuitry and bipolar technology for the analog functions.

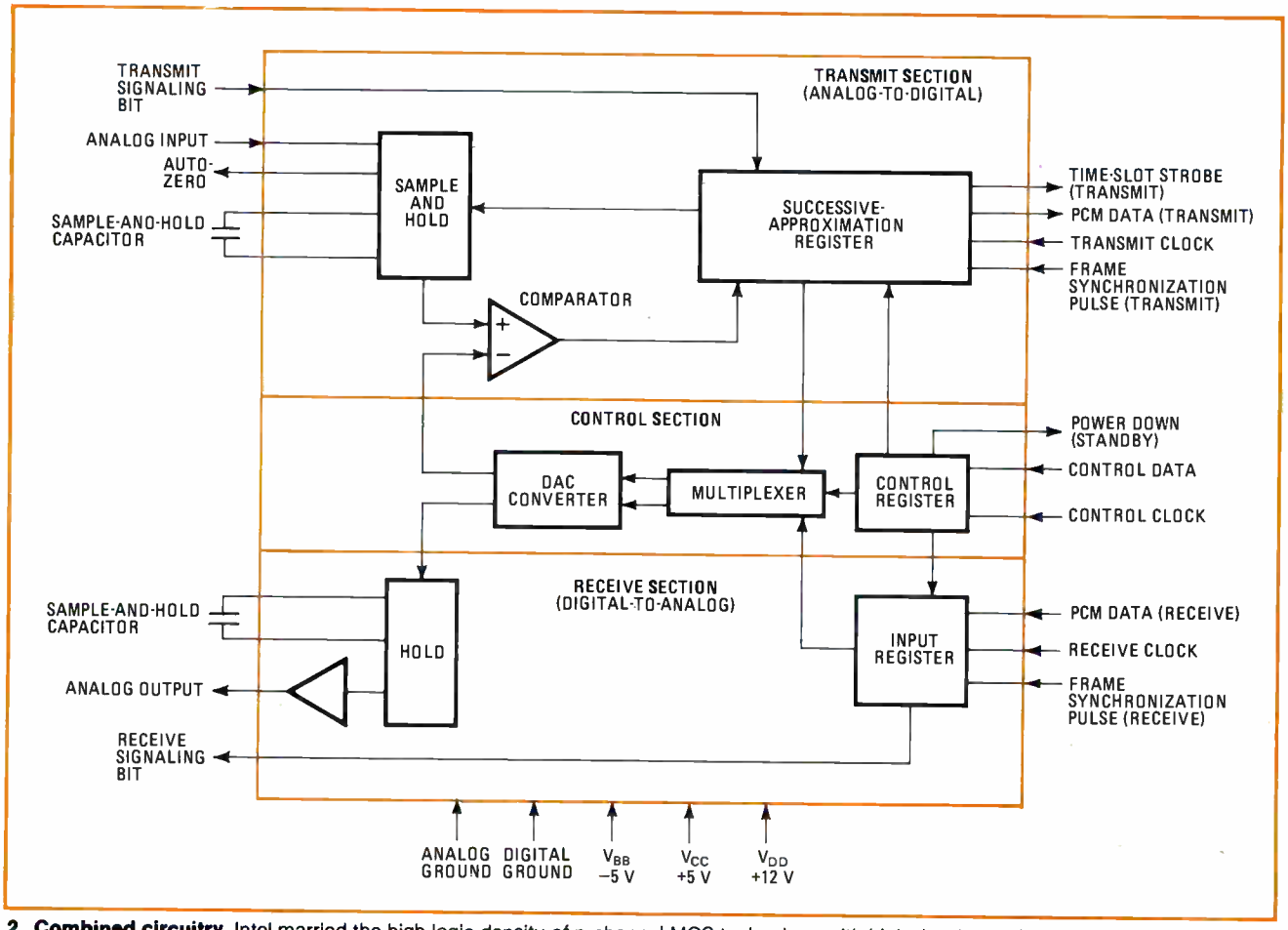
One of a kind

What makes BNR's design unique is its on-chip filtering (Fig. 1). A monolithic, single-channel pulse-code-modulated codec with associated filters, the chip is fabricated using straightforward two-level polysilicon-gate n-MOS–charge-coupled processes. This technology allows for the storage and combination of analog signals in precise relative amplitudes—essential for any method of filtering and useful for practical methods of coding.

The process provides analog storage in two physically different structures: on capacitors formed between the two polysilicon levels and on capacitors or charge-coupled elements formed between one of the two polysilicon levels and an inversion channel in the silicon substrate. The two types of capacitors may also be superimposed, providing high capacitance per unit area. Double-polysilicon capacitors can be highly voltage-independent and therefore free from distorting effects, but to achieve comparable low distortion in charge-coupled devices or inversion-layer capacitors it is necessary to allow for voltage dependencies. This is achieved by matching between input and sensing elements in the CCDs and between coupling and feedback elements in the capacitors and the CCDs.

Coding and decoding according to the required μ-255 coding law—used by telephone companies in the U. S., Canada, Japan, and some South American countries—are performed by the same MOS circuit on a time-shared basis. (A-law coding, used in the rest of the world, can be implemented with minor design changes.) The coder employs a binary-ratioed capacitor array to define the decision levels corresponding to the end points of the coded segments by charge-redistribution techniques. For generating the linearly spaced decision levels between segments, a linear resistor array is used rather than a second capacitor array and an associated buffer amplifier, which were used previously.

Both CCD transversal filters—one in the transmitting direction, the other in the receiving direction—operate at a sampling frequency of 32 kilohertz. An anti-aliasing CCD prefilter section in the transmitting direction operates at a sampling frequency of 160 kHz, and a sample-and-hold output buffer in the receiving direction reduces unwanted output signals at frequencies near the



2. Combined circuitry. Intel married the high logic density of n-channel MOS technology with high-density analog techniques in their single-chip codec, which makes use of a microprocessor-controlled time-slot arrangement for multiplexing up to 32 codecs.

sampling frequency. Total power dissipation on the chip is 230 milliwatts but can be reduced to less than 10 mw for standby operation by a local input signal.

Intel Corp.'s single-channel codec (Fig. 2) includes encoding and decoding functions and a user-programmable time-slot arrangement under microprocessor control that allows multiplexing of as many as 32 codecs. The chip performs all sample-and-hold and a-d and d-a conversion and provides an accurate voltage reference that requires no external components. Also present on chip is a user-programmable time-slot decoder that allows local switching.

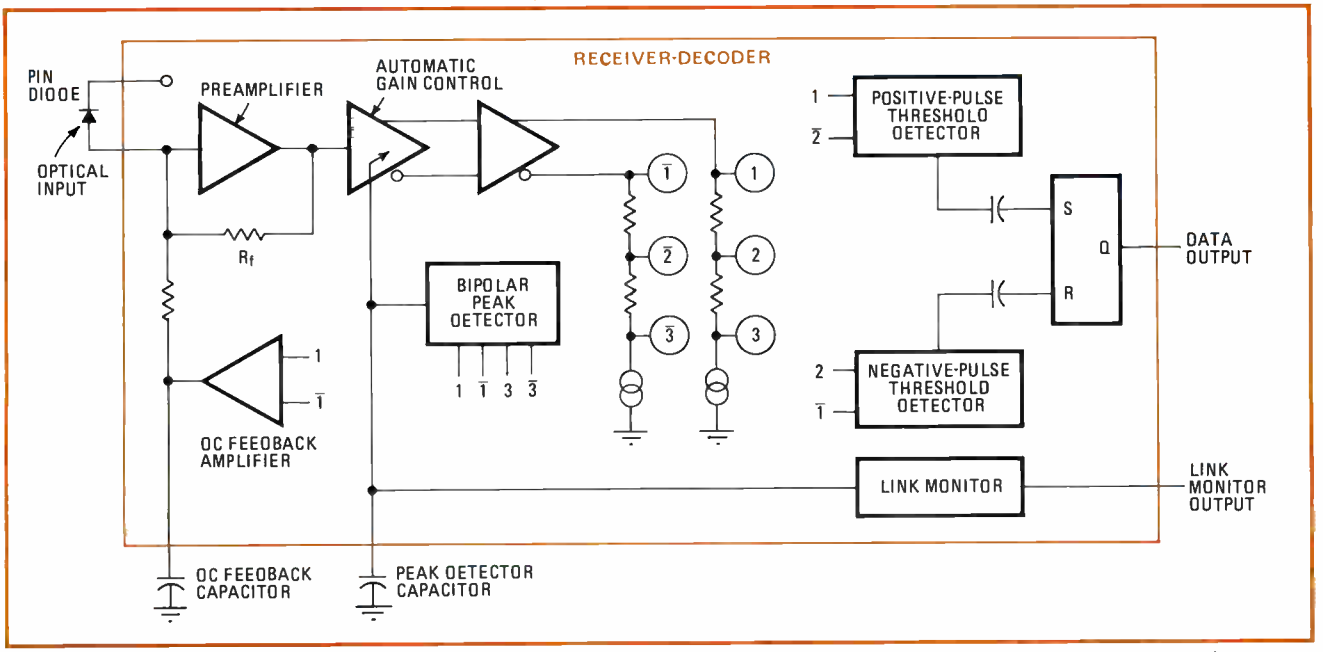
Although independent channels are provided for sending and receiving paths, the digital-to-analog converter must be shared by both, and this requires a transparent internal interrupt for asynchronous operation. Each codec controls the multiplexing and demultiplexing of its own data by means of user-assigned time slots. The sending and receiving time slots may be independently and dynamically reassigned in switching, concentrator, and control environments.

The desired companding code, either the μ-255 or the A-law standard, is produced by a weighted resistor-voltage divider that uses one weighting resistor per segment, or level, of the desired companding law. A resistor-string d-a converter uses one resistor and one transmission gate for each discrete conversion level.

A precision voltage-reference circuit is included on chip. It is based on the difference in thresholds between two suitably implanted MOS devices whose geometry and biasing are controlled to produce a stable voltage reference. To allow for process-related variations in the initial reference value, the voltage is trimmed at the wafer-sorting stage so as to provide the 3.155-volt full-scale voltage level for the converter.

Two-chip codecs

The two-chip codecs from National Semiconductor Corp., Santa Clara, Calif., and West Germany's Siemens AG also share a single d-a converter between encoding and decoding functions. A successive-approximation register is used with the d-a converter to perform the a-d encoding. Since a-d conversion always takes longer, it is continuous until d-a conversion is necessary. Then an interrupt takes place, and the a-d information is stored in memory until the d-a conversion is quickly accomplished. Both approaches use a resistor-ladder network to produce proper companding levels.



3. Fiber-optic receiver chip. HP selected a 1-GHz f_T bipolar process, with Schottky-barrier diode clamps, for its inherent low-noise current, which improved sensitivity, and for its two layers of metal, which provide the needed isolation between input and output.

Siliconix's per-channel codec uses a C-MOS-chip pair and a capacitive charge redistribution technique to provide the d-a conversion levels. In the Santa Clara, Calif., firm's approach, the converter is not shared. One chip is used for encoding, the other for decoding. All necessary analog and digital functions are integrated on each chip, and the companding a-d and expanding d-a converters produce a digital approximation of the μ-255 companding characteristics without external circuits. Each chip operates with +7.5-v supply voltages and ±3-v reference voltages. Power dissipation is less than 100 mW per coder-decoder pair.

Computer analysis provided the design criteria for the various elements of the coder and the decoder. Careful layout techniques, however, were essential to ensure capacitor ratios accurate to within 0.1% with standard metal-gate C-MOS process.

Bell Laboratories, Murray Hill, N. J., has put the encoder function on a single chip. Unlike the other codecs that use a successive-approximation approach implemented with either charge-redistribution or tapped-resistor networks, Bell Labs' codec uses a continuous feedback approach it calls interpolation. To minimize sensitivity to analog circuit parameters, the designers chose to trade off the increased complexity of digital circuits to eliminate analog switches requiring linearity over a 40-decibel dynamic range.

More chips

Other ISSCC sessions discuss additional chips dedicated to communications chores. These include a C-MOS decoder chip for detecting telephone tone signals and two interface chips that provide all the electrical functions necessary to communicate over a fiber-optic link.

At last year's ISSCC, Mostek Corp., Carrollton, Texas, described a tone-dialer chip that generates tone pairs for telephone dialing. This year, Mostek is presenting a C-MOS decoder chip that detects telephone Touch-tone signals, now used throughout the world, and produces a 4-bit digital code.

To meet the surge of activity in fiber-optic communications systems and components, Hewlett-Packard Co., Palo Alto, Calif., has developed two monolithic IC chips that provide all the electrical functions necessary to send and receive data at a 15-megabit/second rate over a fiber-optic link.

The transmitter-coder-driver chip encodes arbitrary sequences of transistor-transistor-logic data of any pulse width from 60 nanoseconds up and provides a temperature-compensated (0°C to 70°C) and voltage-compensated modulating current to drive a high-radiance light-emitting-diode source. At the other end of the link, a receiver-decoder chip (Fig. 3) amplifies the electrical output from a p-i-n diode optical detector and decodes the amplified signal into the original TTL format over the same temperature and voltage range. Automatic gain control is used to provide the wide electrical dynamic range (about 55 dB) needed to ensure proper operation of the fiber-optic link. With AGC, the link can accommodate lengths ranging from a few meters to 1 kilometer without adjustments.

The transmitter chip measures 1.9 by 1.8 millimeters; the receiver, 1.93 by 1.68 mm. Both chips are fabricated using a high-frequency bipolar process with Schottky-barrier diode clamps. The receiver chip, however, combines both high-gain amplifier and digital circuits, and considerable attention to layout was therefore required to prevent parasitic feedback. □

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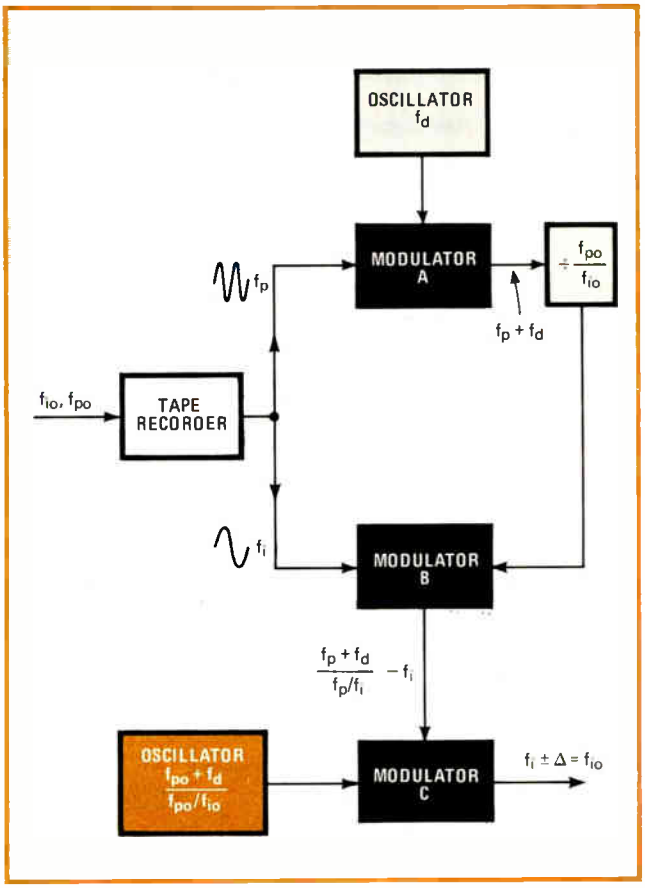
Modulators compensate for tape-recording errors

by Tom Gross
T. A. O. Gross and Associates, Lincoln, Mass.

If accompanied by a pilot signal of known frequency, any analog signal can be accurately reproduced by a tape recorder, independently of its playback speed, when this special amplitude-modulator scheme is used. Such a circuit regenerates the analog-signal frequencies by detecting any change in the pilot signal frequency caused by variations in tape speed and then by using the change to apply a correction factor to the analog signal emanating from the recorder. Almost perfect error correction is the result.

The principle on which the frequency-compensator operates is diagrammed in Fig. 1. Both the analog or information signal of frequency f_{io} and a pilot signal of frequency f_{po} are initially on tape. During playback, the corresponding output signals f_i and f_p, whose frequencies are linearly proportional to tape speed, are generated. Signal f_p is then translated into a frequency of $f_p + f_d$ by means of fixed oscillator f_d and modulator (mixer) A. After the upper sideband has been divided by an amount equal to f_{po}/f_{io}, it is introduced to mixer B and modulated by f_i.



1. Error correction. Block diagram details technique for precise recovery of input frequency f_{io} from variable-speed tape recorder. Standard modulation processes, plus judicious choice of oscillator frequencies and divider ratio, ensure that proper correction factor is applied to recorder's output signal.

The resultant lower sideband signal is then modulated in mixer C by a fixed oscillator whose frequency is equal to $f_{io}(f_{po} + f_d)/f_{po}$. This last oscillator ensures that signal f_i is restored to frequency f_{io}. Although in theory f_p, f_i, and f_d could be of any frequency, practical considerations such as the minimization of frequency-modulation distortion products determine the actual ratios of f_p to f_i and f_p to f_d.

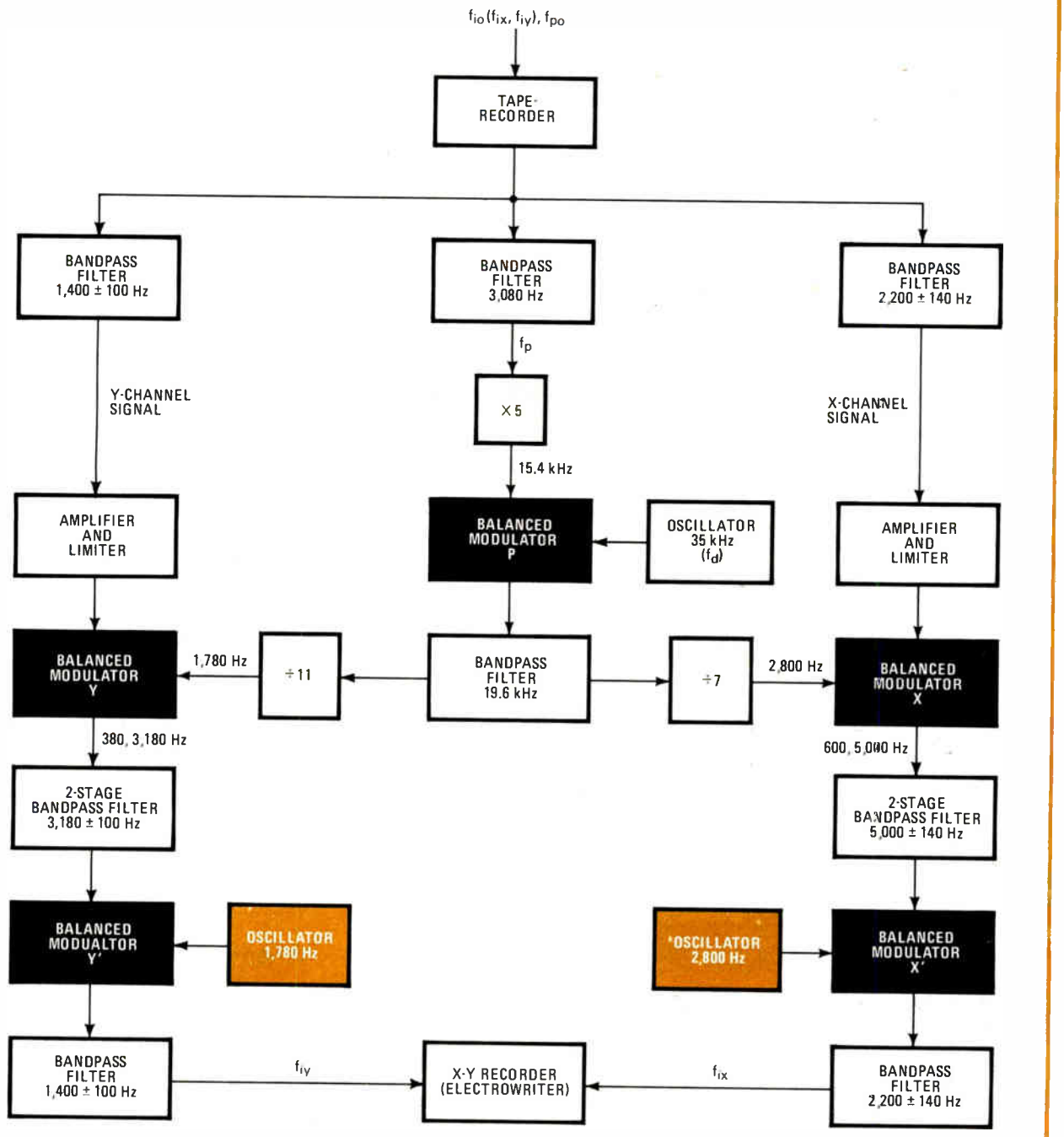
An application requiring extraordinary precision in signal recovery is facsimile reproduction on an X-Y recorder. The block diagram of an actual system is shown in Fig. 2. This compensator was developed for the Polaroid interactive lecture system,[1] which uses the Infolink model 25 Electrowriter to record and play back drawings. Here, two information signals are required, one for each channel.

The Electrowriter processes signals within the bands of (2,200 ± 140) hertz and (1,400 ± 100) Hz for the X and Y channels, respectively. The X- and Y-channel midband frequencies correspond to pen positions in the center of the reproduced drawing. These data signals, which are stored on tape, are played back on the Electrowriter receiver at the operator's convenience.

A pilot signal of 3.08 kilohertz has been selected. Multiplied by 5/7, this signal equals the X-channel center frequency; multiplied by 5/11, it equals the Y-channel center frequency. When so multiplied, the pilot signal ensures that the amount of frequency-modulation distortion contained on f_p will be equal to that of f_i. It can be shown that when f_p and f_i are mixed, the components in each signal causing distortion are virtually cancelled at the output of the circuit.

The system compensates perfectly for frequency changes when the f_p/f_i ratio is exactly equal to the actual divider ratio f_{po}/f_{io}, the f_p and f_i path delays to mixers X and Y are equal, and the fixed oscillators are stable. If f_i varies over a considerable band, the circuit will overcompensate when the actual divider ratio is less than f_{po}/f_{io} and will undercompensate when the divider ratio is greater than f_{po}/f_{io}.

Mixing of identical pilot and information-signal frequencies poses practical circuit problems. In this case, for instance, dc output voltages would be generated by modulators X and Y. To prevent this, the pilot frequency is translated upwards by means of a 35-kHz oscillator and mixer P. Such a modulation process has no effect on the absolute value of the frequency-modulation distortion at the output—so long as the 5/7 and 5/11 multiplying



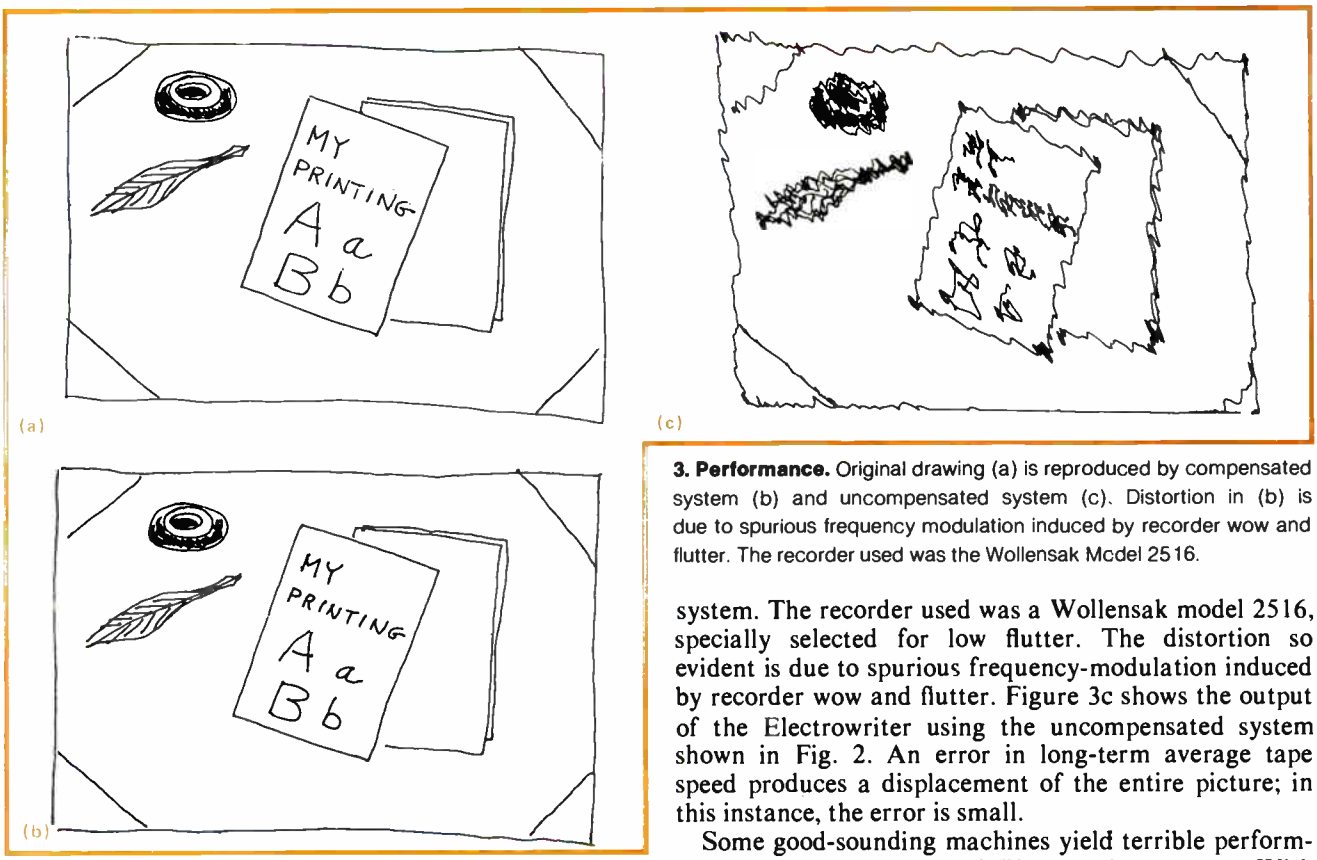
2. Application. Typical data-recovery system for facsimile reproduction requires two information channels. Several bandpass filters are needed throughout to eliminate unwanted sidebands caused by modulation process. Amplitude-modulated noise is eliminated by limiters.

ratios are still preserved, compensation is almost perfect.

Note in Fig. 1 that when f_d and f_p signals are summed in mixer A, any distortion products on f_p appear in the upper sideband. Thus a distortion-free signal at the output can only be obtained by extracting the lower-sideband signal from mixer B, because the distortion products add in its upper sideband and subtract in the lower sideband. In the circuit of Fig. 2, however, the difference frequency is extracted from mixer P, so distortion errors on f_p appear inverted in the lower sideband. Thus the compensated output signal, devoid of most distortion, must be obtained from the upper sideband product emanating from modulators X and Y.

Amplitude-modulated noise is another source of error. It is eliminated by the limiter in the f_{ix} and f_{iy} channels and by the use of modulators with a high a-m rejection. The LM311 has been found to be a satisfactory limiter and the 1496 an effective balanced modulator.

Also note that a number of bandpass filters are used after each mixer, to ensure that only the sum (or differ-



3. Performance. Original drawing (a) is reproduced by compensated system (b) and uncompensated system (c). Distortion in (b) is due to spurious frequency modulation induced by recorder wow and flutter. The recorder used was the Wollensak Model 2516.

ence) frequencies are extracted and the unwanted sideband is rejected. Care must be taken in the design of the filters to ensure that the time constants of each are equal, to maintain excellent circuit compensation.

The performance of the system is illustrated by the three-part photograph. Figure 3a is the original. Figure 3b shows the output of a compensated Electrowriter system. The recorder used was a Wollensak model 2516, specially selected for low flutter. The distortion so evident is due to spurious frequency-modulation induced by recorder wow and flutter. Figure 3c shows the output of the Electrowriter using the uncompensated system shown in Fig. 2. An error in long-term average tape speed produces a displacement of the entire picture; in this instance, the error is small.

Some good-sounding machines yield terrible performance in an uncompensated Electrowriter system. With the Wollensak recorder, there is little audible difference in the signals producing Figs. 3b and 3c, yet the difference in picture quality is evident. This suggests that an uncompensated X-Y record system would be ideal for testing tape-recorder and tape-cassette quality. □

References
1. Stuart F. Wilson, Technology Review, Vol. 74, January 1972, pp. 50–58.

Low-cost scanner checks diode matrix automatically

by C. S. Chi
Shrewsbury, Mass.

Manually testing a diode matrix for open or shorted elements is tedious, because every matrix point has to be checked to isolate failed diodes. But faults are detected automatically with the circuit shown in the figure.

This tester steps through each matrix row to find the location of any open diodes, then turns into a simple go/no-go matrix tester to check for the (rare) presence of a shorted diode. Although intended specifically for testing an eight-channel read/write head used for computer mass-storage applications, the circuit can be modified for testing a matrix of any kind or size.

The eight ferrite-head assemblies forming the read/write 8×2 matrix are mounted in a head block, the standard configuration (a). The head block is activated by asserting a logic 0 on the two control lines, HSA and HSB. Each individual ferrite head in the block is selected by means of lines S_0–S_7.

Of the nine test sequences generated by the circuit, eight test the matrix channel by channel. Each activates a different channel sequentially and checks it for open elements. The ninth test sequence deactivates all channels simultaneously to check for shorted elements. Note that in this particular circuit either the diode or the ferrite coil may be faulty.

In the scanner (b), a voltage-controlled oscillator, the 4024, generates the 10-kilohertz clock signal required for the 7493 binary counter. The counter steps the 7442 decoder through each of the eight matrix points, while the 7300 displays the scanned location.

In the circuit's active mode (the first eight sequences), only the channel selected at the 7442 can force current into its respective head block terminal S_0–S_7. If the elements in the channel are good, current flow will return to ground by way of the HSA and HSB lines.

When all is well, Q_1 and Q_2 will be saturated, and Q_3

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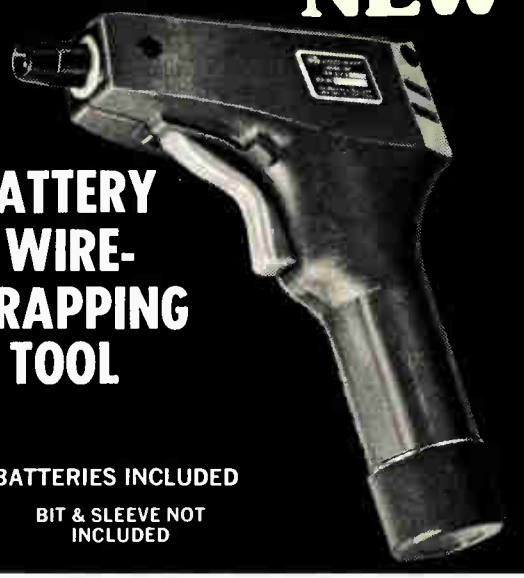

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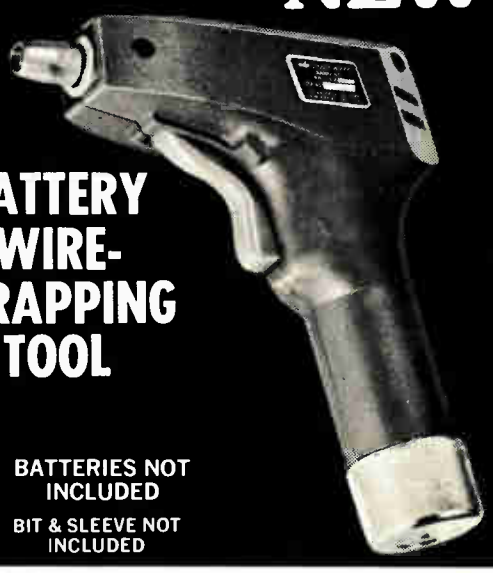

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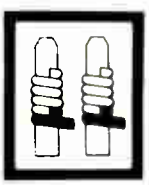

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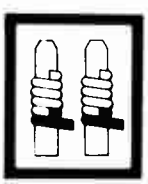

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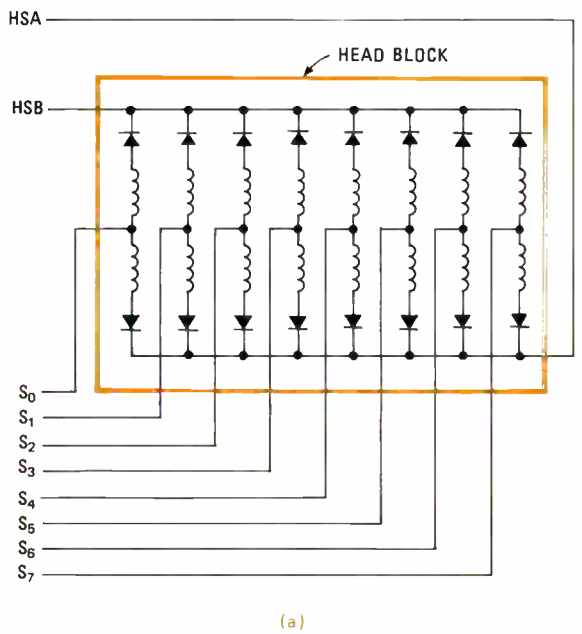
will be off; the signal at A will be low, and light-emitting diode L_1 will be on, indicating no fault. If current fails to emanate from HSA or HSB, however, Q_1, Q_2, or both will turn off, Q_3 will turn on, and A will go to logic 1; thus the 7473 flip-flop F_1 will set, disabling the clock, and L_2 will turn on. The 7300 will indicate the channel which has the open diode.

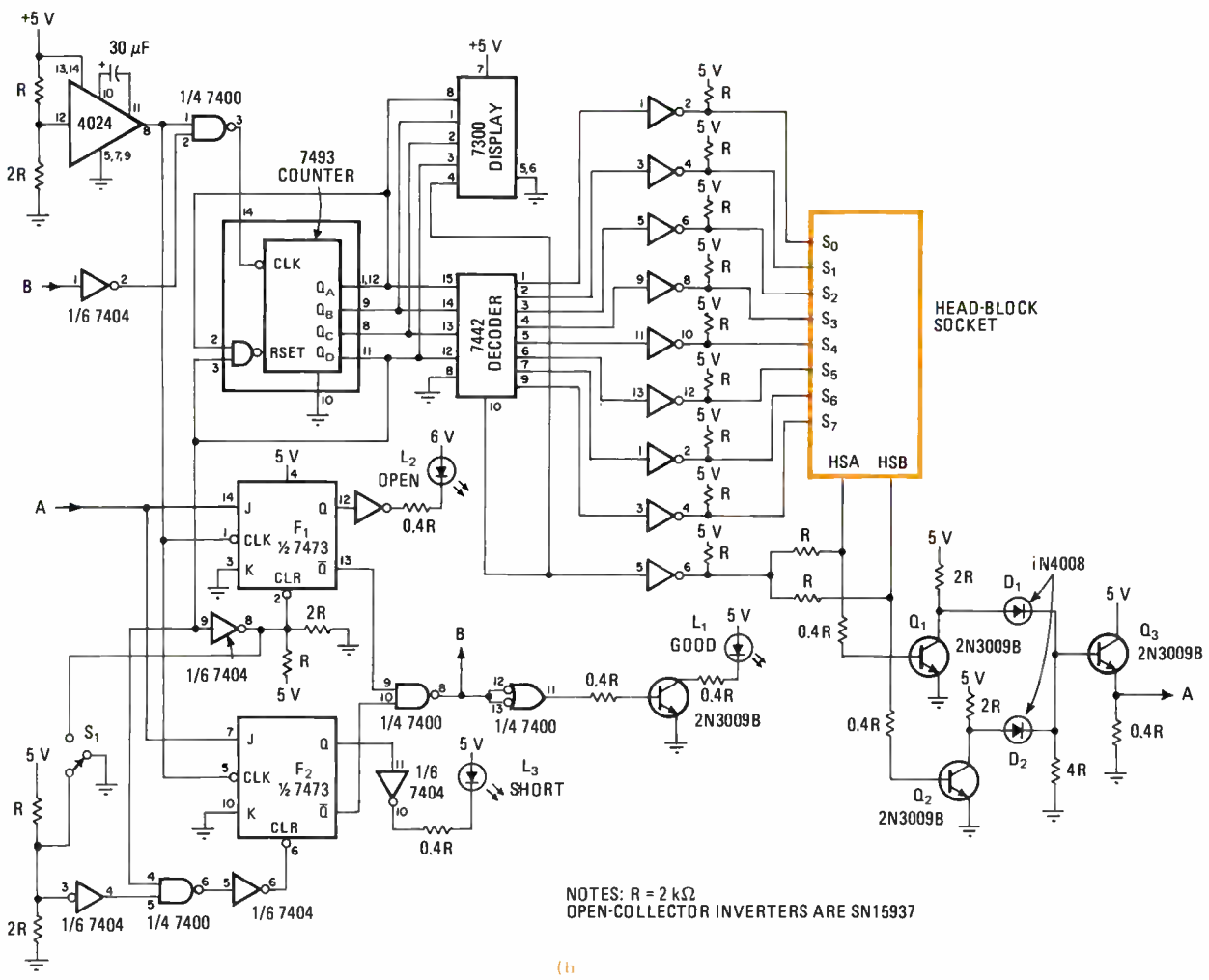
After each channel has been activated in succession, the blocking mode is entered, which turns off all channels. Lines HSA and HSB are brought to logic 1, thus back-biasing all the diodes in the head. Should any of the diodes be leaking or shorted either Q_1 or Q_2 or both will turn off, causing F_2 to set and L_3 to light. The system clock is again disabled.

Detecting one fault in the matrix does not preclude the possibility of finding other faults. The reset switch, S_1, can be used to clear F_1 and F_2, to start the system clock again. The circuit counter, which has been sitting at the location of the last matrix point found faulty, then continues on until the next fault is found. □

Engineer's notebook is a regular feature in *Electronics*. We invite readers to submit original design shortcuts, calculation aids, measurement and test techniques, and other ideas for saving engineering time or cost. We'll pay $50 for each item published.



(a)



(b)

Matrix tester. Circuit automatically scans diode matrix (a) to find open or shorted elements. It sequentially activates each channel in read/write head to locate open elements, deactivates all channels simultaneously to check for shorted components (b).

Engineer's newsletter

How to measure the standby power of C-MOS RAMs

The attractively low standby power of complementary-MOS static random-access memories—typically only 40 to 100 μw for a 1,024-bit device—is actually a function of the pattern stored in the RAM, points out Conrad Boisvert, an applications manager at Synertek in Santa Clara, Calif. This power is at its minimum (P_{min}) if you measure it immediately after applying V_{CC} (before any memory-write operations), but at its maximum (P_{max}) if you read the pattern and then store its complement. Indeed, P_{max} is frequently several orders of magnitude greater than P_{min}.

Knowing P_{max} is often necessary, but measuring it directly is very difficult and sometimes impossible. **One way to simplify the measurement yet still determine the absolute worst-case value is to take advantage of the equality: $P_{max}+P_{min} = P0+P1$,** where P0 is the power with all zeros stored, and P1 the power with all ones stored. This equation may be rewritten as: $P_{max} = P0+P1-P_{min}$. The three right-hand terms are all relatively easy to measure on moderately priced test equipment. In your application, if it is unlikely that the worst-case standby-power pattern will occur, then you only need to determine P0 and P1, which are easy to measure even with the simplest equipment. In fact, just with this minimal test, you will be able to detect any severe leakage paths.

Controller ICs service microcomputer peripherals

If you're designing microcomputer-based equipment, be sure to take a look at the new LSI peripheral controllers, which can replace tens of TTL packages. Because they provide all the necessary control logic and drive signals for a particular peripheral, these large-scale integrated circuits **free the central microprocessor for general data and control functions.** Besides being available from all microcomputer suppliers as part of their families, they are being offered by a host of independent manufacturers. But whoever the supplier, most of the chips are bus-compatible with the popular microcomputer systems. They include controllers for keyboards as well as displays, in addition to devices for direct-memory-access control, data-link interface, and encryption chips.

Where to get the lowdown on LSI reliability

All too often, reliability data for microprocessors, memories, and other LSI devices is hard to obtain. Now the Reliability Analysis Center is offering **a databook that inspects the failure rates, screening, and burn-in results, as well as failure modes and mechanisms, of the latest LSI parts.** To get your copy, send $50 prepaid ($60 non-U. S.) to: Ordering No. MDR-7, Reliability Analysis Center, Griffiss Air Force Base, N. Y. 13441.

New IEEE dictionary lists 10,000 acronyms

Much electronics jargon is an alphabet soup of acronyms that often befuddle the novice and can confuse even the expert. So the Institute of Electrical and Electronics Engineers has included a list of some 10,000 acronyms in its second edition of the IEEE Standard Dictionary of Electrical and Electronics Terms. **Besides the acronym section, this expanded edition contains more than 20,000 entries, over 7,000 of which are new or revised.** Until June 30, the price is $22.45 for members and $24.95 for nonmembers; after, it is $33.75 and $37.50, respectively. Copies are available from the IEEE Service Center, 445 Hoes Lane, Piscataway, N. J. 08854, as well as from Wiley-Interscience, a division of John Wiley and Sons Inc., and technical bookstores. **Lucinda Mattera**

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The AD534 is a completely self-contained, self-sufficient multiplier which can generate complex transfer functions very close to theoretical. Our active laser trimming of thin film resistors on the chip to adjust scale factor, feedthrough and offset allow you to plug in the AD534 and run it virtually without adjustment.

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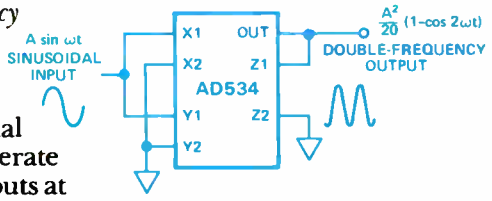
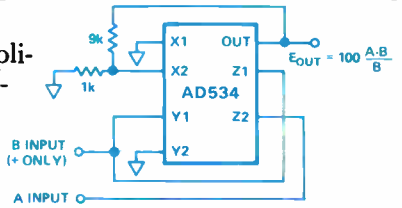
and use,

In Frequency Multiplication. Nonlinear circuits which accept sinusoidal inputs and generate sinusoidal outputs at two, three, four, five or more times the input frequency make use of trigonometric identities which can be implemented quite easily with the AD534 as shown. For this frequency doubling circuit the output should be AC-coupled to remove the DC offset resulting from the trigonometric manipulation.



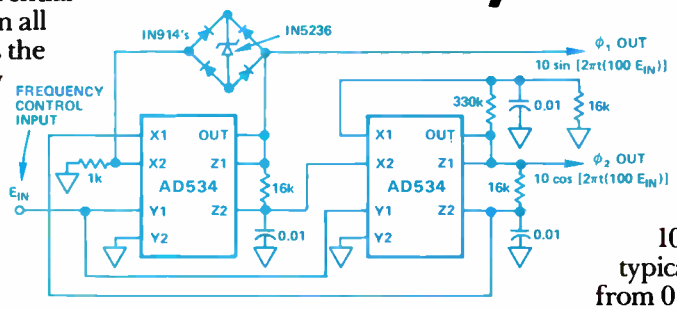
and use,

In Ratio Computing. The percentage deviation function is of practical value for many applications in measurement, testing and control. The AD534 is shown in a circuit that computes the percentage deviation between its two inputs. The scale factor in this arrangement is 1% per volt although other scale factors are obtainable by altering the resistor ratios.



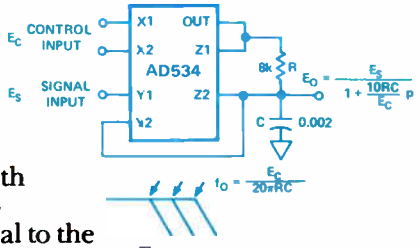
and use,

In Sine Wave Function Generation. The voltage controlled 2-phase oscillator uses two AD534's for integration with controllable time constants in a feedback loop. The frequency control input, E_{IN}, varies the integrator gains, with a sensitivity of 100Hz/V and frequency error typically less than 0.1% of full scale from 0.1V to 10V.



and use.

In a Voltage Controlled Filter. The output voltage, which should be unloaded by a follower, responds as though E_s were applied directly to the RC filter but with the filter break frequency proportional to the input control voltage $\left(\text{i.e. } f_0 = \frac{E_c}{20\pi RC}\right)$. The frequency response has a break at f_0 and a 6dB/octave rolloff.



These uses of our new Single Chip Analog Computer, the AD534, are only the beginning. For the big picture call Doug Grant at (617) 935-5565. Or write for a copy of our new Multiplier Application Guide and the data sheet on the AD534.

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Industry researchers say the multiple-sourced 6500 outshipped the Z-80, 6800 and 8085 during the last quarter of 1977. Benchmark it!

For more information, contact your nearest Rockwell distributor or Rockwell International GmbH, Microelectronic Device Division, Fraunhoferstrasse 11, D-8033 Munchen-Martinsried, Germany. Phone: (089) 859-9575. Or Rockwell International Overseas Corp., Ichiban-cho Central Building, 22-1 Ichiban-cho, Chiyoda-ku, Tokyo 102, Japan. Phone: 265-8808.

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Circle 144 on reader service card

Fast printer-plotter writes thermally

Vacuum system holds paper and microprocessor allows programmed control of microstepping desktop unit

by Raymond P. Capece, Computers Editor

Two things are bound to strike someone watching Hewlett-Packard Co.'s thermally writing plotter-printer as it quietly executes an annotated line drawing. The first is its speed—characters spew forth almost as quickly as straight lines. The second is its bidirectional drive mechanism—it can spool out more than 16 feet from a paper roll, reel it rapidly back in, and return accurately to the starting point.

The model 7245A plots as capably as it prints. As a plotter, it features user scaling, graph rotation, and even point-digitizing: it can tell a host computer over the IEEE-488 bus what is the digital address of the point appearing beneath its cursor. As a printer, it offers two upper- and lower-case 128-character fonts and writes at a speed of up to 38 characters per second. Moreover, it prints in four directions—a feat beyond most printers.

Several factors contribute to the 7245A's combination of speed and capability. The thermal print head has a novel array of 12 tantalum-aluminum thin-film resistors so arranged as to facilitate printing dot-matrix characters in four directions. An additional resistor, larger than the others, draws the vectors.

The paper is sprocket-fed and held taut by a vacuum system, which flattens out the writing surface and makes the unit reliable enough to move paper at the high speed of 20 inches per second. Even after casting out 16 or more feet of paper, the 7245A can reel it back and lay a redraw down precisely on top of a first plot. Repeatability is a remarkable ±250 micrometers.

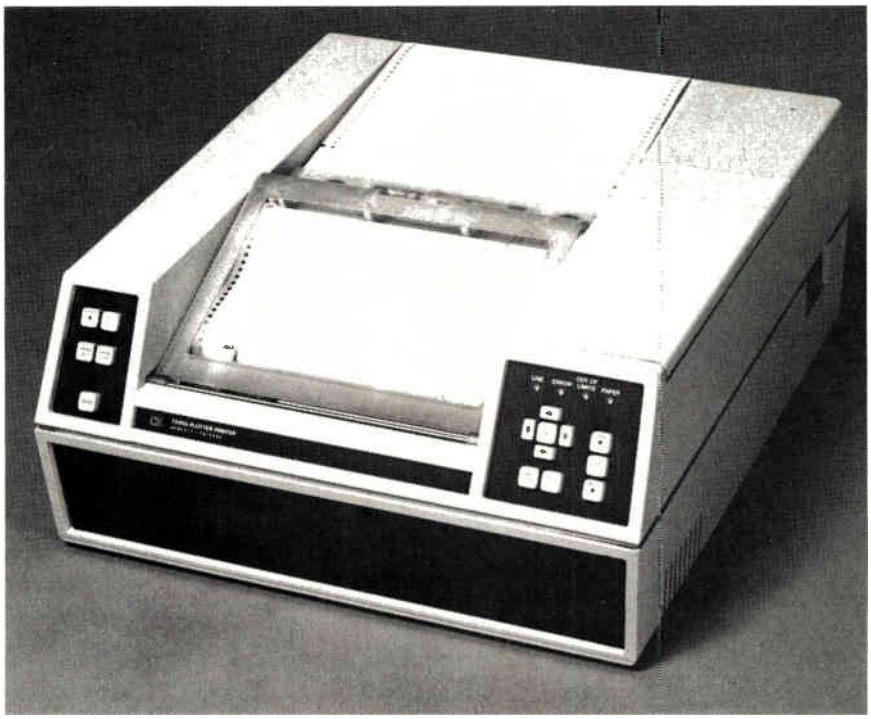
The microprocessor-based plotter-printer has an open-loop control system—positioning is by pulsing of stepping motors. But the device has the speed and line smoothness characteristic of more elaborate and costly closed-loop servo systems. Microstepping, a technique of driving the steppers with currents at levels between the binary-switched extremes, is used to get better resolution without sacrificing speed. The smallest step in the 7245A is 25 μm, but plotting speed can reach 0.25 meter per second.

The technique bucks resonances in the motors. But even so, wavy lines are normally produced at some of the microstepped positions because of even-harmonic resonances in the motors. However, says Pat Fobes, product marketing manager at HP's San Diego division, "By adding odd harmonics to the phase current waveforms for each motor, we can smooth out the ripples."

The 7245A has 44 built-in programmable instructions that take care of scaling, graph-rotation, and other common plotting operations. The 8½-in.-wide paper accommodates 88 columns of 7-by-9-dot-matrix characters or 44 columns of the 14-by-9-dot extended characters. A total of 8 matrix fonts is available, including 6 foreign character sets, and in all fonts characters can be underscored as they are printed.

The 7245A is priced at $4,600, and delivery time is four to six weeks.

Hewlett-Packard Co., 1501 Page Mill Road, Palo Alto, Calif. 94304 [338]



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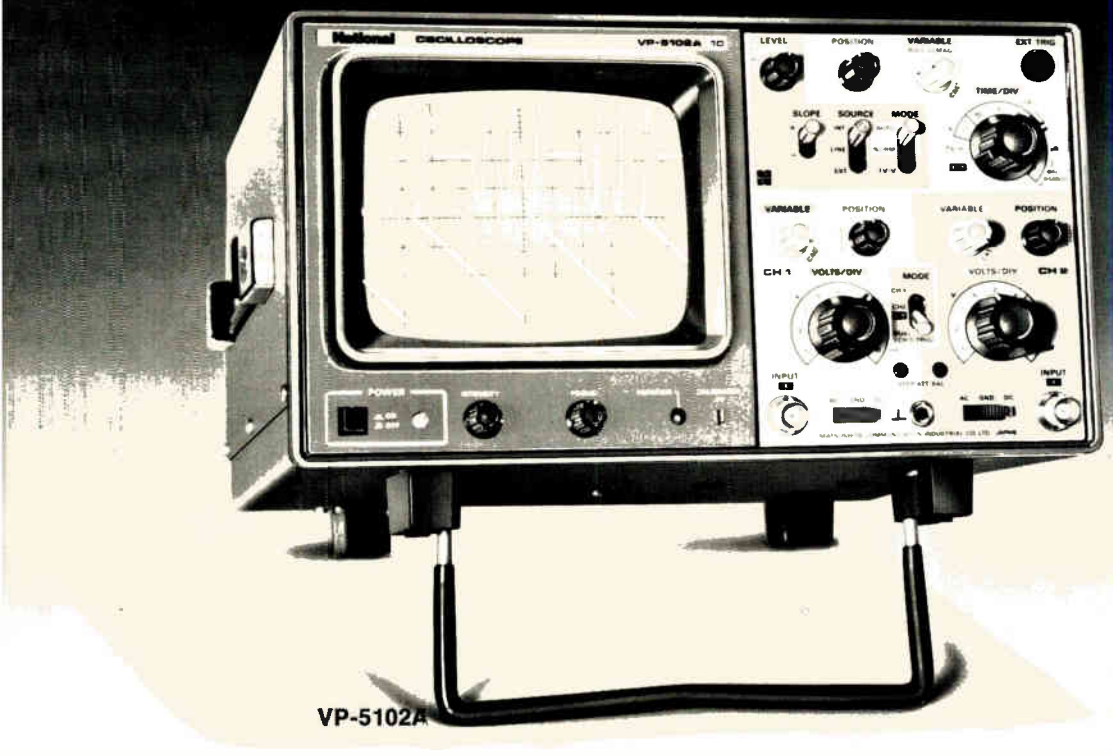

VP-5102A

Full Features in a 26cm Square

The National VP-5102A is a unique instrument designed to give you the greatest number of extra features while taking up the least amount of working space possible. Use of a newly-developed short-necked CRT enabled National to pack a dual-trace display with DC-10MHz bandwidth (−3dB) and calibrated X-Y operation, a built-in x5 sweep magnifier and an AUTO Trigger function into a cabinet that measures only 148 x 260 x 260mm and weighs only 5 kg.

Extra Sensitivity

Nor did National stop there. To guarantee 3 percent accuracy at 10mV/DIV, the VP-5102A employs an Internal Graticule CRT for this 10MHz oscilloscope. To ensure greater versatility, this unit also incorporates a tilt stand for easier trace viewing, a built-in amplitude calibrator, a front-panel trace rotation control plus TV waveform triggering circuitry. All of which combine to make the VP-5102A a great little addition to your working equipmemt.

VP-5100A

The VP-5100A

The National VP-5100A, like the 5102A, features an Internal Graticule CRT and compact (148 x 260 x 260mm) unit size. Other features include a sensitivity of 10mV, variable control for vertical deflection factors and sweep rate plus STEP ATT BAL control.

National

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Communications

Optical links are catching on

Five firms join ranks of those offering equipment for fiber-optic communications

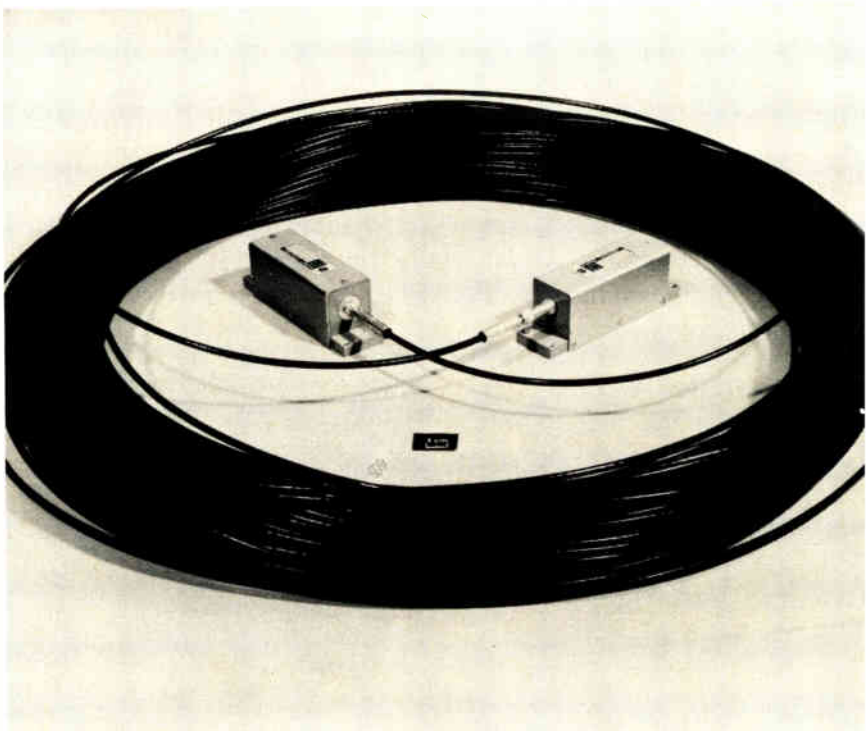
Fiber-optics technology has lured five more companies into adding new fiber-optic assemblies to similar products already on the market from ITT, Harris, Meret, Augat, and others. And that's not counting the digital-data communications link that should be available from Hewlett-Packard early this year [*Electronics*, Oct. 27, p. 31].

All but one of the new entries consist of complete analog and digital fiber-optic links that include transmitter and receiver assemblies. The exception is Texas Instruments' family of sources and photodetectors with pigtails of fiber cable terminated in AMP fiber-optic connectors. It seems certain, however, that later this year TI will offer transistor-transistor-logic-compatible transmitter and receiver modules as well.

These self-contained data-transmission systems contain all the necessary components to allow users to "get on the air" immediately with no engineering effort required. Both analog and digital systems with various data rates over simplex and duplex lines are fast becoming off-the-shelf components for applications such as linking computers to peripheral equipment and for transmitting control data in industrial environments. For the first time, they offer a price-competitive alternate to using modems and shielded cables for transmitting data over 1-kilometer distances.

What's more, the fiber-optic links are not prone to electromagnetic interference, nor do they require high-cost installation by union electricians. In fact, one company is stuffing fiber-optic links down an elevator shaft in a high-rise building to connect data terminals to a

Fast. Thirty-megabit-per-second simplex link from Plessey comprises separate transmit and receive modules. It can operate with single-fiber cables up to 2 km long.



computer area recently moved some five floors away.

Although most of the fiber-optic links being offered are for one-way or simplex transmission—two would be needed for two-way or duplex operation—Valtec Corp., West Boylston, Mass., offers a full-duplex, asynchronous data link especially formatted to the RS-232-C standard used in computer-to-peripheral communications. They also provide a TTL-compatible duplex link for applications requiring a larger bandwidth capability. Both links contain power supplies and can be powered directly from house current.

The RS-232-C link provides a transmission capability of dc to 20 kilobytes per second over distances of 1 km. It is offered in two versions: RSK-D1 operates in the near infrared (about 820 nanometers) and costs $1,200; RSH-D1 operates in the visible spectrum (about 660 nm) and is priced at $1,000. The full-duplex, TTL-compatible link handles data rates of 10 megabits per second for distances of 1 km. Model TTK-D1 (near infrared) sells for $1,300; model TTH-D1 (visible spectrum) costs $200 less, but data rates are limited to 30 Mb/s for distances of less than 100 meters. Valtec also sells duplex fiber-optic cables with connectors attached for about $3 per meter.

RCA Corp.'s Electro-Optics and Devices Operation, Lancaster, Pa., has a simplex 20-Mb/s digital fiber-optic data link using RCA light-emitting diodes and silicon photodetectors with amplifier and threshold-drive circuitry. The transmitter requires +5 v at 250 mA, while the receiver needs three voltages: +6 v at 30 mA, −6 v at 20 mA, and a positive-bias supply voltage of from 6 to 45 v depending on the data rate required. The transmitter and receiver modules are priced between $700 and $1,000 and are available in 30 to 60 days after order.

The customer must provide his own fiber-optic cable with connectors that mate to the AMP fiber-optic connectors on the RCA modules. Although the system was designed to optically mate with Du Pont's plas-

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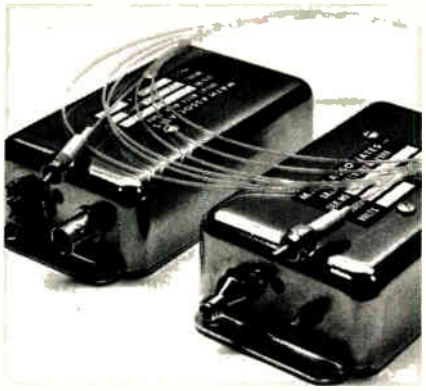
Circle 158 on reader service card



Variety. Math Associates offers both 30-MHz analog and 30-Mb/s digital links.

tic-clad PFXS-120 silica cable, other types can be accommodated.

Math Associates Inc. of Great Neck, N. Y., offers analog links covering dc through 30 MHz and digital links that transmit 30×10^6 pulses per second (30-Mb/s data rates). Both transmitter and receiver are fully TTL-compatible and contain built-in voltage regulators that accept ±15 v to ±18 v dc, or 12 v ac. A plug-in transformer, similar to those used with hand-held calculators, allows the system to operate from 115/230 v, 50 to 60 hertz.

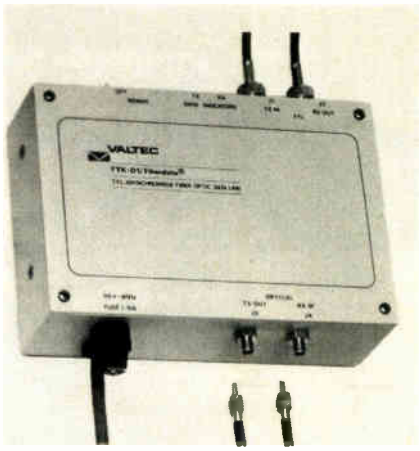
All systems can be supplied with 890-nm wavelength sources for use with glass fibers or 660-nm sources for use with all-plastic fiber cables used for shorter link lengths.

Several analog systems offer the user a choice of bandwidth. The RA-1000 (receiver) and XA-1000 (transmitter) form a simplex link with a bandwidth from dc to 1 MHz (3-decibel point) that will operate for 2 km with less than 1% nonlinearity. This system and an ac-coupled version cost $430. Two other versions are available: a 10-Hz to 10-MHz link for $650 and a 10-Hz to 30-MHz link that costs about $850.

The TTL-compatible digital link consists of a transmitter module, XD-1000, and a receiver module, RD-1000, that will handle up to 10^6 pps over a 2-km link. Both units, which can be powered from +7 v to +15 v dc or from 6.3 to 12.6 v ac, cost $378 each. Delivery of all units is from stock to 2 weeks.

Plessey Optoelectronics and Microwave, Irvine, Calif., offers a

New products



Duplex. Asynchronous RS-232-C link from Valtec operates full-duplex to 20 kb/s.

simplex, TTL-compatible 30-Mb/s link that operates over a 2-km path length using low-loss silica fiber cables. The transmitter uses the firm's own LED operating at 900 nm, and the receiver uses a low-noise p-i-n silicon photodetector. The system, not including cable, sells for $1,950.

Texas Instruments, on the other hand, has a family of emitter and photodetector assemblies. Each contains a length of fiber-optic cable with an AMP connector at the end. They offer the silicon detector assemblies, TXED-453, with 25-cm, 50-cm, and 100-cm lengths of fiber cable that sell in 100-piece quantities for $22, $24, and $28, respectively.

There are two source assemblies, each with a 25-cm length of fiber cable attached: TXES-475 provides a typical optical power of 50 microwatts at a 50-mA drive, and TXES-476 provides 75 mW of optical power at the same drive level. In quantities of 100, the 475 costs $50 and the 476 is priced at $75.

In addition, TI offers all-plastic cable assemblies in various lengths from 1 to 50 meters that are terminated at each end with AMP connectors. Regardless of quantity, the 1-meter length of Du Pont PFX-PIR140 costs $19, and the 50-m length costs $179.

Math Associates Inc., 320 Northern Blvd., Great Neck, N. Y. 11021. Phone (516) 466-9818 [401]

Plessey Optoelectronics and Microwave,

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For application note and other information please write to:
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Queensway, Glenrothes,
Fife, Scotland. Tel: 0592 753811,
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Belgium, Regulation-Mesure S.p.r.L., 73 Ave. Vandendriessche, 1150 Brussels. **Denmark**, A/S Nordisk Elektronik, Transformerves 17, DK-2730 Herlev, Denmark. **Finland**, Oy Honeywell AB, Ruukintie 8, SF 02320 Espoo 32. **France**, Beckman Composants SARL, 52 Chemin Des Bourdons, Gagny, 93220. **Germany**, Beckman Components GmbH, 8 Munich 40, Frankfurter Ring 115, Munich. **Israel**, Eastronics Ltd., 11 Rozanis Street, Tel-Baruch, P.O. Box 39300, Tel. Aviv 69018. **Italy**, Beckman Instruments Italiana SpA. Via Arese 11, 20159 Milan. **Norway**, Hefro Teknisk A/S, Postboks 6596, Rodeløkka, Oslo 5. **Portugal**, Eltec Electronica Com.e Ind. Ltd., Avenida Almirante Reis, 30-2° Floor, Lisbon. **South Africa**, Beckman Instruments (Pty.) Ltd., Temple House, 59-61 Buitenkant Street, Cape Town. **Spain**, Aeromarine and Electronics Intl. SA, Averida Pio XII, 10-12, Madrid 16. **Sweden**, AB Nordqvist and Berg, Box 9145, Bergsunds, Strand 37, S-102 72, Stockholm. **Switzerland**, Megex Electronic AG, Industriezone Nord, 8902 Urdorf-Zurich.

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New products

1641 Kaiser Ave., Irvine, Calif. 92714. Phone (714) 540-9934 [402]

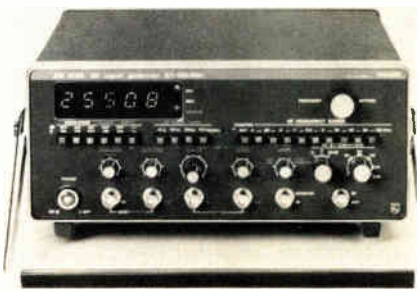
RCA Electro-Optics and Devices, New Holland Avenue, Lancaster, Pa. 17604. Phone (717) 397-7661 [403]

Texas Instruments Inc., Inquiry Answering Service, P. O. Box 5012, Dallas, Texas 75222 [404]

Valtec Corp., West Boylston, Mass. 01583. Phone (617) 835-6082 [405]

Signal generator covers 100 kHz to 125 MHz

Designed especially for use in radio- and television-development laboratories, the PM5326 rf signal generator is a wide-band instrument that covers the frequency range from 100 kHz to 125 MHz. It has four swept-frequency ranges for the alignment of intermediate-frequency amplifiers in fm radios and TVs in both development labs and repair facilities. The generator has a maximum output of 50 mv into 75 ohms and a calibrated attenuator that can take the output down more than 100 dB from that maximum. Double-box construction ensures that low-level outputs on the order of 0.5 μv can be used with confidence. Both internal and external amplitude modulation can be obtained over the full frequency range; fm is only possible in the i-f and rf bands.



The PM5326 has a special input that allows its five-digit frequency display to be used as a frequency counter to check other oscillators. It sells for $1,525.

Philips Test and Measuring Instruments Inc., 85 McKee Dr., Mahwah, N. J. 07430. Phone (201) 529-3800 [406]

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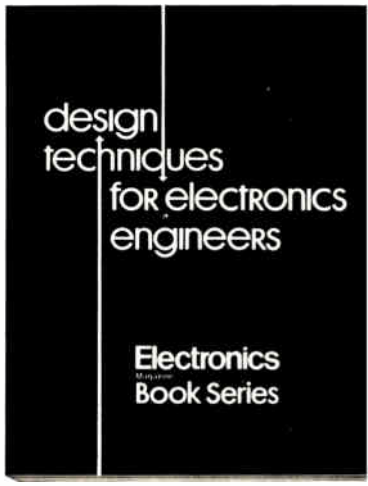

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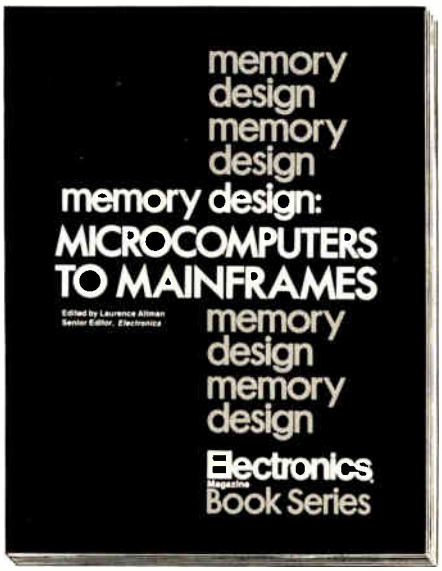

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Static voltages generated during fabrication, inspection, storage, assembly, and shipment of IC-laden printed-circuit boards are a major problem for board makers. These discharges reduce production yields by destroying and degrading integrated circuits and discrete semiconductors, especially metal-oxide-semiconductor and complementary-MOS types.

Until recently, the only effective way of shielding the boards from electrostatic fields was by placing them in bags made from opaque, carbon-loaded materials. But now its proprietary metal-coating technology has enabled 3M Static Control Systems to create the first transparent film capable of protecting sensitive components from static while leaving them and the boards on which they are mounted both visible and easy to identify.

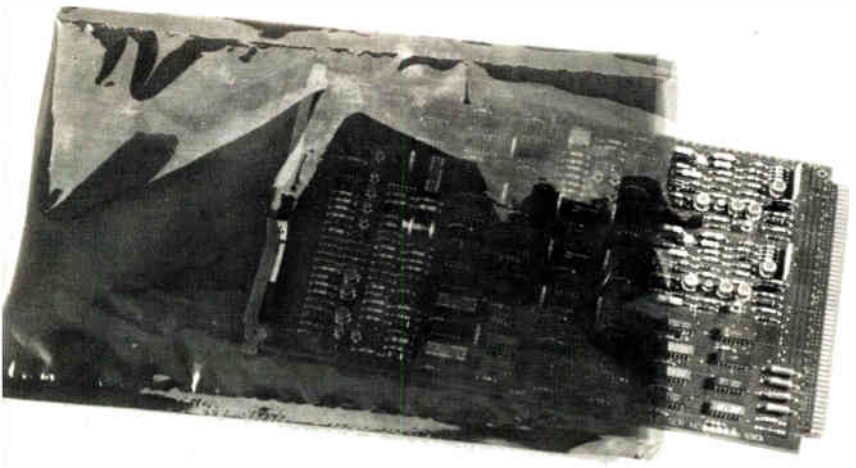
In essence, the three-layer material surrounds the static-sensitive components with a humidity-independent Faraday cage that dissipates electrostatic charge. The outer layer of the film is a 100-angstrom-thick, transparent, conductive metallic shield. Next comes a 1-mil-thick polyester film for high tensile strength and tear resistance. Finally, there is a heat-sealable 1.5-mil-thick polyethylene layer with antistatic properties. Resistance of both the outer layers is less than 10 ohms per square, and the composite film may be used over temperatures ranging from -70°F to $+220^{\circ}$F.

Bags of the material are available in a wide variety of standard sizes, from 4 by 4 inches up to 15 by 18 in., as well as special and custom sizes. For easy opening, J lips are provided. Other static-shielding film configurations besides bags should be available in the future.

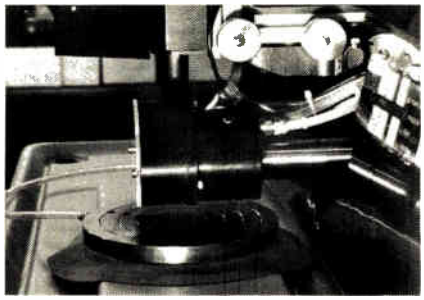
3M Co., Dept. SC8-1, Box 33600, 3M Center, St. Paul, Minn. 66133 [391]

Saw dices 5-in. wafers at feed rates to 12 in./second

The model 1000 programmed dicing saw can automatically dice wafers up to 5 inches in diameter at feed speeds up to 12 in. per second. The saw contains three microprocessors for performing necessary calculations and controlling four axis



New products



motors. Among the key advantages of the model 1000 are its rigidity, which allows it to cut kerfs as narrow as 1 mil, and its microprocessor-controlled cutting speed. This latter feature allows the saw to begin a cut slowly to prevent damage, speed up after entry, and then slow down as it leaves the wafer. The model 1000 can be used with all blades currently manufactured.

Micro Automation Inc., 3170 Coronado Dr., Santa Clara, Calif. 95051 [393]

System speeds manual component insertion

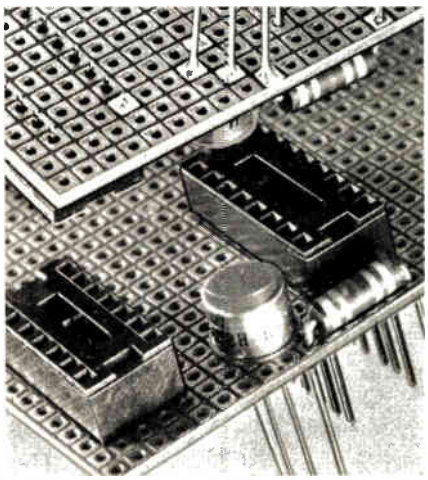
A computer-controlled guidance system called the model 6232 Man-U-Sert performs all pc-board assembly functions except actual component insertion. It automatically positions the work, shows where and how to orient a component on a printed-circuit board, offers the right component, and then cuts and clinches the

leads—all of which promotes fast manual insertion of a variety of components. The system is claimed to reduce both assembly time and assembly errors. In addition, the manufacturer says that the quality of the assembled boards reduces solder touch-up time by as much as 90%. Among the different types of components that can be accommmodated by the Man-U-Sert's 80-compartment bin are resistors, capacitors, single and dual in-line packages, several types of transistors, jumper wires, transformers, and radial-lead components.

Universal Instruments Corp., Kirkwood Industrial Park, P. O. Box 825, Binghamton, N. Y. 13902. Phone (607) 772-7522 [394]

Plugboards have a solder pad per hole

A family of large, pad-per-hole plugboards permits convenient breadboarding of either custom circuits or boards compatible with the S-100 microcomputer bus. All boards in the family have an array of isolated



solder pads surrounding holes spaced on 0.1-inch centers. One of the boards, the model 8801, is designed to be compatible with the S-100 bus. The other two are made without card edge connectors. The 45P80-1 is 4.5 inches wide and 8.08 in. long, and the 106P106-1 measures 10.6 by 10.6 in.

One corner of the 8801 has an area for two TO-220-packaged regulators mounted in a low-profile heat sink. The leads of one regulator are prewired to raw power and ground and to primary buses such as the collector supply. Leads of the other regulator are uncommitted and can

be used for other power buses, such as a drain supply.

The epoxy-glass boards are clad with 2-ounce, 0.027-inch copper. The pads and buses are solder-tinned, while the edge connectors are gold-flashed nickel plate. The 8801 sells for $19.95, the 45P80-1 is priced at $9.96, and the 106P106-1 goes for $18.99. All are available from stock.

Vector Electronic Co., 12460 Gladstone Ave., Sylmar, Calif. 91342. Phone (213) 365-9661 [395]

Software package debugs in-circuit test programs

A-Pact, an acronym for automatic program aid for in-circuit testing, is a software package that can do much of the user-program debugging for Zehntel's line of Troubleshooter in-circuit test systems. Using a component data list and a floppy disk containing the generation software, A-Pact creates a fully formatted Troubleshooter test program. This program, combined with a probe-point test fixture and a circuit board, enables A-Pact to correct the test program automatically. A-Pact is priced at $1,750 and has a delivery time of 30 days.

Zehntel Inc., 2440 Stanwell Dr., Concord, Calif. 94520. Phone Craig Pynn at (415) 676-4200 [396]

High-pin-count socket puts no stress on IC pins

Intended for use with integrated-circuit packages that have many pins—24 and up—the LIF-lock connector socket has contacts that apply no force to the IC leads during insertion or extraction. After the package has been inserted, a screwdriver-operated, cam-actuated mechanism releases the contacts, which grip the leads on both flat faces with a contact force of about 200 grams. Available in 24-, 28-, and 40-position configurations, the sockets fit standard 0.100-by-0.600-inch

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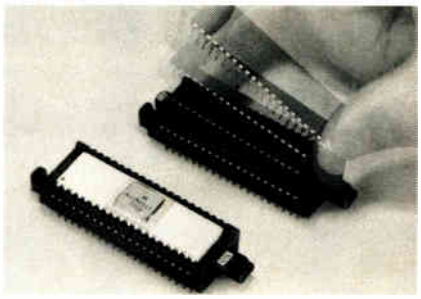


printed-circuit-board hole patterns. The beryllium-copper contacts are rated at 3 A and have a contact resistance of less than 25 mΩ. The socket housing is molded from a glass-filled thermoplastic suitable for more than 100 open-close actuating cycles.

AMP Inc., Harrisburg, Pa. 17105. Phone (717) 564-0100 [397]

Flat-cable assemblies join D-type connectors to DIPs

A line of flat-cable assemblies with 9, 15, 25, 37, and 50 lines are available with D-type subminiature connectors on one end and dual in-line connectors on the other. The cables are usually furnished in EIA color-coded 26-gage wire, but other sizes and types can be provided. The D-type connector has soldered terminations and is potted for strain relief. If desired, the DIP header can be omitted and the cable end supplied as stripped and tinned bare wires. The cable can exit from the back or side of the D-type connection.

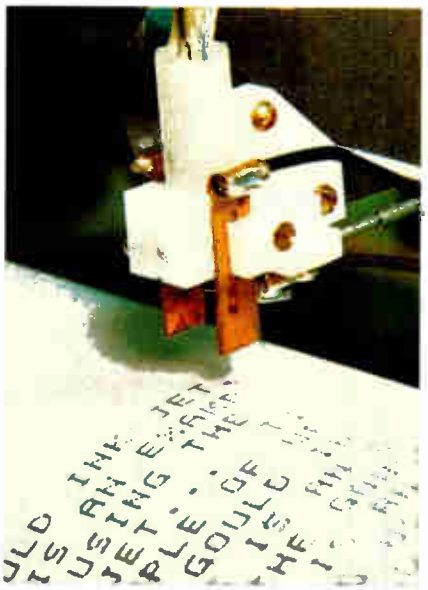
Aries Electronics Inc., P. O. Box 231, Frenchtown, N. J. 08825. Phone (201) 996-4096 [398]

INK JET WILL TELL YOU WHAT HAPPENED, WHEN IT HAPPENED.

Gould's new Ink Jet annotation device allows you to automatically print time, date and other data parameters alongside your Gould analog traces.

The Ink Jet writing system employs the most advanced technology consisting of ink reservoir and electrostatic charging and deflection plates to print highly legible characters in a 5 x 7 dot matrix at chart speeds of up to 50 mm/sec. Any desired annotation of up to 256 characters may be entered by means of our optional keyboard or from an external ASCII parallel data source.

Designed to complement the Gould 2000 Series pressure ink direct writing recorders, Ink Jet

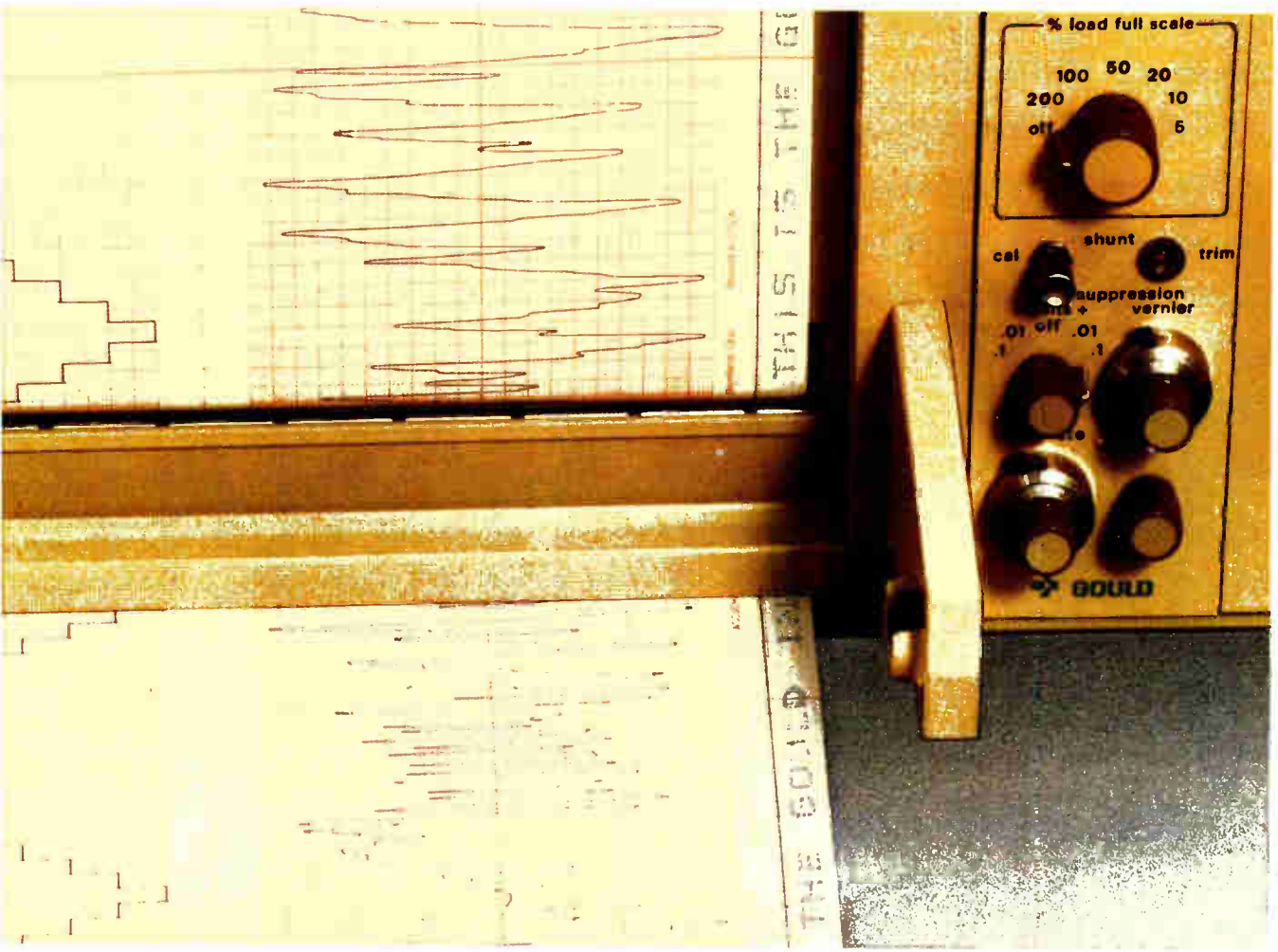


adds an entirely new dimension to analog data display. Medical, industrial, research and engineering users now have a means of immediately annotating all pertinent information while a study is taking place.

Consider the additional breadth of data display that only Ink Jet applications will bring to you. For more information contact, Gould Inc., Instruments Division, 3631 Perkins Ave., Cleveland, O. 44114. Or Gould Alco S.A., 57 rue St. Sauveur, 91160, Ballainviliers, France. **For brochure, call toll free (800) 325-6400, Ext. 77.**

In Missouri: (800) 342-6600.

GOULD



We've Bridged the Gap

If GenRad's 1796 dynamic digital/analog board test system is too much machine for your application, and you need more performance than GenRad's 1795 digital tester normally provides, then you probably need GenRad's new 1799 Digital/Analog Test System. Our unmatched experience with board testing tells us that the 1799 is just the right system for many of today's applications.

A key feature of the 1799 is that it is an integrated system, which simply means it was **designed** as a hybrid tester. When you compare its performance with other hybrid testers on the market which are derived by adding analog capability (via IEEE-bus based instruments) to a digital system, you'll find a world of difference.

Interface for the unit under test (UUT) is compatible with that of the 1795 and with the hybrid section of the 1796. Also, the fixed or programmable digital driver/sensors operate through a universal scanner which allows either digital or analog source and measure capability at each I/O pin.

For the complete story on the 1799 Digital/Analog Test System, request a copy of our new brochure.

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New products

can be adjusted to zero with an external potentiometer. Full-scale gain error is 0.1% for the VFC52.

Other specifications include an output voltage range of 0 to +10 v and an operating temperature range of −55° to +125°C. The response time of both converters to input-signal-level changes is specified for a full-scale step at 1 μs plus one period of the new frequency. Typical settling time to within rated linearity for a positive input voltage step of 10 v is 101 μs for the VFC42 and 11 μs for the VFC52.

Both converters are available immediately in plastic 14-pin dual in-line packages; hermetically sealed metal versions will be ready within several months. Prices are identical to those of the VFC32; $14.80 each in 1–24 quantities, $8.90 each for 100 and above.

Burr-Brown Research Corp., International Airport Industrial Park, P. O. Box 11400, Tucson, Ariz. 85734. Phone (602) 294-1431 [382]

8-bit a-d converter operates at 20 MHz

The model ADC-TV8B is an 8-bit analog-to-digital converter with a maximum encoding rate of 20 MHz—more than sufficient for such digital video applications as time-base correction, frame synchronization, and special-effects processors. The converter, which includes a sample-and-hold circuit, combines four thin-film hybrid circuit assemblies with various standard analog and digital ICs, including some emitter-coupled logic. It is available in two versions: one is

Don't limit Mostek's new tone dialers and tone receivers to the telephone.

Limit them to your imagination.

Applications for Mostek TONE II™ integrated tone dialers and the new MK 5102 integrated tone receiver are limitless. These two CMOS integrated circuits now create a multitude of possibilities for digital communications and control applications. Previously, these applications were impractical because of system design complexity and the resulting high system cost. But now, with encoding and decoding functions integrated onto single IC's, you can unleash your imagination.

Start with these facts: Mostek tone generators and tone receivers use the economical TV color crystal for reference. Both operate using the world-recognized TOUCH TONE * DTMF system. Both meet or exceed most standards for stability, distortion and timing. Both are microprocessor compatible and are in volume production today.

Additional features of the MK 5102 include 5-Volt ± 10% power requirement latched three-state outputs with data valid strobe, low pre-filtering requirements and superior talk-off protection — all in a 16-pin package. The MK 5087 through MK 5091 TONE II™ dialers provide simple, low-cost solutions for a wide variety of circuit designs ranging from fixed supply to direct phone line applications.

There's more information on Mostek's communications products. Contact Mostek at 1215 West Crosby Road, Carrollton, Texas 75006. Telephone:(214)242-0444. In Europe contact Mostek GmbH, West Germany Telephone: (0711) 701096.

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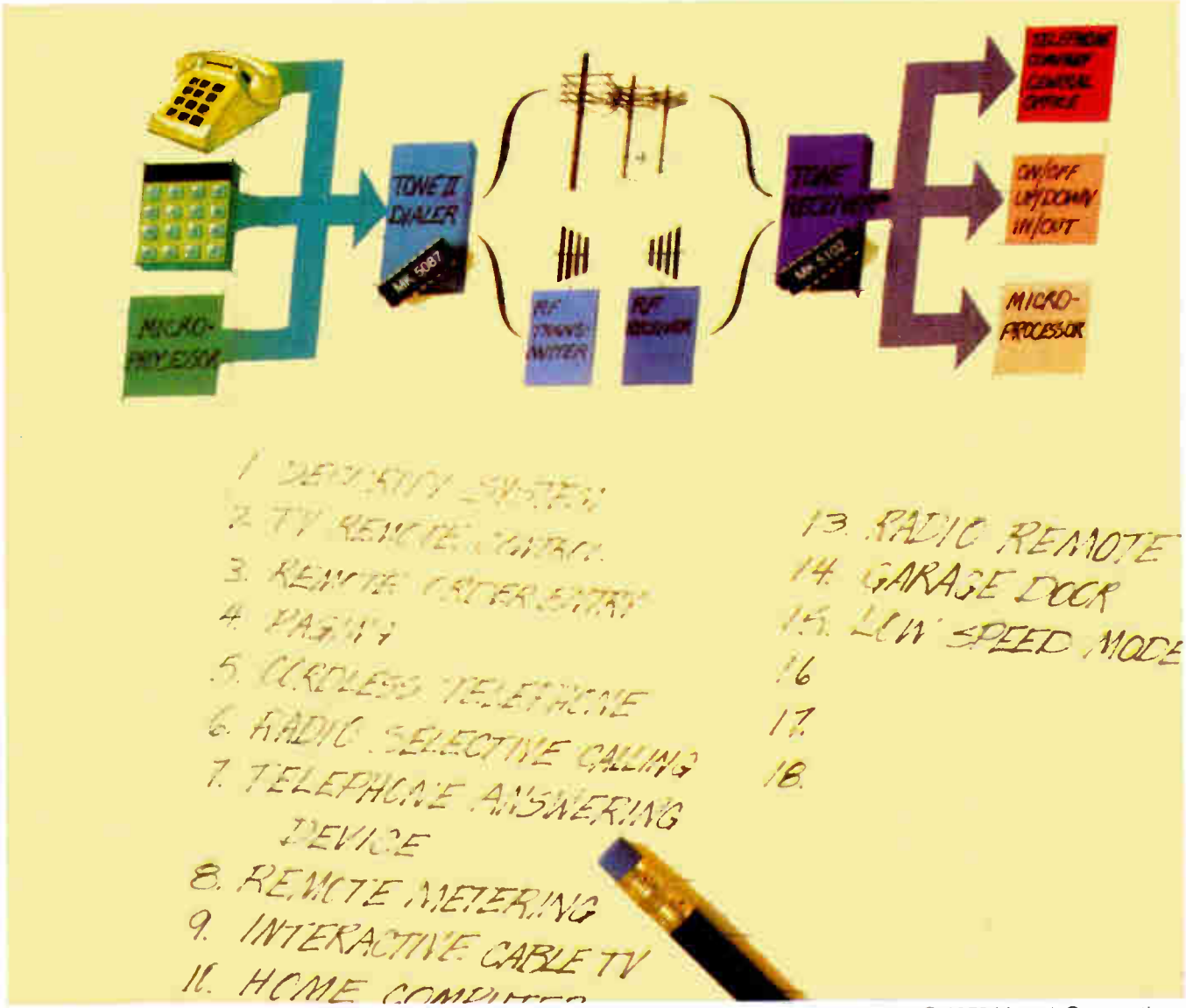

Touch Tone is a registered trademark of AT&T.

New products

compatible with ECL, the other with transistor-transistor logic. A choice of three input impedances (50, 75, and 93 Ω) is also offered as are six input-voltage ranges (0 to +1, 0 to +2, 0 to +5, ±1, ±2, and ±5 v). The standard converter operates from 0°C to 70°C, comes in an anodized aluminum case measuring 7.5 by 4.25 by 0.875 inches, and sells for $1,995. A version that operates from −55°C to +85°C is also available.

Datel Systems Inc., 1020 Turnpike St., Canton, Mass. 02021. Phone Eugene L. Murphy at (617) 828-8000, Ext. 141 [383]

A-d unit converts 8 bits in 50 ns

The model AD208 analog-to-digital converter is a dual-rank unit with a conversion time of 50 ns, corresponding to a conversion rate of 20 MHz. The unit, which contains a dc offset adjustment for the conversion of bipolar as well as unipolar signals, can handle current inputs of up to 512 mA. It includes a wideband amplifier and a track-and-hold circuit. Priced at $1,610, the AD208 is available from stock to eight weeks.

LeCroy Research Systems of California, 1806 Embarcadero Rd., Palo Alto, Calif. 94303. Phone (415) 328-3750 [385]

Programmable attenuator operates from dc to 1 MHz

An externally programmable audio attenuator, the SM-030 provides up to 63 dB of attenuation in 1-dB steps. The module is accurate to within 0.25 dB over the frequency range from dc to 1 MHz. Temperature drift is less than 0.1 dB from 0°C to 50°C.

The input and output impedances for the audio signals are 600 Ω unbalanced. Maximum input power is 250 mW. Supply power requirements are either 5 v or 8 to 12 v dc at 200 mA. The attenuator sells for $211 in small quantities and is available from stock to 30 days.

Syntest, 169 Millham St., Marlboro, Mass. 01752. Phone (617) 481-7827 [386]

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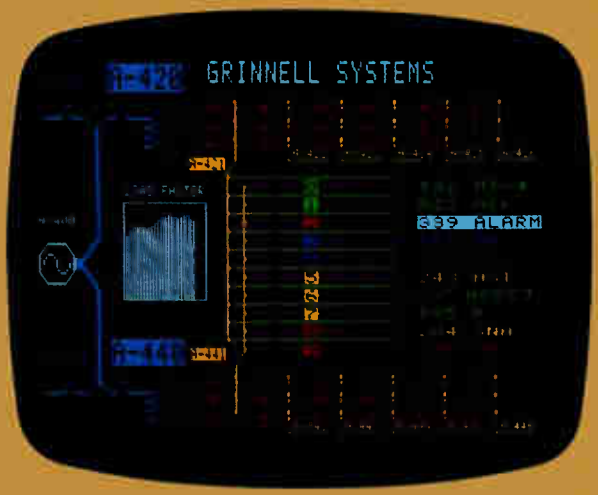

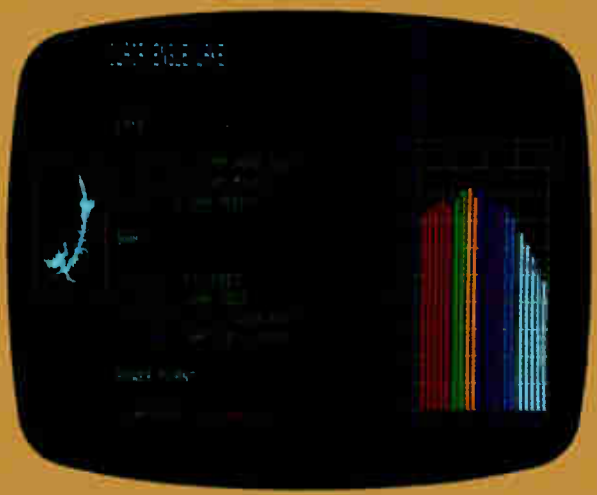

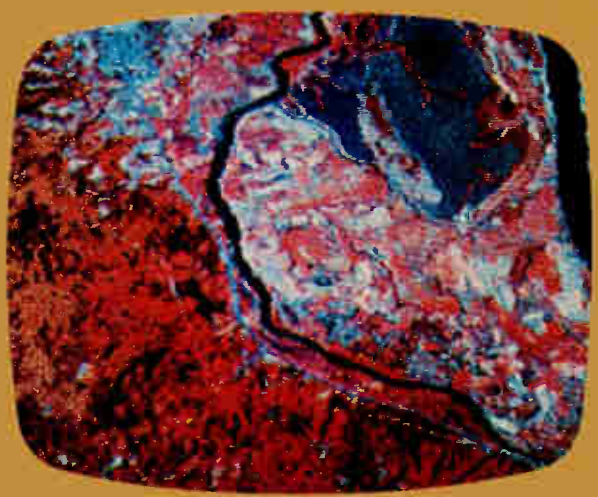

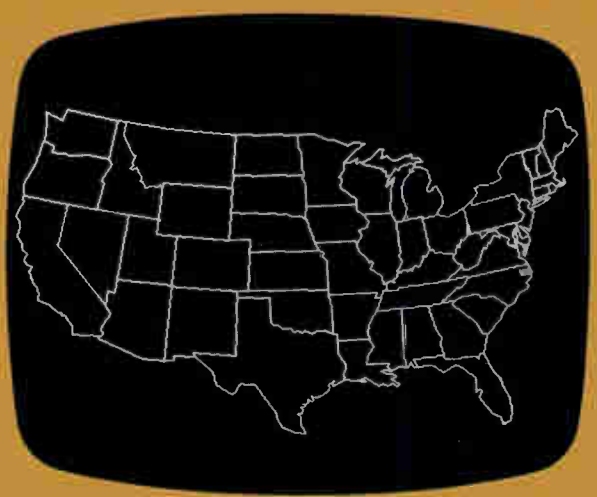

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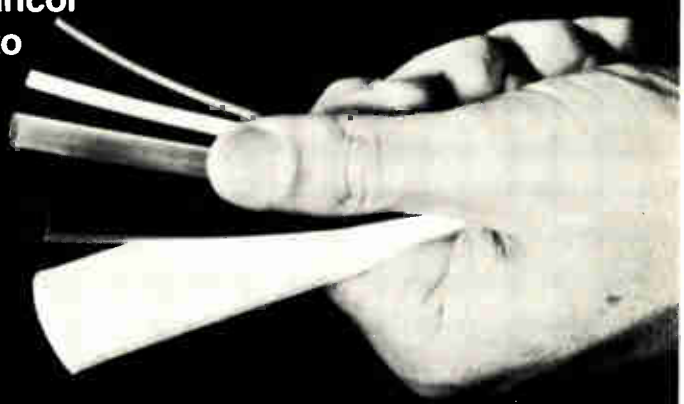

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Semiconductors

Sequencer does controller chores

Field-programmable device requires less design time than bit-slice approaches

Bit-slice microprocessor designs, which have been replacing minicomputers and medium-scale integrated transistor logic in numerous high-speed controller applications, may themselves be replaced by a lower-cost and speedier element. The replacement is a field-programmable logic sequencer from Signetics Corp., a sophisticated addition to the company's family of programmable logic. Designated the 82S104/105, the 21,000-square-mil, 90-nanosecond, bipolar Schottky device works as a high-speed logic sequencer in simple control applications at clock rates as high as 11 megahertz.

"The integration of controller functions with today's bit slices is an expensive and time-consuming job," says Napoleone Cavlan, memory applications manager at Signetics. Usually, says Cavlan, such controller designs consist of only a microprocessor central processing element—such as Advanced Micro Device's 4-bit-slice Am2901 or Intel's 2-bit-wide 3001—and a microprogram sequencer with memory and some support circuits. For still simpler applications, just a sequencer, a read-only-memory, and a couple of decoders suffice.

Short algorithms. But even such simple bit-slice designs confine system functions to fetch-execute cycles, which may be too slow or too complex for such low-end market applications as waveform generation, handshake protocols, and data formatting, and their need typically for relatively short algorithms—about 50 steps or less, says Cavlan. Here, the high startup costs involved in designing a bit-slice approach are justified only if there is a relatively high sales volume and if response time to the market is not too short, he points out.

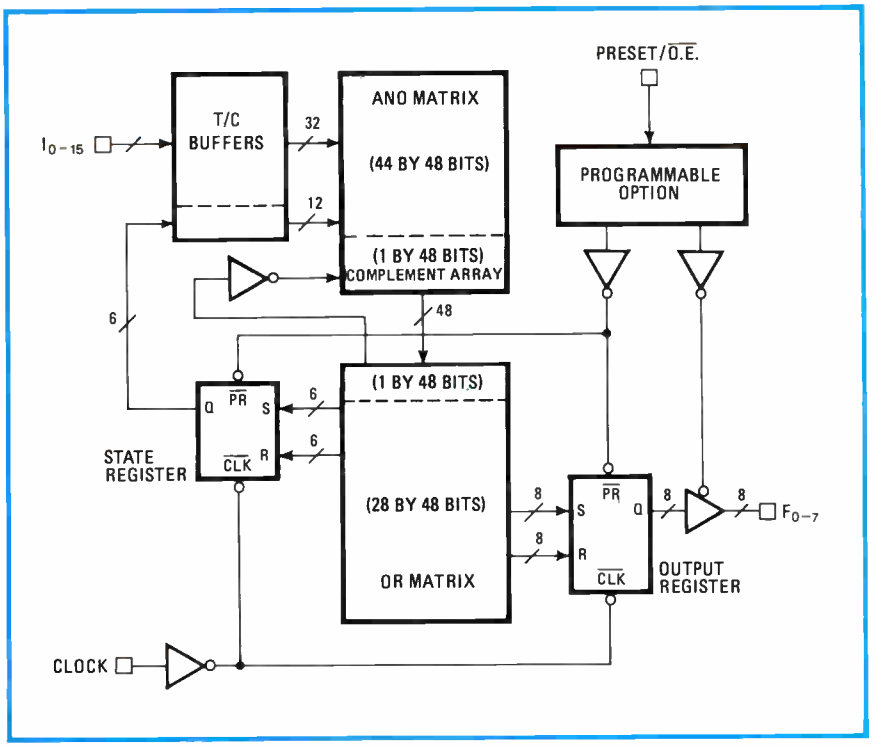
That leaves a large segment of this low-end controller market that is low in volume-per-customer and requires a very short design cycle, says Cavlan, and it is into this niche that the Signetics field-programmable logic sequencer (FPLS) fits.

"The control functions at this low end are relatively simple-minded," he says. "Basically it's a matter of combining inputs from the outside world, making a decision, and generating the necessary output while jumping to the next step in the sequence."

The FPLS is of the Mealy machine type, in which present state and present input determine its next output. Available in dual in-line ceramic or plastic packages, the 28-pin FPLS can handle 16 input variables, 8 output functions, and 48 state transitions. Like other members of the same logic family, the 82S104/105 is fabricated with a nickel-chromium fusible-link technology that allows a user to easily program a particular logic sequence in a short time and at a low cost.

Maximum input-to-output delay time of the FPLS is about 90 ns, with a typical power dissipation of no more than 650 milliwatts. "Presently, to do a comparable function, a bit slice requires a minimum of at least 5 or 6 integrated circuits and more typically 10 to 15," Cavlan says. Available in the first quarter of 1978, the device costs $25 to $30 each in 100-up quantities. In high volume, the price of the FPLS will be significantly lower.

Signetics Corp., 811 E. Arques Ave., Sunnyvale, Calif. 94086 [411]

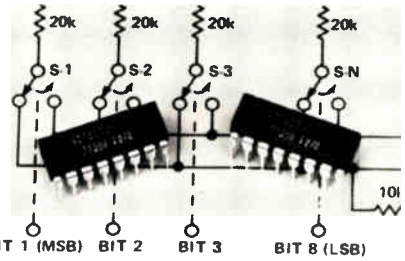


8-bit multiplying d-a converter sells for $2

Built of complementary-metal-oxide-semiconductor circuitry, an 8-bit multiplying digital-to-analog converter sells for only $2 when purchased in thousands. The AD7523 uses thin-film-on-C-MOS technology to provide 8-bit resolution, 10-bit accuracy, and 20-mw power consumption. It has a settling time of less than 100 ns.

The $2 AD7523JN is linear to within half a least significant bit (0.2% of full scale). A $5 version,

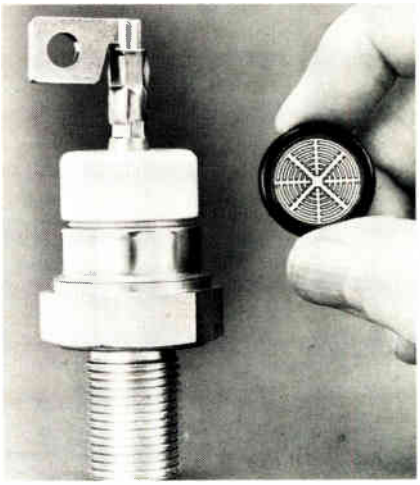
New products



the KN, is linear to within a quarter LSB, and a $7.50 model has a maximum nonlinearity of one eighth LSB. All provide a feedthrough of half LSB at 200 kHz, and all are guaranteed monotonic from 0°C to 70°C. The converters are housed in 16-pin plastic dual in-line packages.
Analog Devices Semiconductor, 829 Woburn St., Wilmington, Mass. 01887. Phone Jeff Riskin at (617) 935-5565 [413]

Transistor dissipates 500 W at case temperature of 100°C

Using a press-fit fabrication technique that eliminates bonding wires and their current limitations, the D60T transistor is rated for operation with peak currents of 200 A, a continuous current of 100 A, and a maximum power dissipation of 500 W at a case temperature of



100°C. Westinghouse's largest switching transistor, the new device is offered in three voltage ratings: 450, 500, and 550 V; these are $V_{CO(SUS)}$ ratings. Applications for the transistor include high-frequency in-

New products

verters, switching power supplies, power amplifiers, induction-motor controls, and chopper controls for vehicle drives. The unit has turn-on and turn-off times of less than 500 ns. The 450-v version sells for $200 in small quantities; delivery time is 10 to 12 weeks.

Semiconductor Division, Westinghouse Electric Corp., Youngwood, Pa. 15697. Phone (412) 925-7272. (In Europe, write to CDS Westinghouse, BP107, 72003 LEMANS Cédex, France.) [414]

IC oscillator has 1,000:1 linear sweep range

Stable to within 20 ppm/°C, the XR-2209 voltage-controlled oscillator is a monolithic integrated circuit with a linear sweep range of 1,000:1. The oscillator produces independent, symmetrical, triangle- and square-wave outputs. Its basic frequency is set by an external RC combination anywhere in the eight decades from 0.01 Hz to 1 MHz. The device can then be swept by a control voltage from that point. These characteristics make it suitable for fm tone and sweep generation as well as for voltage-to-frequency conversion.

An internal regulator allows the XR-2209 to operate from single supply voltages from 8 to 26 v dc or from split supplies from ±4 to ±13 v. The commercial XR-2209CP operates from 0°C to 70°C and sells for 97 cents in quantities of 100 or more. A military version, the XR-2209M, operates from −55°C to +125°C.

Exar Integrated Systems Inc., P. O. Box 62229, Sunnyvale, Calif. 94088. Phone (408) 732-7970 [416]

Data handling

Computer offers upgraded features

Intermediate Prime model has cache memory, operating system of larger machines

By adding some of the strengths of the Prime 400 to the lower-priced 300 system, engineers at Prime Computer Inc. have come up with the Prime 350—a system that outstrips the Prime 300 in performance but still costs less than the 400. The Prime 350 incorporates the 400's 2-kilobyte, 80-nanosecond-access bipolar cache memory and a substantial subset of the 400's Primos IV operating system.

Those two features, plus inclusion of standard single- and double-precision floating-point arithmetic, make the 350 some 50% faster than a 300 in executing Fortran programs. In addition, the 350 runs Cobol programs about twice as fast as the 300 because it emulates the business instructions featured in the Prime 400 and 500. The system is expected to compete in a class that includes Digital Equipment Corp.'s PDP-11/60 and PDP-11/70 and Hewlett-Packard Co.'s 3000 II series.

Joseph D'Angelo, Prime's director of planning, says that the 16-bit machine gives users simultaneous access to 2 million bytes of virtual memory. With the Primos IV operating system subset, the 350 can run programs as large as 756 kilobytes, compared to a maximum of 128 kilobytes for the 300. D'Angelo says that the 350 is well suited for education applications requiring an interactive system with mid-range performance at a small-system price.

Because of its ability to run large programs, the 350 is also useful in engineering applications usually associated with large mainframes. Then, too, it fits a variety of commercial data-processing applications, such as interactive sales-order processing by users sharing multiple programs and a data base.

Users can create programs in macro assembly languages as well as a mix of high-level languages, such as Fortran, Cobol, RPG II, interpretive Basic, and Prime's Basic/VM compiler. The 350 is fully software-compatible with other Prime systems, having the same file structure, language processor, and utility software as the 300, 400, and 500 models. Prime is also offering a plan to allow Prime 300 users to upgrade to the 350.

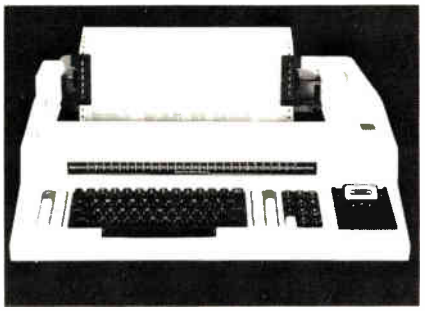
The system has eight direct-memory-access input/output channels, more than 300 instructions, a maximum main-memory capacity of 512 bytes of 600-nanosecond interleaved metal-oxide-semiconductor storage, and up to 1.2 billion bytes of on-line disk storage. It also offers up to four high-speed tape drives, features asynchronous communications for remote job entry, and can operate in a network with up to three other Prime systems by using Prime's network software.

Prices will range from $100,000 to $150,000, depending on the user's configuration, and deliveries will begin in the spring.

Prime Computer Inc., 40 Walnut St., Wellesley Hills, Mass. 02181. Phone (617) 237-6990 [361]

Fast data terminal has many standard features

Capable of printing at 120 characters per second, the SuperTerm data terminal is a microprocessor-controlled device with such standard features as an RS-232-C interface, a current-loop interface, an IBM Se-



New products

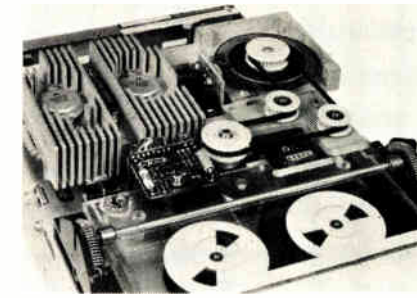
lectric–type keyboard with a numeric keypad, 132-column printing, horizontal and vertical tabs, keyboard lock-out, and automatic top-of-form positioning. Options include a microcassette for off-line data collection (not yet available) and a 180-c/s printing rate, both of which can be added in the field.

The terminal, which uses a dot-matrix impact printhead, is priced as low as $1,995 for a 60-c/s version with no options. It is available immediately. A maintenance contract is available for $25 a month.

Intertec Data Systems Corp., Eastern Regional Marketing, 19530 Club House Rd., Gaithersburg, Md. 20760. Phone (301) 948-2400 [363]

Transport for 3M cartridge is first to use belt drive

By interposing a belt drive between the drive motor and the tape capstan, the designers of the model 650 tape transport have effectively uncoupled the motor mass from the capstan and have thus reduced both motor wear and the likelihood of tape damage. The transport uses



standard 3M DC300A data cartridges. It can store up to 23 megabits (2.9 megabytes) of data on the four tracks of the cartridge's 300 feet of ¼-inch magnetic tape.

An optical tachometer provides precise control of the 650's speed at 30 in./second, which, at the ANSI standard recording density of 1,600 bits/in., yields a data-transfer rate of 48,000 b/s. This throughput rate will fill up a typical cathode-ray-tube terminal in about half a second. With its rewind and fast-search

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speeds of 90 in./s, the transport can reach any portion of its recorded data in about 20 seconds.

Single units sell for $920 complete with operating electronics. The transport is also available as a simple electromechanical assembly at $475. Delivery time ranges from immediate up to 30 days.

Qantex Division, North Atlantic Industries Inc., 200 Terminal Dr., Plainview, N. Y. 11803. Phone Leon Malmed at (516) 681-8350 [364]

Development system speeds software conversions

A software development package that allows users of Computer Automation's larger LSI-2 and 3/05 processors to convert their programs for operation on the new, lower-cost LSI-4 family of Naked Minis will operate on an LSI-2 system with 32 kilowords of main memory, a moving-head or floppy-disk system, and the company's DOS-2 disk-operating system. The software package comprises a TRAN24 translator and the MACRO24 assembler. The TRAN24 reads LSI-2 or 3/05 assembler source statements and generates equivalent LSI-4 source statements. Any statement that cannot be converted without recourse to higher-level instruction sets will result in an error message. The package is available on diskette for $200 or on a 5-megabyte cartridge for $400.

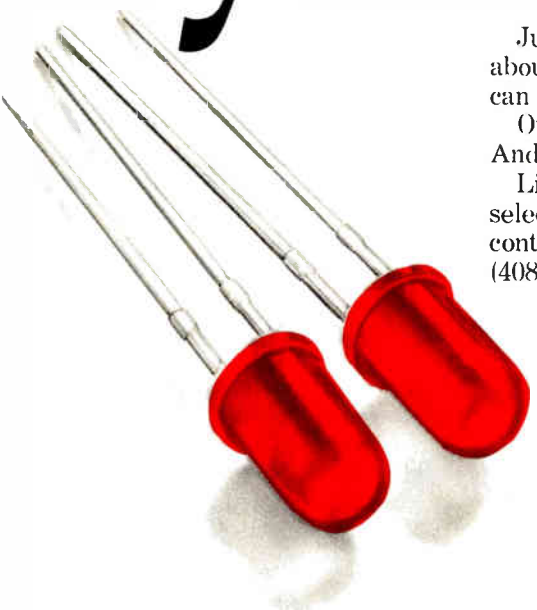
Computer Automation Inc., 18651 Von Karman, Irvine, Calif. 92713. Phone (714) 833-8830 [365]

Display can be partitioned into any number of areas

The Concept 100 cathode-ray-tube display terminal is a microprocessor-based unit with a feature that allows its CRT to be partitioned into any number of independently controlled, rectangular display areas. In addition, the terminal provides forms control, text editing, upper- and

A simple warning.

New LED flashes on/off all by itself.



Just apply 5 volts and our FRL-4403 flashes an attention-getting signal about three times a second. A built-in IC switches it on and off. And you can drive it directly by TTL and CMOS circuits.

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Circle 193 on reader service card

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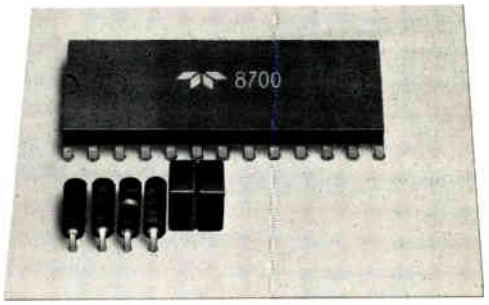
In most A/D converter applications, high speed is a luxury you don't need, but often pay for. Inaccuracy, on the other hand, will almost always hurt you.

At Teledyne, we analyzed the trade-offs and decided to provide a family of A/D converters with ample speed (1 to 20ms) to handle 90% of industrial and instrumentation applications, but with the emphasis on linearity and immunity to noise. And we added a bonus: we made them easy to use; Just add 2 capacitors and 4 resistors — and you're converting.

So ask us about our 8700 series of monolithic A/D converters; 8, 10 and 12 bit binary with or without three-state outputs, and 3½ digits BCD. They are all available off the shelf; they are all reliable; they are all low power CMOS, and prices start at $5.60 for 1K quantities.

For immediate information contact Michael Paiva at (415) 968-9241, X 241.



For specific information on individual A/D converters, please circle the appropriate Reader Service number, as indicated.
Binary, 8, 10 & 12 bits — **266**
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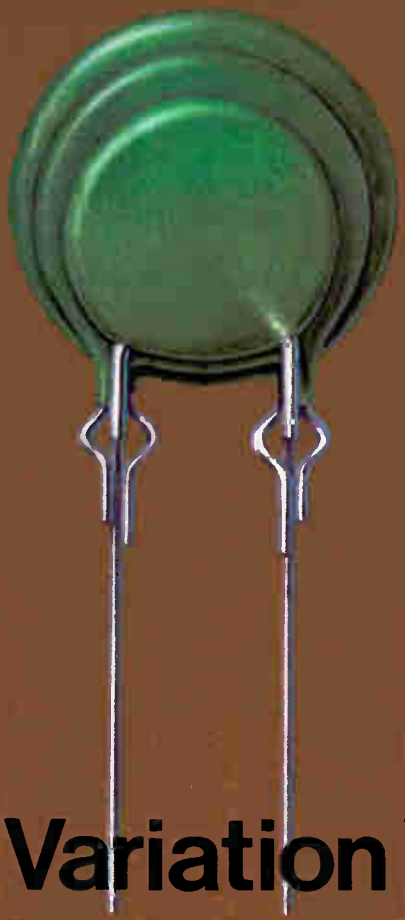

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Circle 197 on reader service card

inches. Intended for original-equipment applications, the recorder measures 5.5 in. high by 14 in. wide and is 6.875 in. deep. Its recording area is visible through its cover.

A choice of analog, incremental, or time inputs allows the recorder to produce X-Y or T-Y records. Also, pen lift—a standard feature—allows the permanent pen trace to be continuous, intermittent, or dotted. The price, for a minimum order of 10, is $770 per unit.

Houston Instrument division of Bausch & Lomb, 1 Houston Sq., Austin, Texas 78753. Phone Louis Arnold at (512) 837-2820 [356]

Audio tester includes meters, filters, and four generators

The model 4400A audio-test facility is a complete test system in a single compact package. It contains a function, a log-sweep, a pink-noise, and a comb generator, all of which are followed by a burst-gating facility and a power amplifier. On the input side, it includes an instrumentation front end; tunable low-pass, high-pass, bandpass, and band-reject filters; a log-swept bandpass filter for spectrum analysis; and a semiconductor memory for the storage of data for X-Y plots. Four plots can be stored, with each axis for each plot capable of resolving 256 steps. The vertical axes can be absolute amplitude, decibel ratio, spectral energy, or phase shift. The horizontal axes can be frequency or time. A built-in digital meter measures frequency and true-rms power levels in dBm. The 4400A sells for $3,650; it has a delivery time of four to eight weeks.

Amber Electro Design Ltd., 4810 Jean Talon St. West, Montreal, Quebec H4P 2N5, Canada. Phone (514) 735-4105 [357]

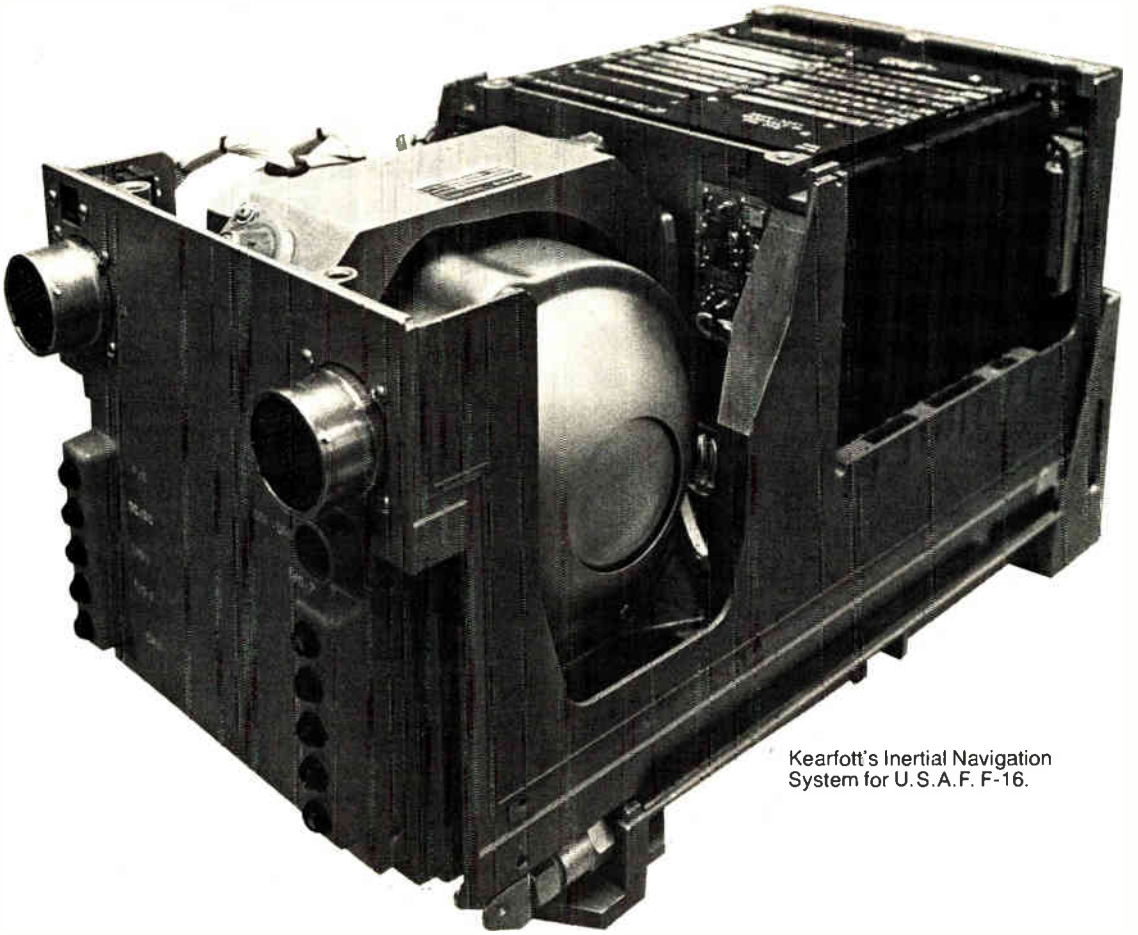
3-digit multimeter sells for $99.50

The model LM-300 from Non Linear Systems is a 3-digit (1,000-count) multimeter with a liquid-crystal display and a $99.50 price tag. A companion instrument, the model LM-350, resolves 3½ digits (2,000 counts) and sells for $125.

Both meters, like all earlier units in the NLS Volksmeter line, measure ac and dc voltage, ac and dc current, and resistance. Because of their small size and lower power consumption, Volksmeters are widely used in field-service work.

Non Linear Systems Inc., P. O. Box N, Del Mar, Calif. 92014. Phone (714) 755-1134 [358]

THE STANDARD FOR INERTIAL NAVIGATION SYSTEMS



Kearfott's Inertial Navigation System for U.S.A.F. F-16.

Kearfott's Inertial Navigation System (INS) for the F-16 consists of two major line replaceable units—Inertial Navigation Unit (INU), and a Fire Control Navigation Panel (FCNP). It is a prime sensor for aircraft velocity, attitude, and heading, and a prime source of navigation information.

Navigational data are developed from self-contained inertial sensors consisting of a vertical accelerometer, two horizontal accelerometers, and two-axis displacement GYROFLEX® gyroscopes. The sensing elements are mounted in a four gimbal, gyro-stabilized inertial platform with the accelerometers, which are maintained in a known reference frame by the gyroscopes, as the primary source of information. Attitude and heading information is obtained from synchro devices mounted between the platform gimbals.

The system provides pitch, roll, and heading in both analog (synchro) and digital form. In addition, the following outputs are provided on a serial MUX channel (MIL-STD-1553):

- Present Position—Latitude, Longitude, Altitude
- Aircraft Attitude—Pitch, roll, Heading (True and Magnetic)
- Aircraft Velocity—Horizontal and Vertical
- Steering Information—Track Angle Error

In order to permit operation in aided-inertial configurations, the INS accepts the following digital inputs in MUX serial format (MIL-STD-1553):

- Position Update—Latitude and Longitude
- Velocity Update—Velocities in INS coordinates
- Angular Update—Angles about INS axes
- Gyro Torquing Update—Torquing rate to INS gyro axes

Significant features:

- MUX interface (MIL-STD-1553)
- Lightweight—33 pounds
- Small Size—7.5″h x 15.2″d x 7.5″w
- High Precision—better than 1 nm/h
- Rapid Align—9 minutes at 0° F
- Fast Installation/Removal—rack and panel-type mechanical interface
- Provides Back-up MUX Control in Event of Fire Control Computer Failure

For additional information write to: The Singer Company, Kearfott Division, 1150 McBride Ave., Little Falls, N.J. 07424.

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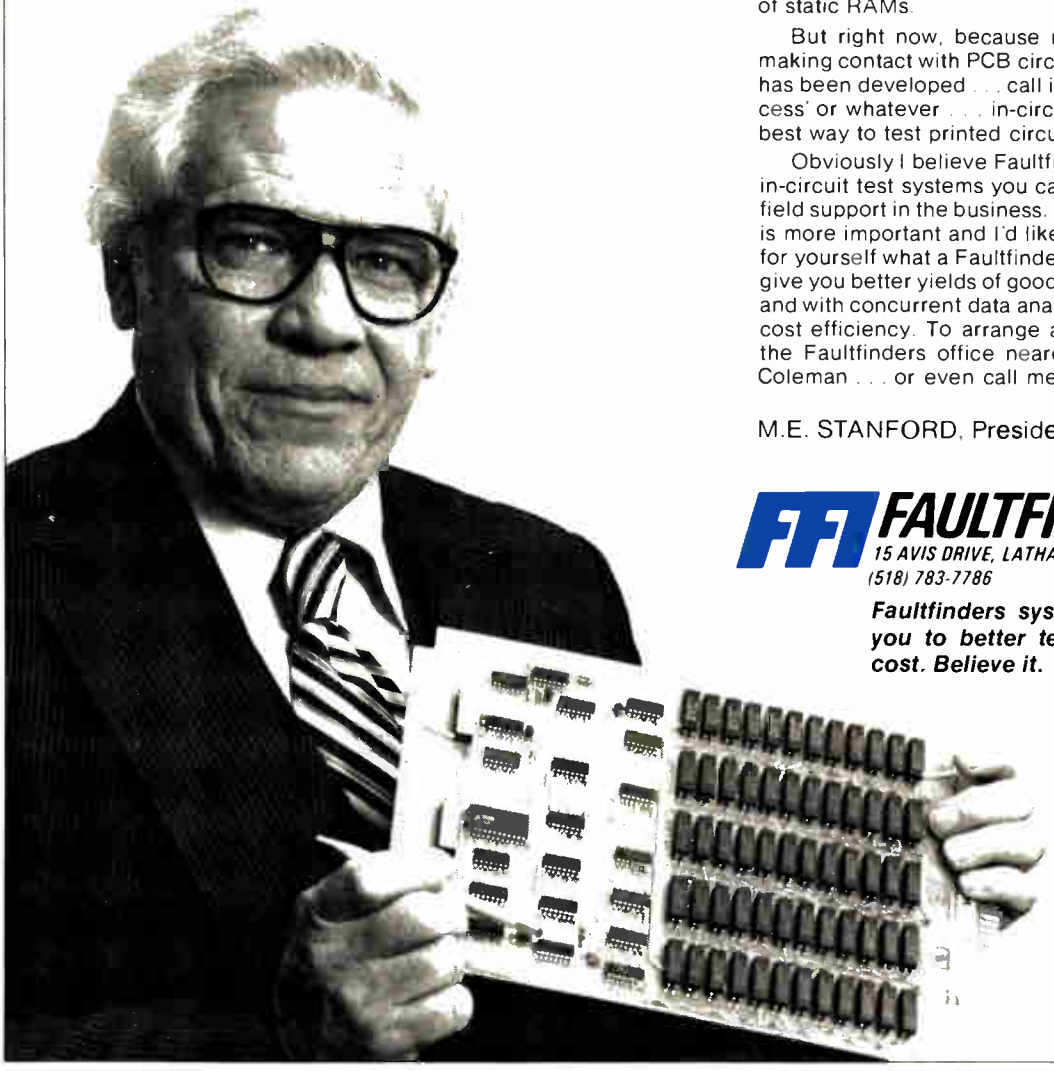

"It's hard to imagine the problems and the cost of testing industry's present volume of PCBs with the methods we used in the '50s. Even in 1962, when General Electric engineers developed the Pacer system, the need for faster, more accurate, more reliable test methods was apparent. I was there, involved in the Pacer development, and I was convinced that this technique of positive electrical access to the PCB solder nodes would become the method of choice for verifying circuit integrity. In-circuit testing has accomplished that and much more.

Texas Instruments uses Faultfinders automatic in-circuit test systems now. So do Analog Devices, Data General, Reliance Electric, and many, many more. They use Faultfinders system because they achieve higher yields at lower cost. We've brought the state-of-the-art to the present generation of FF101C and FF303 computer-based systems which can perform precise in-circuit *and* functional tests on digital, analog and hybrid printed circuit assemblies. In many cases, these systems will completely eliminate costly, software-intensive functional testing.

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But right now, because no better method of making contact with PCB circuits and components has been developed . . . call it 'bed of nails' or 'access' or whatever . . . in-circuit testing is still the best way to test printed circuit assemblies.

Obviously I believe Faultfinders offers the best in-circuit test systems you can buy and the finest field support in the business. But what you believe is more important and I'd like to invite you to see for yourself what a Faultfinders systems can do to give you better yields of good boards at lower cost and with concurrent data analysis for even greater cost efficiency. To arrange a demonstration, call the Faultfinders office nearest you, or call Tom Coleman . . . or even call me."

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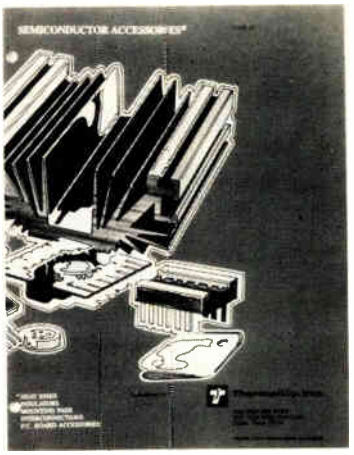
New literature

NBS publications. "Publication of the National Bureau of Standards" lists all scientific, technical, and consumer publications issued by the Commerce Department's National Bureau of Standards during 1976. It tells how each paper can be obtained, citing some 2,200. The catalog is the first to include citations of patents given to NBS inventors and grantee-contract reports prepared by NBS contractors. Information on previous catalogs and on the availability of papers published in past years is included. The publication, stock number 003-003-01743-4, can be obtained for $8.25 from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Safety standards. The amended Underwriters Laboratories "Catalog of Standards for Safety" references 396 standards for safety, including 10 first-edition standards and 12 proposed standards. It is divided into two sections. Part 1 lists the already published standards in alphabetical order by title and then in numerical order by UL standard number designations; part 2 lists the 96 proposed standards. Also provided is information for each standard, including edition dates, latest revision dates, and prices. Underwriters Laboratories Inc., Attn: Publications Stock Dept., 333 Pfingsten Rd., Northbrook, Ill. 60062. Circle reader service number 422.

Conversion factors. A pocket-size booklet featuring conversion factors and formulas that help in selecting capacitors for specific applications is available from Plastic Capacitors Inc., 2623 N. Pulaski, Chicago, Ill. 60639 [423]

Evaporation materials. Over 250 purified and degassed evaporant materials used in optical coating, vacuum deposition, sputtering of thin films, and metal-oxide-semiconductor work are listed in a 15-page brochure. Also included are boron nitride and vitreous carbon, two receptacle materials used in vacuum-evaporation work, as well as special



intermetallic-metallizing evaporators and a special boron-nitride parting agent. Atomergic Chemetals Corp., 100 Fairchild Ave., Plainview, N. Y. 11803 [429]

Capacitance-switching. The use of TouchControl switching—a capacitance-switching technique that employs standard microcircuits—is explained in a 16-page designer's guide. The application note describes how TouchControl works and how capacitance panel sizes, spacings, and materials are selected. It includes data on how to deal with or avoid problems such as high static environments and noise, how to interlock the switches, and generally how to design reliable touch-switching systems. Included are curves and nomographs to aid in determining capacitances and the values of other design parameters. American Microsystems Inc., 3800 Homestead Rd., Santa Clara, Calif. 95051 [424]

A-d and d-a converter testing. An 8-page application note gives an overview of analog-to-digital and digital-to-analog testing with particular emphasis on the operation of the GenRad 2230 component test system. A sample test program for a 12-bit a-d converter is given along with a step-by-step explanation of the program. GenRad Inc., 300 Baker Ave., Concord, Mass. 01742 [425]

Handtools. Descriptions of electronic assembly and production aids, including thermal wire strippers, liquid

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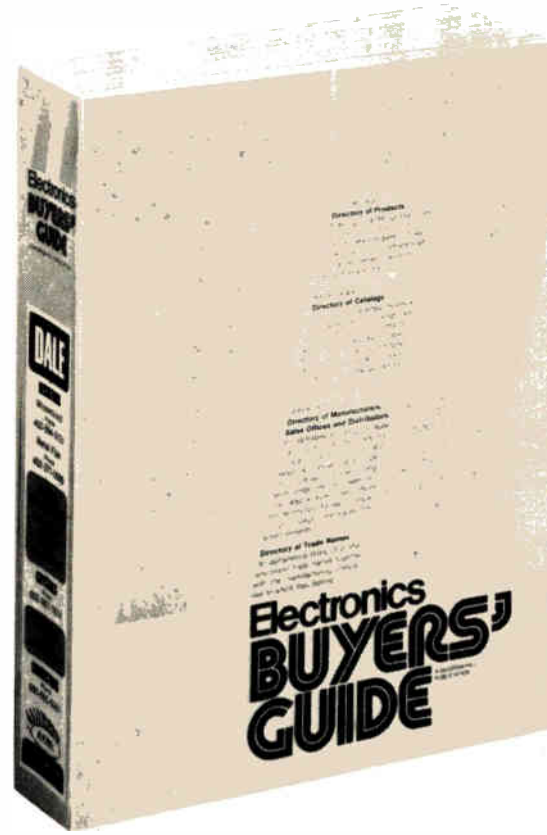

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New literature

spot masks, titanium printed-circuit finger-masking clips, and flux and solvent dispensers, are given in a 12-page catalog. It is available from Electronic Production Equipment Corp., P. O. Box 5238, Manchester, N. H. 03107 [426]

Analog components. A 48-page catalog contains basic application information, detailed electrical characteristics, dimensional drawings, and photographs of a line of synchros, resolvers, gimbal pickoffs, stepper motors, torque motors, ac and dc servo motors, and tachometers. The catalog also provides application data for both brush- and brushless-type units, and general information on torque motors, servo motors, and motor tachometers. Clifton Precision, Litton Systems Inc., Marple at Broadway, Clifton Heights, Pa. 19018 [427]

Semiconductor accessories. A 68-page catalog is intended for engineers, technicians, and buyers who specify or purchase heat sinks, insulators, mounting pads, sockets, or printed-circuit-board accessories. The heat sinks are indexed by case style, thermal performance, and part number. Heat-sink case styles include those designed for dual in-line packages, and assorted TO cases. Technical application notes are included, as are complete engineering drawings, thermal performance curves, photographs, and isometric illustrations. Dept. M., Thermalloy Inc., 2021 W. Valley View Lane, Dallas, Texas 75234 [428]

Centrifugal blowers. Technical information and schematics for ac and dc motor-driven centrifugal blowers are provided in an 84-page catalog. A separate section of technical notes covers such items as calculating required air flow, determining system pressure, and specifying the air mover. Electrical and mechanical design options for various air movers are given, along with information on dielectric and resistance tests. IMC Magnetics Corp., Marketing Division, 570 Main St., Westbury, N. Y. 11590 [430]

New products/materials

A water-soluble oil developed for use in automatic wave-soldering machines has a long life, low smoking characteristics, and a mild odor. Alpha 4004 is compatible with both water-soluble flux systems and aqueous cleaning systems for rosin fluxes. It is available in 54-gallon drums and 5-gallon containers.

Alpha Metals Inc., 600 Rte. 440, Jersey City, N. J. 07304 [476]

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Transene Co., Rte. 1, Rowley, Mass. 01969 [477]

A one-part electrically conductive coating will shield against radio-frequency interference, prevent electrostatic buildup, and serve in similar applications. X-COAT 200 can be sprayed, dipped, or rolled on to provide shielding of up to 50 dB at most frequencies. It has a resistivity of less than 5 ohms per sq. Available from stock, it sells for $75 a gallon.

Electro-Kinetic Systems Inc., 2500 Ridley Ave., Chester Pa. 19013 [478]

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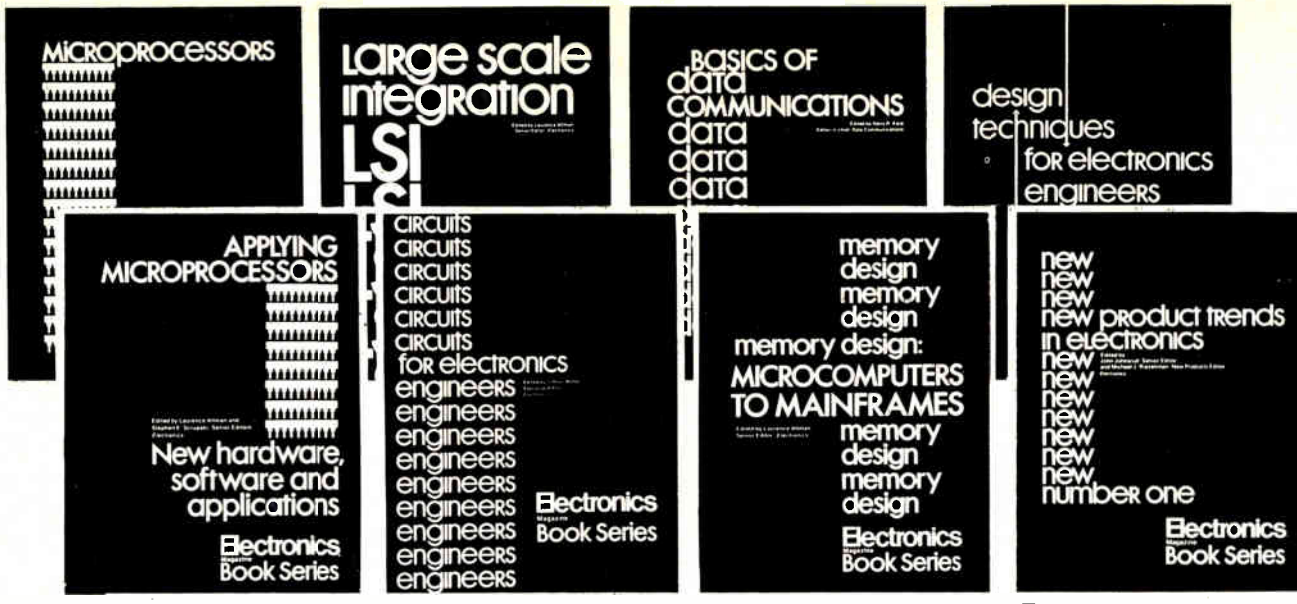

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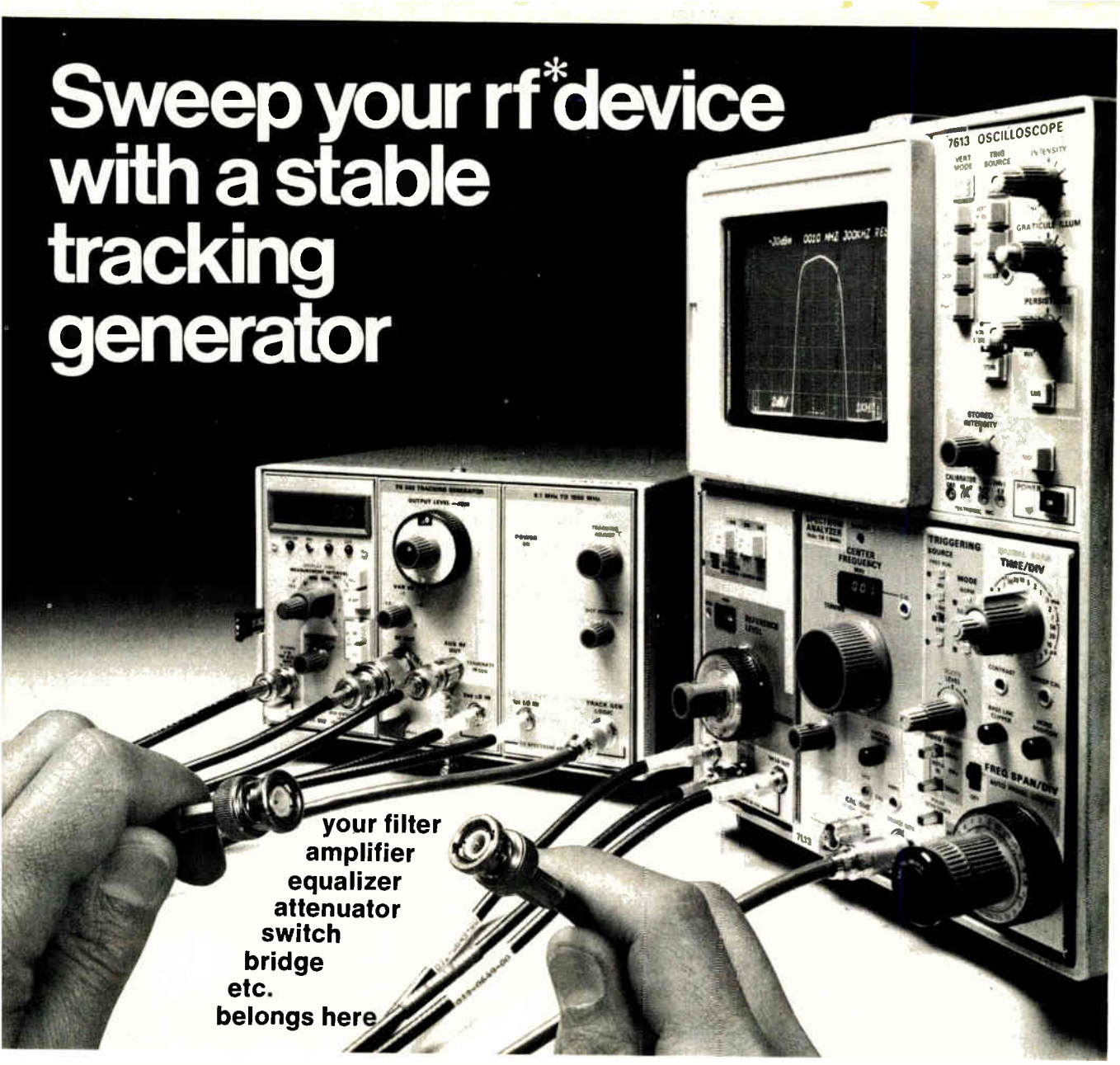

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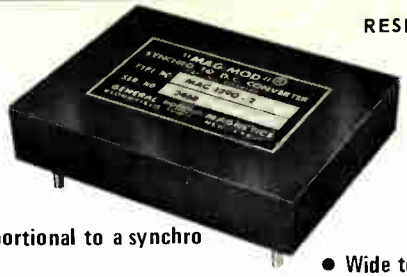

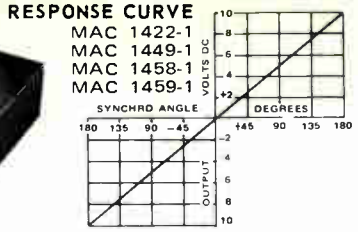

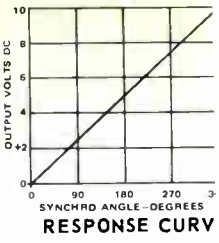

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FULL SCALE OUTPUT	±10V	±10V	±10V	±10V	+10V	+10V
OUTPUT IMPEDANCE	<1Ω	<1Ω	<1Ω	<1Ω	<1Ω	<1Ω
L - L INPUT IMPEDANCE	>10K	>30K	>2K	>10K	>10K	>30K
REFERENCE VOLTAGE (VRMS)	26	115	26	115	26	115
OPERATING TEMP. °C	–25 - +85	–25 - +85	–25 - +85	–25 - +85	–25 - +85	–25 - +85
D.C. SUPPLY	±15V	±15V	±15V	±15V	±15V	±15V
D.C. SUPPLY CURRENT	±75MA	±75MA	±75MA	±75MA	±75MA	±75MA
BANDWIDTH	10Hz	10Hz	OPT.	OPT.	10Hz	10Hz
WEIGHT	6 oz.	6 oz.	6 oz.	8 oz.	6 oz.	6 oz.
SIZE	3.6x2.5x0.6	3.6x2.5x0.6	3.6x3.0x0.6	3.6x3.0x1.0	3.6x2.5x0.6	3.6x2.5x0.6

A.C. LINE REGULATION

A new method has been developed which allows us to provide a low distortion highly regulated AC waveform without using tuned circuits or solid state active filters of any kind.

The result is a frequency independent AC output regulated to 0.1% for line and load with greater than 20% line variations over a wide temperature range.

FEATURES:

- 0.1% total line and load regulation
- Independent of ± 20% frequency fluctuation
- 1 watt output
- Extremely small size
- Isolation between input and output can be provided

Specifications: Model MLR 1476-1
AC Line Voltage: 26V ±20% @ 400Hz ±20%
Output: 26V ± 1% for set point
Load: 0 to 40ma
Total Regulation: +0.1%
Distortion: 0.5% maximum rms
Temperature Range: –55° C to +125°C
Size: 2.0" x 1.8" x 0.5"

Other units are available at different power and voltage levels as well as wider temperature ranges. Information will be furnished upon request.

High Precision Analog Multipliers

PRODUCT ACCURACY (MCM 1519-1) ± ½% OF ALL THEORETICAL OUTPUT VALUES OVER FULL MILITARY TEMPERATURE RANGE OF –55 C TO +125 C. ZERO POINT ERROR FOR ANY INPUT COMBINATION IS ± 2MVRMS

Features:

- No external trims required
- Distortion free AC output over entire dynamic range
- Linearity, product accuracy and zero point virtually unaffected by temperature
- All units are hermetically sealed and are not affected by external fields
- High analog product accuracy and wave quality allows dual multiplier assemblies to be matched with 1% of point over the specified temperature range
- Full four quadrant operation
- Package size, power supply requirements and other specs. may be altered to your exact requirements at no extra cost.

Specifications:

- Transfer equation: Eo=XY/10
- X & Y input signal ranges: 0 to ±10V PK
- Maximum zero point error (X=0; Y=0 or X=±10; Y=0 or X=0; Y=±10): 2MVRMS
- Input impedance: Both inputs 20K min.
- Full scale output: ±10V peak
- Minimum load resistance for full scale output: 2KΩ
- Output impedance: 1Ω
- Short circuit duration: 5 sec.
- Frequency response characteristics (both inputs) 1% amplitude error: DC to 1200 Hz (min.) 0.5 DB Amplitude error: DC to 3500 Hz min. 3 DB point: Approx. 10K hz Roll off rate: 18 DB/octave
- Noise Level: 5MV PK-PK @ 100K Hz approx.
- Operating temp. range: See chart
- Storage temperature range: -55°C to +125°C
- DC Power: ±15V ±1% @ 30MA
- Dimensions: 2" x 1.5" x .6"

Type No.	Product Accuracy	Operating Temperature Range
MCM 1519-1	0.5%	–55 C +125 C
MCM 1519-2	0.5%	–25 C +85 C
MCM 1519-3	0.5%	0 C +70 C
MCM 1520-1	1.0%	–55 C +125 C
MCM 1520-2	1.0%	–25 C +85 C
MCM 1520-3	1.0%	0 C +70 C

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