MARCH 24, 1981

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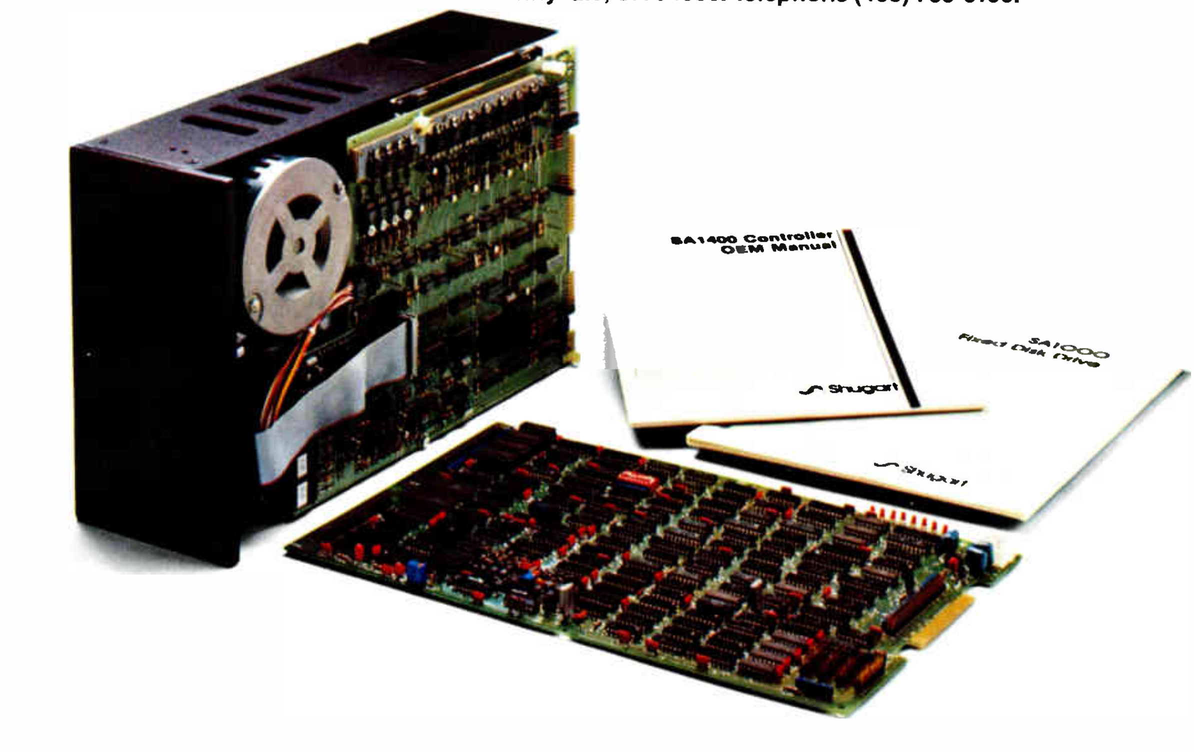

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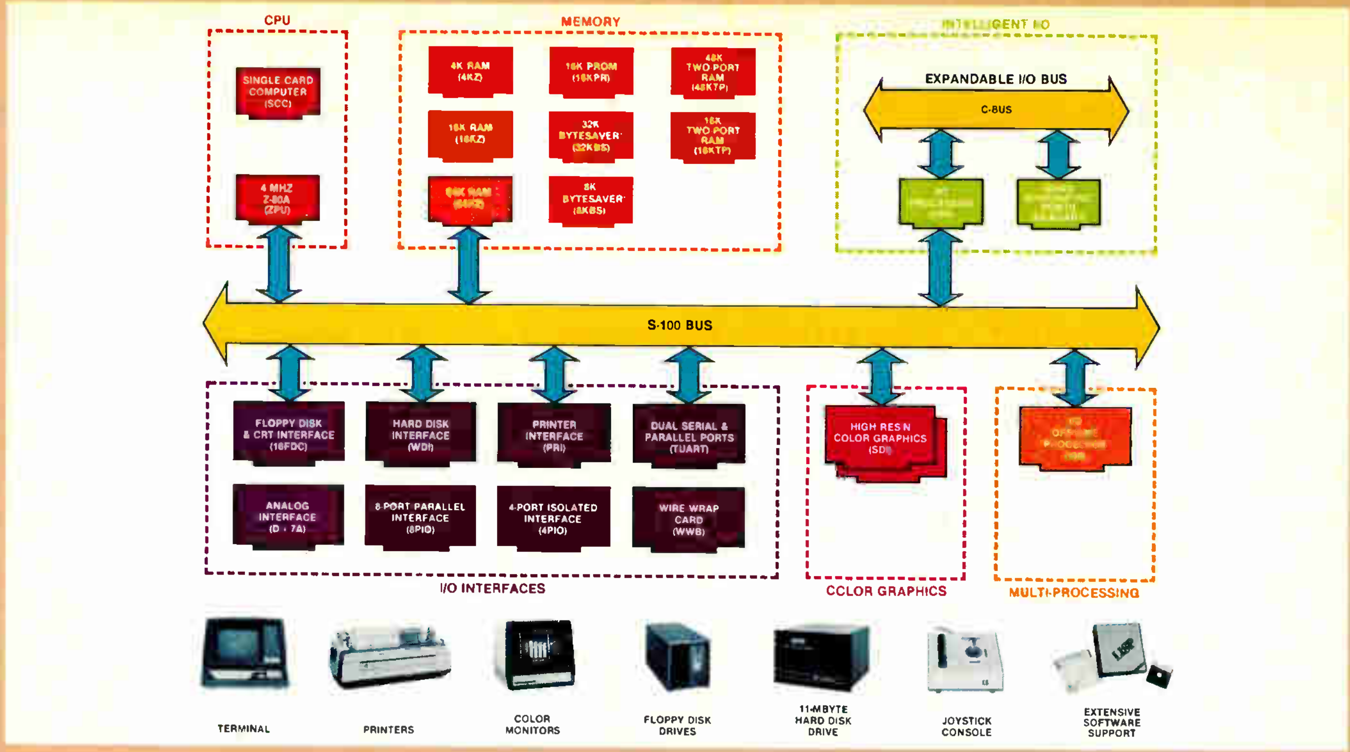

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Electronics

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Electronics

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Highlights

Cover: Unix operating system keeps winning adherents, 119

The Unix operating system, written by Bell Laboratories, is being adopted by so many firms that it could well be on the way to becoming an industry standard. Two articles illustrate the implementation of a Unix-based operating system. The first discusses the adaptation of the Bell operating system to a software development system for the 16-bit Z8000 (p. 120). The second explains an original implementation for PDP-11 and LSI-11 computers that looks identical to Unix to the programmer (p. 125).

The cover construction is by Robert Strimban.

Users take to data bases that know how to relate, 102

Relational data-base management systems—those that organize and access large groups of interrelated files—are gaining popularity, thanks to their two key advantages over other types: simplicity and flexibility. IBM is the most recent of some dozen firms to offer such software for mainframe computers, and a number of new firms have written or are working on relational data-base packages for small computers.

Company's standards supplement IEEE-488, 131

The Institute of Electrical and Electronics Engineers' standard for interfacing instruments with computers is finding a ready reception in the commercial world, but IEEE-488 does not go all the way in specifying how to use the bus. Undefined are the language sent over it and how the physical communications system is to be employed. One instrument maker has devised a set of standards for its own use that fill this void and may help others.

Electro/81 shows the Northeast's strength, 141

The success of this year's Electro show and exhibition, to be held in New York, April 7–9, the largest one yet, is indicative of the Northeast region's continued vitality as a center of electronic high technology, says this preview, which also discusses the major technical papers that will be given.

C-MOS a-d converter works with most microprocessors, 150

Given the spread of microprocessors in the analog world, an analog-to-digital converter chip that interfaces easily with almost all microprocessors is a welcome arrival. This successive-approximation device can be used in 12-bit applications and offers the low power of complementary-MOS as well.

And in the next issue . . .

A new multifunction analog integrated circuit . . . private branch exchanges for voice and data: a special report . . . a sophisticated color graphics control IC . . . low-cost rf power transistors . . . a complementary-MOS single-board computer that is compatible with the Multibus.

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53 REV. ORIG.

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Publisher's letter

Variants of Bell Laboratories' Unix operating system are turning up with increasing frequency in the microelectronics field. If you doubt that, turn to page 119 for the introduction to a pair of technical articles that detail two such versions: Zilog's Zeus for its Z8000-based development system and Whitesmiths' user-transparent Idris. Our software editor, Colin Johnson, who edited the articles, expects that Unix interest will spread.

But does the spread of the operating system and its programming language, C, surprise their authors, Ken Thompson and Dennis Ritchie of Bell Labs in Murray Hill, N. J.? In a way, no, says Ken, for the key event was their spread to the universities in the mid-1970s, about five years after work on Unix began.

The Unix operating system is well suited to academic problems, he says. "It was sort of courageous of these people to abandon manufacturer-supported operating systems and take up this undocumented system." With students introduced to Unix and C, it's not surprising that now it's beginning to pop up in the microprocessor system world, he notes.

The academic orientation of Unix also suits it to smaller computer systems for business and professional uses, say its authors. "But it's not going to take over with mainframes running large numerically oriented programs," Dennis says.

The personal computer is fast on its way to becoming as vital an engineering tool as the hand-held calculator. In recognition of this fact, we are inaugurating a new occasional feature in Engineer's Notebook, which we're calling Computer Notes. The inspiration is, of course, our Calculator Notes, but since we've moved up a level or so in complexity, we're looking for hardware ideas as well as software tips for the popular machines.

"Actually, we're been running notebooks on personal computers all along," says Vince Biancomano, our circuit design editor. "It's just that now we've decided to call them out." In the March 10 issue, for example, Peter Bradshaw advised on adapting a personal computer for data acquisition. This issue, on page 163, we have Michael A. Wyatt's program for calculating inverse LaPlace transforms and plotting them with the Apple II.

"I do want to stress that programs should be about 100 lines maximum—more won't fit on a page," says Vince. "Also, they should be aids for the engineer in his work, not recreational programs." So fall to, out there, and remember we pay $75 for each article published.

For our annual Electro preview, we take a look at the electronics business in the Northeast and find it surprisingly vigorous and growing. The show itself—April 7 to 9 in New York—is the biggest since it started alternating between New York and Boston. The preview, which also reviews Electro's technical sessions, begins on page 141.

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Readers' comments

Fixing Fortran

To the Editor: Wolfgang Nooss makes some debatable points in "Adapting Fortran to top-down programming" [Dec. 4, p. 150].

First, he connects the rule "never use a GO TO statement" to structured programming. But it is well known that structured programming does not mean programming without GO TO statements. The key is to use the Fortran GO TO statements and their related statement numbers only in a disciplined fashion—that is, to implement only the structured programming constructs: IF . . . THEN . . . ELSE, DO . . . WHILE, REPEAT . . . UNTIL, FOR . . . I, REPEAT . . . EXIT, CASE, and so on.

Secondly, as far as "the extra time the structured programming code takes to write" is concerned, it is my opinion that Mr. Nooss has introduced an incorrect structured programming strategy. Implementing it by subroutines wastes program execution time, takes up additional memory, and, as the author points out, decreases the programmer's overall performance.

I suggest that it would be more suitable for real-time applications and program readability to take the usual approach to structured programming in Fortran and use versions of the language that have been designed for it.

Gregory Prokter
Haifa, Israel

■ **The author replies:** *Many people seem to like dear old Fortran. We all feel that much can be done to keep this popular instrument up to date. In 1976 J. L. Wagener suggested "structured Fortran—an evolution of standard Fortran" as an extended, upwardly compatible compiler because he considers what Mr. Prokter calls "the usual approach to structured programming in Fortran" to be only an interim solution to the situation.*

For those who cannot utilize a new compiler, I tested in the direction of downward compatibility (something I call poor people's security structuring), with CALL . . . WHILE (ON, SUB, and so on) as an ordinary Fortran statement and with the subroutine's name as a block identifier that frees the designer from "thinking deeper" during top-down program design.

This approach did not "decrease the programmer's performance" if test and maintenance are taken into account. The additional computation time is a compromise, like a safe but slow vehicle. In microcomputers, saving computation time often produces nothing but more idling.

I agree that disciplined programmers can afford to use GO TO, but will others resist the temptation of the statement numbers in such a program when they have to alter it? Breaking the task into so many extremely small subroutines is a radical cure, indeed. With real-time applications it can be necessary to step backward from transparency toward efficiency. But that is usually done by rigorously writing critical parts of the program in the assembler.

Wrong division

To the Editor: The consumer section of the Technology Update issue [Oct. 23, 1980, p. 214] indicated that the Project Green Thumb terminal was designed by the Motorola Communications division.

In fact, that effort was directed by the Consumer Strategic Marketing division of the Motorola Semiconductor Group in Phoenix.

Don Sheppard
Motorola Semiconductor Products Inc.
Phoenix, Ariz.

In more ways than one

To the Editor: In response to the Publisher's Letter on the Ada programming language [Feb. 10, p. 6], it is perhaps noteworthy that Jean Ichbiah, the originator of Ada, is reported to see Ada as "the last computer language." As Ada is designed especially to meet the needs of the U. S. Department of Defense and as the needs of the Department of Defense are to wield weapons of awesome power, Ichbiah's predictions may well come true in a way rather more unfortunate than originally intended.

William F. Clocksin
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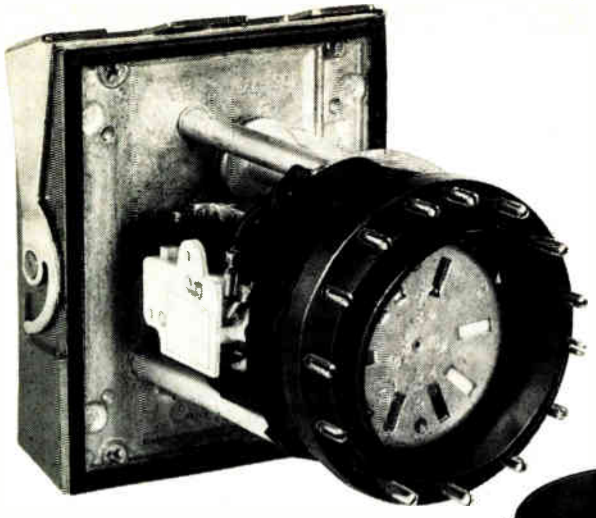

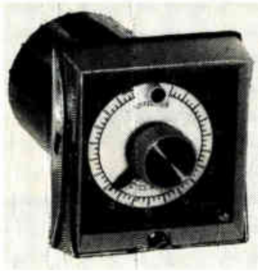

News update

■ Less than a year after its creation, Telesensory Speech Systems is out of the chute and running with a speech synthesis product for original-equipment manufacturers. Of course, the Palo Alto, Calif., operation has a built-in advantage: it is a division of Telesensory Systems Inc., which has been building end-user talking systems, primarily for the blind.

The parent company wants to take advantage of the proliferation of uses for speech synthesis technology, so it set up its new division last summer [*Electronics*, July 31, 1980, p. 14]. The new operation plans to exploit Telesensory Systems' linear-predictive-coding technology that synthesizes high-quality, humanlike speech. Thus, its first product is a programmable talking board.

More coming. Designated the Speech 1000, the board has a large vocabulary with a typical data rate of 2,200 bits a second, allowing it to deliver 3½ to 5 minutes of synthesized speech in either a male or female voice [*Electronics*, March 10, p. 33]. Already, the division has developed a prototype of a text-to-speech board, a complex stand-alone unlimited-speech system peripheral, says Gabriel F. Groner, vice president and general manager of the division.

Slated for mid-1982 availability, it will incorporate a dictionary of 1,500 exceptional words that do not follow typical phonetic rules, he notes. "Although this first-generation product produces highly intelligible speech, it does not sound completely natural."

The next step in the development program will be products "that will ultimately allow real-time generation of natural, human-sounding speech from character-storing input," Groner says. The first will let Speech 1000 users create individual words in the same voice used for their original vocabularies encoded by Telesensory Speech Systems. Next will come a similar product that will allow development of naturally inflected phrases, and then the firm will produce a second-generation text reader that will generate real-time speech as a natural-sounding voice. **-Christina Lindauer**

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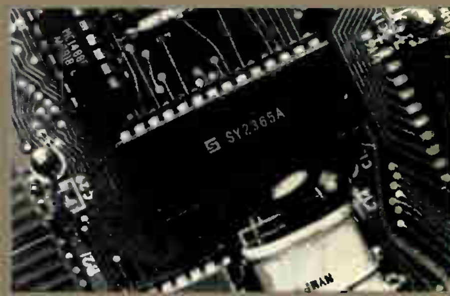

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People

Prothro may lead Mostek into custom-logic gate arrays

Don't be surprised if Mostek Corp. starts showing up in custom-logic gate-array markets, hints Charles V. Prothro, recently named chairman of the United Technologies Corp. subsidiary. That could be one of the results of Mostek's involvement with UTC's Microelectronics Center in Colorado Springs, Colo.—work that Prothro sees as fulfulling a duty to the parent company and "giving us terrific leverage with our existing customer base."

Traditionally, the Carrollton, Texas, MOS maker has dealt in high-volume, commodity markets. "One of the big pluses of last year's UTC acquisition is that the strategy of Mostek is unchanged," says the 38-year-old Texan, a former production planner at Texas Instruments Inc. He joined TI after receiving a Harvard master's degree in business administration and a bachelor's in industrial engineering from Stanford.

The UTC deal was forged by then-chairman L. J. Sevin, founder of Mostek, who in late 1979 was fighting an unfriendly takeover bid by Gould Inc. UTC took on the role of white knight and also took over Mostek. Prothro, who was president, was later promoted to chairman after Sevin's resignation in January.

"We leaders at Mostek and UTC have converted a potential negative in the early days of the acquisition into a positive," says Prothro, referring to the present relationship between his company and the Hartford, Conn., conglomerate.

A key element in the hands-off approach, says Prothro, has been the creation of the center in Colorado, which now reports to the new Mostek chairman. The center, opened in June 1980, serves the internal needs of UTC divisions by designing parts.

"As I said, you've got to be a realist, and if the center is not a success, it will reflect badly on Mostek because it's our people and our process," he states. "United Technologies needs access to the semiconductor-processing technology we have at Mostek, and it needs access to people who know how to hire the computer-aided design specialists to make gate array programs successful," explains Prothro, who has been with the firm since its creation in 1969. "Gate arrays use complementary-MOS. We, of course, know about C-MOS, but gate arrays are a low-volume product—something we have not been into."

But therein lies the advantage of the custom-logic gate-array project: "It will give us much closer ties with existing customers. That's why I say it's feasible. It has the advantage of serving UTC needs as well as Mostek needs," says Prothro.

Interstate's Hoffman sees three major growth areas

Moving to operations vice president for systems of Interstate Electronics Corp. of Anaheim, Calif., gives Jim Hoffman a "fivefold expansion of view and a change of overview," altering his concern about one division to "looking for a balanced position instead of having a parochial, short-term outlook."

In his new post, he will be in charge of the five operations of Interstate, his employer for the past five years. Hoffman, who received his Ph. D. in physics and bachelor of

Delay. Hoffman of Interstate does not see very low-cost plasma soon.

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Circle 15 on reader service card

science in engineering from the University of Kansas, sees military equipment, plasma displays, and voice recognition as the major growth areas over the near term, but advanced systems and display products will also get attention.

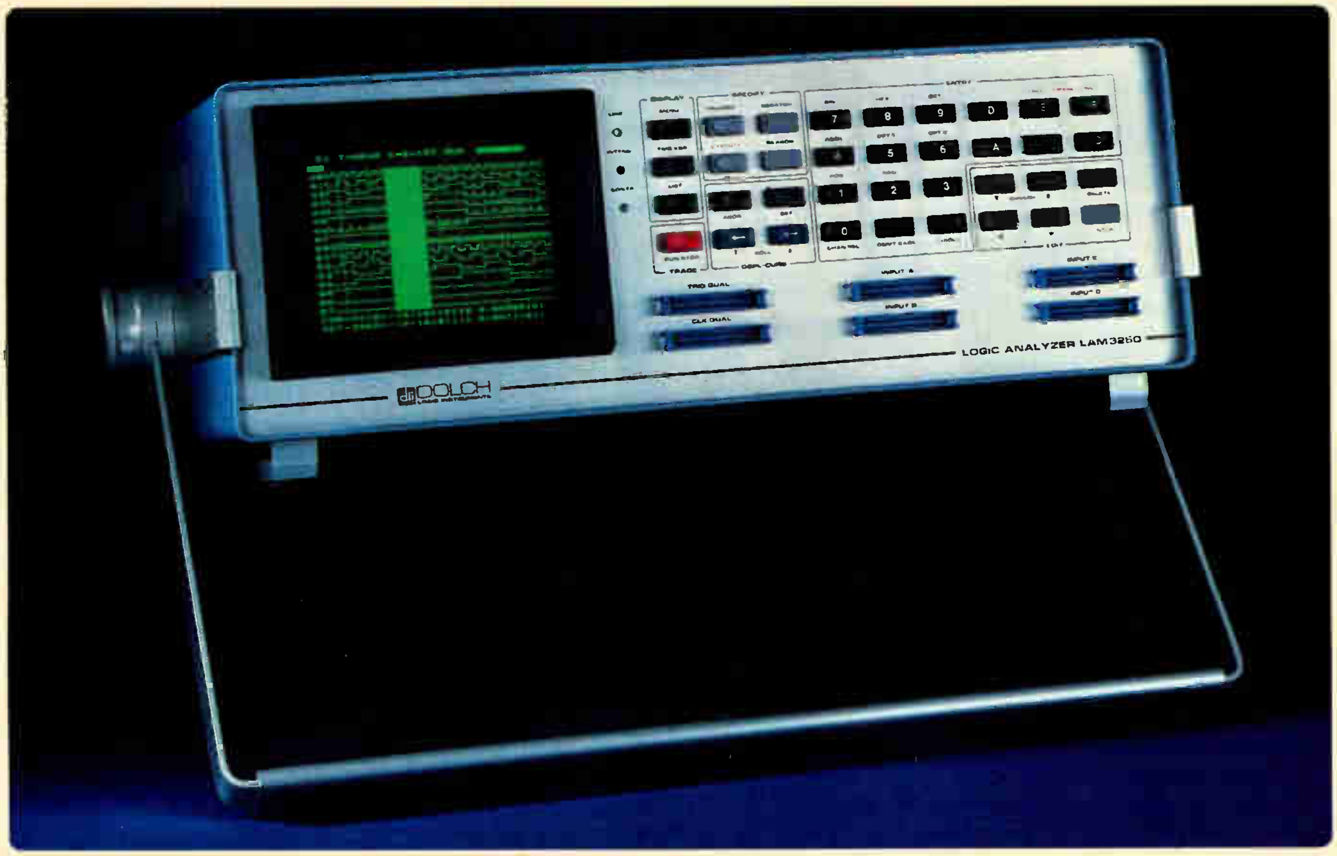
Too high. Although Interstate is a key U. S. supplier of plasma displays, Hoffman feels that it will be years before industrial and military developments will lower the cost of plasma significantly, and he also "doubts seriously whether they'll ever reach $200 to $300 for consumer applications." Another drawback to widespread use of plasma is the lengthy development cycle anticipated for color displays.

On the bright side, however, Hoffman believes that "plasma will replace black and white cathode-ray tubes for full military requirements" in a short time. Interstate's sales in that area should exceed $10 million in about two years, he says.

Developments in voice recognition are expected to be a major factor in diversification into commercial markets. Although speaker-independent, conversational chips are a long way off, Interstate now has a limited-vocabulary chip set and markets board-level systems. Hoffman thinks that the market at the current state of the art is huge and predicts rapid growth as prices drop.

Hoffman anticipates heavy use of voice recognition in computer-aided design and for terminals in such high-intensity areas as airport control towers, because both applications require much concentration and can benefit from the quickness and accuracy of voice commands.

Military contracts, once Interstate's only business and still about three quarters of its sales, appear promising under the Reagan Administration. Interstate has several ongoing contacts and expects to be included in the new push in defense spending. "But I hope they don't dump a lot of money into defense," Hoffman says. "I'd rather see a more rational approach instead of throwing out a lot for a couple of years and seeing it drop off again for the next two." □



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Dolch Logic Instruments' third generation logic analyzer, the LAM 3250, lets you meet your troubleshooting needs now, and expand for the future. The LAM 3250 records up to 32 channels of information at sampling rates to 50 MHz, and with optional Channel Expansion Probes, its capability can be extended to 64 channels. And there's more.

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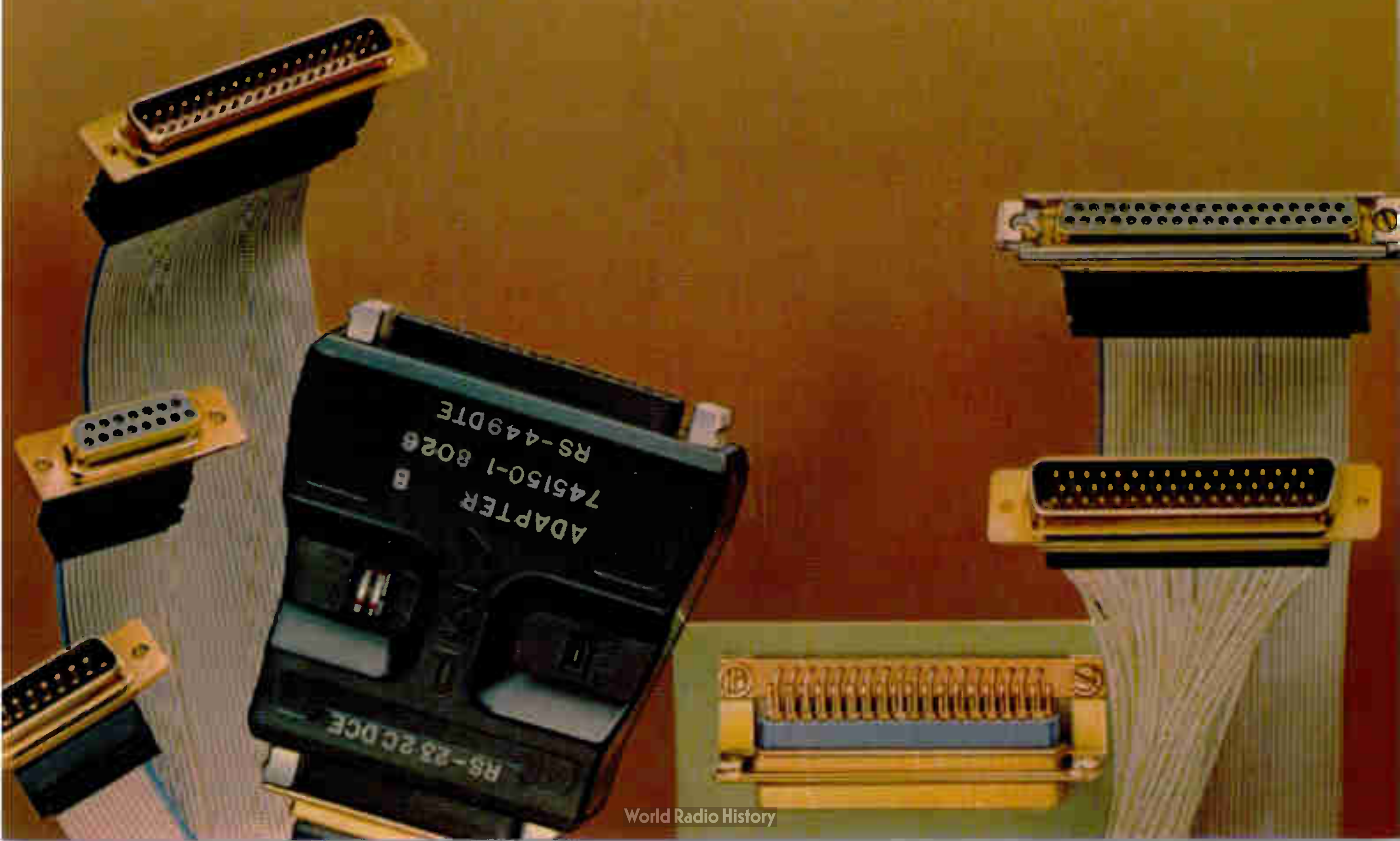

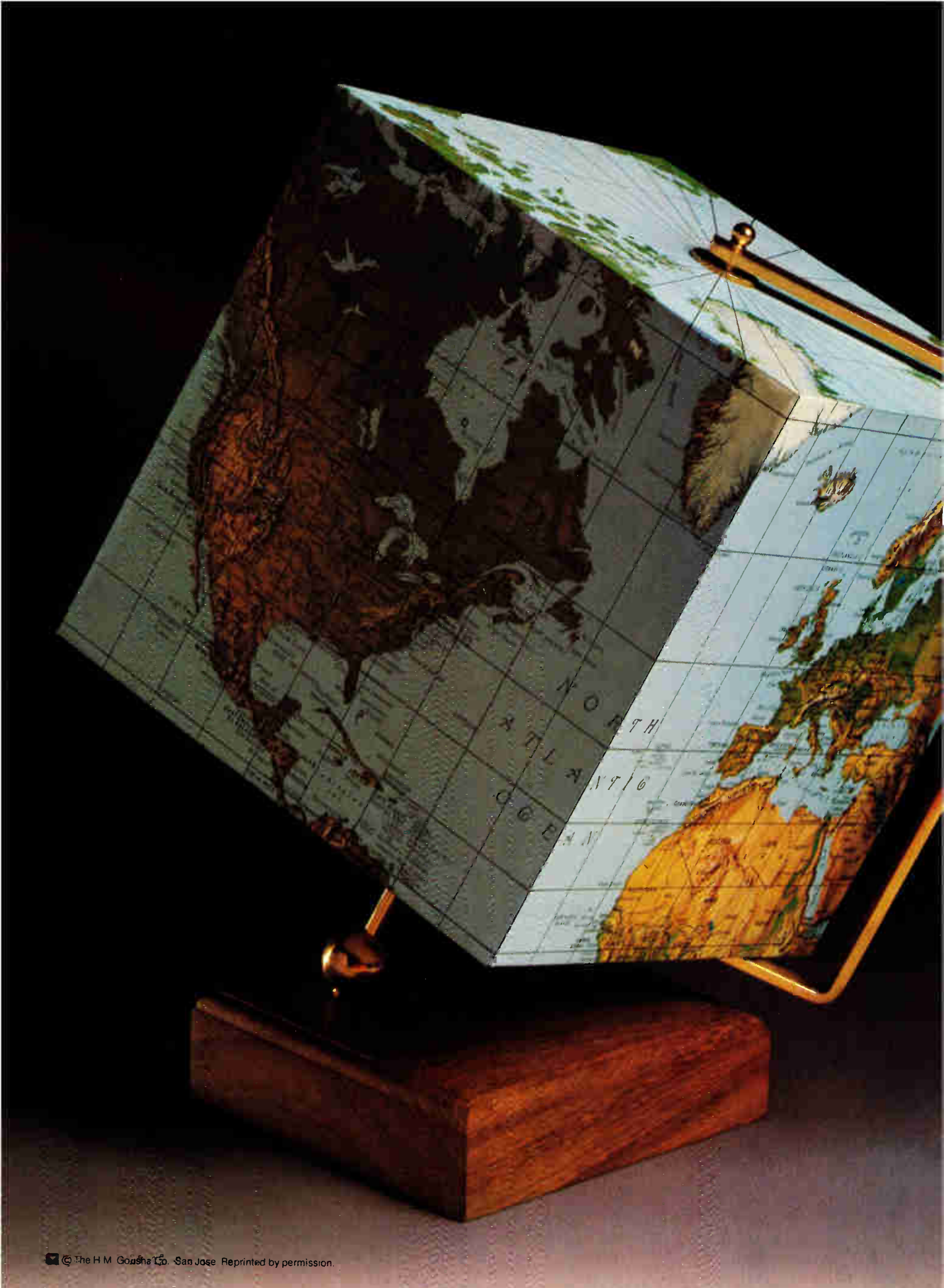
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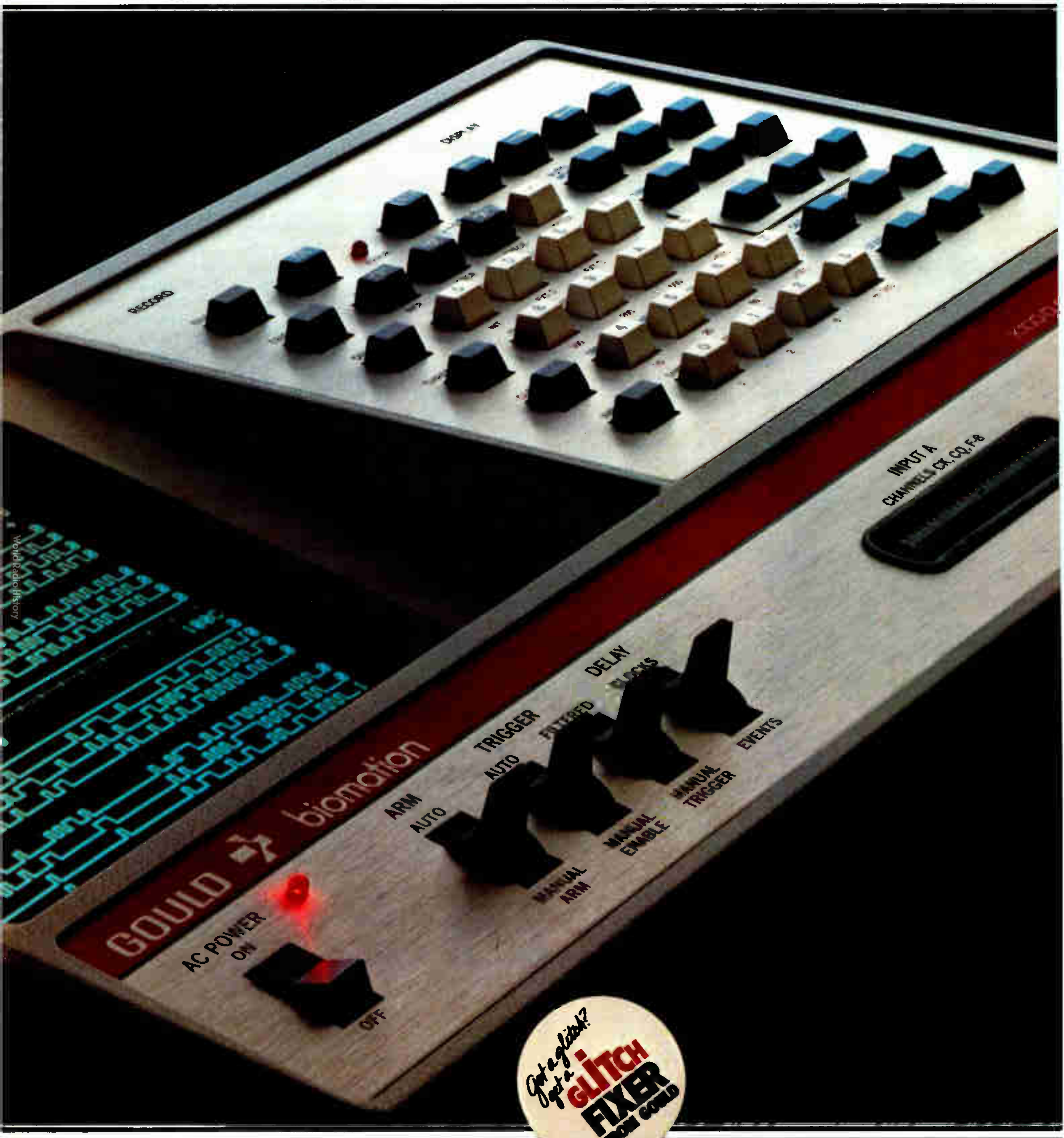

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The final analysis.

To help you evaluate these two fine instruments before you buy, we've prepared a point-by-point *competitive comparison* of the two. If you're designing and debugging high-performance digital systems, you'll want to read this document carefully. To get your free copy, just use the reader service number or write Gould Inc., Biomation Division, 4600 Old Ironsides Drive, Santa Clara, CA 95050. For faster response, call 408-988-6800.

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Speed: to 20 MHz
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Memory: 256 words
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Speed: to 100 MHz
Resolution: 10 ns
Memory: 1024 words
Channels: 16 timing or 16 data, or 32 data

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Quality is a design parameter

The quality issue in the semiconductor and computer industries is being settled—not from atop soap boxes, but from executive offices, fabrication lines, production floors, and shipping desks. American companies challenged by Japanese producers to compete on quality as well as performance are doing just that. The results are bound to be healthy for all concerned.

Quality is good business because it contributes to profits and raises competition to a new level. Price alone, although it will always be important, is not the driving force it used to be.

Today, quality plus performance is a vital part of the product value equation. Companies are no longer content to "test in" quality or reliability. Now the objectives are to design in quality, as well as ways to predict reliability, starting at the drawing board.

As an executive at Texas Instruments points out in the story on that company's quality-reliability program (p. 95), when parts are returned by customers it is too late to fix a quality problem. To make quality a competitive tool, in TI's view, it is necessary to seek out indicators that can be read before shipment.

If the task becomes a common practice, it will in large part be the responsibility of the design engineering functions. It means very close relations with customers, not only at the purchasing level, but also at the engineering level. What's more, it means tracking quality from design to shipping and tweaking quality levels at each stage.

There are situations in which changing a test specification at outgoing inspection to improve quality actually causes a drop in yield. But if a performance specification is tightened as a result, yield not only recovers, but improves. The resultant devices exhibit performance test results that are tightly spaced in the middle of the test parameters rather than scattered. Confidence that there will be fewer or even no defects in a lot increases. Testing is reduced. Cost savings mount.

For those companies in which programs are supported from the top, where everyone is involved and everyone understands the new expectations, these are exhilarating times indeed. For many years the objective was simply, "Ship it." Now it's, "Ship it right the first time."

How to stagnate while growing

In the U. S., baseball teams head for Florida or Arizona and electronics engineers head for Electro. But in France, spring means it's time for Composants—le Salon International des Composants Electroniques, to give it its proper title—at the Porte de Versailles. Composants is a get-together, a sales meeting, and a curiosity, as our European editors point out in their preview of the 1981 show on starting page 99.

This year, however, those gathering at the site in suburban Paris will have to temper their spring joyousness because Europe has not been able to escape the global hard times affecting the growth of electronics markets. Interestingly, electronics component makers will not face the slumps that their bretheren in the traditional industries—steel, textiles, autos—must handle but actually will see a certain amount of growth. Still, this is not enough in electronics, where investment for innovation demands a high growth rate. As one executive says, "We can function only when the market is expanding by 15% to 20% a year."

Electronics is one of the few industries in this world that can stagnate while growing—a sobering fact for those planning expansion.

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Meetings

IOCC '81—Third International Conference on Integrated Optics and Optical Fiber Communication, IEEE and Optical Society of America, Hyatt Regency Hotel, San Francisco, April 27–29.

ISCAS '81—1981 IEEE International Symposium on Circuits and Systems, IEEE, Radisson Chicago Hotel, Chicago, April 27–29.

29th Annual National Relay Conference, National Association of Relay Manufacturers and the School of Electrical Engineering, Oklahoma State University (Engineering Extension, 301 EN, Oklahoma State University, Stillwater, Okla. 74078), OSU, April 27–29.

1981 International Tool and Manufacturing Engineering Conference and Exposition, Society of Manufacturing Engineers (P. O. Box 930, Dearborn, Mich. 48128), Cobo Hall, Detroit, April 27–30.

1981 National Design Engineering Show and Conference, American Society of Mechanical Engineers (Clapp & Poliak Inc., 245 Park Ave., New York, N. Y. 10167), McCormick Place, Chicago, April 27–30.

Powercon 8—International Power Electronics Conference, Power Concepts Inc. (P. O. Box 5226, Ventura, Calif. 93003), Loews Anatole Dallas Hotel, Dallas, April 27–30.

27th Annual International Instrumentation Symposium, Instrument Society of America (P. O. Box 12277, Research Triangle Park, N. C. 27709), Hyatt Regency Hotel, Indianapolis, Ind., April 27–30.

Society for Information Display International Symposium, SID (654 N. Sepulveda Blvd., Los Angeles, Calif. 90049), Grand Hyatt Hotel, New York, April 27–May 1.

26th National SAMPE Symposium and Exhibition, Society for the Advancement of Material and Process Engineering (P. O. Box 613, Azusa, Calif. 91702), Hyatt Hotel, Los Angeles Airport, Los Angeles, April 28–30.

12th Annual Pittsburgh Conference on Modeling and Simulation, School of Engineering, University of Pittsburgh (Modeling and Simulation Conference, 348 Benedum Engineering Hall, University of Pittsburgh, Pittsburgh, Pa. 15261), University of Pittsburgh, April 30–May 1.

NCC '81—National Computer Conference and Personal Computing Festival, American Federation of Information Processing Societies (P. O. Box 9658, 1815 N. Lynn St., Arlington, Va. 22209), McCormick Place, Chicago, May 4–7.

PICA/81—12th Power Industry Computer Applications Conference, IEEE Marriott Philadelphia, Philadelphia, May 5–8.

AAMI 16th Annual Meeting and Exhibit, Association for the Advancement of Medical Instrumentation (1901 N. Fort Myer Dr., Suite 602, Arlington, Va. 22209), Sheraton Washington Hotel, Washington, D. C., May 10–13.

The European Consumer Electronics Show, Industrial and Trade Fairs Ltd. (Radcliffe House, Blenheim Court, Solihull, West Midlands B91 2BG, England), Nuremberg, West Germany, May 10–13.

34th Annual Conference, Society of Photographic Scientists and Engineers (7003 Kilworth Lane, Springfield, Va. 22151), Grand Hyatt Hotel, New York, May 10–14.

CICC '81—Custom Integrated Circuits Conference, IEEE, Americana Hotel, Rochester, N.Y., May 11–13.

31st ECC—Electronic Components Conference, EIA and IEEE, Colony Square Hotel, Atlanta, May 11–13.

Intermag 81—International Magnetics Conference, IEEE *et al.*, Alpes-Congrès, Grenoble, France, May 12–15.

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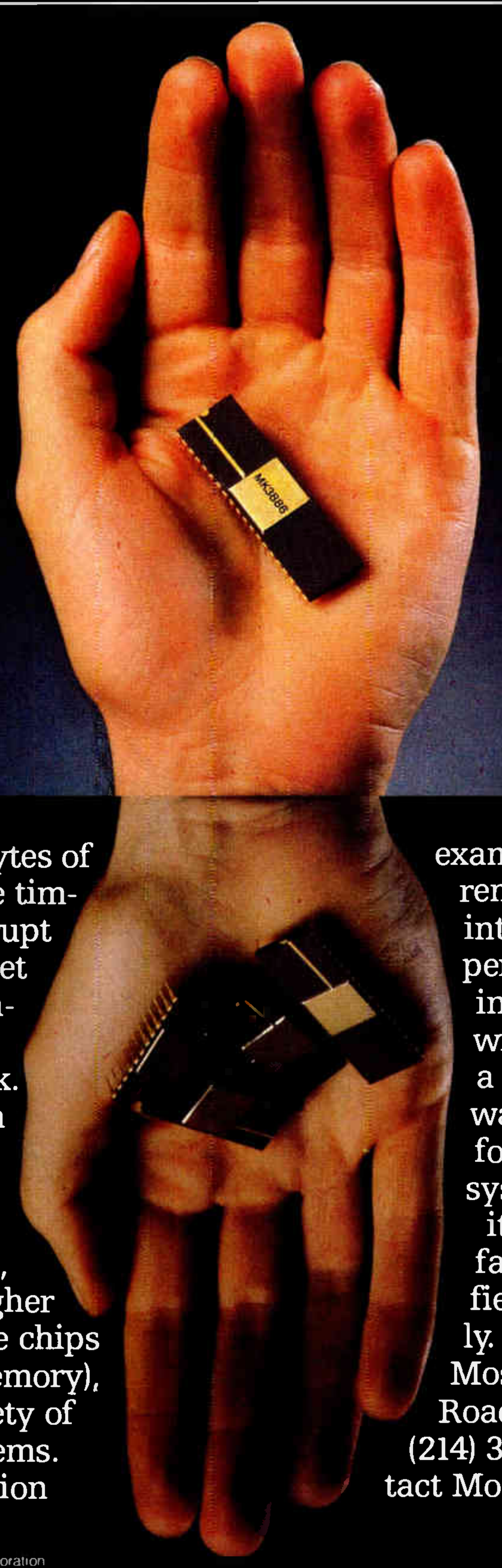

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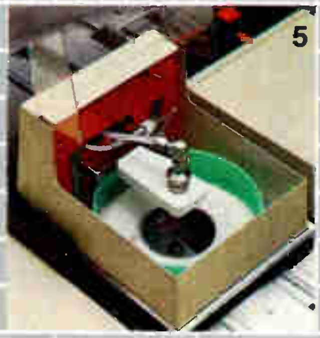

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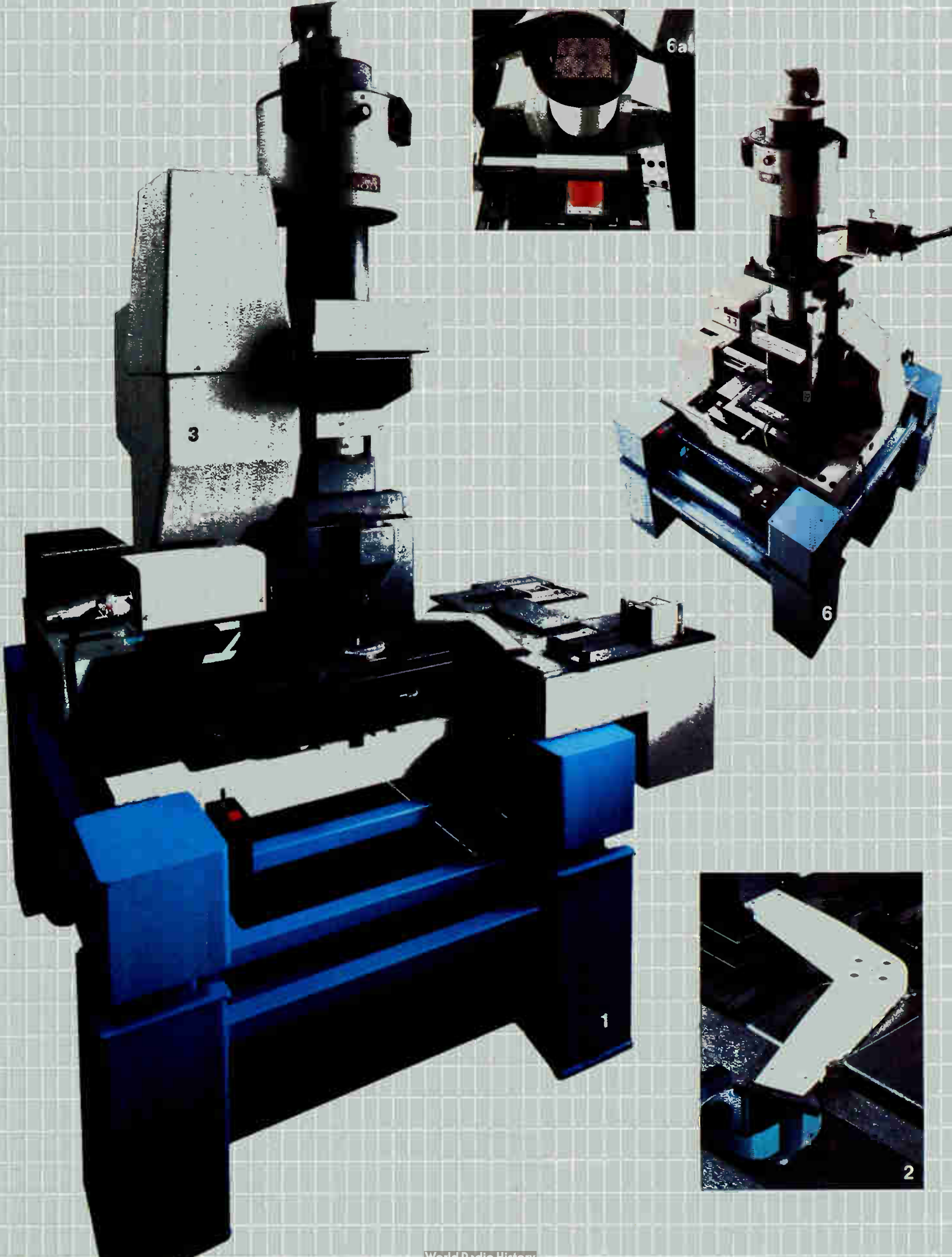
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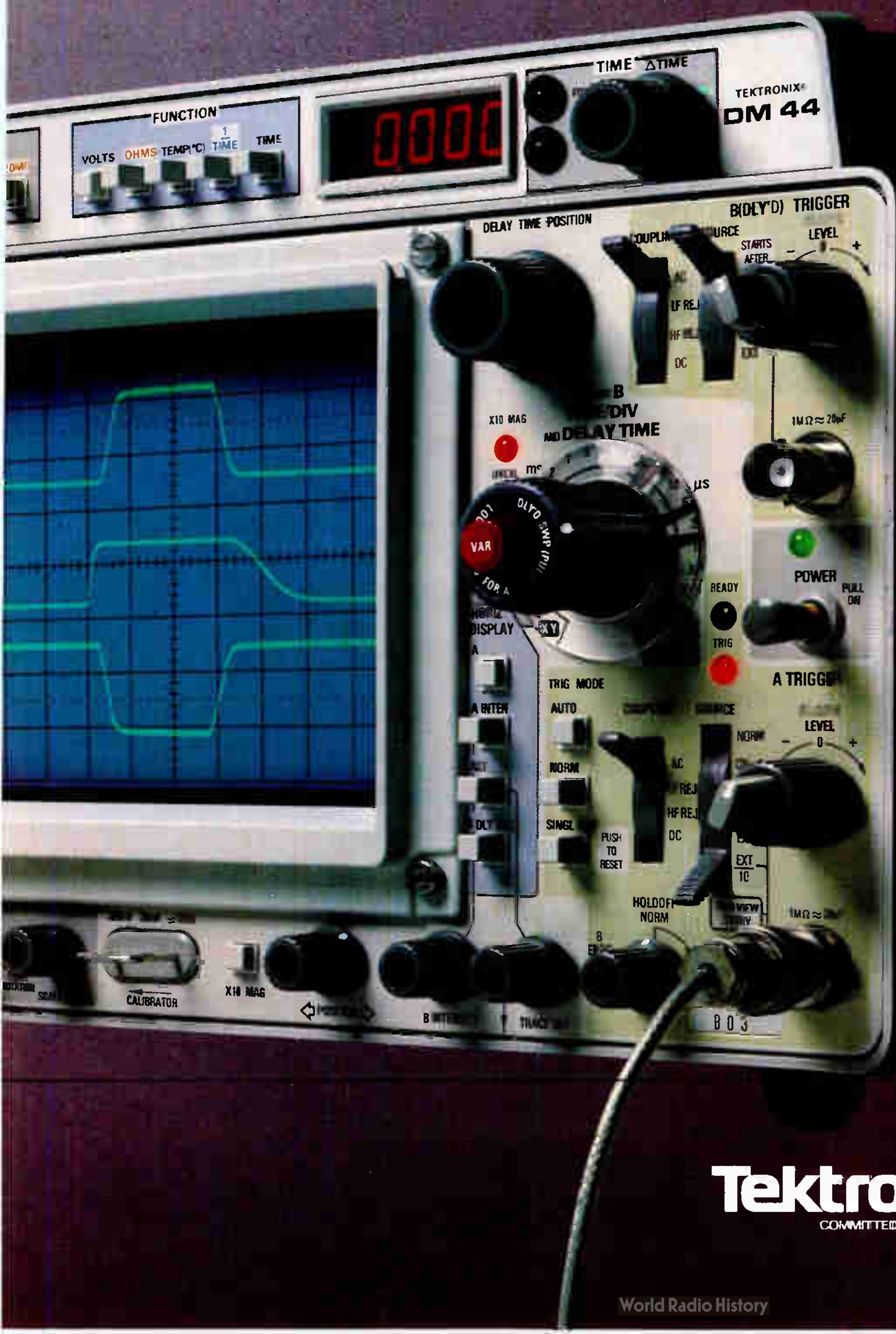

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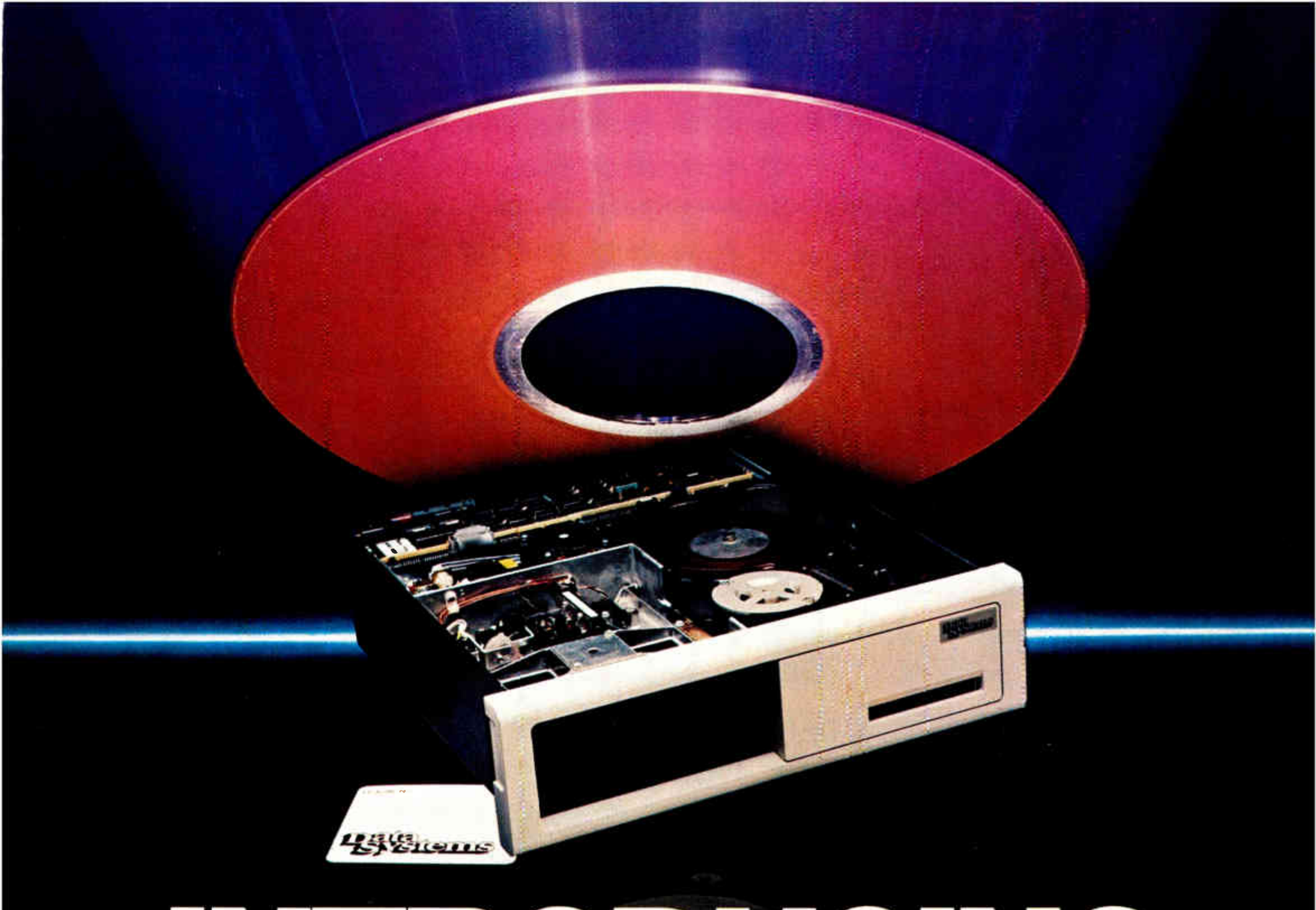

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Circle 32 on reader service card

DEC readies 'KO' in personal computers

Digital Equipment Corp. is moving quickly toward its long-expected entry into the personal computer market now dominated by Apple Computer and Radio Shack. Observers say that the computers could be on the market by 1981's third quarter and that DEC's moves will be carefully timed **to acquire a major share of market before the Japanese enter the domestic personal computer field.** The effort, called "Knockout," or "KO," by the Maynard, Mass., firm, involves developing several small system configurations with code names like Mighty Mouse and Tiny. Systems with varying amounts of main and bulk memory are being readied and compared; one would use 5¼-in. soft disks, others 8-in. floppies. Two Winchester disk configurations are also reported to be under study. Industry observers say that DEC is considering using the CP/M operating system, indicating that DEC's initial entries would be 8-bit machines.

Osborne tackles low-cost computers

Formerly a publisher of books on microprocessors and systems, Adam Osborne has founded his own company, Osborne Computer Corp., to compete in the low-cost computer market. His first entry, to be announced next month and to be shown May 4–7 at the National Computer Conference, **is a Z80-based system that is portable and incorporates an unusually large number of features** in a $1,795 package. The Osborne I computer system will include a CP/M operating system, two 100-K-byte minifloppy-disk drives, keyboard, numeric keypad, and 5-in. cathode-ray tube, as well as the WordStar word-processing system. It will support CBasic and MBasic and will also have RS-232 and IEEE-488 interfaces. Options are a modem; battery pack; 12-in., 80-column display; and double-density, dual-sided floppy disks.

Alphas spread to bipolar RAMs

Chip makers hoping to crack the market for 64-K MOS dynamic random-access memories have been forced to apply polyimide coatings to protect against alpha radiation. Now, surprisingly, the same may be happening with bipolar RAMs—TTL and emitter-coupled-logic—at the 4-K density levels. Alpha-induced soft errors are causing problems with these devices, says an official at one major Midwestern computer company. **Chip vendors are "taking too long to recognize they are going to need a coating,"** he complains, though he does report that several have begun supplying some coated 4-K bipolar parts. However, several Silicon Valley sources say they know of no such problems.

Thin-film 5¼-in. drive doubles load

Just as it is reaching volume production levels of its pioneering 5¼-in. Winchester disk drive, the ST 506 [*Electronics*, June 19, 1980, p. 105], Seagate (formerly Shugart) Technology of Scotts Valley, Calif., plans to introduce next month the first 5¼-in. Winchester drive using thin-film head technology. **This represents a leap for thin film from 14-in. drives, bypassing the 8-in. versions altogether.** The two-platter drive, the ST 512, will cost about 25% more than the ST 506 but will have twice the unformatted capacity, or about 12 megabits. The new drive does not use thin-film disks, but its thin-film head design, supplied by Dastek Corp. of Los Gatos, makes it possible to double the number of tracks. The same number of bytes per track as the ST 506 is maintained. Samples of the first ST 512 drives will be available in the last quarter of 1981.

Electronics newsletter

TI to unveil development system

Texas Instruments Inc. is about to introduce its first multiuser microcomputer development system, called multi-AMPL, which will support the Dallas-based firm's 16-bit 9900 family and TM 990 modules. Available in three versions, **the largest of which can support up to eight users,** the network can reduce the cost per user to as little as $10,000.

Qume to introduce Sprint 3, 5 successors

After nearly three years of development work, Qume Corp. of San Jose, Calif., will announce next month the first successors to the Sprint 3 line of printers and the Sprint 5 line of printing terminals. The Sprint 7/45, at 45 characters/s, and 7/55, at 55 characters/s, are the daisy-wheel printers; the Sprint 9/45 and 9/55 receive-only printing terminals, with the same respective speeds, will be based on the Sprint 7 printers. **The key to the new offerings is Qume's MicroDrive mechanism, which eliminates four drive-alignment pulleys used in earlier models.** Both the printers and the terminals use 30% fewer electrical parts than their predecessors and an 8085-type microprocessor instead of the Fairchild F8 used on previous models. The Sprint 9/45 and 9/55 are expected to be priced in the $2,000-to-$3,000 range; competitors estimate the Sprint 7 models will be about $1,200 to $1,500 in large quantities.

Hoerni launching new C-MOS firm

Jean Hoerni, who has helped found Fairchild Camera & Instrument's semiconductor operations, Intersil, Eurosil, and several other semiconductor companies, is setting up yet another new venture. Called Telemos, the new firm will have headquarters in France, but it is understood to be establishing a beachhead in Silicon Valley as well. **Initially, Telemos will manufacture and market complementary-MOS metal-gate arrays,** but it also plans a thrust into the high-speed telecommunications market, primarily with C-MOS large-scale integrated circuits.

Addenda

Toshiba Semiconductor (USA) Inc., the Japanese firm's year-old American subsidiary born out of its takeover of Maruman Integrated Circuits Inc., will soon start producing **2-K-by-8-bit static random-access memories at its Sunnyvale, Calif., plant.** . . . Japanese sources report that Nippon Electric Co. **will build a second semiconductor plant in the U. S.** The site is to be named within weeks. Its other plant is Electronic Arrays Inc. in Mountain View., Calif., a wholly owned subsidiary. . . . The local network standards committee of the Institute of Electrical and Electronics Engineers' Computer Society **has decided to use the new programming language Ada** for the emerging standard's media-access methods. . . . Standard Microsystems Corp. of Hauppauge, N. Y., has completed an agreement **with Hitachi Ltd. that includes worldwide cross licensing of patents as well as payment to SMC.** . . . Western Digital Corp. of Newport Beach, Calif., has dropped its backing of the Ada compiler being developed by Telesoftware of San Diego, Calif., and **will develop its own,** says William Carlson, Western Digital's general manager. . . . **Add to the proliferating versions of the Unix operating system for the Z8000** one for its development system from Advanced Micro Computers of Sunnyvale, Calif., and another, Xenix, from Microsoft of Bellevue, Wash.


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Wirth updates Pascal brainchild in new language

by R. Colin Johnson, Microsystems & Software Editor

Definition of Modula-2 includes facilities for structured programming that are Pascal extensions

Niklaus Wirth, the author of Pascal, has just introduced to the software community Modula-2, his answer to the widely perceived deficiencies in that landmark structured-programming language. At the Fifth International Conference on Software Engineering in San Diego this month, Wirth also demonstrated his all-Modula personal computer.

Modula-2 adds the three facilities that have emerged over the past five years as absolutely necessary extensions of Pascal for writing large structured programs: independent modules, separate compilation, and multitasking. These facilities have been added to most Pascal implementations, including those of Texas Instruments and SofTech Microsystems, and have also appeared in the standard definition of Ada, the U. S. Department of Defense's similar language designed for universality [*Electronics*, Dec. 18, p. 39].

Adds facilities. The new language's modules (called units in one well-known implementation, UCSD Pascal, and packages in Ada) allow procedures and data sets to be encapsulated into a single segment, thus eliminating the need for cumbersome global variables or common blocks. The separate compilation of modules makes for more convenient software development, and multitasking (co-tasking in Modula-2) allows simultaneous execution of more than one program.

The new language is a complete redefinition of Pascal, rather than a simple extension that tacks new functions onto an existing compiler. However, given that so many companies have already made commitments to Pascal and its extended versions, Modula-2 may evoke little response. Also, it is going up against Ada, which the Defense Department is promoting as a standard.

Hardware. Wirth has not been working solely on software. He also brought to San Diego a microprogrammed microcomputer system, called Lilith, that he and Richard Ohran, his co-worker at the Swiss Federal Institute for Technology in Zurich designed to execute Modula-2. "There is no assembler for Lilith, and we don't want one," Wirth says.

All the computer's software, including the compiler, graphics editor, and operating system, are written in Modula-2. Lilith directly executes the pseudocode produced by the compiler.

The machine's architecture was designed to match the language closely. For example, Modula-2 makes extensive use of register stacks in performing operations, and so the computer has a stack implemented in high-speed cache memory. Also, Lilith's microprogram functions closely track the kinds of operations the language performs.

Based on the 2901 bit-slice processor, Lilith requires a 2-K-by-40-bit microcode store and cycles in a fast 150 nanoseconds. Its architecture, based on a 16-word-deep hardware stack with 16-bit-wide data paths, also uses a barrel shifter, 256-K bytes of main memory, and a 10-megabyte cartridge disk.

Wirth conceives of Lilith as a personal work station for programmers, and he has dedicated much hardware to a sophisticated graphics display that includes a 64-bit path to

New language. The father of Pascal, Niklaus Wirth, has devised a successor language that incorporates structured-programming facilities that had previously been extensions.

memory. The software was developed on a Digital Equipment Corp. PDP-11/40 minicomputer. Information on compilers and on Lilith is available from the Institute.

Other participants at the tool fair—a demonstration annex to the conference—showed such programmer productivity aids as structured front ends for nonstructured languages, sophisticated full-screen editors, data-base managers, and query languages. Also on display were higher-level utilities for software project planning, management, and maintenance.

Microsystems

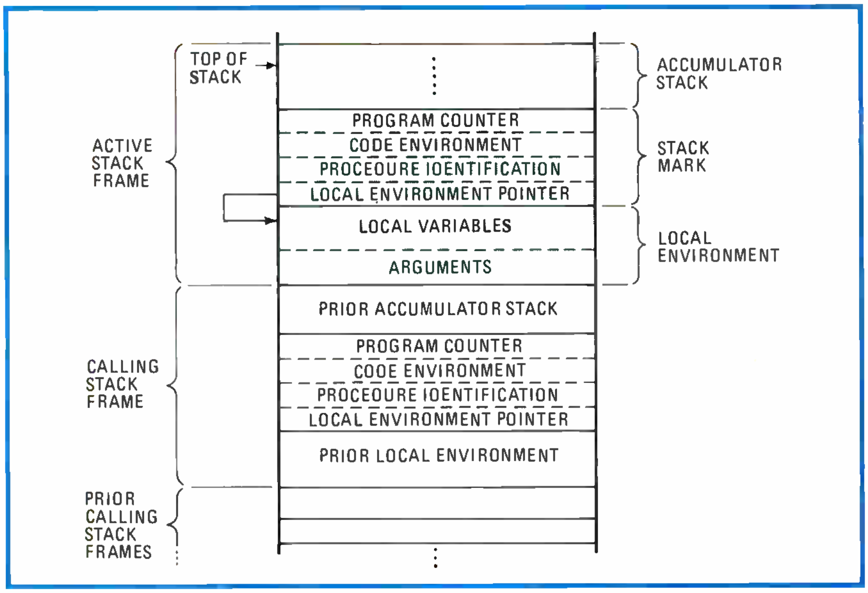
SOS 16-bit microprocessor has 2-μm rules; speed nudges that of bipolar predecessor

A 16-bit C-MOS-on-sapphire microprocessor from Rockwell International Corp. shrinks the minimum design rules for complementary-MOS technology to a new low: 2 micrometers. The proprietary design, meant for avionics applications, may actually outperform a similar bit-slice design now in use.

The part contains 68,175 devices on a 214-by-261-mil die and runs off a 20-megahertz clock for a throughput of 300,000 instructions a second (using 12% floating-point operations). Dubbed the AAMP, for advanced architecture microprocessor, it is software-compatible with the CAPS-7 (Collins adaptive processing system) built from 2901 bit slices—and selected 30-MHz versions should be marginally faster than the bipolar predecessor.

The AAMP comes from the Avionics Advanced Technology and Engineering division in Cedar Rapids, Iowa, formerly the Collins Radio operation. Like the CAPS-7, the new processor has a stack-intensive architecture (see figure), notes the manager of computer technology, Charles E. Kress.

SOS expertise. Rockwell's Microelectronics Research and Development Center in Anaheim, Calif., has extensive experience in military grade C-MOS silicon-on-sapphire technology [*Electronics*, July 31, 1980, p. 84] that was put to good use in developing the part. The company had been using 4-μm design rules, with lab work at the 2-μm level. Many of the present AAMP layout rules are conservative, so there is room to shrink the part further, thereby boosting performance more.



Stacked up. Process stacks in Rockwell's 16-bit C-MOS–on–sapphire processor intended for avionics applications can build frames for new operations on top of existing ones.

As many semiconductor makers are doing, Rockwell uses self-aligned silicon gates to greatly reduce parasitic capacitances. Interconnection layers with aluminum and high-conductivity molybdenum-doped polysilicon result in high circuit densities and typical gate delays under 1 nanosecond.

For operations on 8-, 16-, 32-, and 48-bit data, the AAMP is highly microprogrammed, with a 1-K-by-40-bit control-store read-only memory having a 50-ns access time. It can perform a 16-bit multiplication in 4.85 microseconds and a 32-bit multiplication in 15.05 μs.

Other chips. However, the speed does not match that of the Toshiba Corp. proprietary 16-bit C-MOS processor discussed along with a number of new machines at last month's International Solid State Circuits Conference [*Electronics*, March 10, p. 39]. Toshiba gives the time for a 16-bit multiplication as 1.6 μs.

The Toshiba part uses relatively relaxed 3.5-μm design rules, since it will be turned out in far greater numbers than Rockwell's avionics gear. Hardware is a major contributor to the speed of the Japanese processor: it uses both a parallel multiplier and a barrel shifter.

Even a multiplier alone can give a significant speedup. National Semiconductor Corp.'s n-channel MOS 16-bit 16000 uses one for 5- and 8-μs speeds for the 16- and 32-bit multiplications, respectively.

In the Rockwell AAMP, operations are speeded along by an on-chip register file that serves as a cache for the most often used stack locations from external memory. The stack-intensive architecture causes the processor to operate only on values that are on the top of the last-in, first-out accumulator-stack.

The processor maintains an internal top-of-stack pointer, along with pointers to the code and local data pointers that are held in main memory. Hence, everything necessary for an operation—stack values, local data, and code—are grouped together in the active stack frame.

When a new task is called from the current one, a new stack frame is built above the existing one, enabling easy handling of multitasking. In addition, a special executive process stack schedules interrupt service on the chip.

The AAMP will address 16 megabytes of memory with its 24-bit addressing and dissipates only 0.4 watt from its 5-volt power supply. Rockwell is just seeing first silicon and expects to produce samples, packaged in a 64-pin leadless chip carrier, in the second half of the year. A paper on the AAMP will be given at Naecon '81, the National Aerospace and Electronics Conference, to be held in Dayton, Ohio, May 19–21. -R. C. J.

Making a high-level choice

An important preliminary step for Digital Research in its effort to support third-party vendors was selecting a high-level programming language. "We started out with Pascal but soon concluded that large modular commercial programs could not be written in the standard version, and we felt we had to have an international standard," president Gary Kildall explains.

The company settled on the ANSI standard subset G of PL/1, which Kildall feels is "the perfect commercial programming language because it supports structured programming and separate compilation of modules and, to top it off, can also be run on Data General, Prime, Wang, and now even Digital Equipment Corp. computers."

Digital Research now considers itself an alternative source for PL/1G. "Choosing PL/1 also gives our software OEMs [the third-party vendors] a larger market base, since they can sell to microcomputer and minicomputer users and perhaps even IBM mainframe users," Kildall remarks.

Seminar attendees seemed to agree with his assessment of the programming language. "PL/1 offers a graceful migration path, since I can embed the code I already have in my new expanded PL/1 programs and thus don't waste any past effort," says one applications specialist. **-R. C. J.**

Software

Op systems suppliers turn to applications

Acting largely in self-defense, a number of major companies that sell operating systems to the manufacturers of computer-based products are promoting the efforts of third-party vendors that write applications software. They predict they will gain a competitive edge in their operating systems sales by alleviating the applications software bottlenecks in systems development.

Among these companies is Digital Research, originator of the popular CP/M operating system, which boasts more than 200,000 installations to date. It has started a concentrated effort to aid the applications houses in developing reliable and compatible programs, kicking it off early this month with the first of a series of intensive seminars near its Monterey, Calif., operation.

"The crisis in the commercial software market can only be solved by third-party vendors," says Digital Research president Gary Kildall. "In fact, we have found that the large OEMs have virtually given up writing all their own applications software. It extends their product development time so much that they just can't compete."

Thus the third-party vendors fill a consultant's role, bringing their expertise to bear on a particular project. But their expertise is partly a function of their familiarity with the operating system to be used, and so companies like Digital Research, Microsoft, and SofTech Microsystems are planning to ensure that familiarity exists.

Others' routes. Microsoft, developer of the Xenix operating system, is taking a middle path in support of original-equipment manufacturers of microprocesor-based systems. The $7.5 million Bellevue, Wash., operation is actively supporting third-party vendors with technical assistance but will not compete with them in the end-user applications market. Instead it is concentrating on producing software development tools and system-level utilities, like database managers, that will make the third-party software vendor's task much more manageable.

SofTech, on the other hand, is going all the way in actively seeking third-party applications packages to license and promote. In fact, C. A. "Al" Irvine, vice president and director of engineering, says one of the driving forces behind the San Diego company's choice of UCSD Pascal for its operating system was to build up the current 70,000-installation customer base to which applications packages could be sold.

Digital Research gave attendees at its early-March seminar a comprehensive look at using the PL/1 programming language (see "Making a high-level choice"), but the company plans other forms of aid for the third-party vendors as well. It is helping set up an independent company to test and approve the potential applications programs so that users will have confidence in the vendor's offerings.

It also will oversee the printing of consistent-looking documentation from the different vendors. Moreover, it will prepare an applications software catalog for buyers of its operating systems.

More. Another important step for Digital Research is to expand the machines it supports with PL/1 subset G. Next in line are the VAX-11/750 and /780 and the forthcoming microcomputer version of this powerful Digital Equipment Corp. minicomputer line and then either Intel's iAPX-432 or Motorola's 68000. The company also will release Z8000 and 8086 versions of PL/1, the latter offering utilizing the 8087 arithmetic coprocessor.

For the long-term solution to the programmer crunch, Kildall sees "automatic program generation as the way things will definitely go. In fact, we have one customer now who has a graphics-terminal-drawn flowchart-to-PL/1 program generator that they use in house." -R. C. J.

Speech recognition

Multiboard systems shrink to chip sets

Speech recognition can now be added to the technologies seeing a dramatic price reduction as they shrink from multiboard to single-board systems. Interstate Electronics Corp. is introducing two chip sets, as well as a single-chip limited-vocabulary implementation, and following shortly will be Threshold Technology's Auricle Inc. subsidiary.

Both companies are starting with board-level systems and paring away at the chip counts. Thus Interstate Electronics has reduced its 100-word $2,000 voice recognition module to a 10-chip system priced at under $500. Its other set comprises six chips and recognizes 25 words.

In both sets, the company supplies two key chips, and the other integrated circuits are off-the-shelf products that the original-equipment manufacturer buys. The Anaheim, Calif., subsidiary of ATO Inc. expects one of its major markets will be computer and terminal makers, where speech recognition systems could replace special-function keys.

Characteristics. Like the board-level system, the equivalent 100-word chip set will recognize words with 99% accuracy—the 25-word set is to have a 95% accuracy level. Both chip sets will be speaker-dependent with a vocabulary in random-access memory determined by the user—characteristics identical to those of the board system.

For the 100-word VRC 21 set, the company developed a switched-capacitor IC that replaces 200 discrete chips. It performs front-end processing, acting as a bandpass filter to reduce speech to its frequency and amplitude characteristics.

Interstate Electronics' other contribution to the chip set is a read-only memory containing the algorithm that performs spectrum analysis and pattern recognition. The algorithm requires less than 4-K bytes of memory, and the ROM is the same as in the board-level system.

A 6802 8-bit microprocessor controls the system, and the vocabulary is stored in two 8-K static RAMs, replacing eight 4-K RAMs. The remaining components are a quad amplifier and interfacing ICs.

Interstate Electronics will sell its two chips for $120 in quantities of 1,000, and the total component cost will be about $150, says Edward F. O'Neil, voice products marketing manager. The final system, as completed by the OEM, will cost under $500, he says.

Another plan. The plan at Auricle is to offer systems to the OEM. The Cupertino, Calif., company is following much the same philosophy as Interstate Electronics in reducing chip count, but its single-board system (to be introduced by year's end) will be speaker-independent and recognize 40 words, expandable to 128, with 99% accuracy.

Interstate Electronic's 25-word system, the VRC 11, uses a filter IC and a 8-bit microcomputer that holds the algorithm in its on-chip ROM. Both cost $80 in quantities of 1,000. The OEM adds a 1-K-by-8-bit RAM, a quad amp, and two interfacing ICs.

The single chip, the VRC 01, is aimed at toys primarily and will cost $10.50 in 25,000-unit quantities. The VRC 01 is a microcomputer, with the vocabulary programmed by Interstate, and works with a quad amp and an interface IC.

The company is not ready to release other details, but it does say that the accuracy level is 85%. It is considering a 6805 or similar microcomputer for this implementation and for the 25-word chip set.

Interstate has set a July delivery date for all three products, which will be manufactured by custom houses. Though it is clearly ahead with its announced plans, the cutting edge is chip design and technology, in which it has no track record.

O'Neil thinks price drops will expand speech recognition applications vastly, with half of the smart-terminal production in two years including recognition capabilities. However, Texas Instruments Inc., a potential major competitor, does not expect the market for speech products, including synthesis chips, to take off until 1985.

But by 1990, the Dallas firm foresees speech recognition absorbing about half the $3 billion annual sales it predicts for voice products. TI is following its pioneer synthesis work with ongoing development in recognition, but it will not comment on its status at this time. -Terry Costlow

Peripheral equipment

Computer, video disk link to form system

A number of companies around the world are looking forward to the day when laser video disk players will serve both as storage peripherals for computers and as an entertainment medium. Prominent among them is Discovision Associates, which is about to introduce two laser-disk–to–computer interface units that promise to make such links widely accessible.

The two Universal External Interfaces are simple black boxes like the one atop the Apple II in the photograph on page 44. They put the player's video disk under control of the computer, giving the operator direct access to any of the 54,000 video frames stored on either side.

Two types. Designed and to be built by SSM Microcomputer Products Inc. of San Jose, Calif., the interfaces meet either the RS-232-C or IEEE-488 bus standard. Discovision, a Costa Mesa, Calif., joint venture of IBM Corp. and MCA Inc., anticipates that the link will typically be between a small-business system or personal computer and the new version of its industrial laser disk player intended for such applications.

Initially, the disk's video-channel

Tie-in. Discovision Associates will offer a system, with either an RS-232 or IEEE-488 link, that puts a laser video disk player under computer control, making the player a storage peripheral.

data will down-load into the computer's random-access memory. That will require another module, which a source at SSM Microcomputer describes as "not a difficult task." However, the disk's two audio channels can load into the RAM, most likely with control information.

Typical applications will be instructional in nature, either directly for training or education or for running through work procedures as in a point-of-sale terminal. To facilitate such uses, Discovision has added two-way digital communications and more commands to the player.

The user can seek out a specific frame of information with the computer, and the computer can follow various branches of data on the disk, depending on the user's answers to queries posed on the TV screen. The new commands include one that turns individual audio channels on and off and one for overlaying a digital display on the video frame.

The company is not alone in its interest in the laser disk player as a data bank. Thomson-CSF in France has already introduced a 488-type link for its industrial player; but Discovision anticipates that such control applications will be less important than the data-transfer uses possible with an RS-232 link.

Japanese companies appear to agree. Sony Corp., for example, discussed its RS-232 link to a laser-based player at a recent meeting of the National Association of Broadcasters and has already demonstrated its prototype of a player to potential key customers in the U. S. Its introduction is expected at this summer's Consumer Electronics Show in Chicago, as is a similar announcement from the Victor Co. of Japan (JVC).

Bit storage. Such systems are likely to store analog video frames, as does the Discovision setup, and the 54,000 frames on each side of a disk correspond to about 350 megabytes of storage. However, the full potential lies in digital storage.

With digital storage and a 4.8-megahertz bandwidth, each disk could theoretically store 50 gigabytes, SSM Microcomputer engineers calculate. Discovision's new player, the PR-7820-2, has an average access time of about 1.2 seconds and a maximum of 3 s. Hard disks and floppy disks are much faster, at 35 milliseconds and 250 to 350 ms.

However, by the time that disk players are developed to the point where they can store gigabytes of data, the servomechanisms guiding the read head will be closer in performance to those of the disk drives. Laser storage will offer a big capacity advantage—hard disks can store from 5 megabytes to 2 gigabytes and floppy disks store about a megabyte—but, for now, laser video disks are a read-only storage medium.

When the competition with magnetic media begins, cost will be a vital factor. At present, Discovision is planning to sell the PR-7820-R for $2,000 in quantity and the interface for $225. **-Martin Marshall**

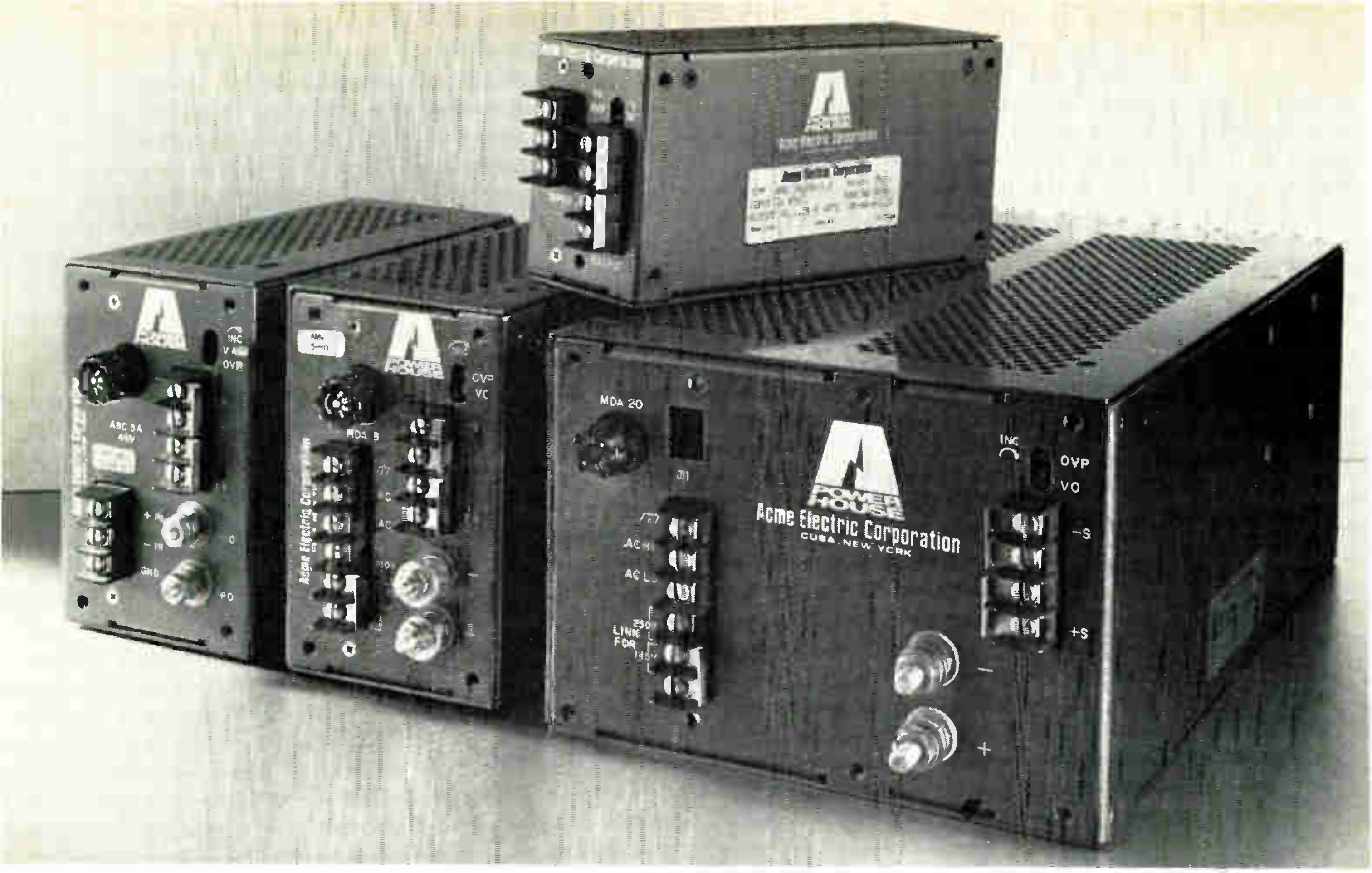
Terminal generates Chinese characters

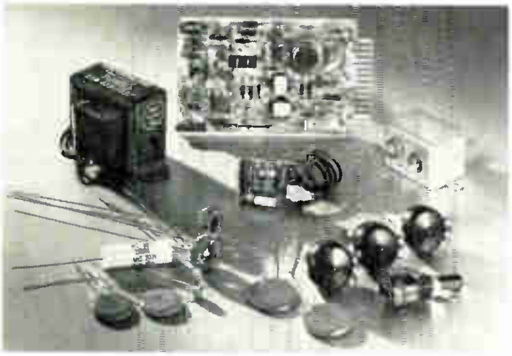
Attacking the fiendishly complex task of generating Asian print characters on a computer system, a fledgling U. S. company has developed a setup it says can generate 40,000 Chinese characters with only 64-K bytes of semiconductor memory. Also, Global Integration Technologies Inc.'s technique can be implemented with a keyboard format much like a typical terminal's.

The Fairfield, Iowa, firm says its approach will make possible significantly lower-cost Asian character systems than those on the market today, which generally require vast amounts of off-line disk storage to generate typically no more than 2,000 to 6,000 characters. Many existing systems use unwieldy nonstandard keyboards or pen-touch tablets, and those that do have typewriterlike keyboards do not have the potential for a multilingual capability that will mix Chinese, Japanese, and Korean characters—as does the Global Integration approach.

Back to basics. The technique's key element is a set of 38 essential structures in the Chinese characters, identified by company president Douglass White, a Chinese language scholar. These building blocks are actually a subset of the 214 radicals used in some Asian dictionaries for character classification, and they differ from the language primitives used in any other approach.

Whereas existing Chinese language systems generally rely upon storage of entire characters, thereby eating up vast amounts of memory, the new system simply stores the 38 basic components plus a set of intermediate structures, which are used to build up the characters. Data-





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Circle 46 on reader service card

Asian characters. Prototype terminal uses a keyboard format, derived from computer practice, representing basic building blocks that combine into Asian print characters.

compression techniques also help reduce memory requirements.

An operator using the Global Integration system bases the initial keystroke in a character word on what he sees when looking at a particular portion of the character. He then looks at other portions and follows five basic rules to determine the successive keystrokes.

An average of 3.2 keystrokes is required per character. Because the input conforms to natural thought processes associated with Chinese-character handwriting, the system can be quickly learned for touch typing at speeds up to 70 characters a minute, White says.

Language-free. Since the operator is looking at character shapes, the technique is language-independent, as are the various corner-encoding approaches in which the operator keys in numeric or alphabetic codes assigned to the corners of the characters. But corner encoding suffers from ambiguity, since more than one character shares similar corner shapes, a problem that White says his approach overcomes.

Ambiguity also can occur in techniques that rely upon phonetic approaches in which syllabary characters are keyed in for conversion to Chinese characters. The problem is that, in Asian languages, more than one word can have the same pronunciation. Also, this method depends on knowing the language.

Fujitsu has a syllabary system that gives the user a key to push in order to run through all the words of the same pronunciation. The company says a trained operator can reach a speed of about 60 characters/min. Toshiba has gone a step further with a system that allows the user to type in phrases, and a computer program then helps select the characters based on the context.

System plans. The prototype terminal in the photograph, demonstrated last November at the U. S. National Economic and Trade Exhibition in Beijing (Peking), uses a 6502 8-bit microprocessor with 4-K bytes of scratchpad random-access memory and 60-K bytes of erasable programmable read-only memory. The company is developing the code to add some 8,000 Japanese-only characters and about 1,870 Korean-only characters, which would lift the system's ROM requirement to 85-K bytes, says David Clark, the company's software development director.

One official from a prominent U. S. terminal and minicomputer maker says he was "quite impressed" with the system he saw in Beijing. He cited the low memory requirement, the keyboard format, and the multilanguage capabilities.

The system does hit a new low in memory requirements, says another Beijing showgoer, Judy Poon, an electrical engineer and president of CPTS-USA, a San Francisco company that publishes a computer journal geared to end users in China. Poon notes, however, that the system does need refinement in the characters' appearance.

Company officials concede that constraints of a 21-by-21-dot matrix and a low memory requirement do mean sharply angular characters. For more refinement, the system could be connected to a mass character storage medium and a high resolution printer, White says.

The company is not ready to specify a likely price tag for a production system. But vice president Alex G.

Green does say it could come in significantly lower than the $5,500 price of some Asian-character small computer systems.-**Wesley R. Iversen**

Speech synthesis

Low data rate yields lifelike voice

High-quality speech at low bit rates is the talking point of a new voice-output system called LISA, for logically integrated speech annunciator. Designed for original-equipment manufacturers who want to add speech synthesis to low-volume computer-based products, it processes speech data from a host computer at rates of up to 4,800 bits a second and can store a virtually unlimited vocabulary in the computer's main memory.

The manufacturer, Centigram Corp. of Sunnyvale, Calif., uses a proprietary speech-encoding and data-compression technique to produce the highly intelligible speech at the low bit rate. The technique also lends itself to a real-time vocabulary development service, costing the OEM only $25 a word.

In use. In a typical application, a host computer program contains the digitized sentences. The computer downloads the sentence or sentences needed at a specific moment into LISA's random-access memory, which can store one minute of speech. The synthesizer has an internal speaker, but it can be hooked up to an external speaker or to a telephone line. Its output is almost indistinguishable from a voice recorded on an analog tape recorder.

Centigram says the low-cost vocabulary development will be important: its $25 cost contrasts with the $200 to $500 per word that semiconductor makers charge for developing the vocabulary for their chip-level speech products. "That discourages OEMs from using a large vocabulary and becomes a significant portion of the overall cost of incorporating voice output, especially when low volumes are planned," says Gerard Currie, president of the Sunnyvale, Calif. company.

Behind LISA's low cost and high intelligibility is Centigram's data-conversion process, called parametric waveform coding. It combines the advantages of two other popular digital speech technologies: linear predictive coding [*Electronics*, Aug. 31, 1978, p. 109] and waveform digitization [*Electronics*, April 10, 1980, p. 113].

Like linear predictive coding, PWC has a moderate data rate, using a minimum of memory for word storage. But unlike LPC, it does not lose the tonal qualities of the speech because it retains the phase relationships of the spectral elements, or frequency components.

The speech quality is comparable to that of waveform digitization, which also reconstructs the amplitude waveform of the voice signal, rather than just the frequency components. However, waveform digiti-

News briefs

Stanford gathers in $7.5 million for IC research center

Stanford University has received $7.5 million in gifts and pledges for its new center for integrated systems from 10 high-technology electronics companies: IBM, Hewlett-Packard, Texas Instruments, Tektronix, Xerox, GE, Honeywell, Fairchild Camera & Instrument, TRW, and Northrop. The center's goals are to increase dramatically the complexity of silicon integrated circuits, to design the software needed to program and use these ICs, and to turn out each year 100 master's degree holders and 30 doctoral degree holders able to design radically new communications and computational systems using such ICs [*Electronics*, Feb. 28, p. 33]. The initial funds will be used to construct the first phase of the center's laboratories and to provide lab facilities for early development of computer-aided design and systems support.

EDS buys business-systems manufacturer

Electronic Data Systems Corp., the Dallas specialist in data-processing services for goverment and industry headed by H. Ross Perot, is moving into the computer manufacturing business. It is buying Centurion Computer Corp., which was founded in 1970 as the Warrex Consultant Service and later called Warrex Computer Corp. Centurion will continue to concentrate on sales of its small-business systems, but it will also provide Electronic Data Systems with an in-house source of minicomputers. No purchase price in the transaction was disclosed.

Tiny burglar alarm uses piezoelectric technology

A low-cost, matchbox-sized intrusion alarm looking for a manufacturer uses neither battery power nor wires to trip up burglars. Instead, it contains a piezoelectric material that detects any movement of a door or window to which it is attached. When triggered, the alarm emits a radio-frequency signal to a range of about 200 feet, activating sirens, lights, or police-calling systems. The detector also is virtually immune to jamming or accidental triggering, says its developer, Bolt Beranek & Newman Inc. The Cambridge, Mass., research and consulting firm will seek an outside licensing agreement for commercial development of the alarm, which it estimates will list for between $10 and $20.

AVX plans to up Japanese ceramic capacitor production

AVX Corp. of Great Neck, N. Y., is expanding its Japanese manufacturing operation. The Tokyo-based AVX KK subsidiary began assembly operations only last October, but it is ready to begin construction by July of a new 50,000-square-foot facility, at a cost near $10 million. AVX hopes to bring its share of the Japanese market, now at 1%, closer to the 16% it holds of the European market; it claims a 33% share of the U. S. market. The 1980 worldwide total consumption of $500 million is expected to grow to $1.2 billion in 1983.

24

NATIONAL ANTHEM®

SEMICONDUCTOR NEWS FROM THE PRACTICAL WIZARDS OF SILICON VALLEY.

National's 74C900 Series. The fusion of innovation and practicality.

SINGLE-CHIP CMOS SOLUTIONS FOR MULTIFUNCTIONAL DESIGNS.

Series/80 BLCs save time and money

A dependable ROM supplier

Two new precision references

Taking the RAM market head on

Fully armed for data acquisition

Practical octal peripheral drivers

The 8050 breakthrough

INS8073 μP executes Tiny BASIC

8070 ISE™ speeds program development

Two new adjustable voltage regulators

Free literature from the National Archives

Digitalker COPS Data Acquisition Logic Transistors Hybrids Linear Interface Bubble Memory RAMs/ROMs/PROMs Transducers Displays Custom Circuits Optoelectronics Memory Boards Microprocessors Development Systems Microcomputers Modules

The CMOS logic population explosion.

National's commitment to CMOS has made them the fastest growing supplier in the industry.

National first introduced the 74C Family back in 1972. And since that time, the Practical Wizards have been steadily reinforcing their commitment to these and other high quality, low power CMOS logic components, including the CD4000 Family. Simply because they have consistently proven themselves in the marketplace.

As a result, National is the fastest growing CMOS logic supplier in the business.

The advanced 74C900 Series.

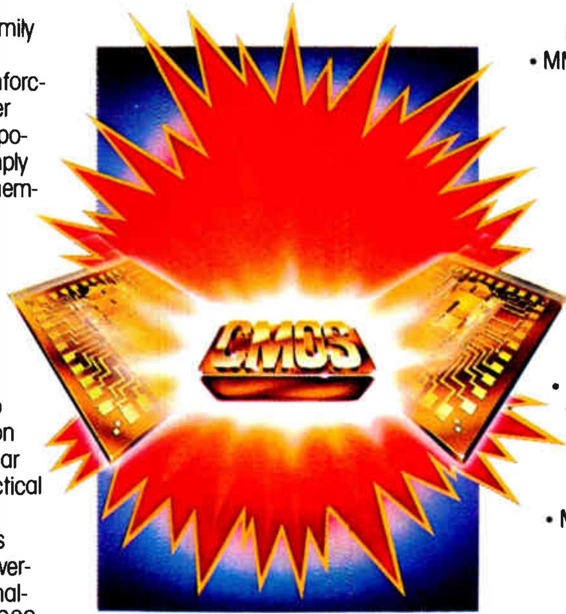
Much of the growing 74C Family's success is due to the approach National took in developing the line. In addition to offering pin-for-pin, function-for-function CMOS replacements for the most popular 7400 Series logic components, the Practical Wizards went one step further.

The expanding 74C900 Series offers carefully selected useful functions in powerful single-chip form. Including the National-designed industry standard A/Ds (ADC0808, ADC0816).

The sheer practicality of this approach shows up in the ease with which the 74C900 parts are designed in. They offer all the benefits of CMOS – most notably the ultra-low power consumption – while minimizing parts count and system costs.

And the microprocessor compatibility of many of the 74C devices stretches their versatility that much further, as in the case of National's TRI-STATE® octal buffers (MM74C240/244/941), octal latches (MM74C373) and octal D flip-flops (MM74C374).

The functionally complex CMOS 74C900 Series was designed to provide high performance single-chip CMOS building blocks for the full range of battery operated and battery back-up applications. The series includes such devices as:



A/D converters.
- ADC0808/09 (MM74C949/49-1): μP-compatible 8-bit A/Ds with 8-channel input analog mux.
- ADC0816/17 (MM74C948/48-1): μP-compatible 8-bit A/Ds with 16-channel input analog mux.
- ADC3511/3711 (MM74C937/38): 3½-digit and 3¾-digit μP-compatible A/Ds.
- MM74C905: 12-bit successive approximation register.

DVMs.
- ADD3501/3701 (MM74C935/36): 3½-digit and 3¾-digit DVMs with multiplexed 7-segment LED drives.

LED display controllers.
- MM74C911/12/17: 4-digit and 6-digit μP-compatible LED display controllers.
- MM74C956: Alphanumeric LED display controller (samples available soon from any NSC sales office).

Keyboard encoders.
- MM74C922/23: 16-key and 20-key keyboard encoders.

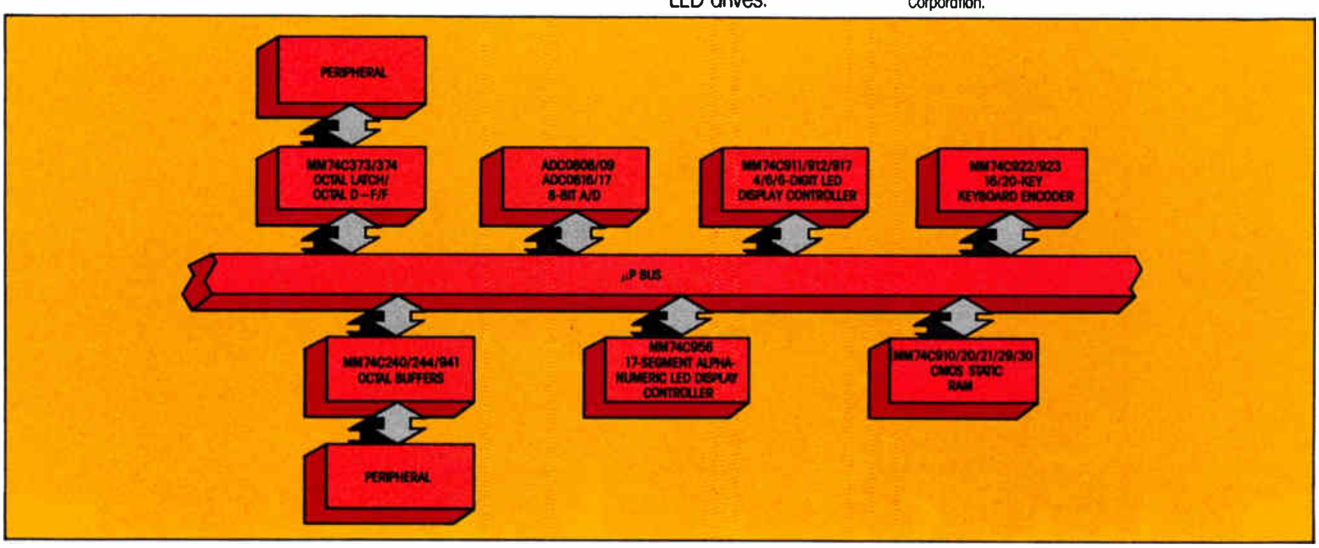
LED/LCD direct drive counters.
- MM74C925/26/927/28: 4-decade counters with multiplexed 7-segment LED drivers.
- MM74C945/46/47: 4-decade up/down counters with direct drive 7-segment LCD drivers (samples available soon).

Memories.
- MM74C910: 256-bit static RAM.
- MM74C920/21: 1024-bit (256 x 4) static silicon-gate RAM.
- MM74C929/30: 1024-bit (1024 x 1) static silicon-gate RAM.

A commitment to innovation and practicality. National has been advancing CMOS products and technology for a long time. It represents a commitment to combining innovation and practicality that keeps on getting stronger as time goes by. They can already fill your CMOS needs for microprocessors, linear, Mil/Aero, MOS/LSI and additional memories.

To get the details on all of National's CMOS logic devices, check box number 061 on this issue's coupon.

TRI-STATE is a registered trademark of National Semiconductor Corporation.



Fully armed for Mil/Aero data acquisition.

National's product breadth, performance and volume production add up to shorter lead times and lower system costs.

National Semiconductor is the broadest based Mil/Aero data acquisition supplier. No longer must design engineers fight with intermittent supply lines and long lead times for high performance parts. The big guns have arrived.

It's all part of a double-barrelled commitment to serve the total system needs of Mil/Aero DEs, the men and women who've been struggling to find a company that can equip them with everything they need for hi-rel data acquisition systems.

Adding capacity cuts costs. National brought two major resources to bear in their efforts: the broadest product line in the industry and sheer brute force.

Specifically, they've substantially increased their hi-rel production capacity and are strategically stockpiling inventories of components, every one totally compliant with MIL. STD. 883 Class B processing.

So not only can National offer the full range of high performance data acquisition parts, they do it with shorter lead times and more attractive prices.

System knowledge: the brains behind the brawn. The third major resource that National has to offer is a complete understanding of data acquisition and process control systems and environments.

And they use every bit of this knowledge in designing the most practical and cost-effective components available.

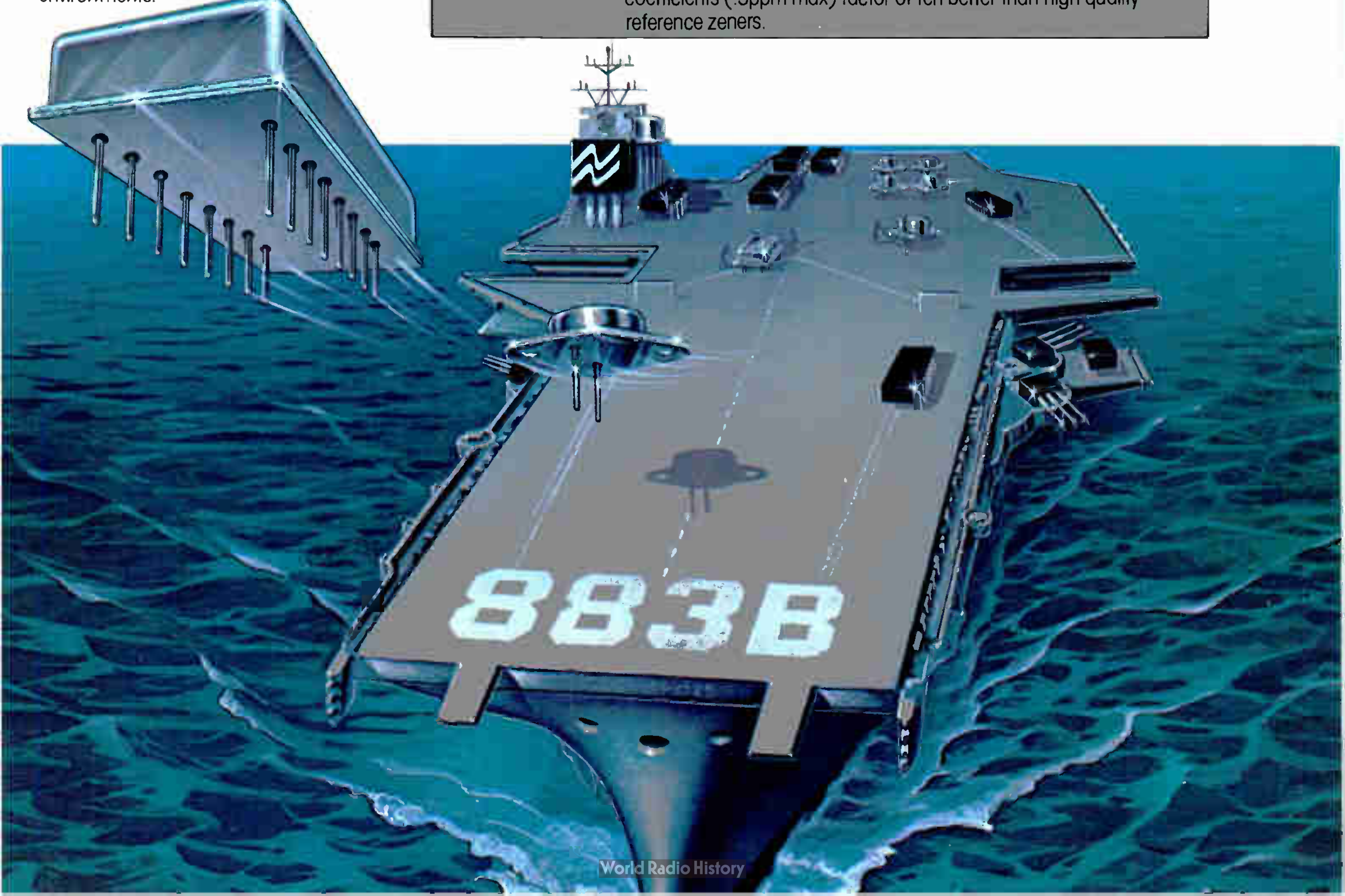
More Mil/Aero DEs are turning to the Practical Wizards than ever before. Because they know that National is fully armed for data acquisition.

For more information on their hi-rel data acquisition arsenal, check box number 062 on the National Archives coupon.

BIFET is a trademark of National Semiconductor Corporation.

A SAMPLING OF THE NATIONAL ARSENAL

PART NUMBER	DESCRIPTION
LF198H/883	This monolithic sample and hold circuit used BIFET™ technology for very high DC accuracy (0.002%) and fast acquisition time (<10μs).
ADC0808CJ/883, ADC0816CJ/883	These low-cost 8-bit A/D converters offer high accuracy ($\pm$½ LSB max), low power (3mA max), a fast 100 μs, a fast conversion time and easy μP interfacing.
ADC1210HD/883	CMOS 12-bit A/D converter combining low power (210 mW max) with a 26μs conversion time.
LM131AH/883	This precision voltage-to-frequency converter combines low cost, guaranteed linearity (0.01% max) and excellent temperature stability ($\pm$50ppm/°C max).
DAC1285HD/883	A completely self-contained 12-bit accurate DAC with voltage out and reference.
LH0038D/883	A precision 12-bit accurate instrumentation amp with 100μV max offset voltage, 0.25μV/°C max offset drift and ultra-low input noise of 0.2μV p-p.
LH0091D/883	This low-cost true rms-to-DC converter features reading accuracies of 0.05% (trimmed) and 0.5% (untrimmed).
LM135H/883	This hi-rel linear IC temperature sensor offers low impedance and linear output to make interfacing to a readout or control circuitry especially easy.
LM199H/883	A precision temperature stabilized monolithic zener with temperature coefficients (.5ppm max) factor of ten better than high quality reference zeners.



NATIONAL ANTHEM

How to turn a μP bus into high current, high voltage peripheral drivers.

The new DP8310/11 octal peripheral drivers make interfacing easy.

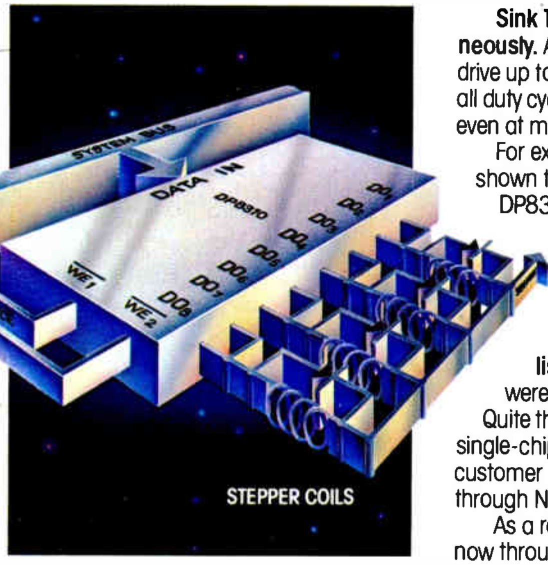
In response to popular demand, the Practical Wizards have produced two versatile new octal latched peripheral drivers: the DP8310 and DP8311.

Since they interface directly to any microprocessor bus, the DP8310/11s easily and economically turn the bus into high current, high voltage peripheral drivers.

Both devices latch eight bits of data with open collector outputs, each output driving up to 100mA DC with an operating range of 30V. The DP8310 is designed for positive edge latching and the DP8311 for fall through latching.

So they're ideal for driving stepper motors, fiber optic LEDs, solenoids, triacs, relays, displays and any number of other high current, high voltage peripherals.

Maximum design-in flexibility. These unique logic interface circuits provide truly maximized design-in flexibility. In addition to the open collector outputs, the DP8310/11s operate from a single 5V supply with ±10% tolerance.



They also feature internal "glitch free" power-up clear to enhance the integrity and safety of the application design.

Sink 100mA in all outputs simultaneously. And even though each device can drive up to 8 peripherals simultaneously, all duty cycle considerations are eliminated – even at maximum ratings.

For example, consider the application shown to the right. Here, a single 20-pin DP8310 with parallel outputs is providing 200mA drive for a four-phase bilfilar stepper motor.

Practical Wizardry means listening, too. These unique ICs were not born of "ivory tower" R&D. Quite the contrary, the demand for these single-chip functions came directly from customer design engineers and relayed through National's FAEs.

As a result, both are available right now through your local NSC sales office or distributor.

The DP8310/11. Because Practical Wizardry means listening, too.

For free data sheets, check box number 063 on this issue's National Archives coupon.

The 8050 breakthrough.

The new pin-compatible apex of the INS8048 Series carries a full 256 bytes RAM and 4K ROM for the most intelligent single-chip solution to 8048 applications.

National Semiconductor announces the largest step forward in microprocessor technology since the 8048.

Their new INS8050, with a full 256 x 8 RAM and 4K x 8 ROM, is the industry's first single-chip solution for more complex 8048 applications.

XMOS™ makes it all possible. National's new INS8050s are pin-for-pin architecturally and software compatible with their entire line of 8048 Series μPs. This includes 27 I/O lines (expandable with the INS8243), an 8-bit timer/counter, binary and BCD arithmetic, the same 96 instructions and a built-in clock oscillator.

As a direct replacement for 8048s and 8049s, the 8050 provides a degree of convenient upward flexibility that until now was simply unavailable.

And because of their leading edge XMOS technology, the 8050s consume over 50% less power in full operation (max 75mA at 5V) and 12 to 35 times less power in standby mode (8.5mA) than do competitive 8048 series devices.

More speed, intelligence and versatility. National's INS8050 is currently available in a fast 6MHz version with a cycle time of 2.5μsec. An 11MHz version (1.36μsec cycle time) will be available very soon.

So an 8050-based design is not only more intelligent and versatile, it's faster too.

Available now at competitive prices. But the 8050 is only one of several microcomputer devices already in production at National – all of which may be programmed using their STARPLEX™ development system with ISE™ (In-System Emulation).

For prototyping or low volume usage, they also offer a ROMless version of the 8050 called the INS8040. And both are available right now at very competitive prices.

The INS8050 breakthrough. Just another reason why they're called the Practical Wizards of Silicon Valley.

Check boxes 029 and 037 on this issue's National Archives coupon for additional literature.

XMOS, STARPLEX and ISE are trademarks of National Semiconductor Corporation.

8050 emulation made simple.

National's STARPLEX development system with real-time ISE (In-System Emulation) is the time-saving solution for 8050 software and hardware development.

Made by the same people who designed the 8050, STARPLEX with ISE includes 32K bytes of real-time map memory, plus all the necessary logic for breakpoints, tracing and memory mapping.

The 8050 ISE can be used to emulate any 8048 series microprocessor. ISE support is also available for the 8070, 8080, 8085 and NSC800 μPs.

All told, STARPLEX is the easiest system for both hardware and software development of μPs, μCs, microcontrollers and programmable logic circuits.

For complete information on 8050 emulation, circle box 037 on the National Archives coupon.

STARPLEX. The fully developed development system.

Adjustable voltage regulators: two new cost/performance alternatives.

The LM317L and LM350 fill out the industry's broadest line of adjustable voltage regulators.

In 1976 National developed the first 3-terminal adjustable voltage regulator. And now they've further strengthened their lead in linear with the introduction of two new inexpensive versions of their time-proven adjustables.

The LM317L is a 100mA version of the well-known 1.5A LM317 now available in the low-cost TO-92 plastic package.

Similarly, the LM350 is the 3A positive adjustable regulator now in the popular TO-220 plastic package. So it extends the line of inexpensive plastic devices to 3 Amps.

Better performance, lower costs. Three-terminal adjustable voltage regulators offer performance that's a factor of 10 better than fixed regulators. Line regulation, for example, is a low 0.01%/V and load regulation is 0.1%.

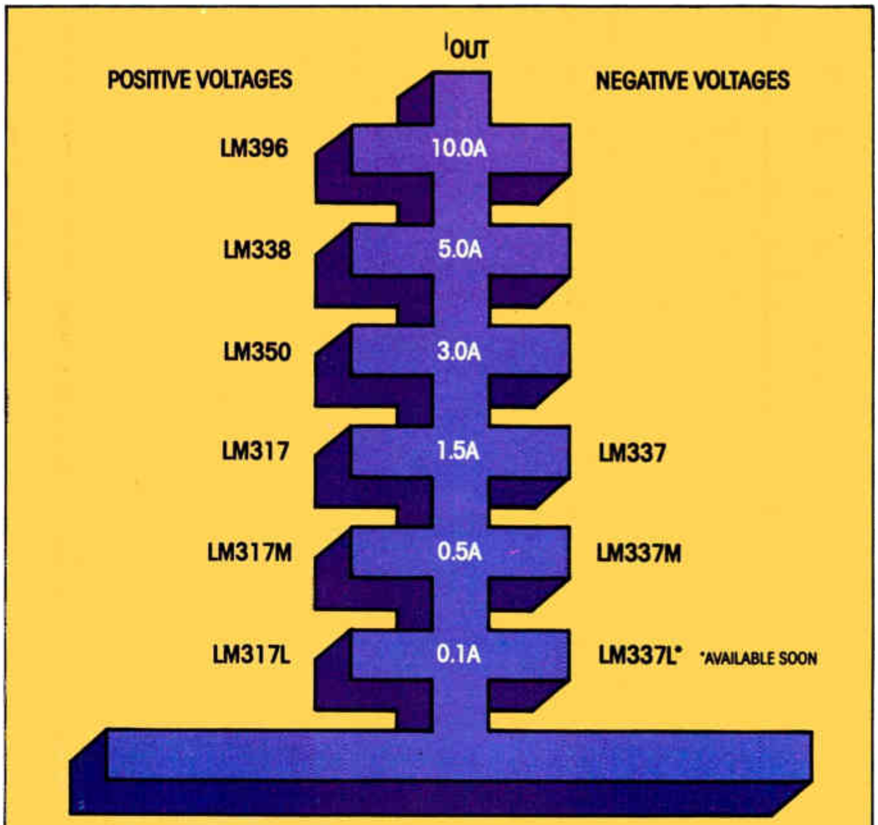
Another advantage of adjustable regulators is the standardization they bring to any design.

The output voltage is easily adjusted by two external resistors. This approach eliminates the expense and trouble of ordering and stocking many different fixed voltage regulators in low quantities.

On-chip protection circuitry. All of National's adjustable voltage regulators feature the same on-chip protection, including current limiting, thermal overload protection and safe area protection.

Additionally, thermal regulation, a new parameter guaranteed for both devices, gives the designer details on the effects of power dissipation caused by line and load changes on the regulator output.

For data sheets and other information on the LM317L and LM350, check boxes 055, 056 and 060 on the National Archives coupon.



NATIONAL'S ADJUSTABLE REGULATOR FAMILY

Improved MAXI-ROM™ quality and reliability with E-beam mask tooling.

Over the last decade National has been building a solid reputation in the ROM business. A reputation based on a major corporate commitment to be the most reliable high-volume supplier of the most reliable MAXI-ROMs.

So far, the response has been tremendous. And it's largely because so few of their competitors are able or willing to commit the kind of engineering and manufacturing resources to ROM production that National has.

Take, for example, their electron beam masking process. This high-precision technique yields ROMs of the highest quality and reliability. E-beam mask tooling provides fewer mask defects, sharper circuit definition and better inter-mask alignment.

Another advantage of utilizing the advanced E-beam masking process is that it reduces the amount of time spent in the mask shop. As a result, National's high volume production capacity assures each customer of a steady supply of highly reliable ROMs.

Which only goes to prove that the Practical Wizards are busy setting new trends in ROM production. Trends toward National's continued leadership in MAXI-ROM quality and reliability.

Trends that can only stem from an all-out corporate commitment to be the best in the ROM business.

Check box number 044 on this issue's coupon for further information.

STARPLEX™ with ISE™ speeds 8070 product development.

STARPLEX with real-time 8070 ISE (In-System Emulation) is yet another complete development system offering from National.

The ISE module uses an 8070 target card that plugs directly into the microprocessor socket on the 8070-based prototype.

The cost-efficient target card approach allows three modes of operation: program development, single processor emulation and multiprocessor emulation.

So 8070 ISE can be used to emulate one or more 8070 Family μP. ISE support is also available for National's 8048, 8080, 8085 and NSC800 microprocessor families.

Also, with ISE's in-line assembler and disassembler, programmers can modify object code and display it in assembly language without having to leave the debug and emulation environment. And without reassembling the entire source program.

For complete information on STARPLEX, ISE and the 8070 emulator package, circle box 037 on the National Archives coupon.

STARPLEX. The fully developed development system.

National carries the broadest line of cost-effective microcomputer boards.

Save time and money with over 85 Series/80 board level computer products from the Practical Wizards.

When it comes to selecting board level computer products, it never pays to gamble on boards that don't easily lend themselves to practical application.

This is precisely why National offers over 85 MULTIBUS™–compatible Series/80 products. Because the Practical Wizards believe that no product should have to be forced into an application.

And although many customers come to National for plug-compatible replacements for Intel® SBC products, their Series/80 BLC line is hardly just a second source supply.

In fact, a full two-thirds of their Series/80 Family is made up of proprietary products, including CPUs, memories, analog and digital I/Os, peripheral controllers, rack-mounted systems, a full complement of card cages, power supplies, cables and other accessories.

And each one features high reliability, functionality of design, and the longest warranty coverage in the business.

Setting a good example. The depth and breadth of the Series/80 product line can best be illustrated by examining just a few of its members.

The BLC-8222 Double Density Floppy Disc Controller can handle up to four dual- or single-sided drives (either standard or mini). It features CRC error checking with programmed re-try, user definable sector sizes and switch selectable base addresses that allow multiple controller systems.

The BLC-8737 Analog I/O board with 12-bit resolution makes each input and output channel appear to be a RAM address. On-board logic eliminates the need for the system CPU to drive the analog circuitry through its conversions. Its 16 single-ended (8 differential) input channels are easily expandable to twice that capacity.

The BLC-8715 Intelligent Analog I/O board was specifically designed for industrial and process control systems. This new product offloads all of the analog data processing and many of the control functions normally performed by the host CPU.

And in doing so, the CPU may then devote more of its valuable resources to the rest of the control system.

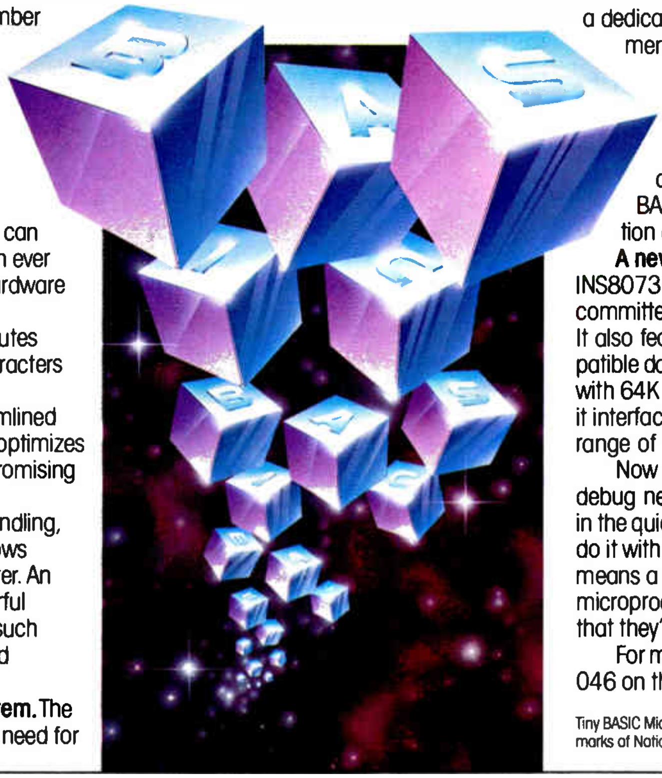
The BLC-8064 A/B Family offers parity and Error Checking and Correction (ECC) on 16K, 32K, 48K and 64K RAM boards. In all, they can deliver a dramatic improvement in reliability over conventional RAM boards. The kind of reliability only minicomputers could supply in the past.

Check box 035 on this issue's National Archives coupon for free literature on these and all of the practical Series/80 products from National Semiconductor.

With the strength of the industry's broadest selection to choose from, you can't go wrong.

The first μP that directly executes Tiny BASIC.

National's new INS8073 microinterpreter significantly reduces software development time and costs.



The INS8073 is the newest member of National's growing family of microprocessors.

The Tiny BASIC Microinterpreter™ speeds the development cycle because it allows users to program in Tiny BASIC instead of assembly language. So now source code manipulation and program revision can be done faster and more easily than ever before. It also pays off in quicker hardware check out.

The new INS8073 directly executes high-level programs from ASCII characters stored in external ROM or RAM.

National's Tiny BASIC is a streamlined high-level language that powerfully optimizes application software without compromising capabilities.

The INS8073 features string handling, logical operators, DO loops and allows program access to the status register. An 8073 based system includes powerful features that are expected of μPs such as full interrupt, multiprocessing and assembly language capabilities.

Requires no development system. The INS8073 completely eliminates the need for a dedicated, full-blown software development system. Rather, it's programmed directly through any RS232C compatible terminal.

STARPLEX™ National's complete development system, can also be used to develop Tiny BASIC applications, with full emulation capability.

A new universe of applications. The INS8073 incorporates 2.5K of internal ROM committed to the Tiny BASIC interpreter. It also features an 8-bit MICROBUS™ compatible data bus and a 16-bit address bus with 64K bytes of addressing capability. So it interfaces easily with National's broad range of memories and μP peripherals.

Now programmers can develop and debug new microprocessor applications in the quickest turnaround time ever. And do it with less development hardware. That means a new universe of cost-effective microprocessor applications. And it means that they'll get to the marketplace faster.

For more information check box number 046 on the National Archives coupon.

Tiny BASIC Microinterpreter, MICROBUS and STARPLEX are trademarks of National Semiconductor Corporation.

National takes the RAM market head on.

Only National has the technical expertise and manufacturing muscle to produce the industry's most popular high performance RAMs.

It takes a great deal of manufacturing and technical know-how to satisfy the ever-increasing demand for static and dynamic RAMs. And National Semiconductor has a lot of both.

In fact, National offers the most popular line of high performance MOS RAMs in the business.

Having just stepped up their production capacity even further, National is able to ship more parts in one month than most suppliers can ship in six. At volumes like these, you can be sure that their prices are competitive.

Vastly superior test facilities. Between the production and shipment of each RAM order come National's high-caliber test procedures.

In addition to their use of conventional component level electrical testing from wafers to tested packages, many dynamic RAM customers request National's unique MST™ (Memory Systems Test) program.*

MST eliminates or greatly reduces your own requirements for internal testing. So your incoming test, board test, and system rework costs are substantially reduced. Because MST parts have already been debugged in a 9 megabyte memory system.

The future looks even brighter. In the months to come, National's MOS RAM product line will grow even broader. They will soon add new low-power XMOS™ static RAMs and new dynamic RAMs incorporating their exclusive polysilicon capacitors.

The new dynamic RAMs will feature (among other things) improved refresh characteristics and a high immunity to soft errors.

To find out just how competitive National really is, contact your local distributor or NSC sales rep or enter number 043 on this issue's coupon.

Between their technical expertise, their high volume production capacity and their high-quality RAMs, it's easy to see that the Practical Wizards are taking the RAM market head on.

*Pat. Pending.

RAM SUMMARY TABLE

STATIC RAMs

Part Number	T_{AA} (ns)	Organization
MM2114	150-450	1K x 4
MM5257	250-450	4K x 1
NMC2114A†	120-250	1K x 4
NMC5257A†	120-250	4K x 1
NMC2141	120-250	4K x 1
NMC2142†	120-250	1K x 4
NMC2147	45-70	4K x 1
NMC2147H†	35	4K x 1
NMC2148	55-70	1K x 4

DYNAMIC RAMS

Part Number	T_{AA} (ns)	Organization
MM5280	200-270	4K x 1
MM5298	150-250	8K x 1
MM5290	120-250	16K x 1
NMC5295†	80-150	16K x 1
NMC4164††	120-250	64K x 1

†Production in 2-4 months
††Production in 4-6 months

MST and XMOS are trademarks of National Semiconductor Corporation.

zation without speech compression has a prohibitively high data rate.

Another advantage of parametric waveform encoding is that it is event-driven. Segments of voice information are delineated by natural changes of the spoken passages, rather than artificial time frames, as with linear predictive coding.

That capability bodes well for the future. Centigram's PWC more easily adapts to packet-switched telecommunication networks, because its naturally segmented voice produces better-sounding speech when reconstructed at the destination, thus opening the potential for store-and-forward systems.

LISA's low bit rate of 4,800 b/s reduces the cost of storage and transmission and compares very favorably with the 56,000 b/s required by other methods producing high-quality digital voice. The system comes in a package that measures 12.5 by 11.4 by 4.2 inches yet contains self-test and host-driven diagnostics, as well as the RS-232-C interface. The single-quantity price is $3,450, and a single-board OEM configuration costs $1,800. LISA will be on display at the National Computer Conference in Chicago in early May. -Gil Bassak

Microsystems

Signetics to add to 68000 family

Motorola Inc.'s 68000 microprocessor is getting more than an alternative source in the just concluded agreement with Signetics Corp. As well as building the 16-bit processor, the Sunnyvale, Calif., subsidiary of NV Philips Gloeilampenfabrieken and Motorola will design better than two dozen support chips that both parties will have the right to make.

Both Signetics and parent Philips will be producing 68000 samples by the end of the year. Three of the support chips are already identified, since they are data-communications parts in the Signetics catalog.

The agreement [*Electronics*,

March 10, p. 53] brings to five the number of sources making the 68000—including Motorola's Integrated Circuits division in Austin, Texas. It also puts the considerable resources of Philips squarely behind Motorola in what is a fierce battle for the 16-bit marketplace.

The unquestioned leader in the arena is Intel Corp., whose 8086 has 60% of the market—not surprising since the company has been in volume production for some time, a point Motorola is just reaching. Zilog Corp. is now in volume production with its Z8000, and Texas Instruments Inc. has updated its pioneering 16-bit 9900 with the 99000.

More parts. Support circuits can be a big help to the 68000 in its drive for market penetration, although it not clear whether Motorola's three other alternate sources—Hitachi, Rockwell and France's EFCIS—will have rights to them. In the 1982-83 time frame, the two companies will develop nine more ICs, in addition to the three Signetics already has.

These three parts are the 2652 multiprotocol communications controller, the 2653 polynomial generator/checker, and the 2661 programmable communications interface. Designed for the company's 2600 microprocessor family, the chips are compatible with the 68000 with only four additional small-scale ICs needed to glue all three to the processor, Signetics claims.

A fourth chip in the 2600 family, a data-communications receiver/transmitter, is likely to be added to Signetics' tally by the end of the year. Future designs will benefit from the common commitment to achieve an architectural compatibility among family members, in spite of a competitive attitude towards the market place on both sides.

A major questiòn on the part of industry observers is whether Signetics will be able to ramp up its n-channel MOS capability in time to become an effective market contender. Long known for its bipolar expertise, the company is benefiting from a widening channel of n-MOS capability from parent Philips.

One result is the 16-bit micropro-

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Circle 59 on reader service card

cessor implementation of a Philips minicomputer [*Electronics*, Feb. 24, p. 50]. To fuel the n-MOS effort, Signetics and Philips are spending $250 million to beef up the former's capabilities, including $100 million for the new Albuquerque, N. M., fabrication plant where three of the four lines will turn out n-MOS parts on sub-4-micrometer scales.

In developing 68000 support ICs, Signetics plans on offering highly sophisticated peripheral chips that can shoulder many of the processor's complex chores. "When we speak of distributed processing, we mean the distribution of function, and not a network of general-purpose microprocessors," says Gabe Moretti, Signetics' manager of software engineering in the microsystems group.

Special-purpose ICs. Signetics and Motorola engineers will take often used software routines like data-base management and will design special-purpose chips to do them. "This should significantly reduce the product development time of manufacturers using the 68000," Moretti adds.

The significance for 68000 users is the relatively small amount of software to be written when the special-purpose peripheral chips are used. The special-function chip is becoming increasingly popular among microprocessor makers, as illustrated in TI's attached processor concept.

For software, it is expected that Philips' current universal development systems marketed in Europe will support the 68000 and that new programs will be compatible with those from Motorola. A complete Signetics low-cost development system for the 68000 is likely, and it will be compatible with an evaluation board that will appear first.

There also seems to be a developing consensus among Motorola, Intel, Zilog, and other microprocessor makers that third-party software houses need to be stimulated into providing much more software support in the area of applications programs. Subcontracting jobs for these houses may be a sure-fire way to do it, IC makers think. -**R. Colin Johnson**

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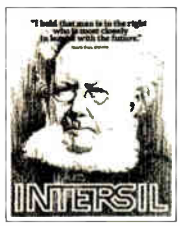

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Washington newsletter

GSA seeks bids for Federal phones . . .

American Telephone & Telegraph Co.'s proposed discontinuance of its bulk-discount Telpak service has driven the General Services Administration to seek competitive bids by April 22 for the annual leasing of nearly 8,000 long-distance telephone circuits to connect Federal agencies in about 200 cities. **Nearly a dozen carriers, including domestic satellite operations, have shown interest in bidding** for at least a portion of the estimated $60 million in GSA business, according to its Automated Data and Telecommunications Service. Awards are expected to begin within 60 days of bid submissions. Operating costs of the Federal Telecommunications System are expected to be trimmed by about 20% compared with standard commercial rates, GSA reports, although the new service will still cost more than Telpak. The 8,000 circuits represent about 17% of the Federal system's capacity, with the remainder—mostly intracity lines—provided by AT&T affiliates or other local carriers.

. . . with operational SBS a potential bidder

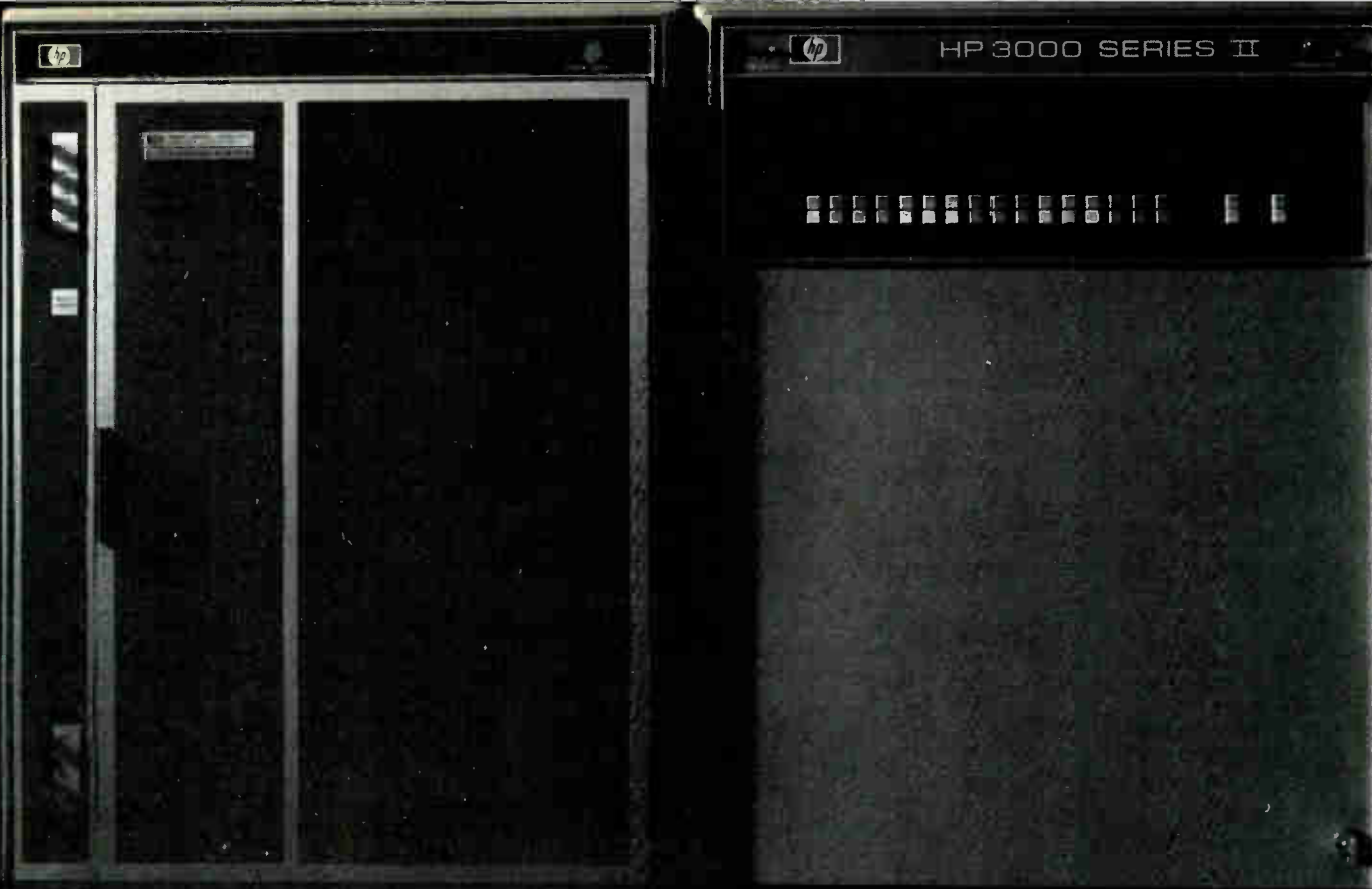
Satellite Business Systems Inc., which began its all-digital commercial communications service in mid-March, is expected to be among the competitors for the General Services Administration business. After five years and a $400 million investment, **SBS's first customer is Boeing Computer Services Co.,** with headquarters in Morristown, N. J. Boeing is using a 56-kb/s link between ground stations at facilities in Vienna, Va., and Kent, Wash. BCS, a subsidiary of the Seattle-based aerospace giant, sells information-processing services to government and commercial markets. It plans to add electronic mail and video conferencing to its initial voice service over SBS. The domestic satellite company, owned by Aetna Life & Casualty Co., Comsat General Corp., and International Business Machines Corp., says its second customer, Atlanta's Isacomm—owned by Insurance Systems of America Inc. of St. Louis—will connect earth terminals in St. Louis and Wausau, Wis. by the end of March, while a six-node network for IBM will be operational by the end of June.

Raytheon, Hughes vie for Amraam

Watch for the selection of Raytheon Co. or Hughes Aircraft Co. before November to begin full-scale development of the advanced medium-range air-to-air missile following Air Force evaluation of the proposals due June 21. The Amraam, an Air Force–Navy program scheduled to begin production deliveries in 1985, **will replace the radar-guided Sparrow** now being produced by Raytheon and General Dynamics. Purchases of up to 20,000 of the new missiles are anticipated. The revised Reagan defense budget calls for nearly $142 million for Amraam in fiscal 1982 compared with the slightly more than $23 million this year.

EIA completes 3 fiber test standards

Three more of the projected 50 standard test procedures for fiber optics and associated hardware are being published by the Electronic Industries Association, raising the total to nine. Under the EIA's recommended standard 455, the new addendum, RS-455-1, covers impact test measurements, temperature cycling of fiber-optic connectors (thermal shock), and acceleration. **An additional 12 test procedures should be ready by the third quarter,** says Amp Inc.'s Joseph Neigh, chairman of the EIA's P-6 fiber optics committee. Copies of RS-455-1 are available at $5.50 from the institute's Standard Sales Office, 2001 Eye St. N. W., Washington, D. C. 20006.



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International newsletter

European viewdata standard likely soon

A single European standard for viewdata systems, which link television by phone to a distant computer, seems likely by June following talks in London last week between Britain, France, and West Germany. Though details are not yet known, hopes appear to rest on the establishment of a second-generation viewdata standard with which both Britain's Prestel and France's Antiope system would be upwardly compatible, safeguarding Britain's investment in its operational viewdata service. A European standard of this kind could provide **strong competition for the Canadian Telidon system in the fight to win the blessing of the Federal Communications Commission** in the U. S.

Philips, Siemens second-source each other's power devices

Europe's two biggest electronics producers, NV Philips Gloeilampenfabrieken of the Netherlands and West Germany's Siemens AG, have signed a deal whereby the two companies will act as second sources for some of each other's power semiconductors. The products involved are **the Siemens range of Sipmos power transistors and the Philips gate-turnoff thyristors, or GTOs** [*Electronics*, March 13, 1980, p. 92; Aug. 28, 1980, p. 78]. The applications for these fast and easy-to-drive devices are complementary, with the GTO primarily used at higher voltages. Their big advantage lies in their ability to be driven directly by TTL circuits and microprocessors.

NTT opens up more buys

Continuing to liberalize its purchasing procedures, Nippon Telegraph & Telephone Public Corp. will announce in April a second batch of products for procurement through open bidding. Unlike the first group of nine items announced in January, the new list of a dozen or so products contains the kind of hardware of most interest to foreign would-be suppliers, including data terminals, facsimile gear, and private branch exchanges. NTT's spending on such equipment in fiscal 1979 totaled about $44 million.

Meanwhile, **36 companies had applied to bid on the initial nine products** by the qualification deadline in late February. Nine were foreign firms, eight of whom want to supply magnetic tape.

VHD video disk systems are gaining ground

The VHD-format video disk system has been adopted by Akai, Sansui, Sanyo, Sharp, Nippon Electric, Toshiba, Mitsubishi Electric, General Corp., Trio-Kenwood, and Yamaha, according to the system's two developers, Victor Co. of Japan and Matsushita Electric Industrial Co. They themselves will **start marketing the system in Japan in October,** in the U. S. next January, and in the UK in June 1982. Their overseas partners, General Electric Co. in the U. S. and Thorn EMI Ltd. in the UK, will also soon start marketing VHD systems.

CII-HB opts for MOS for mainframes

To produce custom logic circuits for its next generation of computers, CII-Honeywell Bull is planning to **combine the MOS technology being developed by Gene Amdahl's new company, Acsys Ltd., with CII-HB's own automated large-scale MOS integrated-circuit design system.** Though the Paris-based Franco-American mainframe maker insists it will stay with bipolar technology for some future machines, product manager François Salle notes that the success of the company's Statos (Système de Trace Automatique pour la Technologie MOS) design project makes MOS technology a better choice for large mainframes [*Electronics*, March 27, 1980,

p. 74]. Though Statos was originally designed to produce 10,000 logic gates with 1.5-μm channel lengths on plasma-etched MOS chips, CII-HB apparently feels it will be able to surpass those goals, thanks to the technology licensing agreement with Acsys announced in early March.

West German color TV to have 2-channel sound

West Germany's Loewe Opta GmbH is Europe's first firm to have come out with color television receivers capable of reproducing stereo and two-channel sound. Developed in anticipation of the start of stereo and two-sound broadcasts by the country's second TV network during the Sept. 4–13 International Radio and Television Exhibition in West Berlin, the Loewe Opta sets cost from about $125 to $225 more than conventional receivers. With **two-channel sound, a feature that could reanimate West Germany's stagnating TV industry,** viewers can choose to watch, say, a movie either in its original language on one channel or with its dubbed-in language on another.

British Telecom to buy no copper cable from 1983 on

In 1983, when British Telecom completes its present 450-km demonstration fiber-optic program, it will be placing contracts for a further 1,400 km of fiber for some 68 systems operating at 140, 34, and 8 Mb/s. Following successful laboratory demonstrations last fall of a 47-km single-mode link [*Electronics*, Sept. 11, p. 67], the corporation is also urgently evaluating **the feasibility of standardizing on single-mode fiber operating at a 1.3-μm wavelength for 140-Mb/s and faster trunk routes** for all bulk purchases from 1985 on. Such a setup would make it possible to space repeaters 30 km apart—an impossibility with the present combination of graded-index fiber and a 0.8-μm wavelength. Whatever the outcome of the evaluation, purchase of conventional copper trunk cable will cease in 1983.

Phone exchange from East Germany uses microprocessor

One indication of East Germany's know-how in telephone switching technology is a new microprocessor-controlled local telephone-exchange system introduced at the just-ended Leipzig Spring Fair, March 15–21. Developed by the East German communications equipment combine VEB Kombinat Nachrichtenelektronik, the OZ 1000 system uses the K1520 microprocessor from the country's computer maker, Robotron. The OZ 1000, a member of the Ensad switching systems family developed jointly by East Germany and the USSR, **accommodates up to 1,024 subscribers with either rotary-dial or push-button phones,** as well as lines from pay phones and private branch exchanges.

Addenda

Hitachi Ltd. says sample shipments of its HN482764 electrically erasable programmable read-only memory will start in April. **The E-PROM is compatible with Intel's 2764.** . . . Look for West Germany's Siemens AG to exhibit at the April 1–8 Hanover Fair the first samples of a family of 85-mm-diameter optical cables containing up to 4,000 fibers—**the highest number of fibers reported for such cables, the company says.** . . . In April, Toshiba Corp. will start selling low–standby-current versions of its complementary-MOS static random-access memories at a 10% premium. Guaranteed at less than 0.2 μA at 25°C and less than 1 μA at 60°C, they can **use button-type lithium batteries as backup.**

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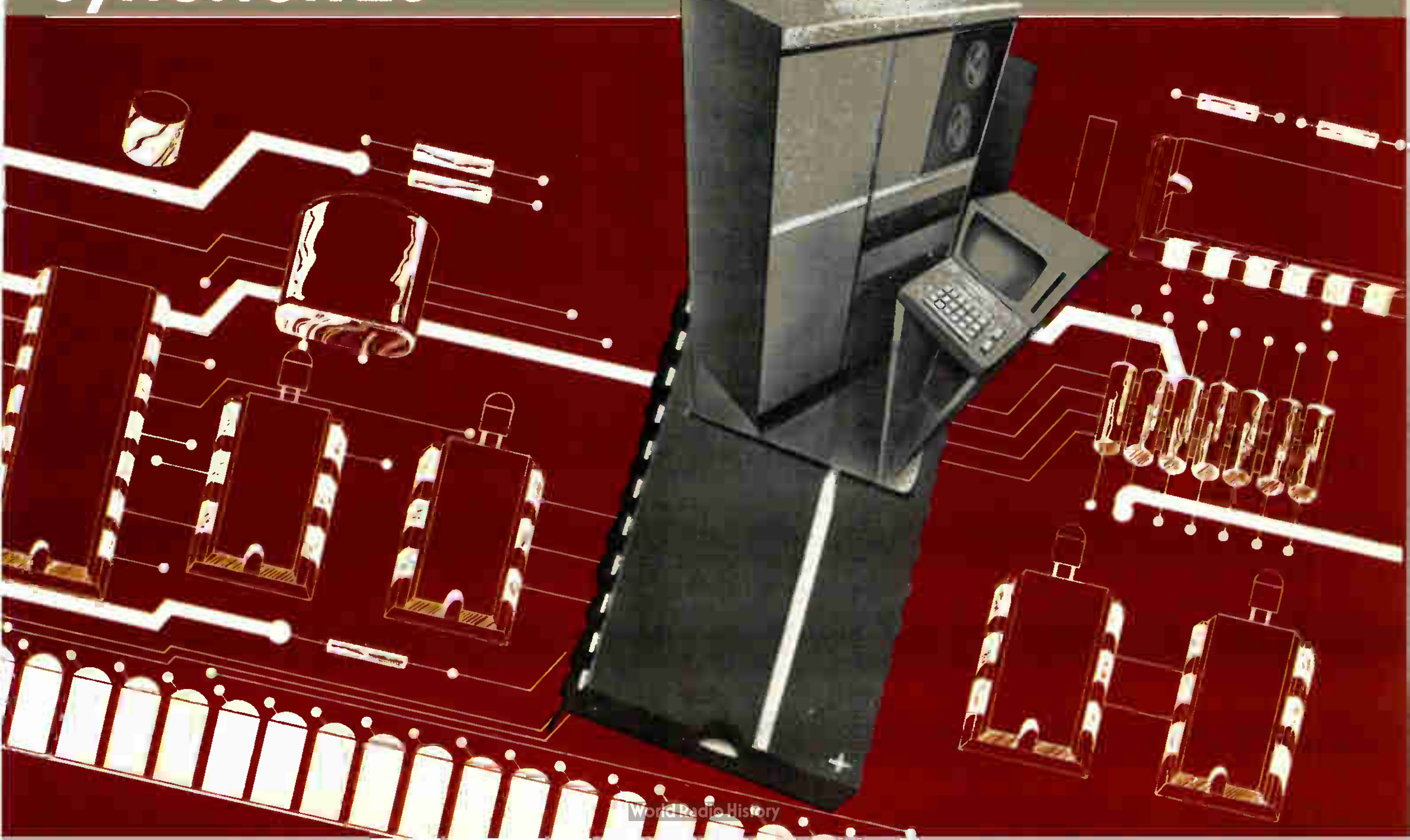

Tektronix' new 7D02. logic analyzer with the

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IF clause defines a data stream event, which may be either single or compound.

THEN clause defines a response to the event. In this case, setting counter #1 to zero and then incrementing every millisecond.

At the same time the counter is set, branch to the second test. (bracketing allows simultaneous actions).

The 7D02 now monitors the data stream for an event to satisfy the second test's IF clause.

If the event occurs, then branch back to the first test and start the program over.

Or if counter #1 has reached 100 mS, then activate the trigger.

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Locating an intermittent fault. The following program gives a limited demonstration of the simplicity and power behind the 7D02's user language. Here the object is to trigger when a second event on the bus does not occur within 100 mS of a first event.

The 7D02 is a 3-wide plug-in for the popular Tektronix 7000 Series oscilloscope. Shown above is a Tek 7603 mainframe housing the 7D02 logic analyzer with a personality module supporting the 6802 microprocessor.

By using the proper personality module, software flow can be displayed using the mnemonics of the chip under test, here the Motorola MC6802.

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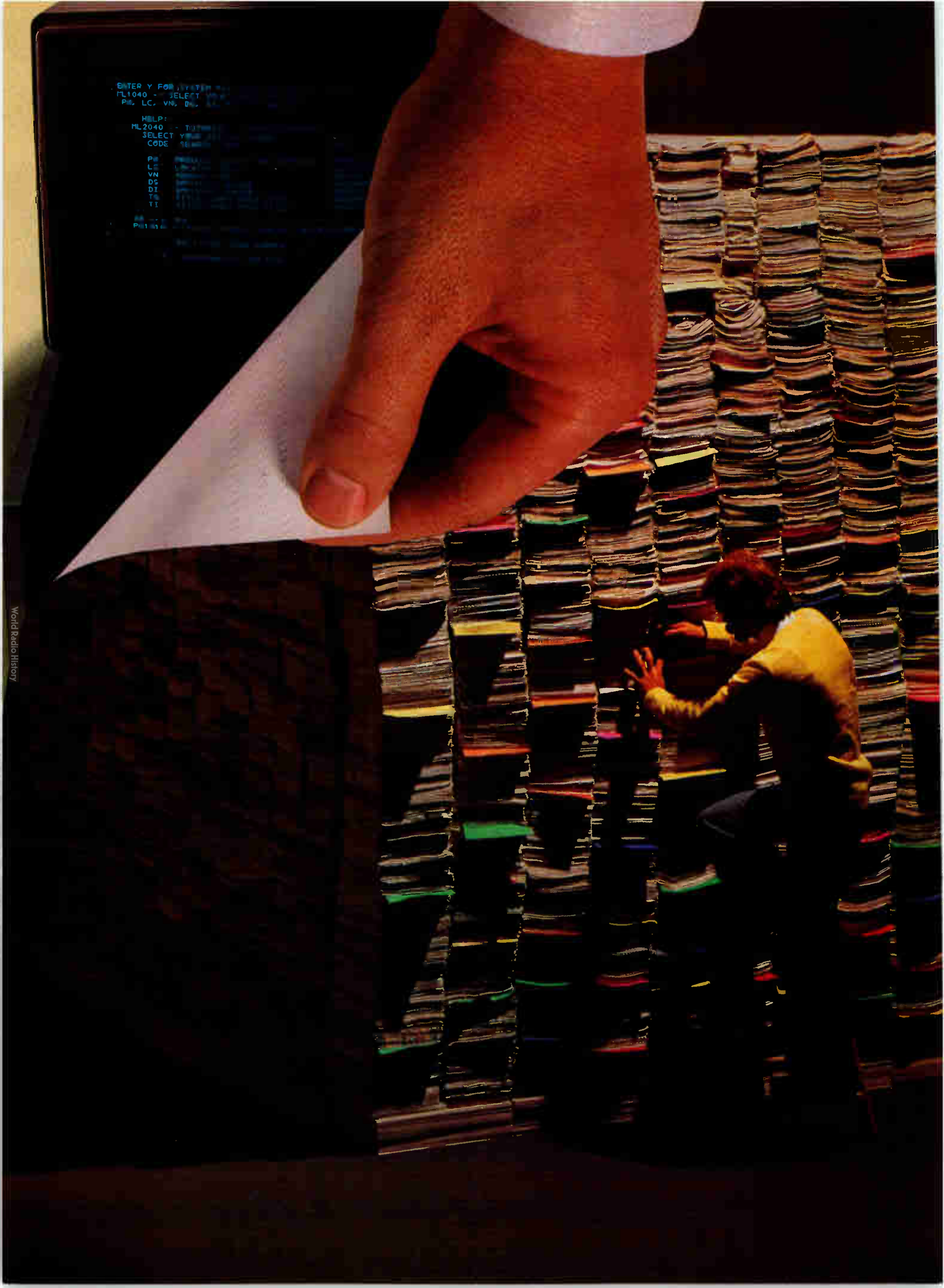
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Liquid-crystal shutter changes monochrome TV images into color

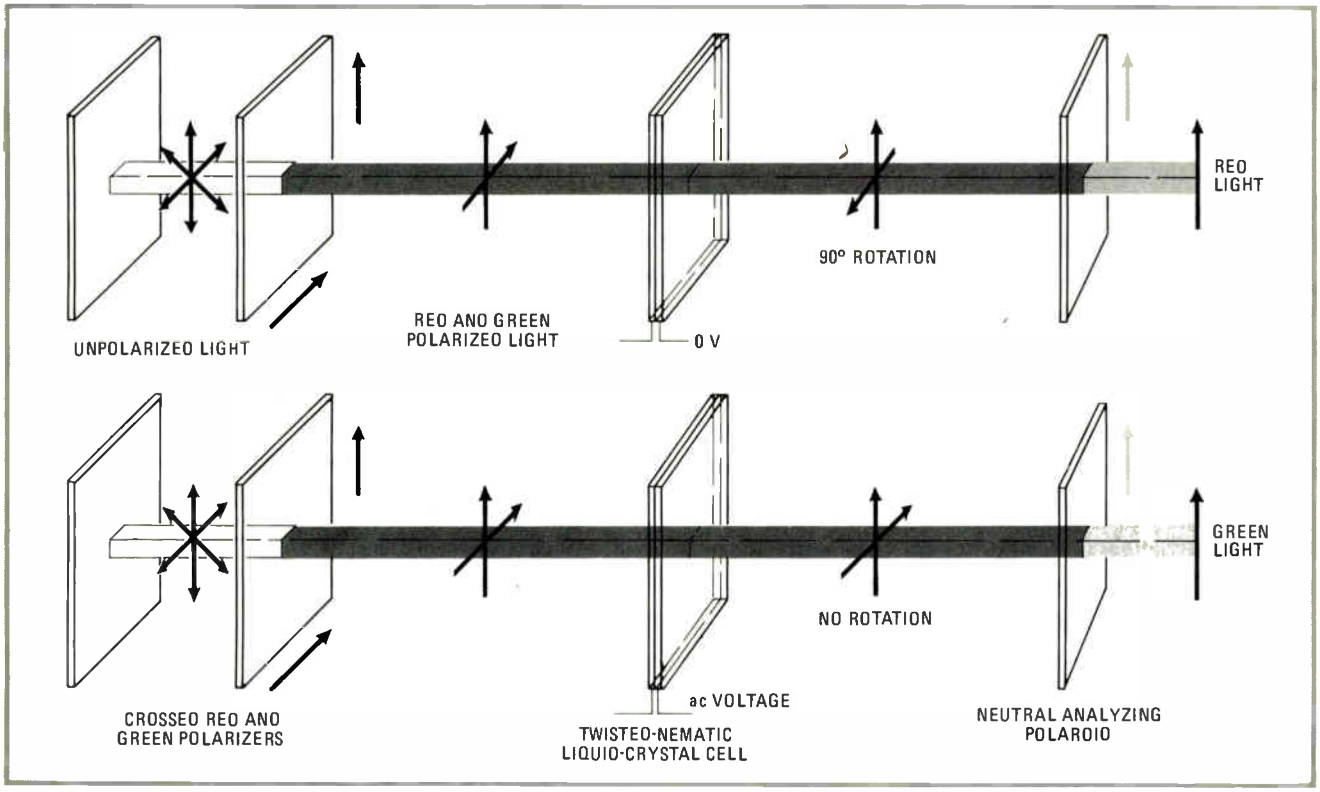
by Kevin Smith, London bureau manager

Technique promises rugged displays in red, green, and colors in between; improves multiplexing of LCDs

Scenes from nature shown on a black and white television screen appear to be in full color if the viewer looks at them through a newly developed liquid-crystal color shutter that is frame-synchronized with the TV. The shutter actually passes only red and green light, but thanks to the brain's color perception mechanism an impression of full color results.

Still, the shutter-based color display is not intended as a rival to the shadow-mask color cathode-ray tube of consumer TV. Instead, its developers at the British government's Royal Signals and Radar Establishment in Malvern say it could serve as a rugged two-color display in military, avionics, and civil applications. It could also be used in test equipment like spectrum analyzers. The display is miniaturizable and more robust than the shadow-mask tube. Also, unlike the Penetron CRT, it easily saturates in both colors without requiring high switching voltages. (In the Penetron CRT, separate red and green phosphor layers are excited by varying the electron-beam voltage.) Moreover, the new display could be retrofitted at low cost to existing systems.

The device employs a property of liquid crystals that researchers are only now learning to exploit: the fact that a carefully selected mixture of nematic and cholesteric liquid crystals can switch abruptly from one anisotropic state to another as the addressing frequency is raised. Nor-



Black and white and color. A liquid-crystal shutter oscillates rapidly on and off, passing alternate frames of red and green polarized light fast enough for the viewer's eye (right) to fuse them and perceive a range of colors, even though the original CRT image (left) is monochrome.

mally, a liquid crystal's molecular anisotropy, or electric dipole moment, causes it to align with an applied electric field and then, when the field is removed, return to its resting state. But by applying a high-frequency burst after the low-frequency turn-on signal to the so-called dual-frequency LCD, it is possible to switch it between the two states at rates of up to 100 hertz. The British researchers employ this effect in a high-speed shutter operating at TV frame rates.

The twist. In the Malvern setup, a 20-centimeter-square liquid-crystal shutter is sandwiched between two polarizing screens. The screen nearer the CRT transmits both green in a vertical plane and red in a horizontal plane, while the screen nearer the viewer passes only vertically polarized light, be it red or green. In the absence of an electric field, the liquid-crystal molecules are so aligned that they twist the plane in which polarized light vibrates through 90° so that only a red image is passed by the screen near the viewer (see figure). But in the presence of a low-frequency electric field, the molecules align their long axes with it: polarized light is passed without rotation and a green image is shown. Then the application of a second field at a higher frequency abruptly switches the molecules to their rest state again, allowing red and green images to be presented in a sequence of alternating frames.

Thus the overall display produces two well-defined red and green colors, as well as any color mix of the two, since the frame rate is fast enough for the persistence of vision to integrate them. Such a frame-sequential display gives acceptable contrast ratios over viewing angles of ±45°, says Michael G. Clark, one of the researchers.

Another use. Potentially, an even bigger application for dual-frequency addressing is overcoming the multiplexing limitations of liquid-crystal displays. To achieve an adequate contrast ratio, LCDs need a sufficient margin between turn-on and hold-off voltages. Yet, as the number of rows to be multiplexed is increased, the maximum theoretical on-to-off ratio tends to unity. Dual-frequency addressing is an effective way of enhancing that contrast ratio under these restrictive operating conditions, though at the expense of an increase in operating voltage and driver complexity.

There are three basic modes of operating: applying a constant high-frequency bias while varying the low-frequency signal between two levels to turn the display element on and off; applying a constant low-frequency bias while varying the high frequency between two levels; and modulating both low and high frequencies simultaneously.

Using available dual-frequency materials not optimized for multiplexing, the laboratory has constructed an experimental display using 15-volt complementary-MOS circuitry that gives a contrast ratio of 5:1 or more over a viewing angle of ±25° when simulating 32-way multiplexing. On the basis of this work, they estimate that display complexities of up to 500 rows of dots appear practical—the equivalent of 70 rows of characters on a seven-by-five-dot matrix.

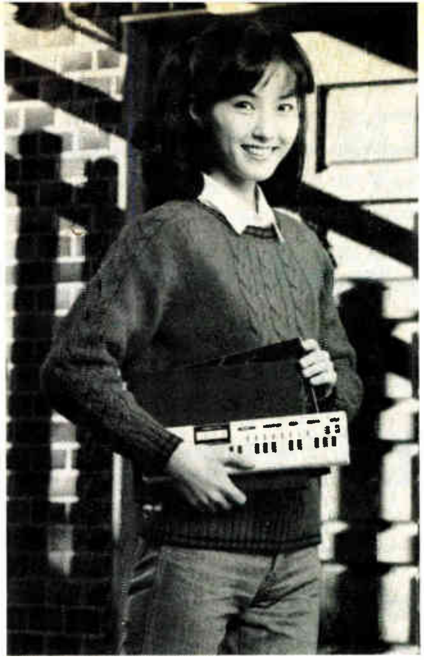
Philips in Europe and Japanese firms, notably Seiko, are also pursuing dual-frequency LCD addressing.

Japan

Casio woos public with novel products

A personal computer, a unique musical instrument, and a Japanese-English translator, all announced in late February, signal Casio Computer Corp.'s intention of becoming first and foremost a creative semiconductor applications house. Long known for its calculators and watches, the Tokyo company is now expanding into new consumer electronics fields, where imagination alone is the limit, according to managing director Noriaki Shimura.

The potentially trend-setting FX-9000P personal computer [*Electronics*, March 10, p. 68] is Casio's most substantial new entry and the harbinger of a big new push by it into small computers. The company's first such machine—the $10,000-range VQ-100—flopped because it was too sophisticated and costly, says Shimura. Casio is thus starting over with the FX-9000P, which went on sale in Japan this month for $720 and will shortly be available abroad.



For would-be musicians. Unique instrument uses VLSI circuit in producing 100 million sounds over 4½ octaves. The memory stores melodies up to 100 notes long.

Backup. Ease of use was the top priority in the unit's design. That is largely accomplished by the use of battery-backed complementary-MOS random-access memory in place of magnetic tape—a feature that eliminates the need to load and unload data and programs whenever the machine is switched on or off. The battery backup also protects data against power failures and accidental unplugging of the machine. "For office use, our approach helps rationalize operations," Shimura boasts. Moreover, he expects other personal computer makers to emulate this C-MOS battery approach.

The computer comes with one 4-K-byte C-MOS RAM in a cassette measuring 4 by 7 by ¾ inches. Additional packs cost $111 each in Japan. Also available are optional 16-K-byte dynamic RAM packs for $92 and a 4-K-byte read-only-memory expander for the same price. The packs may be used in various configurations in four slots on the unit. By the end of the year, Casio plans to

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start offering a dual minifloppy-disk drive with an RS-232 interface for additional memory.

Shimura likens Casio's strategy in personal computers to those of Atari, Commodore, and Sharp, which are also pushing low-cost, simple-to-use models. "We want to make a personal computer as easy to use as a calculator," he says.

Scientific. While stressing that the FX-9000P was designed for general use, Shimura concedes that its software is strongest in scientific applications. Indeed, Casio is stressing the graphics and computational strengths of the machine.

The company is starting modestly with a monthly production of 1,000 units but is already aggressively seeking export orders, though most Japanese companies prefer to sell a new model only domestically for the first year or so. Casio will market the FX-9000P under its own name through its existing U. S. calculator sales channels, which include department and discount stores, at an as-yet undetermined price. About 60% of Casio annual sales of $770 million comes from exports, and Shimura indicates that the ratio should be about the same for the company's three new products.

Yet Shimura does not quite know what kind of sales to expect, because Casio eschews market research. "We just look at other makers to see how much they are selling," he claims. "We think imagining a market is important. If you spend time searching for a market in electronics, progress will pass you by. You have to take certain risks." Casio encourages its engineers to dream up new products or improvements on the assumption that they will create their own demand.

Making music. Illustrating this philosophy is the one-keyboard VL-1, billed as a musical instrument for people who cannot play conventional ones. Casio claims it is the world's first consumer product built around a very large-scale integrated circuit, which has about the complexity of a 64-K RAM. A foot long and weighing almost a pound, it contains 29 keys that can produce 100 million different sounds over 4½ octaves and in dozens of tone combinations. The instrument's memory holds any melody played on it of up to 100 notes. Sales started on Feb. 24 at a list price of $62 in Japan and with an initial monthly production of 70,000 units. An unspecified number is being exported.

Shimura readily admits that he does not know which market segment the VL-1 will appeal to most. But he does not seem troubled by that. "The VL-1's significance is its demonstration of the new types of product that are possible with VLSI," he says.

That is certainly true of Casio's third product, a translator capable of turning 2,508 words in Japanese into English and vice versa and including a voice synthesizer that utters 263 everyday English phrases with intonation. It includes nine 192-K C-MOS ROM devices. **-Robert Neff, McGraw-Hill World News**

France

Speech synthesis laboratory plans to take on 11 European languages

The best way to teach a speech chip from Texas 11 European languages is probably to send it directly to Europe. That is why Texas Instruments Inc. is setting up the first of several European speech synthesis laboratories at its European headquarters.

Billed as the first such installation on the Continent, TI's "speech production lab" in Villeneuve-Loubet, just outside Nice, will not only provide applications support for European customers but also develop speech synthesis algorithms and some hardware specifically for Europe.

At first, the new lab will be largely committed to providing services for European customers—speech recording, digitizing, coding, and editing. Previously, such customers could turn only to TI headquarters in Dallas for these services, an especially awkward procedure for languages other than English.

Right now, the new lab is equipped to handle analog recording and digitizing and the delicate task of manually editing synthesized speech in French and Italian, explains its manager, Larry Brantingham. He was largely responsible for TI's basic synthesis circuit, the TMC 0280 [*Electronics*, Aug. 31, 1978, p. 109]. Within a few months, the lab will also be able to handle the voice-encoding and data-compression stages in the synthesis process, as well as calculate the correlation coefficients for the lattice filter that in TI's linear-predictive-coding system models the vocal tract.

The need to edit. Manual editing of the coded, compressed data is the sticking point in the whole process. "It is an art more than a science," observes Gérard Benbassat, a speech synthesis engineer who recently joined TI Europe's staff. "We want to do 11 languages, so we must reduce the complexity of the editing process."

Pitch is part of the problem—but it is the easiest element to correct manually. And indeed, if TI did not use data compression, pitch correction would be about the only manual editing needed, says Brantingham. But in order to conserve semiconductor memory space, he goes on, it is well worth the trouble of manually correcting the audible deficiencies, that stem from compressing the coded speech data from a mean rate of 1,650 bits per second down to one of 1,000 b/s.

The most common deficiencies caused by data compression are soft plosives (due to incorrect energy levels), wrong voicing decisions (for instance, coding a vowel sound as a consonant or vice versa), and "smeared" transitions between changing sounds.

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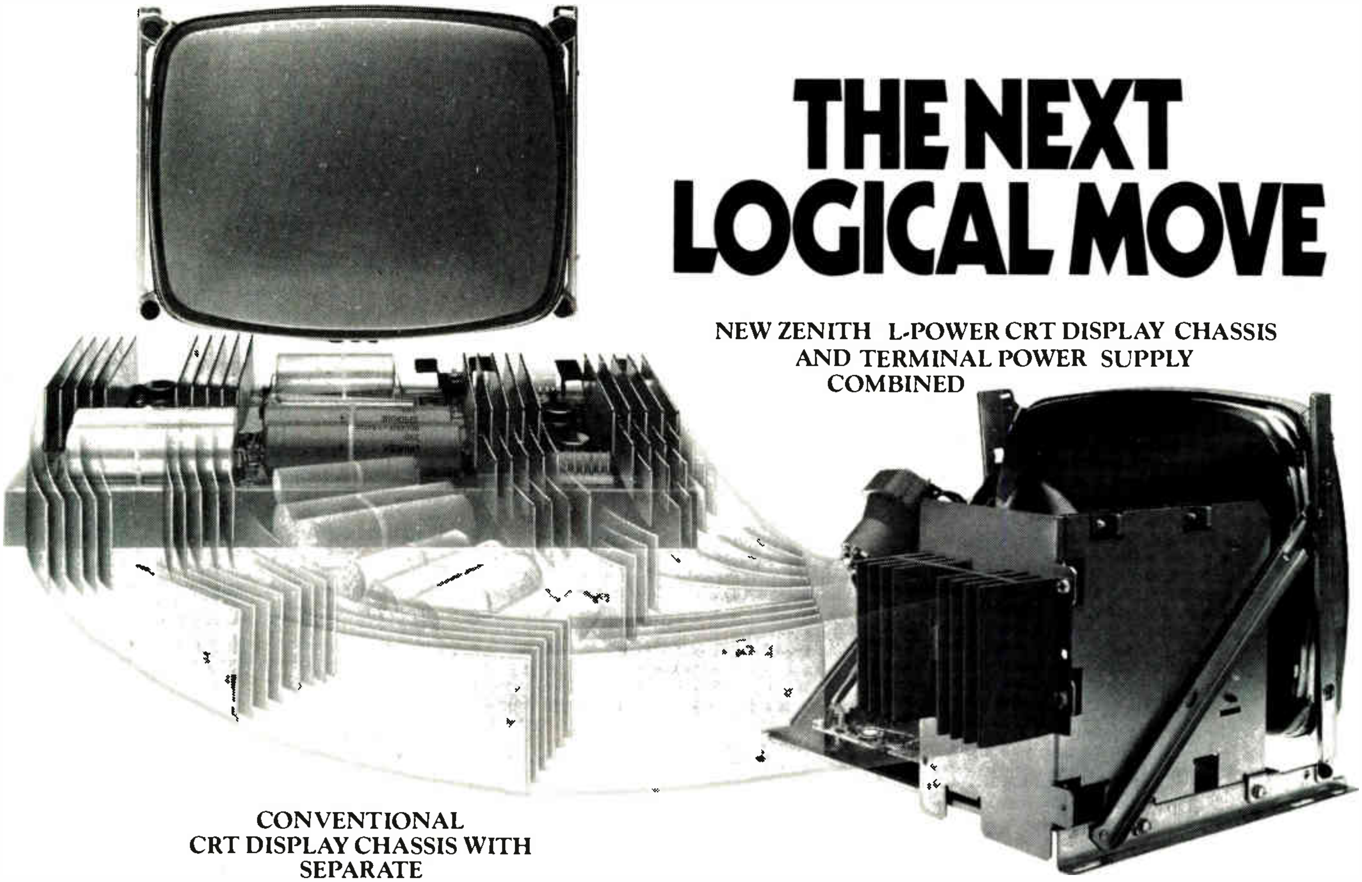

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correct. It stems from the fixed 8-kilohertz sampling time used in TI's existing speech systems. Though the resulting 25-millisecond sampling frame is adequate for most sounds, it is too long for some rapid vocal transitions. In such cases, the transition is "smeared" and correcting the situation requires manual modification of the coefficients controlling the lattice filter.

It is the lack of any obvious relationship between the values of these coefficients and the perceived sounds they result in that prompts Benbassat to describe editing as an "art." "The goal is getting the editing process into more meaningful forms," he adds. And one way TI hopes to do so is by supplying its editors with graphics display screens.

In addition to the basic readout of the values for each of the 10 coefficients used, plus the energy level for each sampling frame, editors will be able to see the digitized speech signal on the screen. Visualizing the spectral amplitude peaks should go a long way toward making the editors' job easier, the TI engineers explain.

Prospects. TI is reluctant to provide much information on the kind of specialized speech synthesis circuits it plans to develop in France once its basic customer service is operating smoothly. But Frank F. E. Owen, telecommunications strategy manager for the company's European semiconductor group, sees speech synthesis circuits working their way into "intelligent" telephones. Such circuits, he explains, could not only supply prompting—for example, asking callers to phone back tomorrow—but could also provide dialing tones. In videotex applications a speech synthesis circuit could also serve as a multifrequency tone generator for telephone access to data banks. **-Kenneth Dreyfack**

West Germany

Post office to install sophisticated phones, leading the way in Western Europe

The new telephone sets that West Germany's post office will start offering its subscribers this summer make calling someone so easy that the postal authorities have dubbed the model the Komfort-Telefon. Like other such phones in the U. S. and Canada, they boast abbreviated dialing, repeat dialing, an emergency direct-call mode, and dialing with the receiver on the hook. And replacing the often shrill ring is a melodious three-tone sound. Even so, the comfort telephone is no larger than an ordinary one, having only one extra row of push-button keys, for 16 keys all told.

Modes. For abbreviated dialing, the user pushes only two keys to call up any of 10 numbers stored in the set. Each number may have as many as 15 digits to accommodate those long international numbers. In repeat dialing, initiated by depressing only one key, the last number dialed can be repeated and sent out any number of times. In the direct-call mode, a particular number stored in the set is automatically called when any one key is depressed—a useful emergency service for the sick and elderly or for small children when their parents are not at home.

All modes may be used with the receiver on the hook, a convenience that keeps one hand free. Furthermore, the volume can be turned up at will, since the set contains a loudspeaker that can allow other people in the room to hear what is being said. Finally, a built-in lock can be used to block the keys and so prevent unauthorized persons from making calls.

Other communications authorities in Europe—those in France, Denmark, and elsewhere—are also preparing to introduce comfort phones. Some will be even more sophisticated than the German sets in that they incorporate a display showing time of day, length of phone call,

and number of elapsed pulses (which communications authorities use to figure out the charges).

Six communications firms are building the West German sets, among them the Stuttgart-based ITT affiliate Standard Elektrik Lorenz AG, which has already received an order to manufacture 60,000 units. The firms must meet the post office's technical and operational requirements but are free to implement them with whatever hardware they choose to use.

More business. For a number of semiconductor houses in Europe also, the new phones have already become a substantial components business. The Freiburg, West Germany–based ITT Semiconductors Group, for example, supplied "several hundred thousand" of its loop disconnect dialer circuits last year, thereby becoming Europe's leading supplier of such devices. For this year the company expects orders of the same magnitude, primarily from France and West Germany.

The ITT group is also supplying 1-K complementary-MOS memories, and starting in the fall of this year it will supply three-tone integrated circuits as well. In addition, the group will deliver its SAA 6002 microcomputer to the Danish communications equipment maker Kirk and to an undisclosed French firm.

In control. The SAA 6002 is a single-chip 4-bit C-MOS microcomputer that can handle all the features of a comfort phone. It also drives a liquid-crystal display showing the time and all call-related information such as the call length, the elapsed time, the stored number being called, or any nonstored number being dialed.

Operating off a 3-volt supply, the microcomputer consumes only 45 microwatts in standby and 135 μW in operation. The chip measures 14 millimeters (550 mils) on a side and comes in a 60-pin plastic flatpack only 2 mm thick.

Other suppliers of microprocessors or ICs to comfort phone builders are Texas Instruments Inc., Siemens AG, and AEG-Telefunken.

Internal use. Aside from telephones for direct access to the public network, the industry is building comfort sets for internal applications; that is, for use within organizations and connected to private branch exchange systems. These sets do not require to have post office approval.

Among the firms offering such sets are Siemens, with its comfoset 150 and Frankfurt-based Telefonbau und Normalzeit, an AEG-Telefunken affiliate, with its TK 4. Both of these telephone sets have roughly the same features as appear on the post office ones. **-John Gosch**

Schottky-TTL and Bipolar Memories from Texas Instruments

DECODERS/ MULTIPLEXERS

VCOs

COMPARATORS

FIFO MEMORY BUFFER

FLIP-FLOPS AND LATCHES

CONTROLLERS

DEVICE	DESCRIPTION
DECODERS/MULTIPLEXERS	
54S/74S138	1-of-8 Decoder/Demultiplexer
54S/74S139	Dual 1-of-4 Decoder/Demultiplexer
54S/74S151	8-Input Multiplexer
54S/74S153	Dual 4-Input Multiplexer
54S/74S157	Quad 2-Input Multiplexer (Noninverting)
54S/74S158	Quad 2-Input Multiplexer (Inverting)
54S/74S251	8-Input Multiplexer (3-State)
54S/74S253	Dual 4-Input Multiplexer (3-State)
54S/74S257	Quad 2-Input Multiplexer (3-State)
54S/74S258	Quad 2-Input Multiplexer (3-State)
REGISTERS	
54S/74S194	4-Bit Right/Left Shift Register
54S/74S195	4-Bit Shift Register
54S/74S299	8-Bit Universal PIPO Shift Register
VCOs	
54S/74S124	Dual Voltage-Controlled Oscillator
COMPARATORS	
54S/74S85	4-Bit Magnitude Comparator
FIFO MEMORY BUFFER	
74S225	16-Words × 5-Bits First-In First-Out
BUFFERS	
54S/74S37	Quad 2-Input NAND Buffer
54S/74S38	Quad 2-Input NAND Buffer (Open Collector)
54S/74S40	Dual 4-Input NAND Buffer
FLIP-FLOPS AND LATCHES	
54S/74S74	Dual D Flip-Flop
54S/74S112	Dual J-K Edge-Triggered Flip-Flop
54S/74S113	Dual J-K Edge-Triggered Flip-Flop
54S/74S114	Dual J-K Edge-Triggered Flip-Flop
54S/74S174	Hex D Flip-Flop w/Clear
54S/74S175	Quad D Flip-Flop w/Clear
54S/74S373	Octal Transparent Latch (3-State)
54S/74S374	Octal D-Type Flip-Flop (3-State)
CONTROLLERS	
54S/74S412	Multimode Buffered 8-Bit Latched Port
54S/74S428	8-Bit Microprocessor Controller
54S/74S482	Expandable Bit-Slice Control Element

DEVICE	DESCRIPTION
TRANSCEIVERS, RECEIVERS, LINE DRIVERS	
54S/74S140	Dual 4-Input NAND 50-Ohm Line Driver
54S/74S226	Latched Bus Transceivers
54S/74S240	Octal 3-State Driver (Inverting)
54S/74S241	Octal 3-State Driver (Noninverting)
54S/74S340	Octal 3-State Receiver/Driver (Inverting)
54S/74S341	Octal 3-State Receiver/Driver (Noninverting)
54S/74S344	Octal 3-State Receiver/Driver (Noninverting)
54S/74S436	Quad Buffer/Memory Driver (Damped)
54S/74S437	Quad Buffer/Memory Driver
54S/74S244	Octal 3-State Receiver/Driver (Noninverting)
PROCESSOR ELEMENTS, OPERATORS	
54S/74S181	4-Bit ALU
54S/74S182	Look-Ahead Carry Generator
54S/74S274	4-Bit by 4-Bit Parallel Binary Multiplier
54S/74S275	7-Bit-Slice Wallace Tree
54S/74S280	9-Bit Odd/Even Parity Generator/Checker
54S/74S281	Expandable Parallel Binary Accumulator
54S/74S283	4-Bit Full Adder
54S/74S381	4-Bit ALU
54S/74S481	Expandable Bit-Slice Processor Element
COUNTERS	
54S/74S162	BCD Decade Counter, Synchronous Reset
54S/74S163	4-Bit Binary Counter, Synchronous Reset
54S/74S168	BCD Decade Counter, Synchronous Reset
54S/74S169	4-Bit Binary Counter, Synchronous Reset
54S/74S196	BCD Decade Counter
54S/74S197	4-Bit Binary Counter
GATES	
54S/74S00	Quad 2-Input NAND Gate
54S/74S02	Quad 2-Input NOR Gate
54S/74S03	Quad 2-Input NAND Gate (Open Collector)
54S/74S04	Hex Inverter
54S/74S05	Hex Inverter (Open Collector)
54S/74S08	Quad 2-Input AND Gate
54S/74S09	Quad 2-Input AND Gate (Open Collector)
54S/74S10	Triple 3-Input NAND Gate
54S/74S11	Triple 3-Input AND Gate
54S/74S15	Triple 3-Input AND Gate (Open Collector)
54S/74S20	Dual 4-Input NAND Gate
54S/74S22	Dual 4-Input NAND Gate (Open Collector)
54S/74S30	8-Input NAND Gate
54S/74S32	Quad 2-Input OR Gate
54S/74S51	Dual AND-OR-INVERT Gate
54S/74S64	4-2-3-2 Input AND-OR-INVERT Gate
54S/74S65	4-2-3-2 Input AND-OR-INVERT Gate (Open Collector)
54S/74S86	Quad Exclusive OR Gate
54S/74S132	Quad 2-Input Schmitt Trigger
54S/74S133	13-Input NAND Gate
54S/74S134	12-Input NAND Gate (3-State)
54S/74S135	Quad Exclusive OR/NOR Gate
54S/74S260	Dual 5-Input NOR Gate

DEVICE	DESCRIPTION
RAMs	
54S/74S189A	64-Bit RAM (16W × 4B) (3-State)
54S/74S201	256-Bit RAM (256W × 1B) (3-State)
54S/74S289A	64-Bit RAM (16W × 4B) (Open Collector)
54S/74S301	256-Bit RAM (256W × 1B) (Open Collector)
HIGH PERFORMANCE PROMs	
TBP18S030	32 Words × 8-Bit PROM
TBP18SA030	32 Words × 8-Bit PROM (Open Collector)
TBP24S10	256 Words × 4-Bit PROM
TBP24SA10	256 Words × 4-Bit PROM (Open Collector)
TBP24S41	1024 Words × 4-Bit PROM
TBP24SA41	1024 Words × 4-Bit PROM (Open Collector)
TBP24S81	2048 Words × 4-Bit PROM
TBP24SA81	2048 Words × 4-Bit PROM (Open Collector)
TBP24S81-55	2048 Words × 4-Bit 55ns PROM
TBP24SA81-55	2048 Words × 4-Bit 55ns PROM (Open Collector)
TBP18S030	32 Words × 8-Bit PROM
TBP18SA030	32 Words × 8-Bit PROM (Open Collector)
TBP28LA22	256 Words × 8-Bit PROM (Open Collector)
TBP28S42	512 Words × 8-Bit PROM
TBP28SA42	512 Words × 8-Bit PROM (Open Collector)
TBP28S46	512 Words × 8-Bit PROM
TBP28SA46	512 Words × 8-Bit PROM (Open Collector)
TBP28S86	1024 Words × 8-Bit PROM
TBP28SA86	1024 Words × 8-Bit PROM (Open Collector)
TBP28S86-60	1024 Words × 8-Bit 60ns PROM
TBP28SA86-60	1024 Words × 8-Bit 60ns PROM (Open Collector)
TBP28S166	2048 Word × 8-Bit PROM

PROM PERFORMANCE SUMMARY

BIT SIZE	DEVICE	ORGANIZATION	TYPICAL ADDRESS ACCESS TIME	TYPICAL POWER DISSIPATION
256	TBP18S030 TBP18SA030	32W × 8B	25 ns	400 mW
1K	TBP24S10 TBP24SA10	256W × 4B	35 ns	375 mW
2K	TBP28L22 TBP28LA22	256W × 8B	45 ns	375 mW
4K	TBP28S42 TBP28SA42	512W × 8B	35 ns	500 mW
	TBP28S46 TBP28SA46	512W × 8B	35 ns	500 mW
	TBP24S41 TBP24SA41	1024W × 4B	40 ns	475 mW
8K	TBP28S86-60 TBP28SA86-60	1024W × 8B	35 ns	550 mW
	TBP28S86 TBP28SA86	1024W × 8B	45 ns	625 mW
	TBP28L86	1024W × 8B	65 ns	275 mW
	TBP24S81-55 TBP24SA81-55	2048W × 4B	35 ns	550 mW
	TBP24S81 TBP24SA81	2048W × 4B	45 ns	625 mW
16K	TBP28S166	2048W × 8B	35 ns	500 mW

A = OPEN COLLECTOR; L = LOW POWER

New PROM numbering system tells you more.

The new numbering system now being used on all TI PROMs is an index to the distinctive qualities of each device. The new code is logical. Convenient. And, with familiarity, easy to understand. Here's how it works:

TBP 2 4S81N — The first digit indicates the Programming Family. All 1s program alike. All 2s alike.

TBP2 4 S81N — The second digit tells you the Output Word Width.

TBP24 S 81N — This letter, or letters, indicates output or performance characteristics. Standard (Schottky) or low-power performance. Power down or registered. Latched. Three state or open collector.

TBP24S 8 1N — This digit, or digits, tells you the complexity. From 256 to 32K bits. 8 means an 8K device.

TBP24S8 1 N — This digit denotes package size and number of pins. In this instance, a 300-mil wide, 18-pin package.

TBP24S81 N — This letter, or letters, tells you the temperature range and package type. N alone indicates a plastic dual-in-line package for operation between 0 and 70° C. J alone indicates a ceramic dual-in-line package over the same commercial range, while MJ indicates a ceramic DIP for the military temperature range of −55° C to 125° C.

For a complete description, see the Bipolar Microcomputer Components Data Book, 2nd edition.

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Quality, reliability top TI's list

Company-wide program makes improvement part of manager's rating and includes comprehensive internal education and training

by Gerald M. Walker, Managing Editor, News

Reliability and quality are right up there with motherhood and apple pie in business circles, but the words no longer are a mere slogan in the semiconductor market. Thanks in part to pressure from Japanese suppliers, quality and its concomitant, reliability, have become competitive weapons to be used in a company's battle for market share. Moreover, quality is now viewed as a means of increasing profit rather than as an overhead expense.

All of the U.S. semiconductor companies are responding to this trend, and among those emphasizing its importance is Texas Instruments Inc. from its headquarters in Dallas. In typical TI fashion, the company has instituted a thoroughgoing, top-to-bottom quality–reliability assurance (QRA) program that involves its end-equipment divisions as well as the semiconductor groups. The goal: a 0.1% rejection rate, which means every device, rather than just samples, must be tested.

In previous years TI has made strategic planning and productivity improvement a part of everyone's lifeblood. Now it's QRA. The fact that president and chief operating officer J. Fred Bucy last December appointed senior vice president and long-time troubleshooter C. Morris Chang to head the company-wide program indicates the seriousness of TI's intent. Chang's mission: to make QRA an integral part of the TI corporate structure.

"The first thing that we are stressing is to identify and refine the quantitative measurements of quality and reliability. I'm a deep believer that if you cannot measure something quantitatively, you can't fix it, and your ability to improve it is handicapped," Chang says.

Late indicators. Some of these measurements, such as the number and kind of products returned from customers, are in place. Chang labels them lagging indicators because they are after the fact. "Returned material is a key index for most semiconductor companies," he observes. "But these are not very useful tools in the day-to-day management of reliability—in order to have useful tools, you need to know what your quality and reliability levels are before you ship the product."

As a result, TI is now stressing measurement tools concurrent with manufacturing as a means of predicting the customer's perception of quality and reliability. The next step, at present in the experimental stage, is to set up leading indicators—tracking quality and reliability before the product is manufactured.

Finally, with a means of measurement in hand, the company will set specific short- and long-term goals in QRA and develop programs to reach

Pointed remarks. C. Morris Chang, who heads TI's company-wide quality and reliability program, is making the effort an integral part of the corporation's structure.

them. These steps fit into the existing planning procedures.

The most important change, however, has been to make quality and reliability improvement a part of the evaluation of managerial performance. By treating QRA in the same way as the bottom line of a profit and loss statement, TI has won the attention of everyone in the company. And top management is taking it all seriously. For example, one aerospace customer rated TI in sixth place out of eight vendors, "and Chang became unglued," in the words of another TI executive.

Once top management sets such a performance ideal (see illustration), subordinates will respond. "It's only human for the line managers to pay close attention to the essentials they'll be graded on," the executive continues. "Quality is an essential. And so is management intervention and pressure to achieve it. Without such backing, [the program] is not going to fly."

The difference is that in the past managers were rated on quality intentions only. Since February, when the QRA factor was added to performance evaluation, it has been the results that count.

Because of the company's complexity and variety of products, not every segment of TI is at the same level in the QRA program. The product group credited with being first to emphasize reliability heavily is the bipolar and discrete semiconductors group headed by vice president J. M. Hubbard, who previously spent some four years managing TI's facilities in Japan.

Sales tool. "Quality-reliability is a major strategic challenge," observes Hubbard. "It's not just developing new products, it's not just cost reduction, it's not just productivity—it involves much more interaction with customers. We need feedback in the form of a customer's report card. We want to use reliability to increase our market share."

On the leading edge of the bipolar group's QRA effort are the product teams that deal directly with customers. These teams are responsible for making sure that TI's outgoing inspection tests correlate with the customer's incoming inspection tests. Running across the product operations to form an interactive matrix are functional quality teams. They represent product and process design, front-end processing, assembly and packaging, test, customer services, and quality culture, an internal educational team. When the product teams identify a problem common to a product sold to several customers, they can work with the functional teams to solve it. Meanwhile, the functional teams are pushing their sectors to pull up the reliability of all the product lines.

For example, in the fourth quarter of 1979, the bipolar group set out to upgrade the front-end processing operation. The front-end team devised a system of certifying and qualifying production workers. To become certified, a worker requires three months of training leading to proof of his or her competence. However, those who make the grade receive premium pay.

Palpable improvement. The result has been a decline in turnover and absenteeism in every quarter since the program began. The team has had measurable impact. Slices processed per hour increased 19%; yield was up 33%. In 1980 rework declined 56% and defect density was down 80%. The goal is to bring rework down to zero by June 30 of this year.

Some 75% of returns are not for electrical faults but for clerical and testing errors. As a result, order and invoice forms have been changed to help reduce typing errors. Inspection of outgoing shipments has been beefed up to make sure that the right parts get into the right orders. Because customers perceive on-time delivery as a quality factor, TI has also organized a customer service quality team. Its job is to concentrate on order-handling paperwork and warehouse and shipping procedures. In addition, this team publishes a quarterly newsletter on quality for customers.

The education and training of personnel is considered important enough to have a team as well. Called the quality culture team, it is responsible for raising employees awareness of quality and reliability. This group drew up the quality performance review form now used for managers. Its efforts have even filtered into the college recruiting program, so that brochures aimed at college graduates include information about the QRA program.

Direct payoff. Does the companywide program pay off? In terms of meeting the goals of increased market share of and increased profit generated by fundamental cost reductions, the answer is yes. Thus, a recent increase in business from three large customers has been directly attributed to quality and reliability improvement.

As one product line manager remarked, "We're dropping motherhood and substituting profits." □

QUALITY PERFORMANCE REVIEW

30 % QUALITY PERFORMANCE FACTOR

NAME: John Doe

POSITION: Product marketing eng.

REPORTS TO: Jane Smith

QUARTER: 1Q 1981

MAJOR LONG RANGE GOALS	QUARTERLY OBJECTIVES	6 MINIMUM ACCEPTABLE	10 OUT-STANDING	WT. %	W3S, KEY MILESTONES, SUPPORT REQUIRED
Material return reduction	1. Reduce order entry related RMRS from 2% to 0.25 %	1%	0.5%	40	• Coordinate with field sales • Check all orders for proper customer p/n • Review backlog twice a month for errors • Investigate reason for return before issuing RMR number
Improved response time on customer requests	2. Improve response time on delivery quotes from 2 days to 8 hours	24 hrs	12 hrs	60	• Coordinate with planning • Set up quote system on TIOLR • Verify customer p/n has SDS/PATS • Support from FCC on new loadings requests needed

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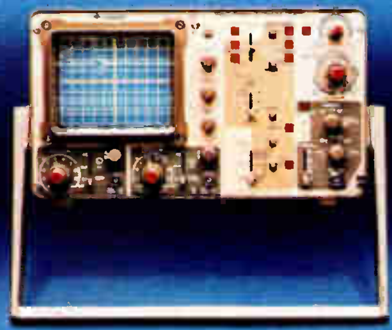

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Electronics abroad

Composants shows an anxious mood

With only 5% growth for semiconductors typical of the trend, officials at big Paris components exhibition search for good signs

by the European editors of Electronics

For the European electronics community, the Salon International des Composants Electroniques in Paris is a sort of annual spring festival. Year in and year out, a particular bonhomie pervades the acres of hardware exhibits at the Porte de Versailles as the world's components suppliers strengthen their contacts with European equipment makers and search out new business, often over a drink in the lounges behind the showcases and showboards.

This year, during the April 6–11 run of the show, the usual *joie de vivre* may well be tinged with *Angst*, for hard times have come to Western Europe. Overall, economic activity in the region will diminish during 1981, so much so that even the high-flying electronics industries will lose altitude. "We can function only when the market is expanding by 15% to 20% a year," explains Guy Dumas, who heads the Semiconductor division of Thomson-CSF, the leading French electronics equipment company.

That kind of expansion is absolutely out of the question this year for the $12.3 billion components markets in Western Europe. Semiconductors as much as anything else set the pace. And, says Dedy Saban, vice president and director of marketing in Europe for the Semiconductor Group of Motorola Inc., "the market will go up 5% at best, with all the growth coming from integrated circuits and optoelectronics." These projections, Saban points out, are based on European currencies. Converted into newly strong dollars, he goes on, the market figures become even worse.

But they are not as dismal as those for capacitors, a mainstay in passive components. "Incoming orders and backlogs are way down," reports Philippe Rietzler, who keeps close tabs on capacitor markets as market research manager for Sprague Europe, a subsidiary of Sprague Electric Co. "We anticipate a weak first half," he says, "and still cannot say when the order drop-off will bottom out." Rietzler now surmises that the turning point, earlier seen as likely for this spring, will not come before summer and is perhaps farther off than that. Sales for 1981, then, could well end up lower than 1980's.

Some sellers. All is not uniformly bleak, of course. Displays of all sorts are selling well and so is input hardware like keyboards. Connector makers, too, should hold their own and then some. And purveyors of printed circuits will do well.

At the other extreme, the most furrowed brows at the Paris show almost surely will be those of product-line managers for MOS memories. "MOS memory is going to hell" is how Frank F. E. Owen put it. Owen, the European telecommunications strategy manager for Texas Instruments SA, maintains the book-to-bill ratio has dropped to well below 1 for everybody in this facet of the semiconductor business. "Up to now," he explains, "the problem has been overcapacity. Now the recession will come into play for MOS." MOS memory markets thus have to get worse before they can get better. With 16-K random-access memories currently selling for less than $2 and Japanese producers driving relentlessly for market share, who could think otherwise?

How much longer components markets will

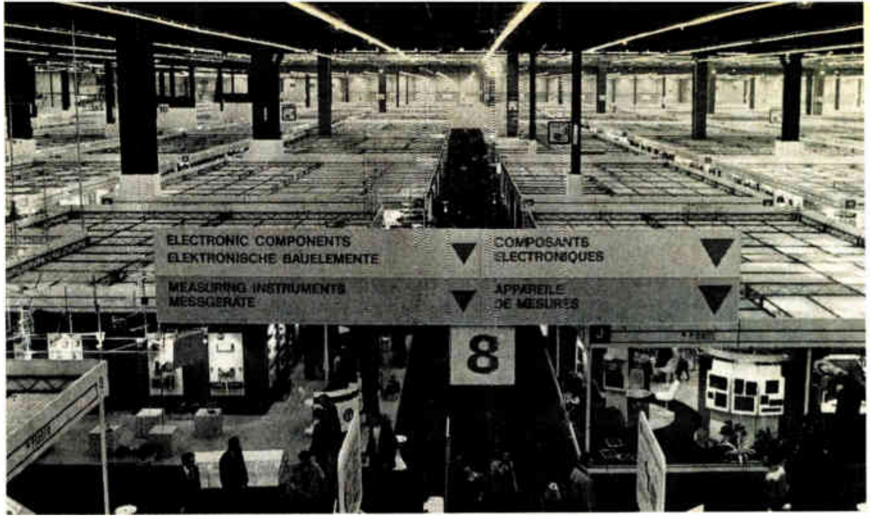
Doorway to spring. Composants show in Paris provides opportunity for European electronics executives to compare notes.

continue to dawdle is a question that will be asked repeatedly in business conversations on the stands of the 1,600-odd exhibitors at the show. Jean Michel Beaujean, who handles studies in electronics-related industries for the Bureau d'Informations et de Prévisions Economiques (BIPE), a quasi-official French econometric agency, does not see any chance of a rebound until after the summer vacation lull, for example. Michael Bews, European components marketing manager for National Semiconductor Corp., sees no pickup in the integrated circuits business until September or October. One of Bews' counterparts in the UK sees much the same timing. "There is going to be a low intake well into the third quarter," predicts Ray Rees, product marketing manager, northern Europe, for Fairchild Camera & Instrument (UK) Ltd.

France favored. Cartographers will have no trouble deciding on how to tint their current maps of Western European components markets. The least somber hue goes to France and the most somber to Great Britain, with the shades for West Germany, Italy, and Scandinavia somewhere in between.

Among the big four of Europe, France alone has a chance of edging its economy upward this year, perhaps by 1%. But uncertainties abound, among them the outcome of the presidential election in May, making consumers queasy. So entertainment electronics markets figure to be flat, with color TV set sales hovering around 1.4 million. Components suppliers, then, will have to look elsewhere for growth.

They should find it at producers of military gear, telecommunications gear, and computers. Thomson-CSF, for example, has heavy order backlogs for its warfare hardware and for telephone exchanges, with exports figuring heavily in both sectors. CII-Honeywell Bull, the major "native" mainframe maker, reports it went into the year with a record backlog. With the lift from the professional-equipment builders, components markets overall should be good for a 9% rise, with semiconductors up



Pigeon's-eye view. The vast Porte de Versailles, site each year of the Composants show, will house some 1,600 exhibitors' booths on April 6–11. This is a view of the floor last year.

about 11%. These are well below the 1980 growth rates.

Germans off. West Germany, still the heavyweight economy in Western Europe, has gone into a downswing that will shrink its output of goods and services by something like 1%—maybe even more. The electronics industries, luckily, should stay on the plus side, although the same heavy pressure on prices will offset any rise in the number of parts semiconductors makers sell. It will be a zero growth year for semiconductor sales, estimates Rüdiger Karnatzke, marketing manager for continental Europe for the ITT Semiconductors Group.

In the UK, it will be another year of ebb tide. The country's hard-pressed economy shrunk 2% in 1980 and is set for a like decline in 1981. That means another 12 months of minimal real growth for components suppliers.

The pattern is much the same as on the Continent. British consumers showed surprising resilience last year despite high inflation and high unemployment; as a result, color TV sales actually edged up 2% instead of sliding slightly downward as expected. And, as across the Channel, the telecommunications and defense sectors have so far not felt the chill. "Our main-exchange order book is 50% up on last year," says Desmond Pitcher, managing director of Plessey Telecommunications Ltd. For the company's private digital exchanges, shipments are up 24%.

David Benda, a market analyst for Mullard Ltd., projects an overall growth of 7% for UK components markets this year, roughly half the rate for 1980. Component destocking by equipment makers, he reports, has just about come to an end. This should bring a bulge during the second or third quarters, followed by continued decline.

The worst might even be over for instrument makers, one of the worst-hit sectors in the current British recession. "Our orders have bottomed out and started to come up again," says Colin Gaskell, managing director of Marconi Instruments Ltd. But, he adds, "I'll be a lot happier when I see the figures for April. Last year, at about that time, the figures went over a precipice."

Sunny Italy. The Italian economy sometimes seems to operate under its own set of laws, prospering when it seems impossible (to outsiders, anyway) for it to do so. But the country's component makers have no miracles to sustain them just now.

Predictions with hard numbers are difficult to come by, but a forecast that 1981 will be down from 1980 would provoke little protest. "Demand will not be equal to last year's because the level inherited from the final months of 1980 was so low," remarks Roberto Taranto, general manager of Reseau, a Milan automation and market-study organization.

Luigi Lang, outgoing secretary for the components group of the trade association ANIE (for Associazione Nazionale Elettrotecniche ed Elettroniche), has much the same view. He reports that among the semiconductor suppliers there is widespread feeling that the current crisis could end during the first half with a gradual increase after that. □

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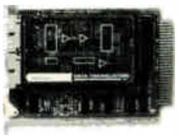

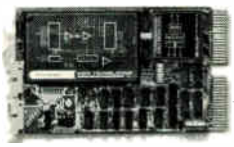

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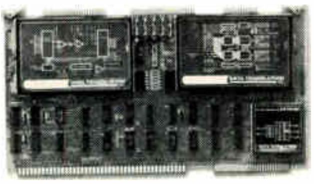

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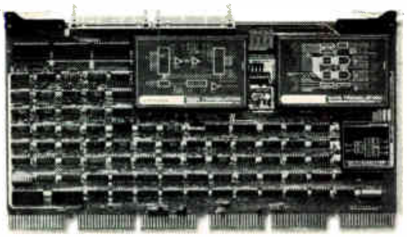

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Software

Relational data bases do it more easily

IBM is latest to join the dozen or more companies offering the simpler and more flexible management system

by Pamela Hamilton, New York bureau manager, and Tom Manuel, Computers & Peripherals Editor

Relational data-base management systems are much in vogue, and the recent announcement of the Structured Query Language/Data System (SQL/DS) by International Business Machines Corp. will undoubtedly enhance their popularity. But IBM is far from the first to offer such a relational or relational-like system: a dozen or more companies offer data-base management systems for use with mainframe computers and aimed at the nonprofessional user.

Among them are Applied Data Research Inc., Control Data Corp., Infodata Systems Inc., International Data Base Systems Inc., and Tandem Computers Inc. Most have offered relational products for several years, and all agree that the relational data-base model features a flexibility and ease of use unavailable with a network or hierarchical data-base management structure.

Data-base management systems are software that organizes and accesses large groups of interrelated files. Their value is that they provide application programs and information independent of the data structure—the user need not know the data's location. The new relational data-base management systems, unlike the older hierarchical and network versions, are homogeneous. They locate data on the basis of its relationship with other groups, sets, or files; to retrieve data is easy and to expand it is simple—just add new data and relationships. The older systems, on the other hand, store data in rigid, structured groups; to make changes requires changing the structure of all the files.

Base unchanged. For example, suppose the task is to create within the data base represented by the two tables printed with this story yet a third table: companies offering a data-base management system for IBM computers for less than $50,000. With the relational model the desired information is simply extracted from the existing tables: the data base remains unchanged. In a network model, if there were no pointers to the file labeled "CPUs supported," the data base would have to be restructured and reloaded with the pointers added.

The relational model is inherently flexible because of the independence of the data structure from the keys used to retrieve the information. There are no embedded pointers or positioners in the data files themselves. The ways the data is used—the relationships, represented by two-dimensional tables—can be re-

RELATIONAL DATA-BASE MANAGEMENT SYSTEM FEATURES

Name of system	Company CPUs supported	Query language	Report generator	Data dictionary support	Price
DMS-170	CDC	Query/Update	Query/Report Writer	partial	from $630/month
Datacom/DB	IBM	Dataquery	Datacom/Datareporter	data dictionary	$47,000 to $57,000
DPL	DEC	DPL language	yes	data base directory	$22,800 to $38,000
DRS/XBS	IBM, Univac, DEC, CDC	via command language	DRS Report Writer II	integrated data dictionary	$22,000 to $60,000
Encompass	Tandem	Enform query language (nonprocedural)	Enform Report Writer (nonprocedural)	Encompass data dictionary	$31,500 license plus $8,500/processor
IDM 500	any	Intelligent Database Language	no	integrated data dictionary	$50,000, including back-end processor
Inquire	IBM	user language	user language	Edict data dictionary	$70,000 to $150,000
Model 204	IBM	user language	user language	Model 204 data dictionary	$90,000 to $150,000
Ramis II	IBM	user nonprocedural language	via nonprocedural language	yes	$22,000 to $43,000
Seed	IBM, CDC, DEC, HP	Harvest query language	Reap report writer	integrated on schema	$9,500 to $25,000
SQL/DS	IBM	structured query language with interactive query	interactive report writer	catalog in system tables	$300/month
System 1022	DEC	yes	yes	no	$17,000 to $24,000

Sources: Datapro Research Corp. and *ELECTRONICS* defined without having to change the data structure each time, unlike the branching trees found in network or hierarchical models of the kind defined by the Codasyl standard. Applications software is therefore easy to develop and modify, and the upkeep of the data base is a cinch. "What you really want to do is to make it so that the end user doesn't have to navigate through the data," notes Harry Kaplowitz, executive vice president for Infodata Systems in Falls Church, Va.

Two points are key for Kenneth A. Parker, vice president and director of marketing for Applied Data Research, Princeton, N. J. The first is that users will be familiar with the data they are manipulating, but not so familiar with the software tools with which they do the manipulation. The second is that data in an unstructured format becomes more usable over time. His company has used an inverted-file-access technique for rapid access and retrieval of data with its Datacom/DB systems.

Implementations of relational data-base management systems can sometimes require large amounts of computer resources. For the most part, they tend to be big programs working on large amounts of information. Often, more main memory needs to be added to a system to support such a system.

Big bases. "The problems come with large data bases," Parker notes. "The computer has to be very smart and have a lot of memory, and there has to be a lot of computer cycles if the user has a large data base. Or else the software has got to put it together; the software has to be optimized," he says.

Companies handle these efficiency tradeoffs in different ways. ADR has an optional data-compression feature to minimize disk storage requirements and a partial data-base feature to ensure minimum use of resources. The facility allows only that portion of the data base currently being accessed by the user program to be mounted; the remainder of the data base can be dismounted when not in use.

For Infodata Systems, the solution is a little different, according to Kaplowitz. "In a pure relational system you deal with flat files [files with no structure or index]. That single level of repetition is easily understood by the user," he observes. "But the system doesn't have to carry out that redundant data. You can have a common structure very easily within the bounds of what is called relational, by exploding those flat files." Thus the fields used in Infodata Systems' Inquire data-base management system may be single-valued or multiple-valued, depending on whether the data under its control is repeating.

According to Ken Strappini, product manager for software at Tandem in Cupertino, Calif., with his company's Encompass system all the disks have two volumes and the data is duplicated for reliability. This duplication has the added effect of contributing to the retrieval efficiency because the data can be read from the volume where the read head happens to be closest to the data element wanted.

Herbert A. Edelstein, vice president for International Data Base Systems, Philadelphia, believes that any costs associated with a relational data base may well be offset by the increased job productivity that should be gained.

The market for data-base management systems is expected to increase 600% between 1980 and 1985 and reach $4.1 billion by 1989, according to a study by Strategic Inc., San Jose, Calif. However, the research firm has some caveats about relational systems.

"If suppliers solve the efficiency problems with relational data-base management systems, relational systems will begin to take off, because almost everyone agrees that they are flexible and easy to use," notes Edward Cherlin, senior analyst. "In large computer systems with very large data bases," the company's study predicts, "the relational model will not go very far before 1985—relational data-base management systems will begin to have an impact by the end of the decade."

Smaller is better. However, Cherlin notes that for small or moderate quantities of data on smaller computer systems the efficiency of relational data-base systems is not so critical because the very long sorting times that occur for very large files are not nearly as significant a problem with smaller files. The research firm believes that the relational model will do much better in the next few years in small minicomputer systems.

In the last three years, the growth of the small-business computer market has created a climate for quite a few relational data-base management systems for small computers. Such companies as Condor Computer Corp. in Ann Arbor, Mich., with a package for Z80-based systems; and Relational Data Base Systems Inc. of Sunnyvale, Calif., offering one for Unix-based systems, are setting up shop. Also emerging as vendors of relational data-base management systems for small computers are RLG Corp. of Woodland Hills, Calif.; RDA Inc. of Beltsville, Md.; Relational Software Inc. of Menlo Park, Calif.; and Rhodnius Inc. of Scarborough, Ont., Canada. □

RELATIONAL DATA-BASE MANAGEMENT SYSTEMS

Company and location	Name of system
Applied Data Research Inc., Princeton, N.J.	Datacom/DB
ARAP Advanced Data Management division, Kingston, N.J.	DRS/XBS
Britton-Lee Inc., Los Gatos, Calif.	IDM 500
Computer Corp. of America, Cambridge, Mass.	Model 204
Control Data Corp., Minneapolis, Minn.	DMS-170
Infodata Systems Inc., Falls Church, Va.	Inquire
IBM Corp. Data Processing division, White Plains, N.Y.	SQL/DS
International Data Base Systems Inc., Philadelphia, Pa.	Seed
Mathematica Products Group Inc., Princeton, N.J.	Ramis II
National Information Systems Inc., Cupertino, Calif.	DPL
Software House, Cambridge, Mass.	System 1022
Tandem Computers Inc., Cupertino, Calif.	Encompass

Source: *ELECTRONICS*

Production equipment

Projection aligners stepping out

Promise of pushing geometries down to 1 μm area makes up for cost and extended shakedown period

by Linda Lowe, Boston bureau

Projection stepping aligners—also called direct-step-on-wafer machines, or wafer steppers—are at last moving onto integrated-circuit production lines in a big way. Their promise of exposing geometries as small as 2 micrometers and less on the wafer, users agree, compensates for the difficult period of adjustment these machines require before they finally hit their stride.

Assimilating any new technology can be a delicate process, but semiconductor makers bringing in projection steppers face risks and difficulties perhaps unprecedented. Most of the machines are unproven and difficult to evaluate and compare; delivery times stretch out to a year and a half in some cases, and even the initial investment must be enormous since stepper systems cost an average of $500,000. By mid-1980, steppers accounted for the lion's share of a typical semiconductor house's capital equipment expenditures—23.5%—according to a report by Electronic Trend Publications in Cupertino, Calif.

"Getting in at the front end of this technology means sharing the risks and the burden of development with the stepper manufacturers," observes Lynn E. Londry, project leader for advanced development at NCR Corp.'s Microelectronics division in Miamisburg, Ohio. "But if you wait until all the bugs are ironed out, you'll end up eating your competitors' dust."

The specter of competition, expected to keep stepper sales booming despite the current slow economy and tight money [*Electronics*, Feb. 24, p. 108], is not the only factor driving the market for these systems.

"In 1980, wafer areas with geometries finer than 3 μm accounted for 7% of all silicon processed worldwide," says Robert K. Meister, senior staff consultant at Mackintosh Consultants Inc. in San Jose, Calif. "By 1985, however, that percentage will be 50% and the industry feeling is that only steppers can handle it."

Even at top capacity, manufacturers will meet only about 75% of the demand, Meister predicts. "It will be a real sellers' market," he says, and he sees worldwide shipments of steppers rising from $75 million in 1980 to a staggering $929 million in 1985—an average annual compounded growth rate of 65%.

Setting down. Projection steppers aim to take over where current optical lithography techniques leave off—in the 2-to-3-μm range of chip geometries—and to push ultimate resolution down to the 1-μm range [*Electronics*, April 12, 1979, p. 107]. Typically, they work by shining ultraviolet light through a blown-up portion of an IC pattern, called a reticle, and projecting that image down through a reduction lens onto the surface of a photoresist-covered wafer. Only a small portion of the wafer, consisting of one die or group of dice, is exposed; then the table bearing the wafer steps mechanically to a new site for another exposure. Image projection ratios can be 10:1, 5:1, or 1:1.

Steppers represent the most complex equipment the processing engineer has ever encountered, incorporating sophisticated optics, lasers, sensors, microprocessors, computers,

Head start. GCA Corp.'s Mann 4800 DSW wafer stepper is the only model that is operating on a significant number of production lines. But other makers are rushing into the market.

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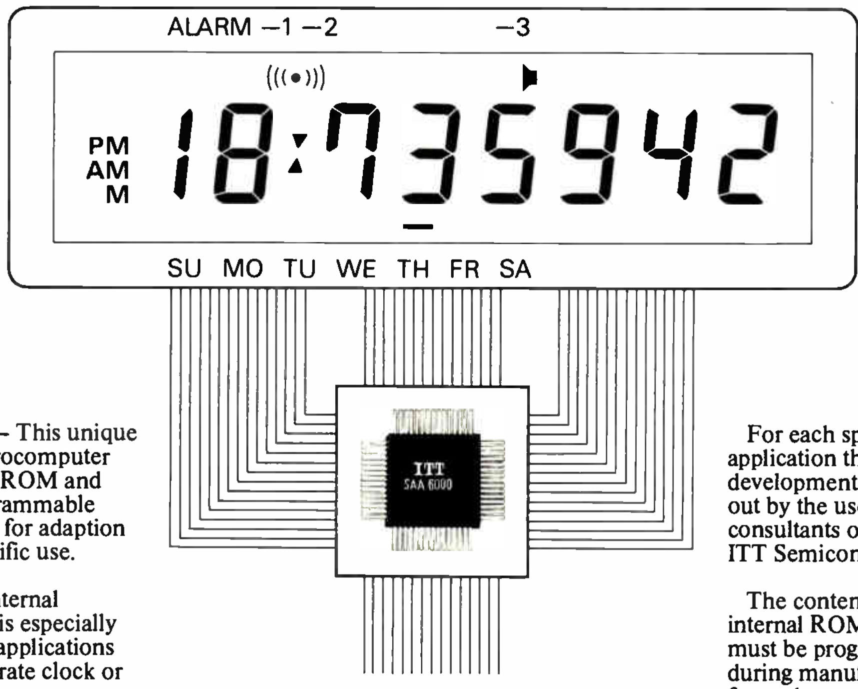

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Probing the news

and control electronics and software—all critically interdependent in a single system. This, and the users' inexperience with the steppers—only GCA Corp.'s Mann 4800 DSW currently operates on production lines in any significant numbers—make this equipment an unknown quantity.

Users shopping for good resolution, tight alignment and overlay accuracies, high throughput, reliability, ease of operation and maintenance, and a host of other performance factors cannot go by specification sheets or an afternoon's demonstration by the vendor. "It takes many months of working with these systems to understand and characterize them," says Eugene D. Feit, senior scientist at the advanced technology department of Harris Corp.'s Semiconductor division.

Big stake. So the user's investment is both early and risky. Feit says his Melbourne, Fla., firm will spend $2 million to $2.5 million on hardware alone this year—just for evaluation and comparison. Beyond the investment in dollars and evaluation time, "we have to count on tying up hundreds or thousands of hours of work by technical people as well," adds Willard Kauffman, vice president of components production at Intel Corp. in Santa Clara, Calif. Intel also is looking at several different steppers, Kauffman says. Industry speculation is that one of these systems is Censor Corp.'s much heralded—and soon to be delivered—SRA-100, though Kauffman would neither confirm nor deny those reports.

He does agree there is little industry experience on which to base evaluations. GCA's 4800 DSW is one of the systems Intel already has looked at, and Kauffman says the machine's performance has him satisfied that it can meet the specifications claimed by the Beford, Mass., vendor. "GCA got a head start and has the field experience; the key issue for the by the Bedford, Mass., firm. "GCA live up to their billing as they go into production."

These newer systems include the TRE700SLR and TRE800SLR from TRE Semiconductor Equipment Corp. (formerly Electromask) in Woodland Hills, Calif.; the model 8010 and model 807 systems from Optimetrix Corp. in Mountain View, Calif.; the model 900 from Signetics Corp's Ultratech division in Santa Clara, Calif.; and two steppers from Canon USA Inc. in Costa Mesa, Calif., which are Americanized versions of Canon's Japanese models MPA-500FA and FPA-112FA [*Electronics*, Jan. 27, p. 172]. Announcements are anticipated from Nikon and Philips this year.

With many variables and critical dimensions affecting a stepper's performance, users rank vendor support and assistance high on their list of needs. "Close cooperation with the vendor at every stage is indispensible," says Intel's Kauffman. "We're taking big risks right up front here," agrees another user. "The vendor has to be willing to be there with us, helping to make the risks pay off."

Some users may find the lure of the tried and true irresistible. Mostek Corp., for instance, is throwing its lot in with GCA's Mann 4800 DSW. The Carrollton, Texas, firm has over a dozen systems installed "and lots more on the way," says James S. Piker, Mostek's fine-imaging group manager. One industry source estimates Mostek's investment in GCA's systems will top $20 million.

Willing teacher. "We went with TRE Semiconductor Equipment Corp. Because we found it the most open of all the vendors," says NCR's Londry. "The company was willing to educate us on every aspect of its machines and work closely with us while we solved the problems and got into production."

Whether users continue to play the field and evaluate all comers for a year or so, or settle down with a single supplier, "there's no getting around the uncertainty and risk involved," concludes Feit at Harris Semiconductor. "The technology's moving too fast, and in just a couple of years we'll have to be looking at electron-beam lithography and X-ray systems and in a few more years perhaps even ion-beam printing. It's become a real crapshoot, and the game will continue for a long while to come." □

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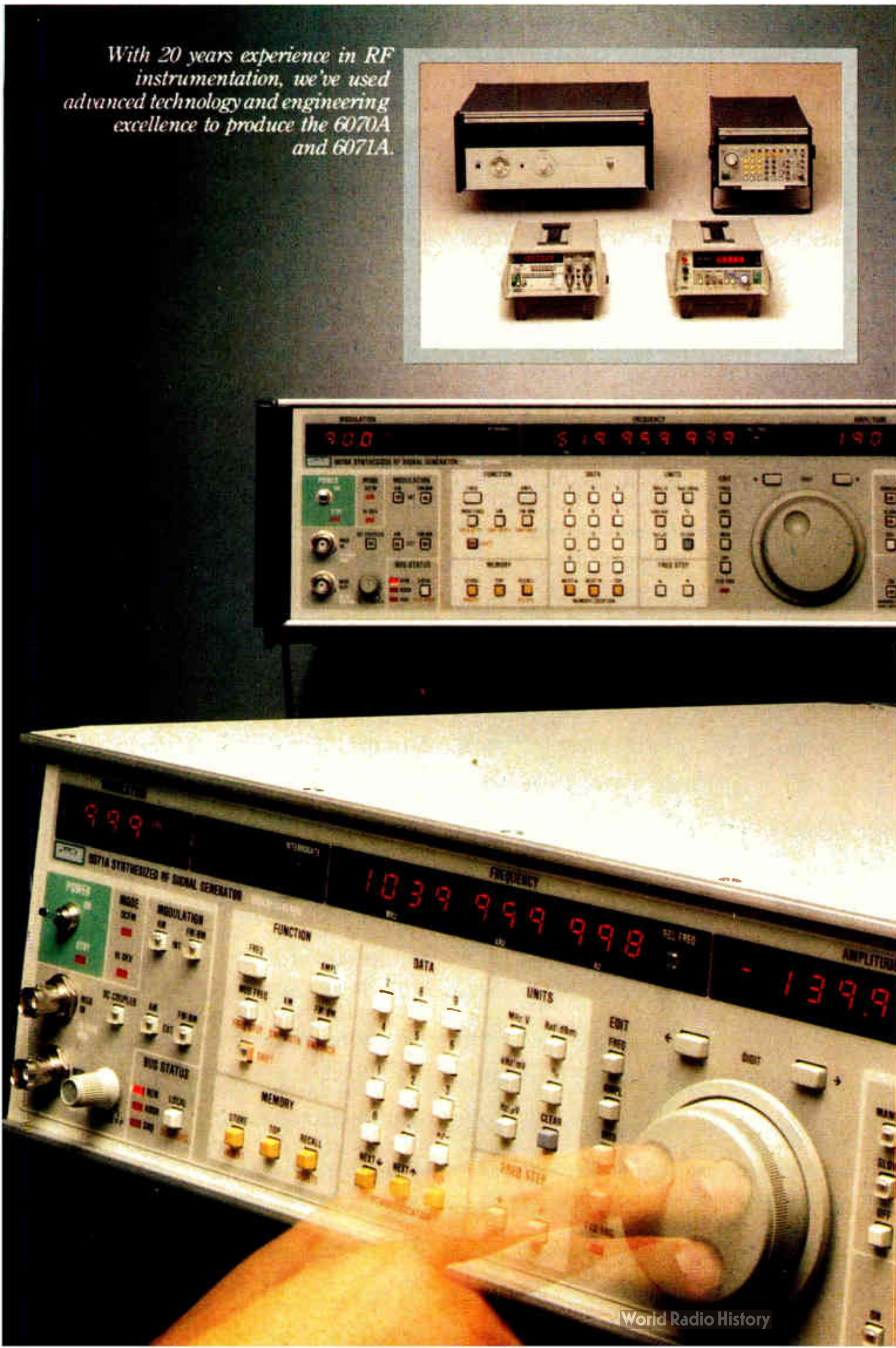

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Automotive

Auto slump drags IC prices down

At the same time, added competition and cost pressures force semiconductor makers to look for more efficient processing

by Gil Bassak, Industrial/Consumer Editor

For semiconductor manufacturers seeking to sell to automobile makers, last month's annual exposition in Detroit of the Society of Automotive Engineers revealed two rapidly emerging trends.

First, increased competition among the integrated-circuit houses in the auto market, coupled with sagging car sales, has forced prices down. "It's a fierce environment out there," says Myles H. Kitchen, Intel Corp.'s automotive marketing manager. "Prices are down significantly—in some cases by 50%." For example, an 8048 single-chip microcomputer costs $9 to $10 in 100,000-piece lots for the 1980 model year. For the 1982 year, the price for the part is $4 to $5.

Second, the increase in competition—Intel, Nippon Electric Co., and Signetics Corp. were first-time exhibitors at Detroit—and the added price consciousness of the auto firms have shifted the emphasis from development of new products to improved manufacturing methods designed to bring down the prices of the old ones. "Investment costs in developing new products are staggering," says Kitchen. "The biggest job now is to improve efficiency and productivity." At the same time, tailoring products to new requirements takes on added importance.

Thus, Intel announced at the show that it would turn out a new high-temperature, high-reliability "automotive grade" version of its MCS-48 single-chip microcomputer family (able to operate at $-40°$ to $+100°C$, compared with a maximum of $+85°C$). The improved parts will be made by the Santa Clara, Calif., company's automotive operation, which is expanding into new facilities in Phoenix.

High hopes. The Gossamer Albatross, the man-powered craft that flew the English Channel, hanging above the SAE show's exhibits, could symbolize auto makers' hopes for a sales lift.

Nippon Electric, which is "just beginning to get involved with U. S. auto manufacturers," according to Ian Ebel, national sales administrator for its U. S. microcomputer subsidiary in Wellesley, Mass., concurs with Intel. "With the volume going up and prices coming down, the semiconductor industry is trying to push products that will have a very long run."

The result, says Intel's Kitchen, is that "products are becoming commodity parts, and though the semiconductor companies that intend to remain in the business are still moving ahead [with new designs], this is slowing down." In fact, Ebel adds, "if NEC had been working with the auto makers from the start, we'd probably be cutting back. But since we are just entering the market, we still have room for growth."

Building pressure. Though Japan's Toshiba Corp. and Hitachi Ltd. were not exhibiting at Detroit, their presence, as well as that of the Japanese in general, was felt. "Some of our major competitors are the Japanese, and I don't expect things to change," says Kitchen.

There was no lack of willingness on the part of the IC makers to reaffirm the promise of electronics to the auto industry to help supply cleaner and more efficient engines, greater convenience, and eye appeal. One old hand in the business, National Semiconductor Corp. of Santa Clara, demonstrated a prototype multiplexed wiring scheme; NEC's contribution was an electronic dashboard

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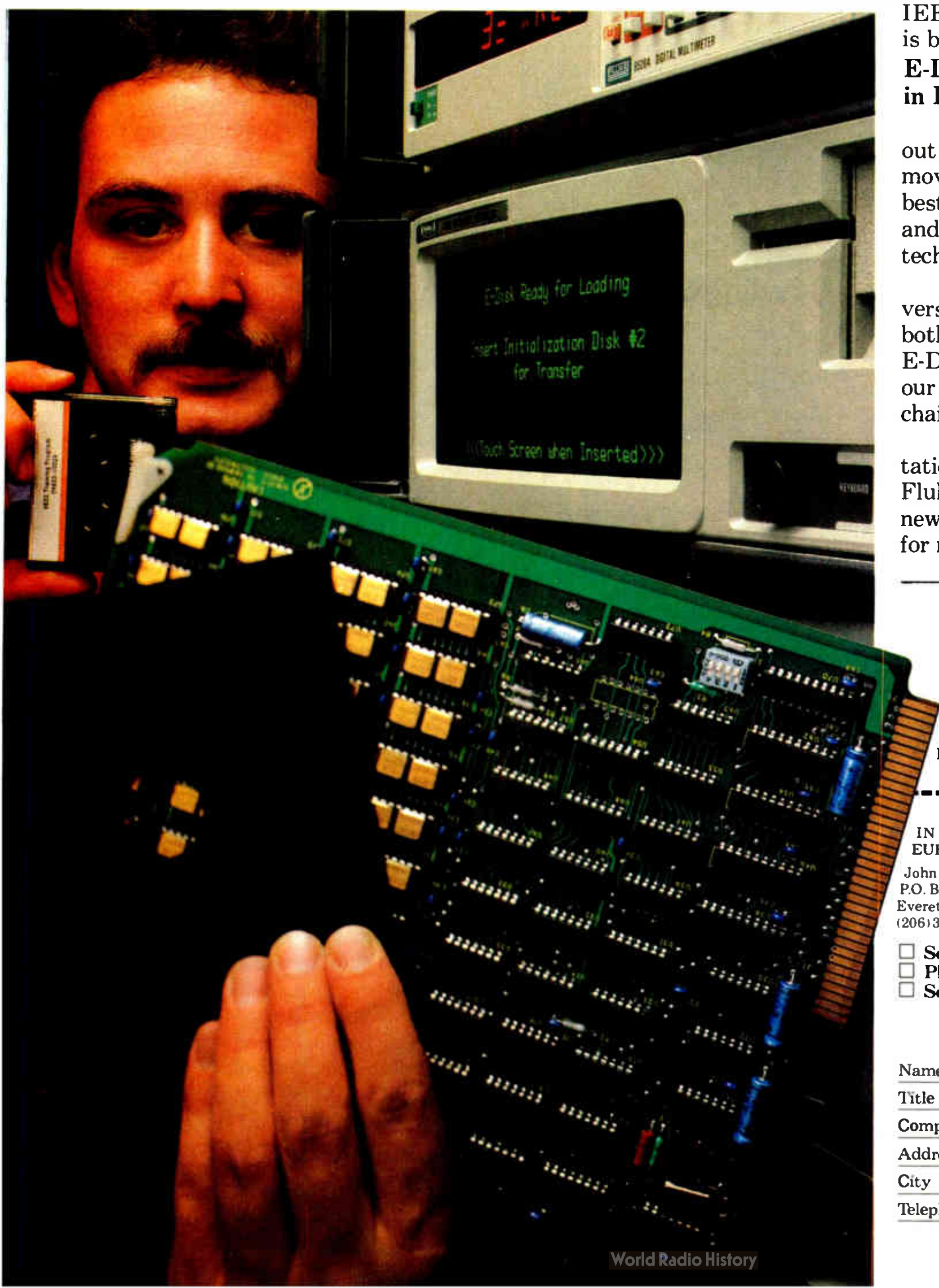

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panel that showed multicolor readouts in both liquid-crystal and vacuum fluorescent technologies. However, its latest model, not yet for sale, is a dot-matrix readout with a highly flexible format for displaying symbols, letters, and numbers.

Other companies also aimed at the dashboard: Hewlett-Packard with a high-brightness light-emitting diode and Zenith Radio Corp. with a cathode-ray-tube display [*Electronics*, March 10, p. 42].

National also displayed a range of components and systems covering audio noise reduction, speech synthesis, fluid-level detection, and solid-state dc-operated control for audio volume, tone, and balance that eliminates the need for mechanical potentiometers.

Although it has not managed to penetrate the engine-controls area with its microcomputers, National sells a line of analog and digital parts, such as voltage references, operational amplifiers, and analog-to-digital converters, that are used in conjunction with the engine computers. The company has aimed its processors at feature and convenience applications—for example, it recently announced an a-m stereo decoder chip. "Feature electronics is what will get people turned on to buy a car," says Mark G. Grant, marketing manager for automotive systems.

Dynamic display. In line with that philosophy, National displayed an IC-based noise-reduction system that appears to take a step past Dolby. The system behaves like a dynamically variable low-pass audio filter, screening out high-frequency noise, or hiss, when there is little or no signal at the upper part of the audio spectrum. When higher-frequency signals do appear, the filter opens, up to 30 kilohertz if necessary, to pass the signal.

Dubbed dynamic noise reduction, or DNR, by National, the approach itself is new to consumer equipment, where up to now it has been deemed too expensive to employ. With a new chip-level variable transconductance amplifier, however, National has brought the technique to the automobile makers.

One manufacturer, General Motors' Delco Electronics division in Kokomo, Ind., which makes radios, is going to use DNR in its higher-priced units. As James P. Karlow, a Delco service development engineer, puts it, "Prior systems to reduce noise acted on impulses and bursts of noise, but the National chip adds white-noise reduction."

Reduction of white noise can be accomplished by other methods, such as Dolby encoding. But such approaches require the program material to be processed beforehand, during recording. Since that is not usually done for broadcast material, the DNR system has the advantage of working with a-m and fm radios, as well as with taped material. Karlow comments, "It's got a lot to be said for it. We get rid of both radio and tape noise. In a lot of ways it's better than Dolby." □

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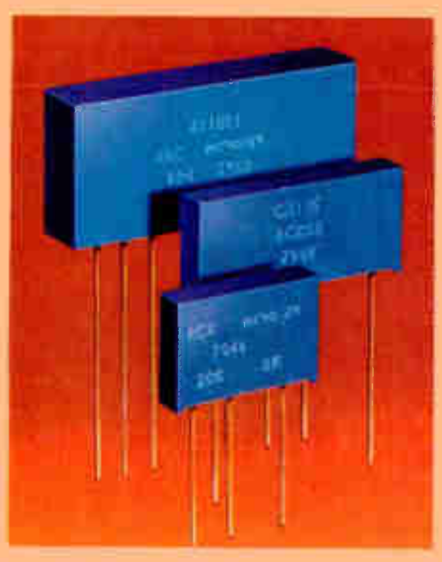

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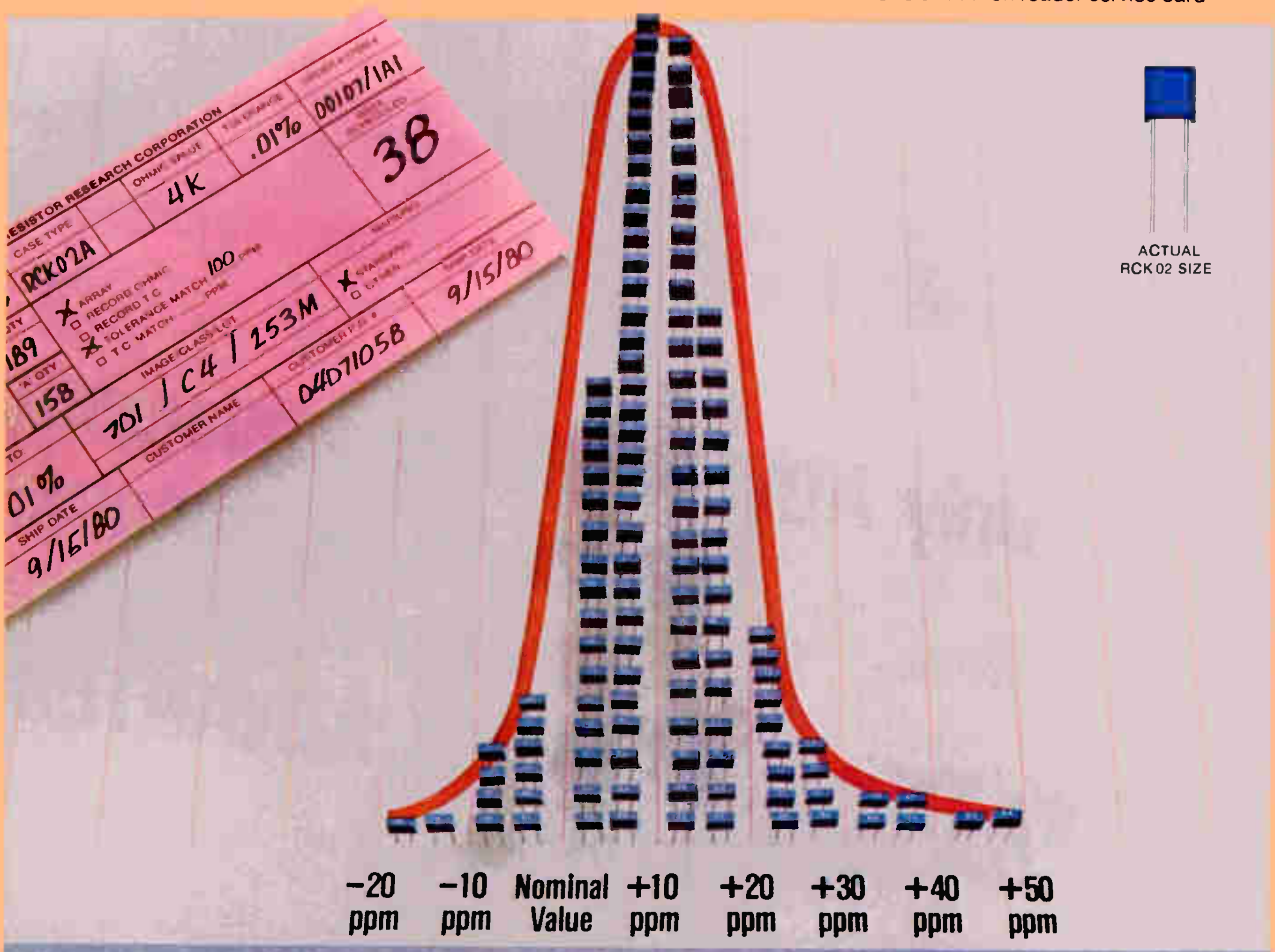

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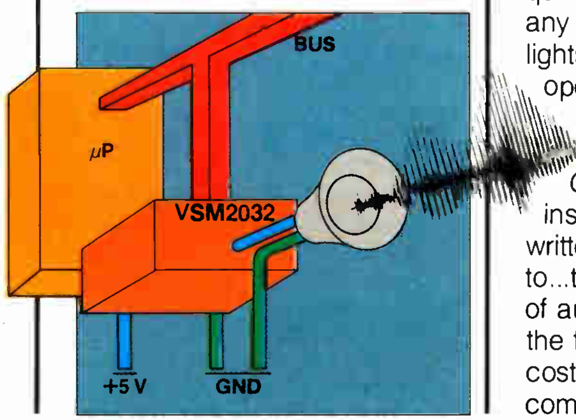

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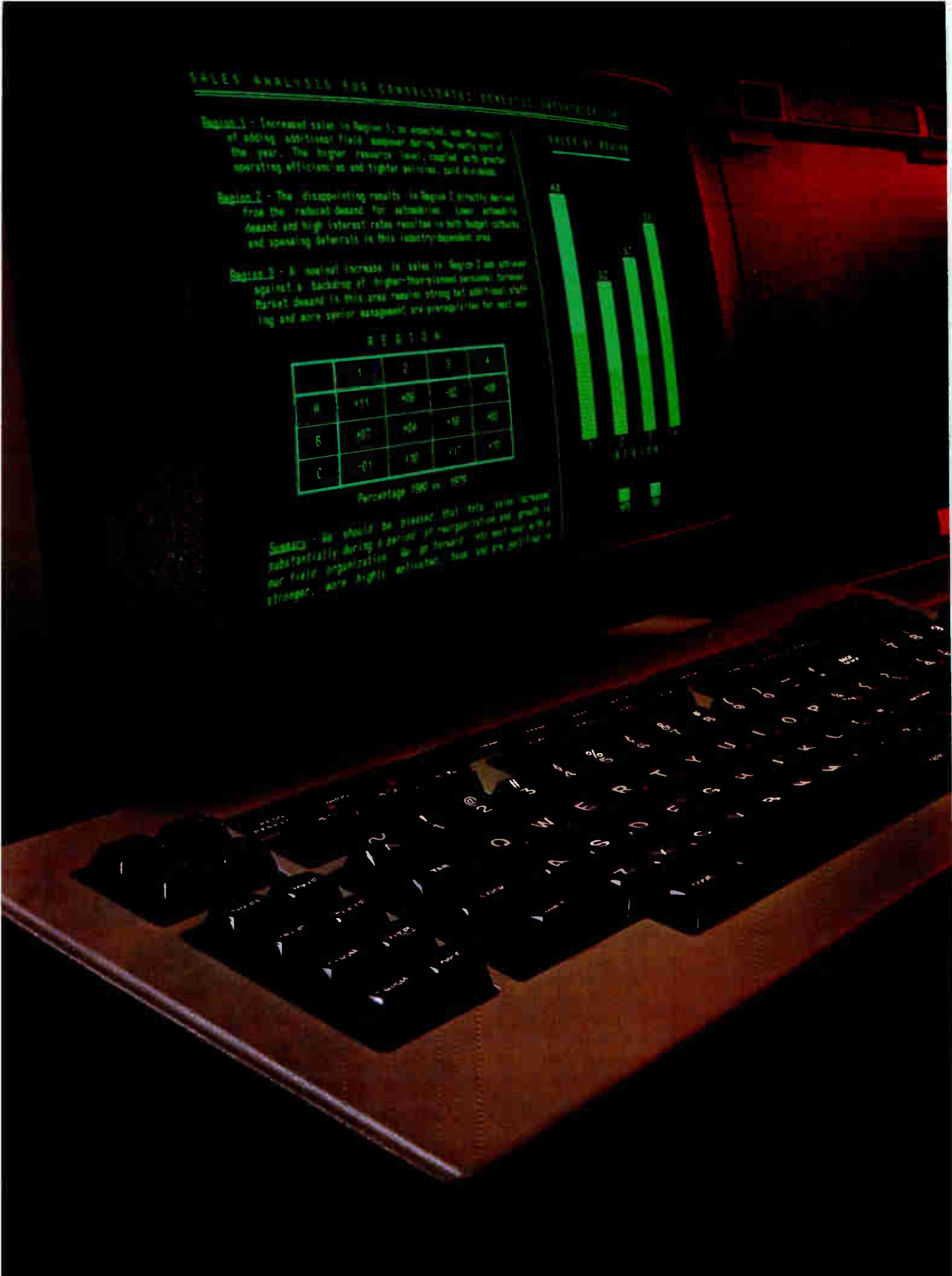
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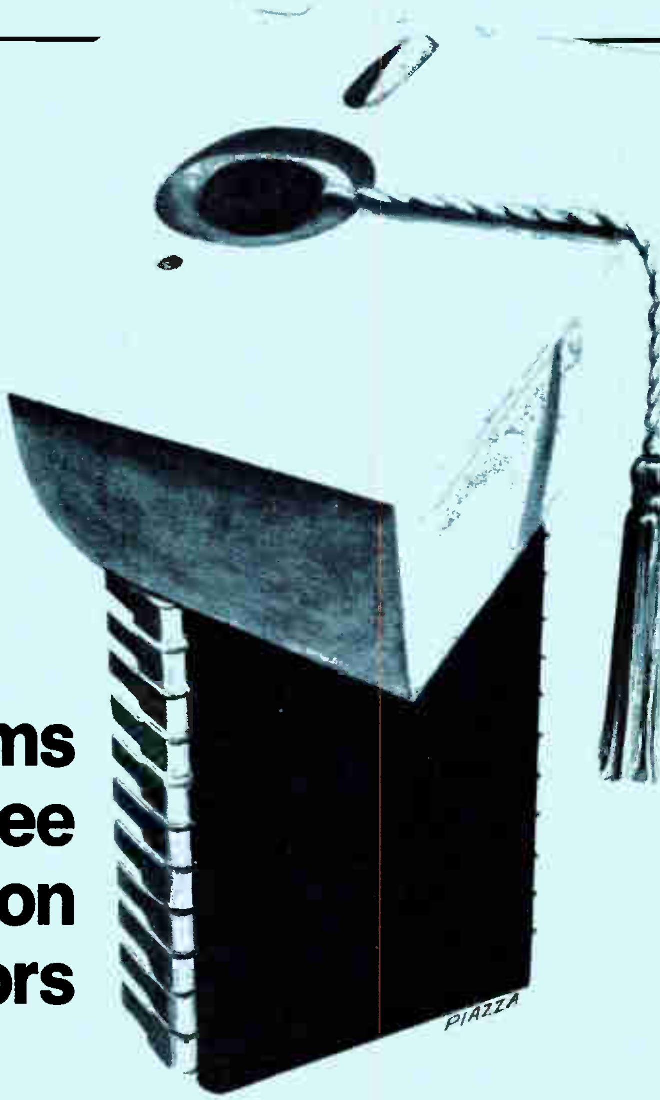


Operating systems confer new degree of sophistication on microprocessors

☐ Unix, it has been said, will become the Fortran of operating systems because of its ever-increasing popularity. Programmers who use it become enamored of it quickly, noting that Unix allows them to be extremely productive while maintaining a relaxed working environment. One admirer says the experience is "like sitting behind the wheel of a well-tuned sports car—when you press on the gas it goes, and when you hit the brakes it stops. It is the ultimate in responsiveness, and yet all the while you are riding in comfort." (See "What is Unix anyway?" p. 121).

Before 1979, however, the Western Electric Co. division in Greensboro, N. C., that licenses Unix for Bell Labs (see "A short history of Unix," p. 126) originally was granting only unlimited-user versions costing $11,700. In response to increased interest from original-equipment manufacturers desiring to implement Unix on smaller systems, Western Electric came up with a limited license scheme in which the number of users on the system determines the fee. That fee amounts to only $750 for the first user and $250 for each additional one. Of course, the original-equipment manufacturer will add to the basic licensing fee the development costs accrued while adapting Unix to a particular hardware configuration; but even so, it is now affordable for small systems.

Even before this development, however, Unix was being offered to small-system users by vendors who wrote operating systems that are indistinguishable from the Bell product to the programmer sitting at the system console. Now that the original Unix has become so cost-effective, numerous adaptations are cropping up. Even some of the larger microprocessor manufacturers are beginning to adapt it to their systems—a trend that could make Unix a *de facto* standard for the 16-bit microcomputer in much the same way that Digital Research's CP/M has become a standard for 8080-based 8-bit microcomputers.

The following two articles exemplify two approaches to implementing an operating system based on Unix. In the first article, Zilog has taken the original Unix, renamed it Zeus, and modified it for its Z8000-based development system. Whitesmiths Ltd. has written from scratch its user-transparent version of Unix for mini- and micro-computers, the Idris system, described on pages 125 through 129. **-R. Colin Johnson**

Adapting Unix to a 16-bit microcomputer

Z-Lab software development system with text-processing utilities supports 16 users in C language, has 32-bit bus for future expansion

by Bruce Weiner and Douglas Swartz
Zilog Inc., Cupertino, Calif.

☐ In systems based on 16- and 32-bit microprocessors, software will account for the bulk of the development cost. As more and more logic is squeezed onto a single chip, the hardware development process is being simplified and its costs reduced. Simultaneously, however, more complex and, hence, more expensive software is going to be required.

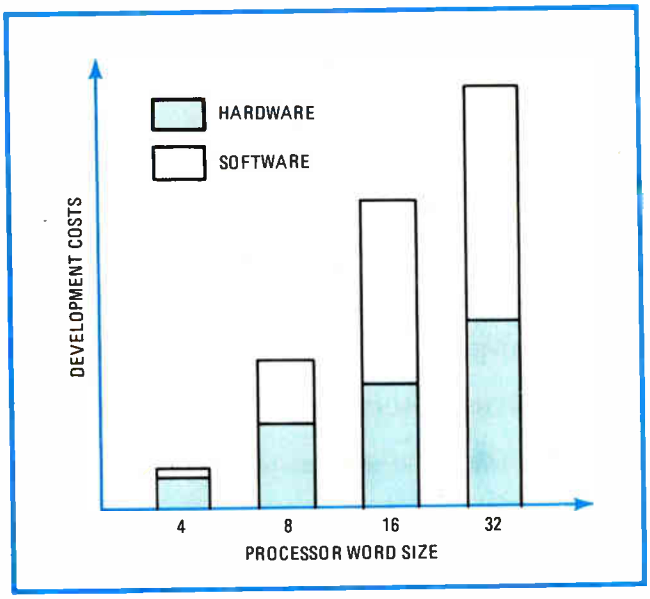
Zilog's recognition of this trend in computer technology (shown in Fig. 1) led to Zeus, the adaptation of the Unix operating system for the Z-Lab 8000 microcomputer [*Electronics*, Feb. 10, p. 33].

Both software and hardware played crucial roles in the creation of the Z-Lab development system. Components such as the Z8001 microprocessor, the memory management unit (MMU), and the Z-bus backplane-interface (ZBI) bus structure were as critical to the potential of the system as was the software itself. Together, the Z-Lab and the Zeus operating system foster a software development environment that is a major step toward controlling the rapidly escalating software costs of microprocessor products.

Transporting a system

In selecting an operating system, there were two options: writing a new one from scratch or transporting an existing one to the Z8001. The decision was made to transport one—provided it was possible to find an existing operating system that could be adapted quickly and was well-suited to software development.

The search for such an ideal software environment ultimately led to the Unix operating system. This system was selected for four reasons: it was designed specifically for software development and text processing; it had already been transported successfully to 16- and 32-bit computers; it had a large existing software base with applications pertinent to a development environment; and it had a large user base.



1. Skyrocketing software. As products use more sophisticated microprocessors, there is an increase in the amount of engineering effort required to write software. As hardware costs drop, software costs are becoming the major product development expense.

What is Unix anyway?

As a general-purpose, multiuser, interactive operating system, Unix offers facilities that are seldom found even on larger mainframes. Through its hierarchical file structure, any file can be traced back to a single root directory, thereby facilitating the management of mass memory. In addition, peripheral device handlers, files, and interprocess communications are all compatible with each other, simplifying program development. Since one major goal of Unix is to increase programmer productivity by providing a responsive working environment, Unix includes a vast library of utilities ranging from spelling correction routines to various compiler compilers and supports over a dozen languages, including the language C in which it is written.

However, the most important role of any operating system is still managing the mass-storage files in which all the programs and data reside. Unix imposes no particular structure upon the content of these ordinary files. Instead, it distinguishes between two kinds of special files even though they are treated identically by the programmer.

The first of these is a directory file that simply lists the names and vital statistics of other files. These other files may, in turn, be programs, data, or even other directories. This hierarchical structure results in an unusually well-organized system in which a file can be specified by its path name, which is a sequence of directory names separated by slashes that terminates with the desired file name. Thus, the same name can be used for files of similar function as long as they have different path names. For example, /Jones/Statistics and /Smith/Statistics both refer to a file named Statistics, but they are not the same file because they have different path names indicating they are listed in the unique directories Jones and Smith.

Just as directories are treated in the same manner as ordinary files by programmers, so are the second kind of special files—input/output calls. This distinction is the most unusual feature of Unix and one of its greatest advantages over other operating systems. These special files are read and written just like ordinary ones, except that the selected device is activated and the data is passed to it using whatever protocol is appropriate. Thus, programs can send data to, for example, a printer in exactly the same way they do to a disk file—except the name of the selected output unit is different.

Unix programs may communicate with each other in the same manner as I/O calls. The output of one program is directed to the input of another while each program thinks it is reading or writing a disk file. The communication link itself is called a pipe and can be created either by the program itself or interactively by the programmer. In this way, a group of related programs may pass data to each other in an extremely efficient manner.

Another feature of Unix is its ability to safeguard original programs. Before a program is executed, a fork, or replicate, operation copies the program, including the code, register values, open files, current directory and the like, into memory. The replicated process is executed, ensuring that the original is never lost or scrambled, in case execution does not take place properly.

Perhaps the most visible portion of Unix is the shell, or fundamental control program, which functions as the primary interface with the system user. As a command language it offers the programmer a productive working environment. Multitasking permits programs to be started without loss of control of the console. Special command files may be set up so that any sequence of shell commands can be executed by a single user command. Commands can even be strung together at the console so that the results of one are fed directly to the input parameters of the next, in the same manner as pipes interfacing programs.

-R. Colin Johnson

When transported, the Unix operating system was enhanced in several ways so that the Z8001 implementation might run more reliably. For example, in the standard Unix operating system, nothing prevents two users from simultaneously modifying a file so that one user can accidentally invalidate the other's changes. The Zeus operating system qualifies the three standard Unix file-opening modes (read, write, and read and write) with three access-control modes specifying what other users can do with the file.

The Zeus access control modes are shared, read-only, and exclusive. The shared mode, the standard Unix control mode, allows other users access to any file they desire. In the read-only mode, other users may access the file only for read operations. In the exclusive mode, other users may not access the file at all; the first user opening the file has exclusive access to it until the file is closed. Any attempted access to a file that violates these parameters results in a failure of that open operation.

Other enhancements

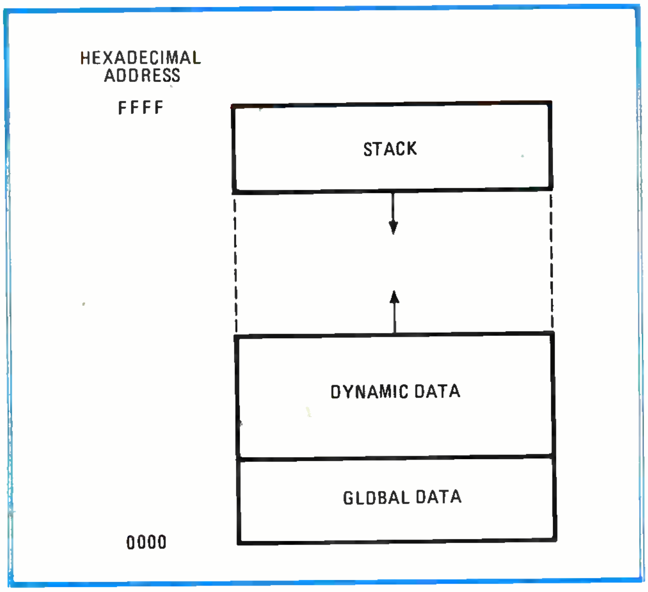
A full-screen text editor, called the visual editor, has been implemented in Zeus for cathode-ray-tube terminals. Its data base contains terminal-control information that permits full-screen editing for almost any combination of CRT terminals. The terminal data base can be updated by the user when adding new terminals to the system.

The editor lets the user display text files one page at a time and rapidly move the cursor on that page, inserting or deleting characters, words, lines, or groups of lines with a minimum number of keystrokes. Several additional features are available, such as cut-and-paste and word-wrap facilities.

Rebuilding the system

Another enhancement is the Sysgen program, which automatically rebuilds the Zeus system, letting the user tailor it to specific requirements. The user can add disk and tape drives or other input/output devices using the Sysgen program as well.

Several other utility programs are supplied with Zeus. Learn, an interactive program, teaches new users how to fully exploit Zeus's facilities; Mail lets users send messages to each other in postal format; Calendar automatically reminds users of events scheduled during the day when they sign on and begin using their terminal; Spell is a spelling-error detection program that uses a 25,000 word dictionary; and Man prints selected portions of the Zeus reference manual on the user's terminal. Over



2. Subdivisions. Zeus separates the memory space for programs and data, the latter being subdivided into areas for the stack, dynamically allocated variables, and global variables. Hardware ensures that the stack and dynamic areas do not overlap.

60 other utilities are furnished with the Z-Lab.

Almost the entire Unix operating system and its application programs are written in C, a system implementation language. The key to transporting Unix software is a C compiler that generates code for the target system, in this case the Z8001-based Z-Lab 8000. Although C carries a certain level of machine independence, this does not mean that the entire Unix operating system can be transported by merely recompiling it. Most application programs, however, can be transported in this manner.

Seventh edition

Specifically, the Zeus operating system is Zilog's enhanced version of the seventh edition of the Unix operating system, which was modified by Bell Laboratories to eliminate explicit machine dependencies and ease its transportation to other computers. Some implicit machine dependencies, however, must of necessity remain in the Unix kernel. For this reason, transportation to Z-Lab is greatly simplified by creating hardware very similar to those architectural features implicit in this kernel.

The two major machine dependencies in the Unix kernel are the size of integers and pointers and the memory management capability required by Unix software. Both the Unix kernel and C assume that integers and pointers are the same size and that integer arithmetic can thus be performed on pointers. Examining the evolution of the Unix system sheds light on how this machine dependency was handled.

C originally was developed to write Unix, and Unix originally was written for Digital Equipment Corp.'s PDP-11 family of 16-bit minicomputers. Further, the seventh edition of the Unix system was written specifically for PDP-11 systems with separate code and data address spaces. Thus, microcomputer hardware that provides facilities similar to those of a minicomputer such as DEC's PDP-11/70 should minimize the transportation effort.

On the basis of this background information, the design team decided to run the Z8001 microprocessor in the nonsegmented mode for user processes and for almost all of the kernel. In a nonsegmented mode, programs use 16-bit addresses and are limited to a single 64-K-byte segment. This means that both integers and pointers are considered 16-bit quantities and therefore integer arithmetic can be performed on them.

Because the Z8000 family can support separate code and data address spaces, user and system programs may have as much memory as a PDP-11/70—128-K bytes, of which 64-K bytes are code and 64-K bytes are data. Furthermore, the Z8001's 24-bit addressing scheme can handle a total system memory as large as 16 megabytes. Because the Z-Lab 8000 can handle up to 1.5 megabytes of memory the need for swapping programs in and out of main memory is reduced, thereby minimizing response time when a large number of users are on the system.

Much of the existing Unix software base takes advantage of the operating system's dynamic allocation of memory. This system characteristic has had a major impact on the hardware design of Z-Lab.

Memory management

Figure 2 shows how a C program's data is laid out in memory. This stack starts at the highest 16-bit data address and grows toward lower addresses. Global data that is statically allocated starts at address 0 and of course does not grow.

The Unix kernel provides system calls that allow a process to dynamically request more data memory. This dynamic data area starts just above the global data and fills in the unused addresses up to stack.

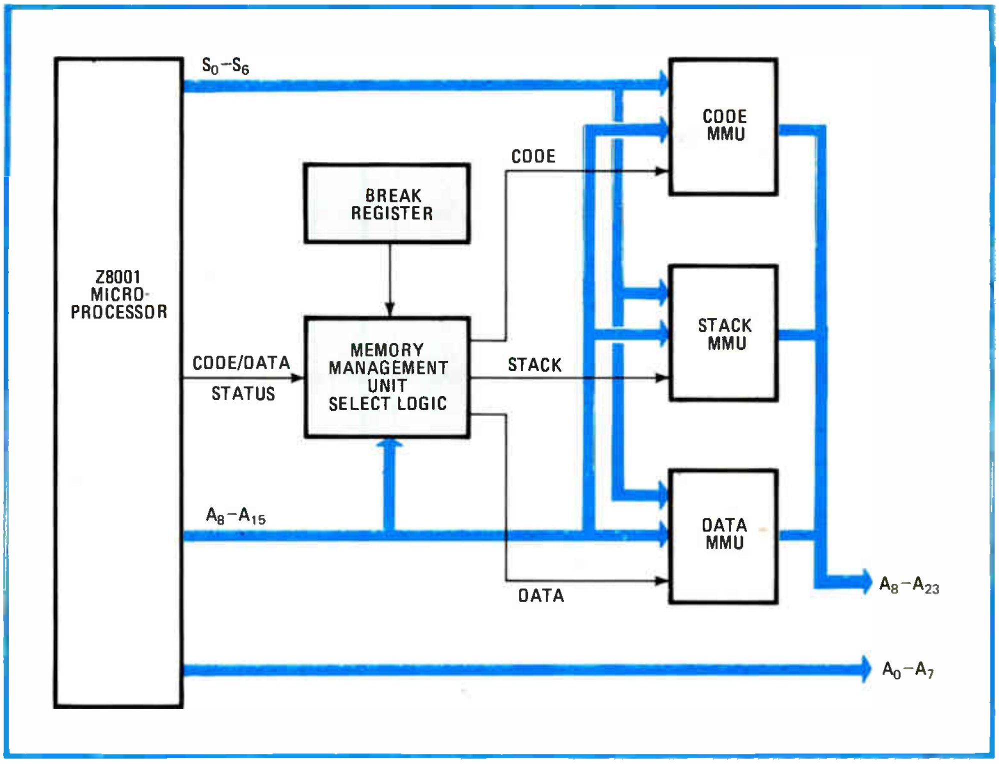
Memory space located between the stack and the dynamic data area is not necessarily allocated to one or the other. The hardware must therefore detect a memory reference in the constantly changing gap between the two memory areas and make sure they do not overlap. When an invalid access is detected, the kernel can either allocate more memory or terminate the process, as appropriate.

To protect the memory areas from invalid access, Zilog's Z8010 memory management unit was selected for the Z-Lab processor board. The MMU relocates addresses so that programs can be placed anywhere in physical memory and keeps the system from being corrupted if a user's program runs amok.

Nonsegmented solution

If Z-Lab were running in segmented mode, the two data areas would be placed in separate data segments, and the MMU could detect address violations as well as the need for more memory. In a nonsegmented mode, however, memory references to both bear the same segment number, so detecting a memory reference in the gap must be accomplished in another way in order to prevent the dynamic data area and the stack from overlapping.

Although the segmented-mode solution could not be used, it did provide the foundation for a nonsegmented



3. Multiple MMUs. In the Zeus operating system, the Z8001 processor runs in its nonsegmented mode, and memory management units divide the memory space into separate code, stack, and data areas. The break register stops the stack and data areas from overrunning one another.

solution, in which the references to the two dynamic data areas are made through two different MMUs. In Fig. 3, a simplified block diagram of Z-Lab's memory management architecture shows that there are separate MMUs for the code, as well as for the stack and data address spaces. The MMU select logic determines which one should be activated and guarantees that only one will be active at any given time.

The operating system sets the break register, the key element in determining whether the stack or the data MMU will be activated, pointing to the highest address in the dynamic data area. On every data reference to memory, address bits 8 through 15 from the Z8001 are compared to the value in the break register. Data addresses greater than or equal to the break value activate the stack MMU; data addresses less than the break value activate the data MMU. The MMU selection occurs quickly enough for no wait states to be required, even with a 6-megahertz Z8001.

Integrating hardware and software

The memory management design discussed above handles Unix software and nonsegmented Z8000 programs. In addition, the memory management architecture of the Z-Lab processor board can be modified under program control to support segmented user and system programs. Future software releases can thus take full advantage of the 16 megabytes of address space provided by the segmented Z8001.

The Z-Lab development project was approached as an integrated product-design effort. A broad-based project team was selected to facilitate close cooperation among the hardware, software, and mechanical engineers, and the memory management architecture thus developed by the team solved problems that could not have been solved independently by any of the individual groups.

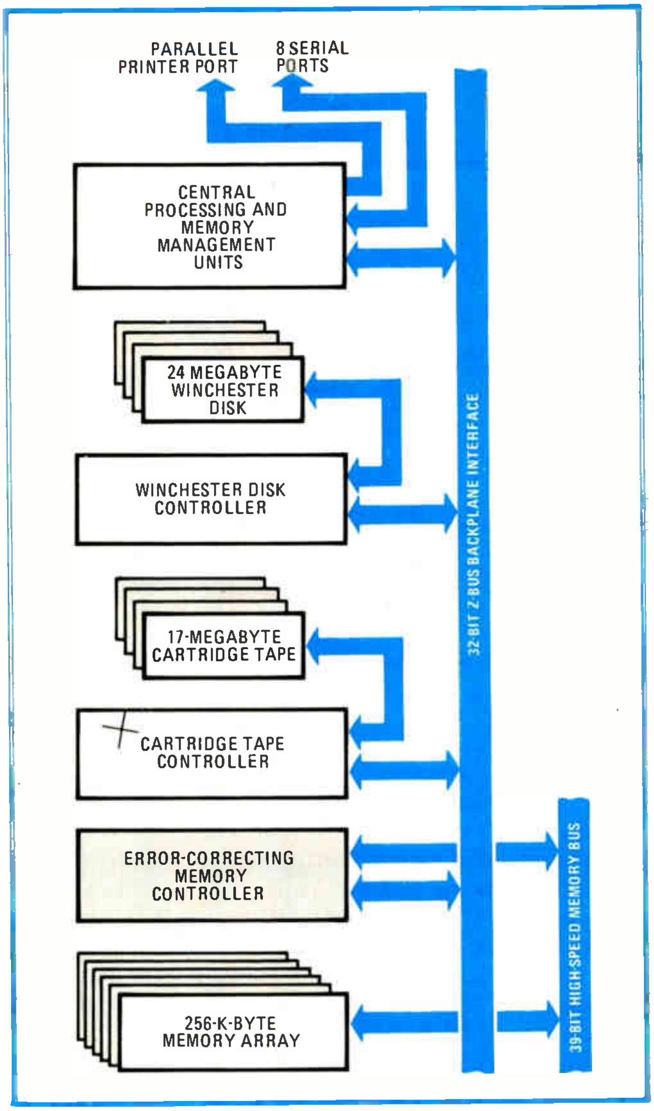
Likewise, the various goals of the Z-Lab system could be attained only with an integrated approach to the hardware, software, and mechanical engineering aspects of the project. Of these goals, the first was to design a Unix-based system with enough flexibility and file-system integrity that users could configure and maintain it themselves. A second goal was a performance level that could comfortably support up to 16 users. The final one involved packaging the system for the office environment.

To best achieve these goals, the project team sought a system design with minimum power consumption and noise levels. Thus, the Z-Lab offers high-performance minicomputer power in a quiet and easily portable package that consumes only 325 watts. It has no special power requirements and no cooling requirements, if ambient temperature stays below 40°C.

Z-Lab system hardware was also designed for expandability. Using a moderate-sized printed-circuit board (approximately 9 by 11 inches) kept the hardware configuration compact while allowing enough board area for future Z-Lab products. A highly reliable two-piece connector, although slightly more expensive than the conventional one-piece card-edge connector, improved connection reliability and permitted more connections per inch of pc-board edge.

Bus with a future

A semisynchronous bus, the ZBI, was chosen for its high level of system performance and input/output interface. All Z8000 peripheral circuits interface with the bus simply, needing buffering only to attain the TTL drive levels required on the backplane. Z80 peripherals can also be attached to the bus by generating the required



4. Architectural planning. The Z-Lab development system uses the proprietary ZBI 32-bit bus, an error-correcting memory controller that communicates with the main memory over a separate high-speed bus, and both Winchester disk and cartridge tape controllers.

Z80 timing with simple interface logic.

The ZBI is a true 32-bit bus with the address and the data multiplexed on the same lines (Fig. 4). The bandwidth of the bus (8 megabytes per second) is sufficient for future high-speed 32-bit processors and for peripheral controllers as well.

The Z-Lab error-correcting memory controller (ECC) supports 8-, 16-, and 32-bit data transfers, performing 32-bit error correction with the aid of seven extra syndrome random-access memories that hold the correction bits for every 32 data RAMs. The ECC communicates with its memory array cards over a very high-speed dedicated memory bus.

Maximizing memory capacity

All timing and refresh circuitry on the controller is centralized, maximizing memory capacity in the system. In addition to a maximum of 1.5 megabytes of ECC memory in the processor module enclosure, the Z-Lab unit has slots for the processor, cartridge tape controller, and Winchester disk controller cards as well.

Two of the Z-Lab's three peripheral controllers are intelligent, using Z80B 6-MHz microprocessors. This offers three distinct advantages.

First, device control chores are offloaded from the main processor. The operating system thus can communicate with the peripheral controllers using high-level commands that let the peripheral controllers work in parallel with the main processor. For example, Z-Lab can issue simultaneous reads or writes to more than one disk drive; the disk controller keeps track of head position, sector position, and data transfer.

Secondly, the intelligent peripheral controllers can perform self-diagnostics on power-up or on command, thus certifying to the host processor with a high degree of certainty that they are functioning correctly before processing begins.

Finally, product maintenance and upgrading is simplified by using firmware. As information is gathered on how the operating system interacts with the disk under different program mixes, the Winchester disk controller can be easily "tuned" for higher performance by altering the firmware.

Initial board set

The Z-Lab board set consists of:

- A processor board containing eight serial channels with programmable bit-rate, a parallel printer interface for either Centronics or Data Products–type printers, a memory management subsystem that supports either segmented or nonsegmented user processes, and read-only memory containing the bootstrap software and power-up diagnostics.
- An ECC memory controller that supports 32-bit error correction for up to 16 256-K-byte memory array cards. This board contains detection and reporting logic for uncorrectable errors and error-logging logic for correctable errors.
- One or more 256-K-byte memory array cards using high-speed 16-K dynamic RAMs.
- An intelligent cartridge tape controller that handles up to four tape drives for file archiving or for backup of the entire system.
- An intelligent Winchester disk controller that supports up to four 24-megabyte 8-in. Winchester disk drives.
- An optional serial I/O controller board that supports an additional eight serial lines and an additional printer port.

Several other subsystems will be offered with Z-Lab in the near future. An expansion chassis will increase the number of card slots in the unit from 10 to 20, the maximum number a ZBI bus can support, for constructing very large systems.

Another offering will be a compatible 40-megabyte Winchester drive (40- and 24-megabyte drives can be mixed on the system's Winchester controller). Zilog also will offer an intelligent serial controller that can perform direct-memory-access transfers to and from main memory, which will help improve system performance by reducing the amount of time that must be spent by the processor in servicing terminal interrupts. □

Unix-like software runs on mini- and microcomputers

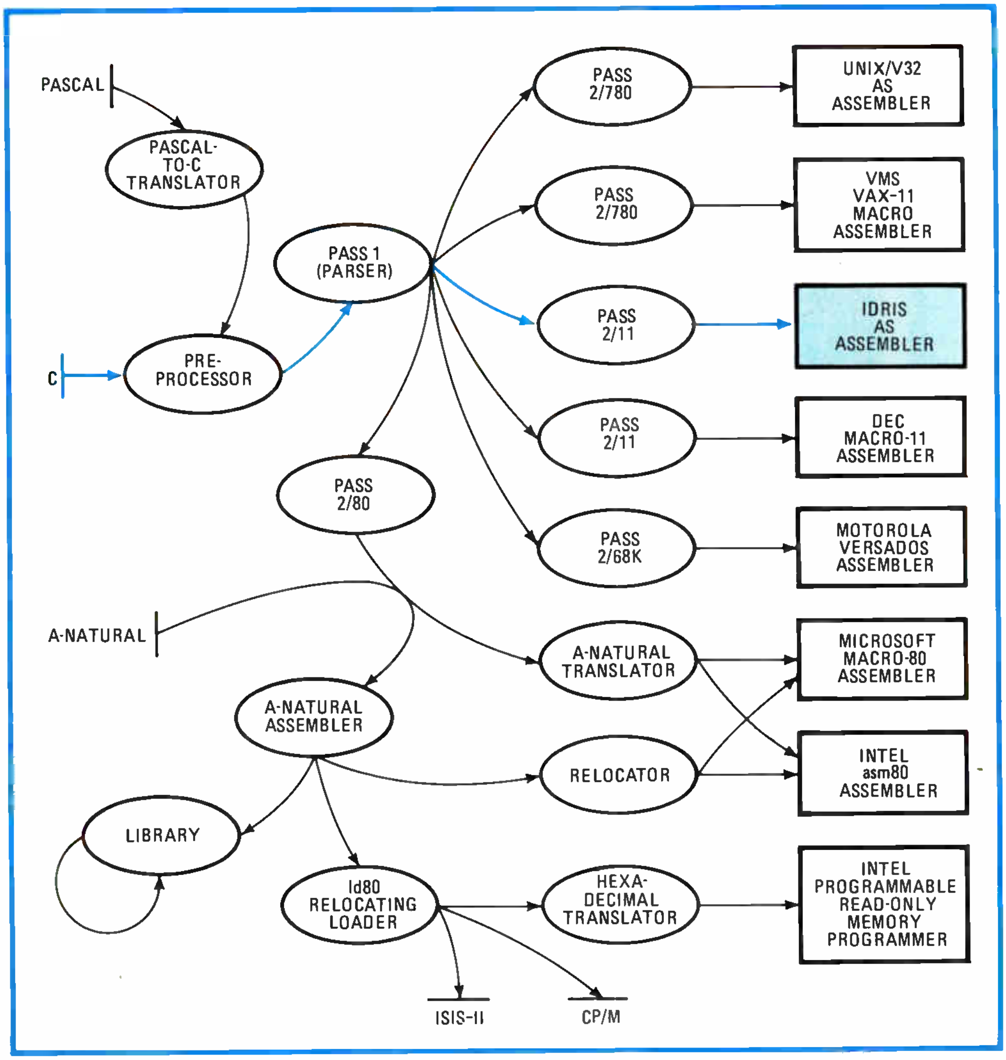
Multiuser operating system uses same file formats and system calls, runs programs without modification

by P. J. Plauger and M. S. Krieger
Whitesmiths Ltd., New York, N. Y.

☐ The Unix operating system has quietly revolutionized the way software is developed by proving itself an excellent workbench for a broad class of applications. Though it was first developed on rather small minicomputers, current versions of Unix can run on machines that support 50 or more simultaneous users. Until recently, larger-scale microcomputers have been barred from exploiting its benefits.

In response, Whitesmiths Ltd. has developed its own implementation of the Unix operating system for both mini- and micro-computers. Called Idris, it is a separate system that has been designed from the ground up—not just an adaptation of the existing Unix system—and hence requires no additional licensing from Western Electric Co. And unlike other operating systems modeled on Unix, Idris looks identical to the original when run on Digital Equipment Corp.'s PDP-11 or LSI-11 systems. Programs that operate under Unix have a high probability of running without modification when moved to Idris, or vice versa (Fig. 1).

As 16-bit microcomputers become more available, the long-felt need for decent development systems will become even more acute, and Idris is an answer. There is a broad gap between computers too big for operating systems such as Digital Research's CP/M and those too



1. Software system. The various programs shown convert high-level language statements into a form compatible with the various assemblers listed on the right. The path traced in color shows the transformations that a C program undergoes with Idris.

A short history of Unix

It all began with Kenneth Thompson's and Dennis Ritchie's frustration with the operating systems available in 1969. The Murray Hill Computer Center for Bell Laboratories was running a General Electric 645 mainframe under the Multics operating system, which was one of the first multiuser interactive systems. Before Multics, however, only batch-oriented operating systems—typically using punched cards and producing printouts—were available. Following in the batch-processing tradition, a major emphasis of Multics was isolating users from one another with several layers of protection to ensure that they did not inadvertently alter each other's disk files. Since sharing files among a well-organized team of programmers was the emerging software project style at Bell Labs, Thompson (right) set out to build a better system. The final result—Unix—was not written all at once, however, but rather evolved in response to more immediate needs.

One of Thompson's ambitious software projects that spurred him on toward Unix was his Space Travel program, which simulated the movement of the major celestial bodies in the solar system. A little-used Digital Equipment Corp. PDP-7 with an excellent display processor was a natural for rewriting Space Travel, especially since it cost $75 to run the program on the GE machine.

The project served as a painful introduction to how difficult program development can be with a computer lacking an adequate operating system. Initially, programs for the PDP-7 were developed on the 645 and carried to the DEC machine on paper tape. But Thompson soon tired of that, first implementing a rudimentary operating system and, finally, an assembler for the PDP-7, both of which were written entirely in assembly language. That adventure set him thinking about the kind of file system that would by its nature encourage cooperative programming projects. As he implemented these ideas, the name Unix was suggested as a play on the name of the soon-to-be-abandoned Multics system.

Thus, Unix was born in the mind of Ken Thompson and continued evolving into its current form in response to its increasing use within Bell Labs. For example, the patent department's interest in Unix resulted in extensive word-processing capabilities being built into the system. As Unix grew, however, its lack of a high-level language became the limiting factor that spurred Thompson to write the language B just before the whole system was transported to one of the first DEC PDP-11/45s ever made. Several utilities were written in B, but it soon became evident that an interpretive language without structures or data typing would not be suitable for rewriting Unix.

Finally, the maintenance headaches became so splitting that Dennis Ritchie wrote C in order to shape Unix into a more manageable form. "One of my primary goals was to eradicate explicit machine dependencies like the Nuxi problem," comments Ritchie, inverting the two syllables of Unix in comic reference to the PDP-11 technique of storing the least significant byte of 16-bit words first.

C evolved along with the whole Unix project, making possible the addition of multiprocessing and the transportability of Unix to other machines. Now one of the most respected structured programming languages around, C is largely responsible for the widespread use of Unix in many multiple-user processing systems.

Currently, Thompson is working on a microprogrammable chess-playing machine with discrete logic components spread over nine large wrapped-wire cards and supervised by an LSI-11. Ritchie is working on network communication problems, but both do all their programming in C and under Unix. "Unix is light years ahead of everything else," notes Thompson, who sounds as though he is still thinking in terms of space. **-R. Colin Johnson**

small for Unix. And with the seventh edition of Unix, which must be stuffed into a PDP-11/23, that gap has widened considerably.

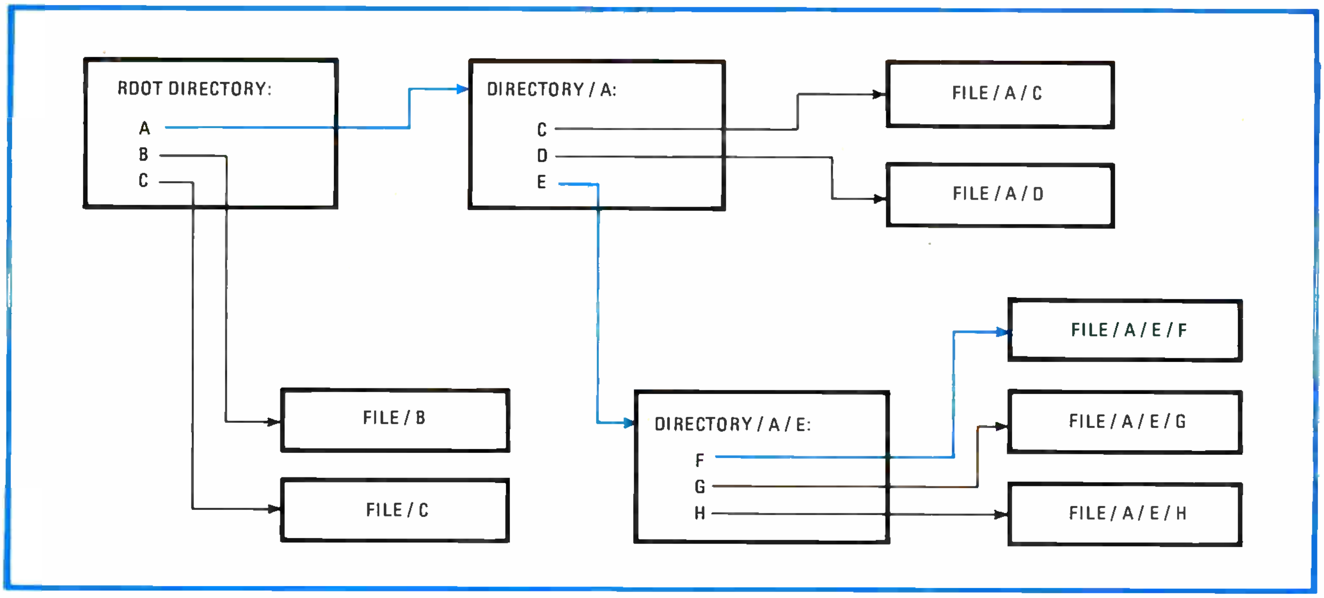
The Idris market lies between these two extremes. There seems to be a large contingent of people who feel that Unix is an excellent operating system, but not large enough. Idris is committed to the notion that Unix is excellent, except it is not small enough.

Idris is a multiprocessing system that manipulates a sophisticated hierarchical file system and multiple input/output devices. Yet only about 60-K bytes of memory are needed for a machine with the code space efficiency of a PDP-11 to hold the resident code plus the largest pass of the C compiler. At least half a megabyte of secondary storage is also required for a reasonable collection of commands and for swapping; but a megabyte is really needed to give one user a comfortable storage area. Idris performs best, however, with a Winchester drive and one or more extra banks of memory.

When a program is being moved between two operating systems, even if both are provided by the same vendor for the same piece of hardware, certain peculiarities invariably spring up. Hardware-dependent system calls are the most obvious difference, since the services made available to a user rely on existing system components such as disk-controller protocols.

The organization of files on disks, conventionally called file systems, differs markedly among systems. This is hardly surprising, given the lack of standards for file-system formats; but it is distressing to find most file systems so poorly documented and idiosyncratic that only the original hardware configuration can read and write acceptable disks. Even more surprising is the fact that magnetic tapes are often incompatible with various systems, making it impossible to produce media in different formats on a single system.

Idris shares two important characteristics with Unix that address those problems: it recognizes the same



2. Hierarchical file structure. A file can be a program, data, or another directory, all originating from the root directory whose name is "/" on all systems. The file named /A/E/F shows its origin by indicating that it is referred to in directories /A/E, /A and /.

system calls, and it manipulates the same file formats. On the PDP-11 and LSI-11, in fact, the in-core images—the binary form of data and programs—of executable files are almost always bit-for-bit–identical between Idris and Unix. On other Unix-like systems, the matchup occurs at the library level, where a set of functions written in the high-level language C performs the necessary transformations to maintain the same external characteristics across implementations.

Inherent differences

Internally, however, there are substantial differences between Idris and Unix. For one, Idris has its own process-priority scheme and its own mechanisms for sharing memory effectively among multiple processes.

On small machines, Idris can run with no memory management hardware at all, which is impossible for standard Unix; a battery of software checks keeps system integrity high even in the absence of hardware memory protection schemes. Idris makes no attempt to maintain shared-text files, which pay off only on large memory configurations, and it is also much more restrictive than Unix in letting dynamic memory-allocation requests dictate how processes will grow in size.

These differences seldom affect the user, but they let Idris effectively use much smaller hardware configurations than Unix. On the PDP-11 family, the Intel 8086, or even on the Motorola 68000, both memory-managed and non–memory-managed hardware can be equally well supported. On an LSI-11/03 with 64-K bytes of memory and double-density diskettes, Idris will support a full multiprocessing environment. This flexibility stems from the fact that Idris has been carefully partitioned to isolate dependencies on memory management hardware (if any) to a few small modules; there is no preoccupation with the PDP-11 style of memory management.

Idris has approximately 40 system calls identical to those defined in the sixth edition of Unix. Half are concerned with process control—spawning new processes, communicating among them, and setting and testing various process attributes—and the other half perform input/output and related control functions.

Unlike many systems, both Idris and Unix have no secret system calls. Though some of them can be performed only by a privileged user, the style in which all processes are written is not affected.

The fundamental control program, called the shell, which corresponds to a command line interpreter or master control program in other systems, is simply another (nonprivileged) process. The shell provided with Idris is a streamlined counterpart of the sophisticated command interpreter evolved on later Unix versions.

Nearly all processes under Idris are initiated by a command made by a logged-in user to the shell. The shell prompts for a text line with a $ (the prompt can be changed by each user) and then reads lines of the form:

```
$ ECHO HELLO WORLD!
```

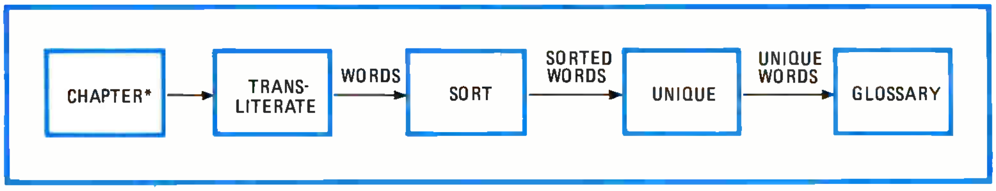
This command calls for the shell, after being passed the three string arguments ECHO, HELLO, and WORLD!, to execute the file ECHO as a program. ECHO is sought and, if found in the proper format, executed. The supplied version of ECHO simply types its arguments to the standard output, usually the user's terminal, and exits.

Such a function is more useful than may be at first apparent. For example, redirecting the standard output:

```
$ ECHO HELLO WORLD! >FILENAME
```

causes ECHO to write its line of output to the file called FILENAME instead of the terminal. It is just as easy to append more data to an existing file or to redirect the standard input from the user's terminal to a file of commands.

How the shell runs a program under Idris or Unix is quite interesting. After it reads and parses, or recognizes, a command line, it executes the fork system call. The fork creates a new process—one that is identical to the original right down to the files it has opened. The



3. Pipelines. Programs may be linked with what are called pipes. Illustrated is a series of programs that convert a text file into an ordered list of unique words—a glossary.

child, or new process, instantly executes the specified program in the command line. The parent, or original, waits until that child has terminated execution, reporting its exit status back to the parent. The child image is lost for good after the program has been successfully executed, which is why the original shell chose to fork in the first place.

With this scheme, an arbitrary tree of processes can be set up, and considerable information can be passed up and down the tree. An additional mechanism called a pipe lets one program pass data to another program as if it were writing to a file and thereby communicate data to another process, which reads the data as if from a file. Such pipelines are easily manipulated, and the shell facilitates stitching together several simple utilities into a powerful new mechanism.

Thus, any program can run any other program, and many separate small programs can be encapsulated under user control. Since the shell is just another process that reads and writes standard output, it is easy to execute a script of commands previously stored in a file; no special submit facility, or spooling mechanism, is required. Command scripts may accept arguments and perform conditional and looping statements just like a compiled program; so the shell is, in a very real sense, an interpreter for a very high-level user-oriented language.

Device independence

Like Unix, Idris easily interfaces processes with disk files and I/O devices. Device independence receives much lip service, but is seldom attained in practice. Idris comes much closer to that goal than most operating systems by using a hierarchical file system structure and by minimizing the internal structure of files, even when files are actually physical devices.

A file system is simply a logical data structure imposed on a contiguous collection of disk data blocks. The blocks are standardized across devices at 512 bytes, but the logical data structure contains information in its header on how many blocks it comprises, so that a broad class of secondary storage devices can support the same structure.

Up to 65,536 blocks may participate in a single Idris file system. Large disks are partitioned into multiple file systems of up to 32 megabytes apiece; conventional diskettes can be formatted as 250-K-byte file systems with the same format.

File systems constructed under Unix on the PDP-11 may be freely interchanged with those written under Idris. Moreover, Idris supports this standard across different machines, regardless of native byte-order or address size—something the Unix community has failed to do. Thus the file systems written on removable media become a true *lingua franca* among diverse machine architectures.

Each file system contains a "root" directory that can lead to an arbitrary number of files and/or subdirectories (Fig. 2). A file is located by its path name, as in ABC/DEF/G or ABC/G. The former identifies the file G in subdirectory DEF of directory /ABC (the difference between directory and subdirectory being academic), while the latter path name identifies a different file G in /ABC. There are no limits to the structural depth of the directory that may be constructed.

To navigate through this potentially huge name space, each Idris process keeps track of the current directory in which it is operating. Files in this directory are referred to by family name, as in G; files in other directories are reached by path names that start at the root ABC/DEF/G or by local navigation from the current directory DEF/G. If the current directory were ABC, both of these path names would identify the same file. Thus, many different users may reuse the same file names with little fear of collision and without the cost of writing a long qualifier for each file reference.

Physical I/O devices are accessed by making special entries in this directory structure. The entries have names just like any other disk file, but cause devices to twitch when addressed.

It is also possible to mount a file system on a physical device, so that all the files appear as a subtree hanging off the existing directory structure. As a result, an essentially unlimited amount of data can be placed simultaneously on line, without requiring any one process to know about more than one directory entry. For most applications, even the 32-megabyte limitation on an individual file system is thus largely irrelevant, since the boundaries in the directory structure are nearly invisible once file systems are mounted.

Uniform files

Nearly all operating systems make a sharp distinction between binary files to be fed to programs and text files destined for users. Idris treats all files the same—as ordered sets of 8-bit bytes. Programs that handle text expect a file to contain zero or more lines, where each line consists of zero or more arbitrary characters terminated by an ASCII linefeed or new-line character. No information stored in the file attributes promises this line structure, however, and many programs work very well without it.

Even physical devices emulate these simple standards as much as possible. Reading an interactive terminal, for example, delivers at most one line of text after character delete and other editing have been performed. Each line is invariably terminated by a new-line character, even if the particular terminal encourages the use of ASCII carriage return instead. Similarly, writing a new-line-terminated line to any terminal causes insertion of carriage returns and delays as appropriate.

As a result, the vast majority of programs are written to read standard input as a text file and write standard output as another text file. Each program is debugged, and often used to advantage as a separate package that interacts with a terminal. Later it can be redirected to files or pipelined to other programs with no changes, greatly simplifying program development.

Software tools

In addition to its operating system facilities, Idris has a powerful group of software tools that can be used either separately or as part of a pipeline (Fig. 3). These tools include a context-sensitive editor, a runoff facility for formatting text, file comparators for source-code control and automated testing, a program for finding text patterns within files, a sort program, encryption and decryption tools, and programs for copying or moving files or subtrees of files. Over seventy tools are currently available with Idris, and together they encompass the functions most widely used at Unix installations.

Similar tools are found in many operating systems; however, in Idris, they have been designed to work together, often in ways never envisioned by the system implementers. Little or no need exists for the many traditional packages built atop other systems—packages with names like source-code control system, word processor, data-base management system, or report generator. All such functions are applications of the standard Idris tools.

A prime example of this system integration can be found in producing a glossary for a set of files named chapter 1, chapter 2, and so on. This task reduces to a shell one-liner that assembles the chapters into a single stream, translates the white space between words into new lines, sorts the resulting word list, discards multiple entries, and then writes the unique entries onto the file glossary:

```
tr "\ t" –t"\n" chapter* | sort | uniq > glossary
```

Software tools such as these make Idris powerful: good system calls and a flexible file system merely provide a hospitable environment. No single enterprise is likely to duplicate the extensive set of tools that has grown up under Unix; but Idris already encompasses many of these valuable facilities, and it can support most Unix-based tools as well.

Most operating systems are written in machine-dependent assembly language. The authors of the Unix system have avoided this pitfall, however, and it has been successfully transported by Bell Labs to several machines. Whitesmiths has followed Unix's lead by writing Idris as much as possible in the highly portable C language. Dependencies on individual machines or memory management styles are kept isolated to a small portion of the resident program (see table below), so that large portions of Idris come up very quickly once a small piece of it is redone.

Transporting Idris

In many ways, the hardest part of transporting Idris is writing a code generator for the C compiler that is targeted to the new machine. Along with this, an existing assembler must be modified for the new instruction set, and a runtime package must be written. That package includes those operations not easily executed by in-line code, such as floating-point arithmetic on computers without floating-point hardware and the forty-odd system calls described earlier. It is also desirable to replace the disassembler portion of the standard debugger with functions that can interpret the new instruction set in object files and core images.

Once this is finished, the resident program is reworked to reflect the target-interrupt structure, memory management architecture, and device peculiarities of the recipient system. Initially, handlers must be written for a console device and at least one disk drive. Most of the resident program modification is done in C, and, all in all, only a small portion of the resident program need be touched.

Utilities can then be moved across—presumably unchanged, although there are always a few surprises when working with a new code generator, on a new machine, or on a machine with different byte-order from any of its predecessors.

For all the preparation that has gone into Idris, Whitsmiths still budgets a minimum of two senior programmer-years to move C and Idris to a new machine. This is a large investment compared with the time required to rewrite an interpreter for a pseudo-code–type machine; but the payoff is the dramatically better efficiency and execution speed resulting from using a true compiler tailored to the target environment. However, it is only a small investment compared with what has been made by others who have attempted to transport operating systems, and it is trivial compared with the effort needed to rewrite most systems. □

PROJECTED IDRIS SYSTEM PARAMETERS

Machine	Master/ slave hardware	Mapping hardware	Program relocation	Instruction and data space	System area access	Pointer size
LSI-11	no	no	software	no	direct	2
8080	no	bank switch	software	no	copy in/ copy out	2
PDP-11	yes	yes	hardware	maybe	copy in/ copy out	2
8086	no	yes	hardware	yes	copy in/ copy out	2
68000	yes	no	software	no	direct	4
VAX-11	yes	yes	paged	no	paged	4
IBM/370	yes	yes	paged	no	paged	4
UNIX VERSION 6 AND 7 SYSTEM PARAMETERS						
	required	required	required	option	paged	2–4

In-house standards fill gaps in instrument-computer interface

Adoption of codes, formats, and operating conventions for IEEE-488 instruments simplifies system design

by Maris Graube, *Tektronix Inc., Beaverton, Ore.*

☐ In 1975, the Institute of Electrical and Electronics Engineers took a giant step toward interfacing instruments with computers when it published IEEE Standard 488-1975. But that standard, also called the general-purpose interface bus, or GPIB, was only a first step; further standardization is needed if equipment from different manufacturers is to be truly compatible. The IEEE is working in this direction; in the interim, Tektronix has developed an internal standard that others may also find useful.

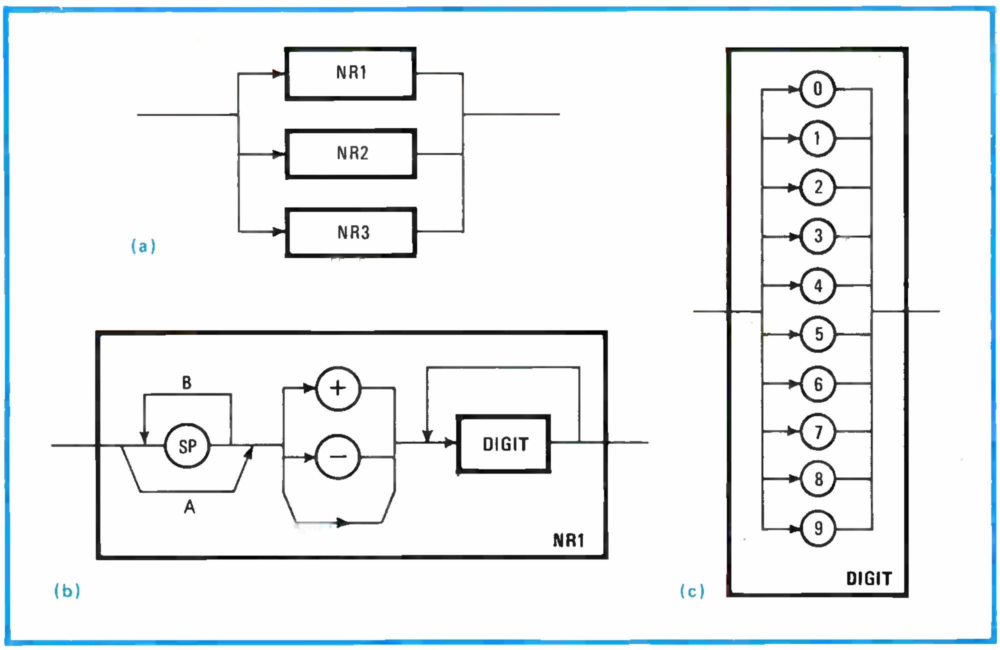
Standard 488 defines three aspects of a computer-instrument interface: mechanical (the connector and cable), electrical (the levels for logical signals and the lines the signals are sent and received over), and functional (the tasks that an instrument's interface is to perform, such as sending data, receiving data, and triggering the instrument). It does not define, however, the language sent over the bus or the manner in which the physical communications system is to be used. This lack of standard ways to use the GPIB causes a variety of incompatibilities.

For example, if a multimeter takes a reading of +3.75 volts and wants to send that reading to a computer, the standard gives eight data lines for transmitting it in byte-serial fashion. But the question quickly arises, "How should the five characters be encoded?"—a question the standard leaves unanswered.

The next question that naturally arises is, "What format is used to send this information? Should the +3.75 reading be sent from right to left, left to right, or some other way?" Here, too, the standard has no answer.

Even if the multimeter uses an acceptable code and format, compatibility is not ensured. For example, to tell the computer it has finished its data transmission, the multimeter may send a carriage return, CR, followed by a line-feed character, LF. The computer, however, may recognize CR by itself as the message-terminating convention. It therefore stops communications after receiving CR, before the multimeter sends the LF character.

Although both computer and multimeter are 488-compatible, they do not work together, because the 488 standard has not defined codes, formats, and operating conventions for using the bus. The designer of an instrument or controlling computer is free to choose them—free, in effect, to create incompatibilities using the GPIB, because these can usually be taken care of by clever



1. Numerical syntax. For each of the three GPIB number formats shown in syntax diagram (a), another, expanded syntax diagram such as that for NR1 (b) can further define it. The circled items in (b) are ASCII primitives, and the digit term can be reduced to primitives as well (c).

TABLE 1: NUMBER TYPES IN ASCII CODE FOR THE GENERAL-PURPOSE INTERFACE BUS		
NR1	NR2	NR3
SP+123	SP1.23	SP1.23E+03
SPSPSP45	SPSPSP.45	SPSPSP.45E-06
+8789	−789.	−789E+0

computer programming. Also, designers have tended to make instruments compatible with the few predominant instrument controllers (or computers) available. But as instruments become more complex and intelligent, incompatibility problems become more severe.

The IEEE is currently working on such standards for the GPIB, but when they will be generally available is not known. It is believed that Tektronix' internal standard, developed for its own use, will be helpful to other instrument and systems designers now and will also comply with the IEEE standard when it is released.

It is quite easy to tell a human being that a particular number coding format is to be used; but a microprocessor needs to have an explicit, unambiguous message, or else it will send or receive information that is obviously erroneous. Most instruments and other GPIB devices now use ASCII-coded characters to send and receive data, so ASCII coding is becoming a *de facto* standard.

In addition, the American National Standards Institute's X3.42 standard format is used by most instruments to send and receive numbering. This format states that there are three types of numbers—integer, real, and real with exponent—and that they should be sent with the most significant character first.

Simply defining a format verbally is insufficient, however; it can lead to misinterpretation and misunderstanding. Therefore, syntax diagrams are used to describe precisely what is meant by "number" or by some other character sequence. Syntax diagrams are similar in function to the state diagrams used in the IEEE-488 standard to describe the workings of the GPIB.

Picture-perfect standards

Once a format has been described by a syntax diagram, it can be precisely described in a computer program or in microprocessor firmware. The syntax diagram in Fig. 1a says there can be three types of numbers. If a path is traced through this syntax diagram by following the arrows in this figure, then one of the three types will be encountered.

The diagram still does not say what a number really is, but only that there are three distinct types. As it appears in the syntax diagram in Fig. 1b from left to right and following the arrows, a format NR1 number may begin with a sequence of spaces, SP. The spaces are optional, since path B can be taken as many times as needed. Next, a plus or a minus sign can be selected; these are also optional. Then one or more digits can make up the character string.

In this example, the characters SP, +, and − are inside circles. In the language of the syntax diagram, that means that they will not be defined any further; they are the primitives—in this case, the ASCII characters. "Digit," however, is in a rectangle and has to be defined further, as in Fig. 1c.

Thus, eventually everything is defined in terms of ASCII primitives. The syntax diagram states that an NR1 is an integer number with at least one numeric character that may optionally be preceded by a sign and/or spaces. The number types NR2 (real) and NR3 (real with exponent) can be similarly defined as shown in Table 1.

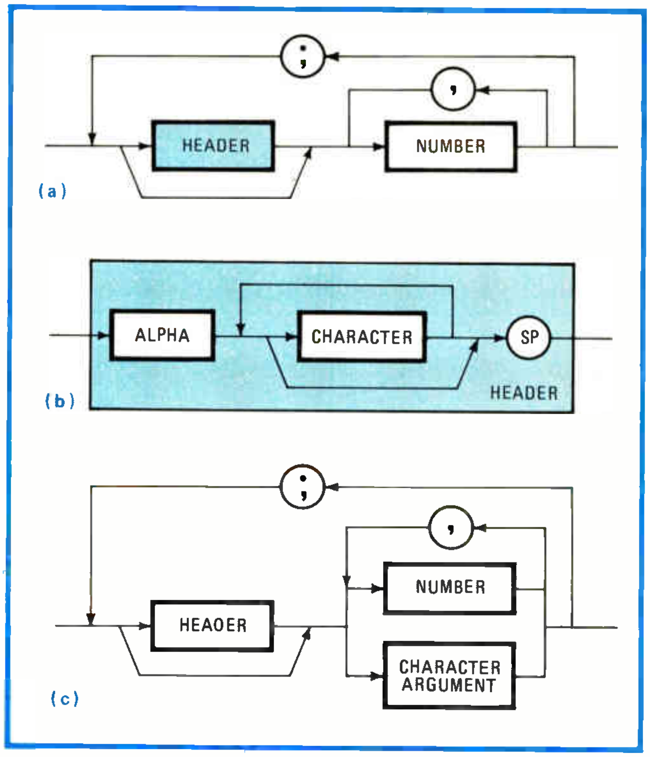
Although syntax diagrams are useful, they have their limitations. For example, they cannot show that a negative 0 should not be sent.

Numbers in context

To have a computer or instrument controller interact with intelligent devices, however, code and format conventions must be more comprehensive than simple definitions of numbers. If a device makes a group of measurements and is asked to report them, a group of numbers must be sent. To separate one number from the next, a comma can be used. For example, the position coordinates from a digitizer might be sent as NR2, NR2.

Further, if a device makes two different types of measurements—for example, frequency and phase—there should be a means of identifying these two types of numbers. This can be done by first sending a header—a description of the number. If the headers and numbers are sent consecutively, they must be separated from each other. This is done by sending a semicolon (;) as a separator. These conventions are shown in the syntax diagram in Fig. 2a.

A header should be a description that people can read



2. Letters with numbers. Sending groups of readings over the bus is facilitated by using semicolons and commas as separators (a). The header describing the number's meaning (b) can be used with a character argument also (c) for data types such as range auto.

TABLE 2: ARGUMENTS FOR DIFFERENT TYPES OF DATA TRANSMISSION

Name	Function
String	for sending text to a display or printer
ASCII block	for sending blocks of ASCII-coded data of known length
Binary block	for sending binary blocks of known length
End block	for sending binary data of unknown length or format

and should be kept short to minimize the transmission time on the bus. For the header in Fig. 2b, "alpha" is upper- or lower-case ASCII alpha characters. "Character" is defined as any ASCII printing character, excluding (,), (;), and (SP) and some other characters that have a particular meaning. The SP character is used as a separator between the header and the number.

The syntax diagram specifies only the data structure of a measurement but not what is being measured—that is, how a particular instrument makes a measurement, what the accuracy or resolution is, or any particular instrument characteristics. Clearly, this is a step toward language compatibility without forcing or interfering with instrument design.

Codes and formats have been presented so far as increasing compatibility between devices on the bus and making it easier for a computer to communicate with instruments. But a person must still write the program to make the computer send something on the GPIB. The computer is simply an intermediary, transmitting the user's intent over the bus to the instrument.

An instrument can be designed in one of two basic ways. It can be designed with minimal intelligence to accept "hieroglyphics" that it can conveniently interpret and execute. For example, a power supply could require the sequence 2 3 7 4 to put out 15.7 V; the "2" stands for the 0-to-50-V range, and the "374" represents the range fraction (50 V)374/1,000, which is the desired voltage. In this case, the power supply needs a 4-byte latch and a simple digital-to-analog converter to be programmable. On the other hand, the power supply could be built with processor intelligence and could accept NR1, NR2, or NR3 numbers. In that case, to put out 15.7 V the programmer simply sends the character sequence 15.7.

The latter method of interacting with instruments is a great deal more convenient for people, not only when the computer program is first written, but also later, when someone other than the original programmer has to find out what the program is supposed to do. To promote this compatibility between devices on the bus and between humans acting through a computer, appropriate codes and formats are needed.

Beyond numbers

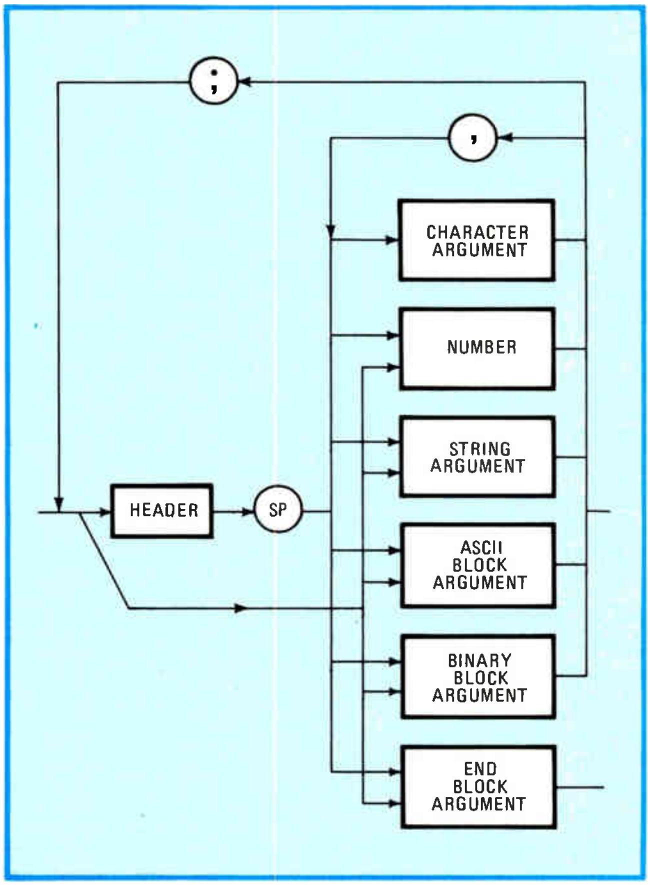
Numbers in the NR1, NR2, or NR3 formats are good for both computers and people. People, however, often need to send directions to instruments in a format other than numbers—trigger enable, switch on, and range auto, for example. In these situations, the first word can be treated as a header and the second as a nonnumeric data type. This can be shown by taking the syntax diagram in Fig. 2a and modifying it slightly (Fig. 2c) to include a character argument—a sequence of ASCII characters a person can read. Other arguments useful for various purposes are given in Table 2.

All data types can be summarized into a single syntax diagram (Fig. 3) describing the general format for all types of bus communications. Though more complex than the diagrams shown earlier, this diagram eliminates some subtle problems.

The overall syntax diagram has been constructed and the arguments have been defined so that a message conforming to this convention can be parsed—that is, easily taken apart and clearly understood by a computer or instrument. Most instruments need not implement all the types of constructs possible—only those appropriate for a particular application. Thus the diagram's complexity does not mean that instruments need be equally complex.

Message conventions

To avoid incompatibilities, a standard way to terminate messages is needed. Two common methods are currently being used: one is to send printer format characters such as CR or CR LF, and the other is to assert the end-or-identify (EOI) line. However, some devices such



3. In general. A general syntax diagram for all possible data sent on the bus is shown above. This diagram need not be realized in all devices but makes it easier to parse data into meaningful groups and to construct a format-implementing device in silicon.

TABLE 3: STATUS BYTES COMMONLY NEEDED FOR THE BUS

Name	Code	Function
Normal conditions		
Normal status	000X 0000	Response to serial poll when condition of instrument is normal.
SRQ query request	010X 0000	Tells controller to query device to determine nature of service needed.
Power on	010X 0001	Reported after every power on, informs controller that device has just come up; eliminates problem of device coming onto bus without controller's knowledge.
Operation complete	010X 0000	For a multitask environment, tells controller that entire set of tasks is complete and device is ready for another command.
Abnormal conditions		
ERR query request	011X 0000	Reports error but does not identify it; controller should send query for error identification.
Command error	011X 0001	States that message received cannot be parsed logically.
Execution error	011X 0010	States that message received cannot be executed.
Internal error	011X 0011	States that device is out of calibration or malfunctioning.
Power fail	011X 0100	States that power is failing or about to fail; controller can react by causing data to be stored or noting suspect operation.
Execution error warning	011X 0101	Warns that device has received and is executing a command but a potential problem exists (for example, instrument is out of range but sending data anyway).
Internal error warning	011X 0110	Warns that device has had an internal failure but is continuing to function.

as waveform digitizers have to send messages that may contain a sequence of binary-coded bytes, which, if perceived as ASCII, will appear to be a CR LF and thus be misinterpreted.

The second termination method has no such problems. Asserting the EOI line unambiguously terminates the message. Thus, Tektronix instruments assert the EOI line concurrently with the last byte of the message.

Other problems arise from the lack of conventions for message termination. It may happen, say, that a high-voltage power supply currently set to put out 10 V and limit current to 2 amperes is sent the message to put out 1,000 V at 10 microamperes. Lacking good message-handling conventions, the supply goes to a 1,000-V output immediately upon receiving the first part of the message. But because the current limit is still 2 A (the value from the previous setting), the supply either crowbars or damages the equipment connected to it.

It would be much easier and safer if the power supply had the good sense not to execute any command until the entire message is received. Power supplies and other instruments can be designed such that they do not execute a message until the EOI line is asserted, thus eliminating potential problems.

This could also prevent misunderstandings between a computer and a measurement instrument. When instructed to send a measurement message, an instrument can send an EOI only when the message is complete and will send no more data unless directed to do so. That way the computer knows that no data is lost, and the instrument is not inadvertently stopped from talking in the middle of a message.

A message can be defined, then, as a block of information that begins when a device starts sending data and ends when an EOI is sent or received concurrently with the last data byte. But the beginning of a message needs further clarification. An instrument sending a message may be interrupted by the computer taking control, perhaps as part of a serial poll. When the instrument is made a talker again, it should resume sending the message. Thus a message begins when a device enters the talker active state (TACS) for the first time following a reset or previously sent EOI.

A further refinement of the message convention is that when a device is made a talker, it should always say something. If it has nothing to say and will have nothing to say for an indefinite amount of time, sending a byte of all 1s concurrent with an EOI lets the listening device know that no meaningful data is forthcoming. This null message prevents the GPIB from being held up while the computer waits for a talker that has lost its voice.

Other conventions can make life on the bus easier. A listening device should always handshake, even when it does not understand or cannot execute a particular message. After an end-of-message indication, it can send out a service request if it is confused and, on a serial poll, notify the controller that nonsense has been received.

Though under no circumstances should devices be able to execute a message they do not understand, some do not follow this convention—with disastrous results. One power supply, if sent four letter Os instead of numeral 0s (a common mistake), will put out its maximum voltage instead of its intended 0 V.

Status bytes and queries

The IEEE-488 standard defines a facility for an instrument to send a byte of status data to the computer. However, it defines the meaning of only a single bit—bit 7, which shows whether a device is or is not requesting service. Since there is a need for instruments to report

TABLE 4: QUERIES FOR GPIB DEVICES		
Name	ASCII code	Function
Error identify	ERR?	Requests details of error reported by a device.
Setting	SET?	Asks a device for present setting and other state information; permits learn mode.
Identity	ID?	Requests device's type, model number, firmware version and so forth; permits system self-configuration.

other kinds of status or error to the computer, a more specific status byte convention should be established.

One common need is for instruments to tell if they are busy or ready (bit 5 is used for this purpose at Tektronix). Another common need is for instruments to report if they are encountering abnormal conditions (Tektronix employs bit 6 for this task). More complex conditions besides busy/ready or normal/abnormal are listed in Table 3. Table 3 status bytes are generally useful for most purposes, but certain instruments may have conditions that are peculiar to them. Bit 8 can be used to indicate that the status byte is particular to an instrument. Standard coding for the status byte makes it more convenient to program the system controller; if all instruments have such codings, then a common routine for handling status bytes can be written. But even with all the possibilities status bytes allow, it is often necessary to send more detailed status information. This can be done via a convention called queries.

Normally, a measurement instrument will send a measured value when it is made a talker. To elicit something other than this message, the computer could first send a query to the instrument and then, when the instrument is made a talker, it could send the required information. The queries can take the form of a header followed by a question mark. Some queries and their uses are given in Table 4. Defining a standard way to elicit responses from an instrument eases programming of the instrument system. If all instruments use the same form to perform similar functions, the programmer has to learn only one convention instead of many.

Instruments that incorporate queries offer improved compatibility and usefulness in systems. But the price of greater capability is more complexity and the potential for misunderstanding. For example, what happens when an instrument is sent two queries in a row? Does it honor both requests or does one supersede the other?

The further convention that is called for here is simple: if the queries are in the same message, the instrument responds to both requests in the order in which they were received. If the queries are sent as different messages, then the last supersedes the previous one.

Friendlier operation

As instruments become computers in their own right, more operating conventions will be needed—conventions more characteristic of a mainframe computer and its peripheral processors than small desktop calculators and simple-minded instruments.

But such conventions need not make intelligent instruments more difficult to use. Quite the contrary, an intelligent instrument should be easier to use if its intelligence is employed properly. For example, though an instrument should always send numbers in the correct format described earlier, it should receive numbers forgivingly. Negative zero numbers should not be sent, but if they are received, they should be accepted. An NR3 number should be sent exactly as defined in the ANSI X3.42 standard—that is, as NR2 EXPONENT; but some of today's computers violate this standard and send numbers in the format NR1 EXPONENT. The invalid number should in that case be received and the NR1 portion interpreted as an NR2, with an implied decimal point following the least significant digit. If an instrument receives a number whose precision is greater than it can handle internally, then the number should be rounded off, not truncated.

An instrument should recognize both spaces and commas as argument delimiters. Multiple spaces or commas should not be construed as delimiters for null arguments. This convention is useful because some computers gratuitously generate spaces and send them on the GPIB.

An instrument should receive headers and character arguments in both upper and lower case and equate them: a = A, b = B, and so on. This is useful because some desktop instrument controllers have a problem sending uppercase characters. An instrument sending data about its front panel should use headers and character arguments that correspond to the front panel's nomenclature. These features make an instrument friendly to an inexperienced programmer.

Other useful conventions can also be built into today's instrument. The service request (SR) function and the corresponding status byte reporting are very important. Sometimes, however, a person or a computer does not want to be interrupted—for example, when a sensitive or time-dependent measurement is made. For these cases, a message, RQS OFF, can be sent to disable any service requests. To turn the service request capability back on, the message RQS ON is sent.

Another useful convention is related to the device trigger (DT) function. Sometimes a command message sent to an instrument should be executed immediately; at other times, when the group-execute-trigger interface message is sent. To make the instrument execute demands immediately, the message DT OFF is sent. To make the instrument defer execution of commands, the message DT ON is sent. □

Thermocouple simplifies temperature controller

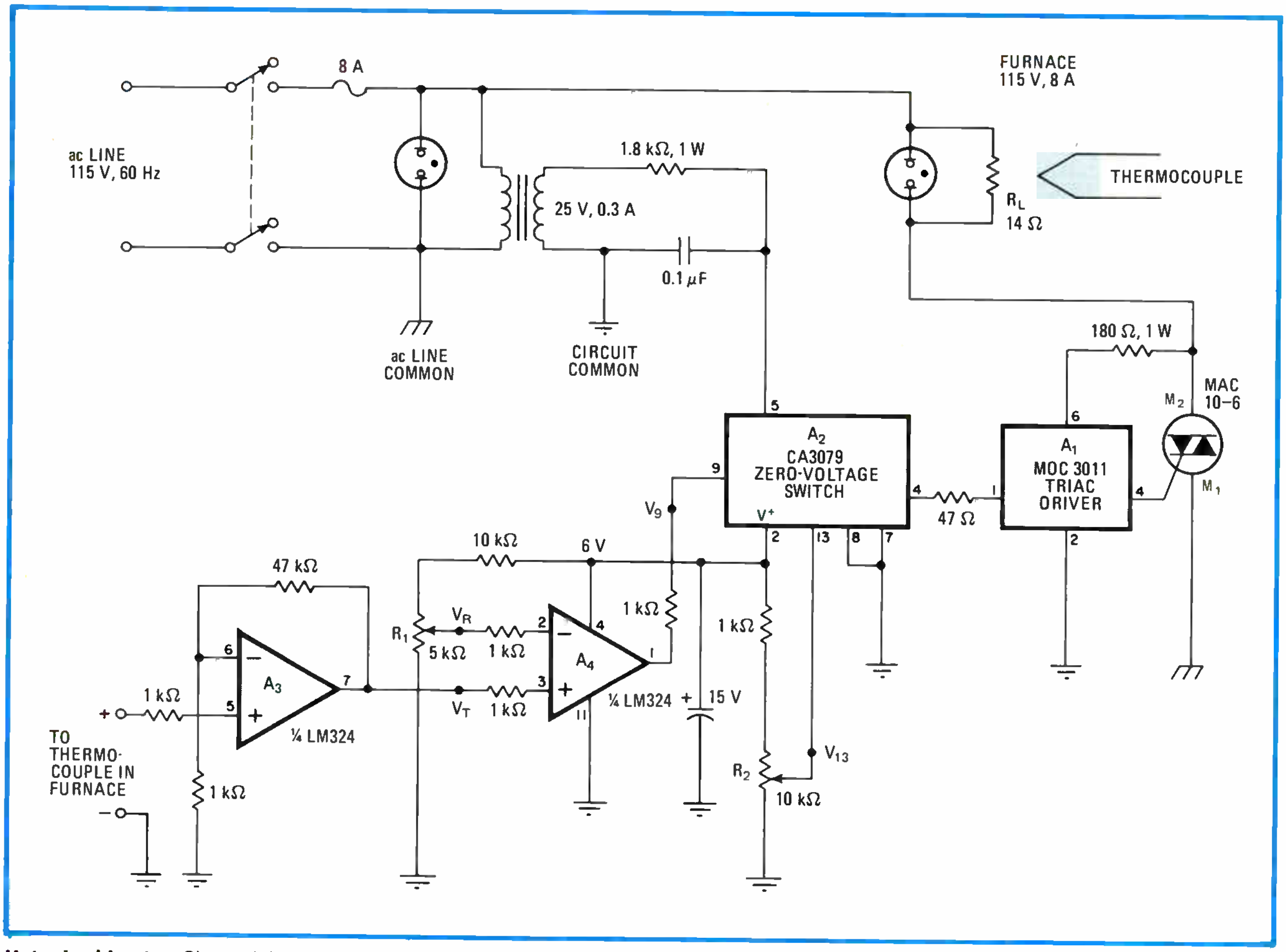
by V. J. H. Chin
National Research Council, Division of Chemistry, Ottawa, Canada

Virtually all the designs for low-noise, high-temperature controllers of the type that use zero-crossing switches have thermistors in the sensing circuit—an impractical configuration in many cases because of the size requirements and availability of the thermistor itself. To overcome these inconveniences, this simple circuit substitutes an ordinary thermocouple for the thermistor, yet works as well as a thermistor-based one—for instance, it controls the environmental (furnace) temperature from room temperature to 1,100°C to within ±2%.

In general operation, the furnace is heated from the ac line through a triac, triac driver A_1, and the CA3079 zero-voltage switch A_2. The CA3079, in turn, switches on when the output differential from the thermocouple drops below a value corresponding to a given furnace temperature. Switching occurs because the amplified thermocouple voltage, V_T, at the output of A_3 falls below the user-preset reference potential, V_R, at the input to A_4. Note that in addition, the CA3079 must be biased so that potential V_{13} is initially less than the comparator's output, V_9, in order that the circuit containing R_L of the furnace will be completed and current will flow when the furnace is cold.

The thermocouple voltage is linearly proportional over its entire range to the temperature in the furnace; consequently, if potentiometer R_1 is linear, it can be directly calibrated in terms of temperature. For optimum switching, the voltage V_{13} should be set at half of the LM324's supply voltage.

As for cost, the prototype circuit was built for an outlay of less than $20. □



Hot-wired heater. Chromel-Alumel thermocouple eases design of zero-crossing-switched temperature controllers. Potentiometers R_1–R_2 set the reference voltage for switching on furnace from CA3079 switch without the need for setting up a complicated reference scheme. Linear response makes it easy to calibrate R_1 as a direct function of desired temperature. Circuit works to 1,100°C, is accurate to within ±2%.

Logic-gate filter handles digital signals

by Andrzej M. Cisek
Electronics for Medicine, Honeywell Inc., Pleasantville, N. Y.

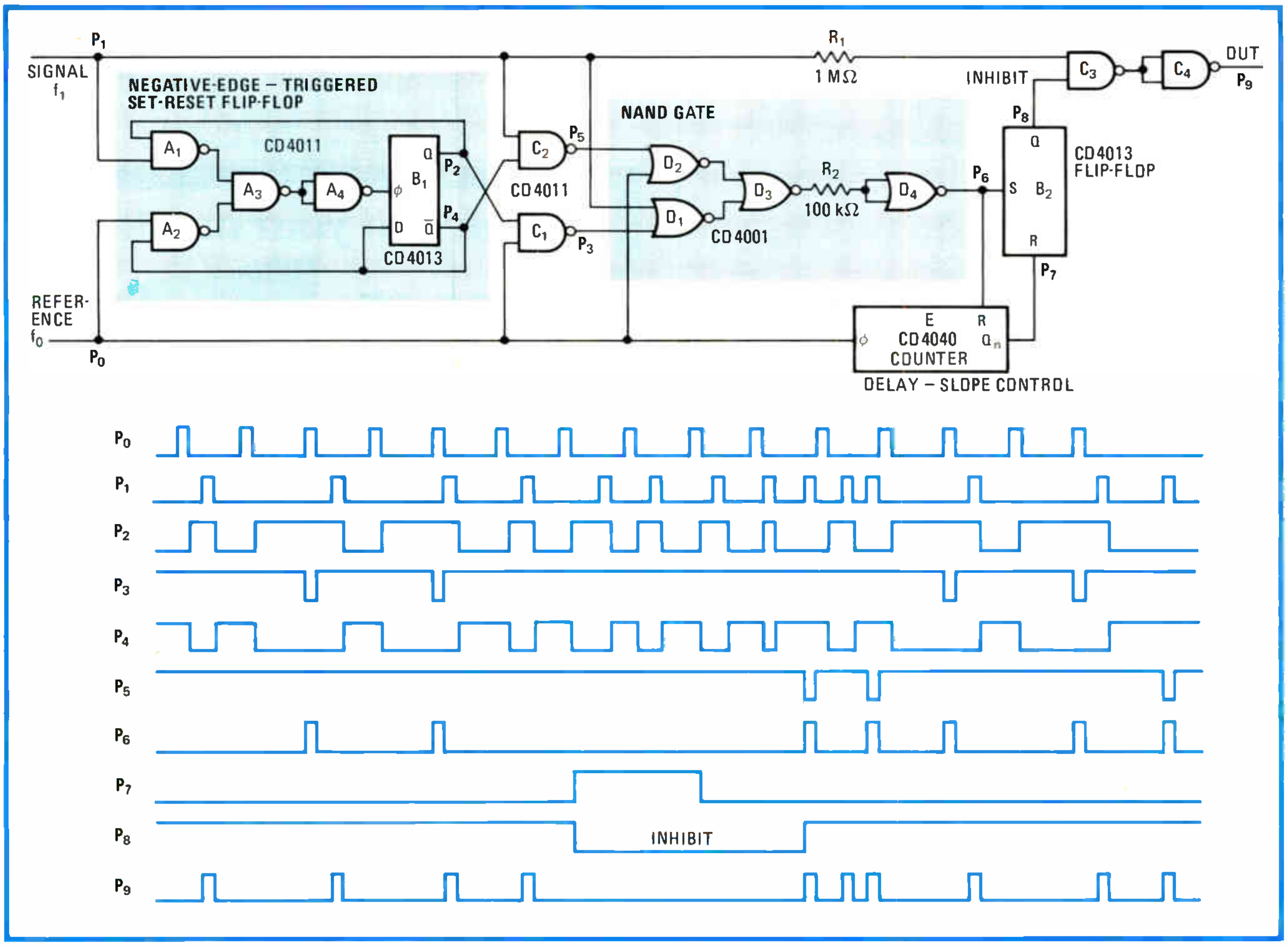
Performing the digital counterpart of electric-wave filtering in the analog domain, this unit can function as a low-pass, high-pass, bandpass, or band-reject filter of a square-wave pulse train. No RC integrating networks or comparators are needed, the all-digital filter being tuned simply by adjusting the reference frequency. Built originally for biomedical applications, it can find much broader use in the field of communications.

Consider the case of the band-reject filter shown in (a) in the figure. As seen with the aid of the timing diagram, the Q output of the edge-triggered set-reset flip-flop formed by the gates of the CD4011, A_1–A_4, and the 4013 D flip-flop (B_1) is brought high by the training edge of reference frequency f_0 and brought low by the falling edge of signal f_1. The combined output of the flip-flop and f_0 appears at gate C_1, moving low if $f_0 > f_1$. Similarly, C_2 moves low if $f_1 > f_0$. Therefore, signals from the output of the NAND gate formed by NOR gates D_1–D_4 appear whenever $f_0 \neq f_1$. Each pulse sets flip-flop B_2 high if it is not already so, permitting signal f_1 to pass through to the output.

Meanwhile, the 12-stage 4040 ripple counter advances on each pulse from f_0. The counter will reach the Q_n state if $f_0 = f_1$, because no reset pulse can emanate from gate D_4 under that condition. These events will disable gate C_3 and prevent f_1 from reaching the output.

The steepness of the filter's roll-off characteristic will be determined by which stage of the counter resets flip-flop B_2. The filter's reaction time to changes in the input and reference frequencies will vary accordingly—that is, the steeper the slope, the longer the response time, this delay being the major drawback of the filter. The corner frequencies are $f_{1\,min} = (N-1)f_0/N$ and $f_{1\,max} = (N+1)f_0/N$, where N is the number of pulses of f_0 required for the counter to produce a reset pulse. The quality factor is $Q = f_0/\Delta f_1 = N/2$.

The stop-band filter can be easily modified to a bandpass type if the $\bar{Q}$ output of flip-flop B_2 is wired to serve as the inhibit line. To convert the filter for low-pass duties C_2 is removed and both inputs of D_3 are connected to D_1. In like fashion, C_1 is removed and both inputs of



Digital damping. To perform band-reject function, this combinational logic circuit ascertains the frequency relationship of two square-wave signals. Tuning is done by adjusting the reference frequency. Selectivity is determined by tap position Q_n of the counter. Waveforms for given points in circuit show timing relationships. With minor changes, the filter is easily adapted for high-pass, low-pass, and bandpass duties.

D_3 are connected to D_2 if a high-pass response is desired. Note that the NOR-gate circuitry is required to avoid any ambiguity of output state when pulses of input and reference signals overlap. Also, resistors R_1 and R_2 neutralize the effect of variable propagation-time differences of f_0 and f_1 through the gates □

Two-chip pulse generator operates at 75 MHz

by M. U. Khan
Systronics, Naroda, Ahmedabad, India

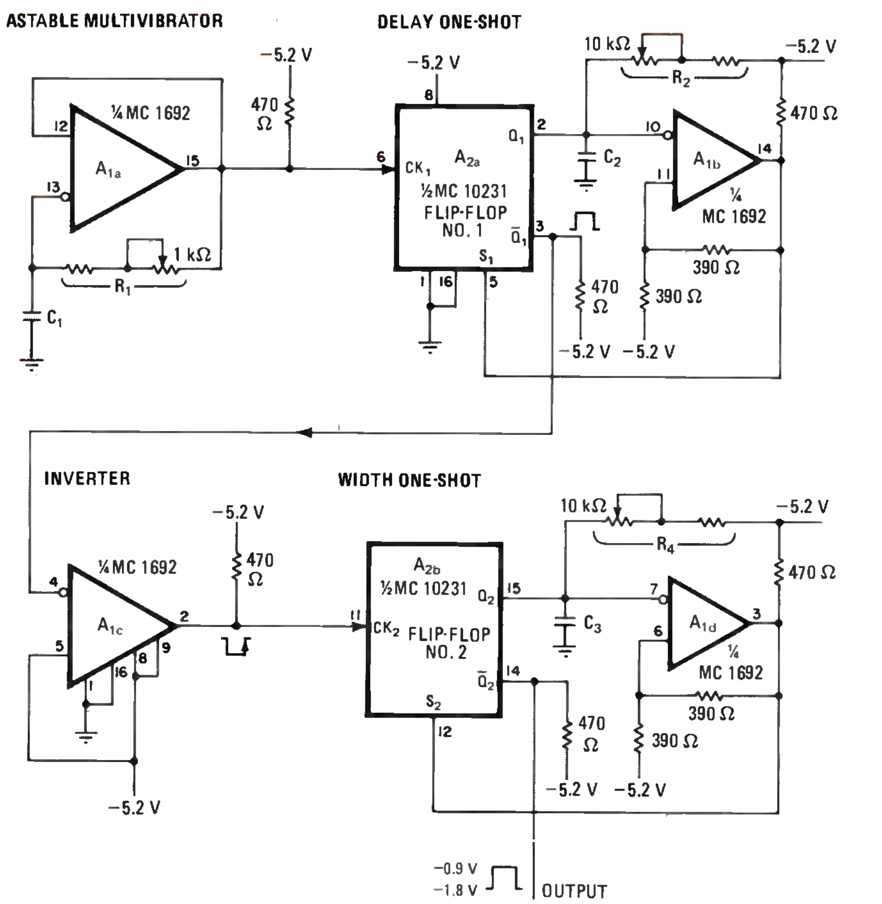
Built from integrated circuits in the emitter-coupled-logic family, this pulse generator can provide independent control of delay and width (variable from 5 nanoseconds to 0.1 second) over the frequency range of 10 hertz to 75 megahertz. Only two chips are required—a quad line receiver and a dual D-type flip-flop.

The MC1692 line receiver, A_{1a}, configured as an astable multivibrator, provides a steady stream of pulses, at a frequency determined by R_1C_1, to the delay portion of the circuit. This section, which uses a second line receiver and one half of the MC10231 dual flip-flop, generates a corresponding pulse at the output of A_{2a} whose duration is proportional to R_2C_2. Its maximum duty cycle is greater than 80% at 10 MHz and decreases progressively to about 50% at 75 MHz. After inversion by A_{1c}, the signal is introduced to flip-flop A_{2b}.

A_{2b} is triggered on the positive-going edge of the signal, and so pin 15 of the flip-flop moves high after a time proportional to R_2C_2, thus effecting the delay time. The duration of the pulse emanating from A_{2b} (that is, its width) is set by the A_{2b}–A_{1d} combination, which is identical to the A_{2a}–A_{1b} configuration. Note that the polarity of the output appearing at Q_2 of A_{2b} matches that of the input signal, because the width-determining one-shot works on an inverted version of that signal.

If the flip-flops are replaced by two MC1670 types, the circuit will work beyond 100 MHz. In either case, the circuits used should be mounted on suitable heat sinks. □

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 $75 for each item published.



FREQUENCY	C_1	R_1 (Ω)
75–10 MHz	10–40 pF	47–1,047
10–1 MHz	360 pF	47–1,047
1–0.1 MHz	0.004 μF	82–1,082
100–10 kHz	0.04 μF	
10–1 kHz	0.4 μF	
1–0.1 kHz	4 μF	
100–10 Hz	40 μF	

DURATION	C_2, C_3	R_2, R_3 (Ω)
*5–30 ns	4–20 pF	330–10,330
10–100 ns	68 pF	330–10,330
0.1–1 μs	0.001 μF	820–10,820
1–10 μs	0.01 μF	
10–100 μs	0.1 μF	
0.1–1 ms	1 μF	
1–10 ms	10 μF	
10–100 ms	100 μF	

*AT HALF AMPLITUDE

Fast and flexible. A simple ECL pulse generator provides independent control of pulse width and delay and works to 75 MHz. The tables outline the component values. Operation can be extended to 100 MHz by substituting an MC1670 flip-flop for A_2.

Electro/81

The biggest Electro in six years turns the spotlight on the Northeast, a region that is learning how to keep its industry from fleeing to other parts of the country

by Howard Wolff, *Assistant Managing Editor*, and the Electronics staff

☐ It may be struggling with aging plant, ballooning energy costs, and high personal and business taxes, but the northeastern area of the U. S., traditionally a spawning ground for electronic high technology, is also fighting to maintain that tradition. And, the state and industry officials involved in that fight say they are more than holding their own, despite the increasing allure of the southern tier of the nation and its favorable tax structures, lower energy costs, and seductive life style.

The feeling of the officials matches the growing strength of the Electro show and exhibition, which alternates annually between Boston and New York City. Electro/81, which encamps on April 7 for its three-day stay in New York, will be the largest of the six held in the years since it was formed by merging the old Intercon and Nerem meetings. Some 40,000 engineers and other electronics professionals are expected to sign in to attend the technical sessions and workshops at the Sheraton Centre Hotel and see the three full floors of displays at the New York Coliseum. This is the first time all three floors of that building have been used, and the sold-out show will have 827 booths reserved by 378 companies.

The attractions of Gotham on the Hudson are well known. But what is the appeal of the rest of the region that is keeping its electronics firms from following the sun, and what actually is being done to encourage them to make that decision?

A new New England

In Massachusetts, which in many ways has the most active cadre of politicians and businessmen trying to improve its admittedly unfavorable business climate, progress is being made. George S. Kariotis, the state's secretary of economic affairs, points out that electronics is the backbone of the Bay State's growth. "Of our approximately 290 industrial expansions last year, about 75% were in the electronics field," he says. The Massachusetts High-Technology Council, a powerful force for growth, is leading the way in creating new jobs. Members of the group are accounting for about 20,000 new jobs yearly, and only a half to a third of the high-technology firms in the state are members.

The banking community also reports that things are looking up. According to Lynne E. Browne, assistant vice president and economist at the Federal Reserve Bank of Boston, and John S. Hekman, assistant professor of economics at Boston College in Chestnut Hill, "a new New England is emerging with a manufacturing base growing faster than the national average." And a new study by the Federal Reserve Bank shows that New England leads the eight major national regions in foreign investment.

While the Northeast has its share of RCAs, IBMs, General Electrics, Westinghouses, GTEs, and the like, the small, innovative companies provide a great deal of the electronics lifeblood in the area. Nowhere is that more evident than in Massachusetts, especially around Boston. There, such institutions as Harvard University and the Massachusetts Institute of Technology attract the sort of electronics manufacturer that needs technologically innovative professionals.

In the eyes of Roger D. Wellington, chairman of Augat Inc. of Attleboro, Mass., the two feed off each other. Wellington, who is also vice chairman of the American Electronics Association and a director of the Massachusetts High-Technology Council, says that the combination of mature, thriving high-technology firms and excellent technical education have encouraged new companies in his state. And they have stayed because of the area's "high quality of life," he adds. As for the discouraging factors, Wellington sees taxes and energy costs coming down because of energy deregulation and the tax cuts mandated by the voters last November. But, he maintains, New England still must go to nuclear, coal, and natural gas energy sources.

Agreeing with that conclusion is Kevin Corbett, president of Memodyne Corp. in Needham Heights, Mass. Satisfied with his location—the company grew 25% in 1980 and the prospects for 1981 look "never better"—Corbett nevertheless sees the cost of oil as ominous but manageable now. However, he adds, "if we don't have alternative energy sources in 5 or 10 years, we've had it."

John J. Toohey III, marketing director for Dynamic Measurement Corp. in Winchester, Mass., likes Massachusetts life as well as its strategic location. "Our New England customers [for data-conversion devices] are seldom more than an hour or two away by car, whereas in California we'd be spread pretty thin, with customers all over the map." And his clients, says Toohey, require considerable custom work and handholding. Also, Toohey adds, the concentration of data-conversion firms in the area means there is a more convenient talent pool.

In one of the oldest electronics centers in the country, the New York City area, especially Long Island, a group of businessmen and lawmakers is gaining ground in its efforts to make the climate more salubrious for electronics companies. On Long Island, where many military electronics suppliers have flourished, the Action Committee for Long Island has been working hard to focus outside interest on the area [*Electronics*, Nov. 6, 1980, p. 102]. Thus far, the group has helped create an Innovation Center at the State University of New York at Stony Brook and the Polytechnic Institute of New York; developed legislation to foster technology; and established a clearing house for information on government grants to business. It has also worked with the Long Island Area Development Agency—a federally funded unit that is trying to set up a foreign trade zone as well as develop a hotel and convention center on the island.

Elsewhere in the New York area, two executives find New Jersey ideal for their companies. At Perkin-Elmer Corp.'s computer operations, William G. Moore Jr., vice president, says there are three reasons for it to remain close to its Oceanport base, within hailing distance of the Jersey seashore.

"The first reason is cost," he says. "If you look at the cost of attracting and maintaining people on the West Coast, it is prohibitive." The second factor is that the European market is far better served from the New York metropolitan area than from anywhere else in the country. Third, and perhaps more localized than the other, is the fact that Perkin-Elmer is the largest high-technology company in Monmouth County after Bell Laboratories. "We don't have many problems attracting professional talent, and certainly we have no problems with technical or manufacturing people. I think the Northeast will get better with respect to the Sunbelt," Moore goes on, "since some of the Sunbelt areas are already beginning to suffer from urban problems, such as urban sprawl, for example."

"In Massachusetts, of approximately 290 industrial expansions last year, some 70% were in electronics . . . a new New England is emerging."

Another New Jersey firm, Timeplex Inc., which manufactures data-communications equipment, finds the answer to nationwide growth simply to expand in the Northeast and the Sunbelt. With its headquarters in Rochelle Park, N. J., the company also maintains operations in Sunnyvale, Calif., and Largo, Fla. However, president Edward Botinick finds "the stability and productivity in general is much better in the Northeast." There are some problems, though: "It is impossible to get people to move [to New Jersey] but there is an infrastructure of technical and professional people already in place that we can draw on."

While not strictly in the Northeast, the Washington, D. C., metropolitan area is the southern anchor of the corridor or megalopolis that extends from Boston through New York, Philadelphia, and Baltimore. "It used to be just the nation's capital, where the principal industry was paper, but now it's much more than that," says one executive about the rapid expansion of the electronics community in the Federal district region, which now embraces much of northern Virginia as well as Maryland almost as far as Baltimore.

"It is the growing capital and new focus of the telecommunications industry," says an official at Satellite Business Systems Inc., the McLean, Va., operation set up at the end of 1975 and owned by International Business Machines Corp., Comsat General Corp., and Aetna Life and Casualty Co. In the beginning, SBS chose downtown Washington to locate its 20 employees because of its proximity to the Federal Communications Commission and other segments of the Federal establishment that had to approve its communications satellite plan. At its McLean headquarters it now employs 335 engineers and technicians, some 35% of its work force; SBS stayed in the area because it is a good place to recruit "a highly qualified labor force," the company says.

That estimate is borne out by membership data from the Institute of Electrical and Electronics Engineers. Between 1978 and 1980, enrollment in the Northern Virginia chapter grew 11.8% to 3,497 members, while the Baltimore-Annapolis chapter expanded by 10.6% to 2,929. The Washington chapter's 4,768 members in 1980 reflect a two-year growth rate of 4.9%. Altogether, that is an 8% increase to 11,194 members for the region. Most sources agree that most of that growth represents industry rather than Government employment.

The high-technology electronics firms in the Washington area are mostly big military and satellite systems organizations.

Systems houses face personnel shortage

Most of these and their fellow suppliers of military gear in the area believe that the location close to the decision makers in high technology has been a key to growth, as Charles Fink, president of Litton Systems' Amecom division in College Park, Md., puts it. But as demand grows, recruiters at systems houses like Amecom, IBM, and Westinghouse expect one of their bigger problems to be finding adequate professional staff to keep pace.

Control Data Corp., like other computer makers, may face the same problem even though its Washington-area operation, directed from Rockville, Md., does not man-

Could it really be finer in Carolina?

Despite the fact that North Carolina's 150 electronics and electrical equipment plants provide 50,000 jobs and $1.5 billion annually in manufacturing value-added shipments, Gov. Jim Hunt is still not satisfied. With relatively few integrated-circuit producers in the state, Hunt is determined to make North Carolina "the East Coast center for microelectronics research, development, and production."

To achieve this ambition, the state last July set up its not-for-profit Microelectronics Center of North Carolina (MCNC) at Research Triangle Park, and Hunt has undertaken a campaign to lure microelectronics manufacturers to his state, especially those faced with the dwindling expansion opportunities and soaring costs of California's crowded Silicon Valley. On a three-day recruiting mission to Santa Clara last November, Hunt stressed North Carolina's relatively low corporate and personal income tax rates and real estate, living, and labor costs, in addition to the new MCNC. The Californians were impressed, recalls Stephen L. Meehan of the governor's staff, "when we showed them slides of the kind of North Carolina home you can buy for $80,000. They said it would cost $130,000 to $150,000 out there." Nevertheless, the governor's first successful score came in the East with General Electric Co.'s disclosure last August of its plan to establish a $100 million Microelectronics Center on a 90-acre site at Research Triangle Park [*Electronics*, Feb. 24, p. 95].

Research Triangle Park got its name when it began nearly 23 years ago because its 5,500 acres in the Carolina foothills are about equidistant from the University of North Carolina at Chapel Hill, Duke University at Durham, and North Carolina State at Raleigh, the capital. With the support of those universities, its initial appeal was to chemical and pharmaceutical corporate researchers as North Carolina sought to attract new industries beyond its big three—furniture, textiles, and tobacco. Now Governor Hunt proudly declares that the output of North Carolina's rapidly expanding electronics industry "represents a quarter of the total production for all eight South Atlantic States," by far the largest share.

With the creation of the state microelectronics center pending appropriation of $24.4 million sought by Hunt from the legislature, the governor expects to continue that expansion. The MCNC, which expects to also draw funds from the Federal government and industry (GE's first payment to become an "industrial affiliate" is $250,000), will function as a research and educational facility with five universities. In addition to the three schools originally participating in Research Triangle Park, the North Carolina Agricultural and Technical State University and the UNC campus at Charlotte have been added. MCNC's directors include the chancellors of those schools, the center's chairman, George R. Herbert, plus four gubernatorial appointees.

Even before the formation of the MCNC, Research Triangle Park began pulling its electronics investments. In 1965, for example, International Business Machines Corp. set up a communications systems development and manufacturing operation in Raleigh that now employs more than 2,500. Now IBM is near completion on a $45 million computer plant investment at Charlotte. Massachusetts-based Data General Corp. has moved in more recently, with a $10 million computer plant investment at Apex and another $5 million minicomputer plant at Clayton. Hewlett-Packard Co. has put up $10 million for a chemical analysis instrument systems plant at Wake Forest, while Siemens-Allis has committed $18 million for an electronic switchgear plant at Wendell.

As Hunt put it to his Silicon Valley audience last fall, "Edson de Castro, president of Data General, which has two manufacturing plants and a research center in North Carolina, said it simply and best. He said his company selected North Carolina because 'we felt the engineers would like to work there.' " **-Ray Connolly**

ufacture anything. For CDC's corporate and marketing operation now numbers 1,983 persons, about 30% of them engineers—a far cry from the 21 persons who set up the operation in 1960.

This, then, is the situation in the Northeast as Electro/81 raises its curtain. There are problems to be sure, but there also is a feeling that they are at least being handled, if not solved, and that the pendulum is beginning to swing back. While the Sunbelt and Far West have bitten off large chunks of the region's industrial base, development officials in the Northeast like to think that the rush to the sun has slowed.

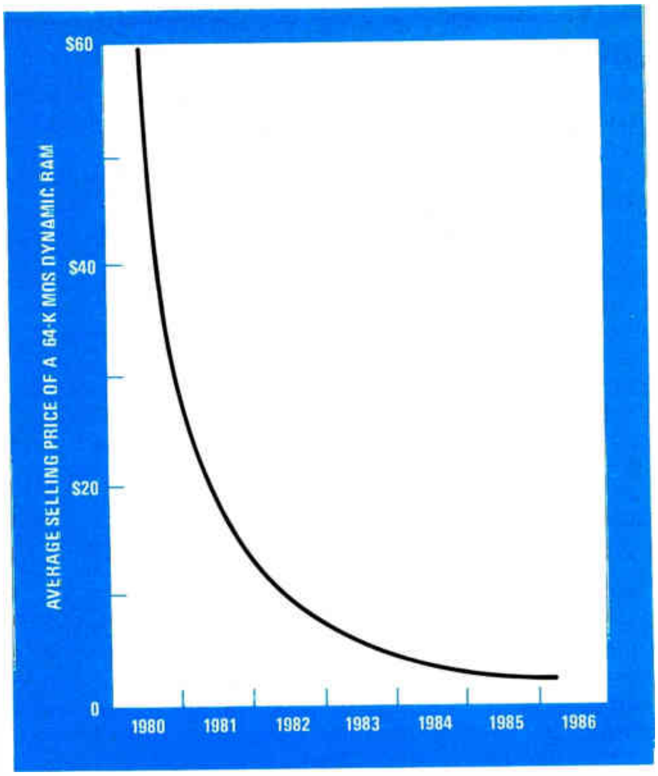
The road to productivity

As for the 38 technical sessions at the show itself, they carry out the theme of "Pathway to Productivity" in their timeliness. Their coverage ranges from radar to home information systems, from automotive electronics to microprocessor software. And a special evening session on Wednesday, April 8, will take up "The New Relationship Between American and Japanese Electronics Industries." A panel discussion involving government and business leaders from both sides of the Pacific, it is being organized by Leo Esaki of IBM Corp., a Nobel laureate for his invention of the tunnel diode, and Bruce Hanney, vice president of Bell Laboratories and foreign secretary of the National Academy of Engineering.

The greatest number of sessions, 11, will relate to the engineer involved in communications work. They cover everything from fiber optics, telephone systems, software-switched networks, and general computer-based communications facilities to the conventional areas of high-, very high-, and ultrahigh-frequency antenna arrays. In this world, the dominance of fiber optics is reflected in the three-part session 8, collectively the largest at Electro.

Session 8a addresses "Optical Fiber Communications Media and Components," with discussions of optical-fiber materials and processes, fiber-cable design and characterization, optical-fiber connectors and splices, and fiber and cable manufacturing. The speakers, all noted in the field, include Mike Blankenship from Corning Glass Co., Corning, N. Y.; Manuel R. Santana and organizer Calvin Miller of Bell Laboratories, and Don Jablonowski of Western Electric Co., both in Norcross, Ga.; and Terry Bowen of Amp Inc. in Harrisburg, Pa.

Session 8b's theme is "Upcoming Fiber Optics Systems and Applications" in the subscriber loop plant,



Market rising, prices falling. The average selling price of a 64-K dynamic random-access memory could eventually drop to $2.50, and in 1983 its cost per bit will equal that of a 16-K. The 64-K market could reach $1 billion by 1983, $2 billion by 1984.

undersea optical communications, and optical data links. Organizer G. Daryanani, of Bell Labs in Holmdel, N. J., has on tap R. J. Mills from Bell Northern Research in Ottawa to discuss system design considerations, rationale, service capabilities, and the worldwide state in his paper "Subscriber Loop Applications of Fiber Optics." P. K. Runge, also of Bell Labs in Holmdel, then speaks of "An Undersea Transatlantic Optical Communications System" proposed for service in 1988, which will carry 4,000 voice circuits at 274 megabits per second and will be expandable to 36,000 two-way circuits. L. K. Anderson, another Bell Labs worker, though in Allentown, Pa., covers "New Frontiers for Optical Data Links," and J. E. Donovan, T. G. Giallorenzi, and L. A. Bucaro of the Naval Research Center in Washington, D. C., together tell of the "Applications of Fiber Optics in Sensors."

In session 8c, the potential impact of fiber-optic technology on the design of equipment is emphasized. Led by Jeff Montgomery of Gnostic Concepts Inc. of Menlo Park, Calif., "Fiber Optics Implications for Equipment Design" includes papers that address radar equipment and missile-guidance equipment (presented by Adrian Popa of the Hughes Research Laboratory in Malibu, Calif., and Rex Powell of the Army Missile Command, Redstone Arsenal, Ala., respectively), and a history and forecast of the market by Frank Dixon from Gnostic Concepts.

Organizer Van Whitis's "Trends in Communications Software," session 7—he is software manager at BNR Inc. in Mountain View, Calif.—will benefit newcomers in the field while offering something of interest to professionals engaged in ongoing work. Opening the session are Tom Miller and Bruce Taylor of GTE Laboratories in Waltham, Mass., who present a ground-floor discussion of "System Requirement Methodology" in which they define a switching system and propose general design guidelines. Stephen Wasilew of Bell Labs in Napierville, Ill., outlines "The Evolution of Cell-Processing Software Architecture," a continuation of the overview. Whitis and BNR co-worker Winnis Chiang then discuss specific switching-system software to emphasize development methodology in a paper containing a significant amount of new material, "State-Machine Development for Cell-Processing Software." Closing out the session is W. Gary Greathouse from SESA-Honeywell Communications Inc. in Herndon, Va., who describes the advantages of the distributed packet-switched network as realized by the French in "Perspectives of State-of-the-Art Software Distribution in Packet-Switched Networks."

As for classical advances in telephone system networks and office-information systems, sessions 6c, 17, and 21 will provide an integrated overview. Session 6c chairman Ronald Yara from Intel Corp. in Santa Clara, Calif., will oversee the presentations in "Contention-Based Local Area Networks Implementation: Ethernet and Net/One." There, Bob Ryan of Intel; Bob Prentis of Xerox Corp. in Palo Alto, Calif.; Dave Potter of Digital Equipment Corp. in Tewksbury, Mass.; and John Davidson of Ungerman-Bass Inc., Santa Clara, will talk about local network architectures and LSI implementations, decentralized management of a distributed system, system performance as influenced by network design parameters, and interconnection services of Net/One.

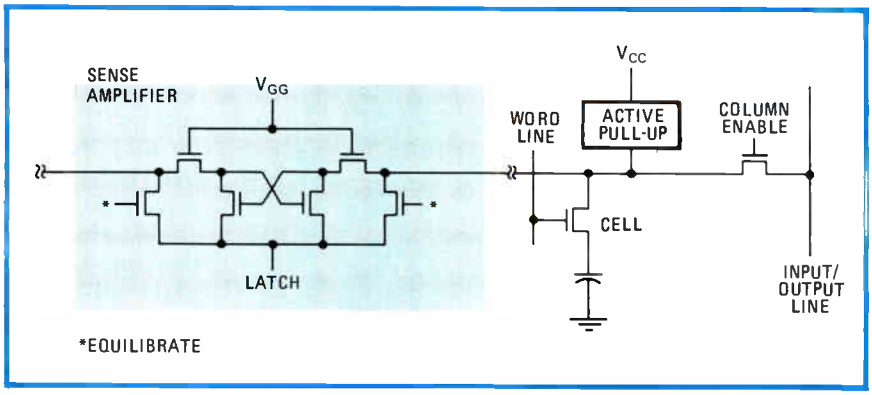
Communicating at the office

Communicating in the computer-automated office is a multifaceted challenge riddled with pitfalls because of the many different ways it can be done. Two of the basic building blocks for integrated office automation systems, local computer networks and so-called electronic mail—better names are electronic message systems or computer-based message systems—are the subject of session 33, "Computer Communications in the Automated Office." (For a special report on integrated office systems, see *Electronics*, March 10, p. 157.)

Anyone thinking about installing a local computer network or who has an idea for designing a better one could profit from the first paper in this session. Talking about the different types of local networks and the likelihood of multiple standards, John M. Davidson of Ungermann-Bass reviews how the emerging local networks may be applied in the automated office over the next three to four years.

Davidson defines three general classifications of local networks and supports his claim that one type, "the communication net," where the "boxes" do not provide computing but instead are there to interface random pieces of user equipment to the net, will best suit the needs of the automated office in the near term. Examples are Net/One from Network Systems Corp. of Minneapolis. The other two types are processing nets and standardized nets. He defines processing nets as those

In the middle. The leader in dynamic RAM design, Mostek, will describe its 64-K chip. To cut power consumption and substrate noise, it uses mid-level sensing, in which both sides of the sense amp (above) are equilibrated or precharged to half V_{DD}.



that provide a distributed environment for processing user tasks, such as Datapoint's Attached Resource Computing (ARC) network, Primenet, DECnet, and IBM's Standard Network Architecture (SNA). Standardized nets, according to Davidson, are "nets to which anybody can attach a box of their own design, because the physical and data link control mechanisms are fully disclosed: Ethernet and nets resulting from an accepted standard like the one the IEEE is working on are examples.

The second paper in session 33, by John M. McQuillan, vice president of BBN Information Management Corp. of Cambridge, Mass., is about what he calls computer-based message systems and how such systems can be phased into and integrated successfully with what is currently in use: memos on paper, telephone messages, and Telex among others.

How to solve some of the practical and organizational problems in starting to automate an office will be discussed by Thomas A. Hannagan, president of Thomas A. Hannagan and Associates Inc. of Palatine, Ill., in his paper entitled, "Getting Started in Office Automation."

Life in front of the TV set

If the U.S. is rapidly becoming a wired society, session 29, "Home Information Systems," will attempt to set out the options available under the umbrella title of videotex.

Walter Ciciora, who directs videotex activity at Zenith Radio Corp. in Glenview, Ill., thinks that satellite links offer the best route. He will provide an overview of the technical aspects of his work at Zenith in a paper entitled "Home Information Systems—Technically Speaking," explaining videotex approaches—broadcast (teletext) and telephone (viewdata)—and the tradeoffs of the different systems that have undergone trials in the U.S.

Balancing opinions will come from Norm Morrison, executive vice president at Viewdata Corp. of America in Miami, based on his work in developing the Knight-Ridder/AT&T trial of an interactive telephone line system in Florida. In his presentation, "Future Nationwide Viewdata Using the Telephone," Morrison intends to "give people a feel for what it's about and what it could mean" to do shopping and banking via the TV. His discussion should offer some insights into what people who have tried them perceive as the best way they could use viewdata systems.

How videotex might achieve commercial success in America will be discussed by Lee Greenhouse in "Direct Marketing Through Viewdata." Greenhouse, who is the director of home media programs at Link Resources Inc. in New York, conducted a consumer survey late in 1980 and will point out what he feels are the unique requirements and opportunities that await those who intend to play a role in development of the wired nation.

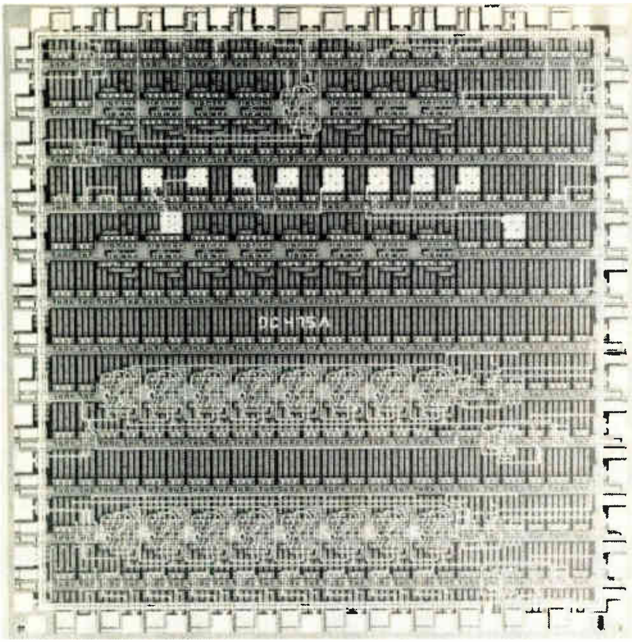
With synthetic speech playing an ever growing role in electronics, session 24 will look at the "Components for Speech Processing: Present and Future." A leader in the field of speech processing, Jonathan Allen of the Massachusetts Institute of Technology will begin with his paper, a "Tutorial Introduction to Speech-Processing Technology," in which he identifies certain similarities and fundamental differences in the areas of speech synthesis and speech recognition.

The secrets surrounding video disk technology are finally coming into the public domain, and Electro has devoted session 25 to the common elements of all video disk systems designs. "The session is a video disk technology overview," says its chairman and organizer, Jon K. Clemens, group head at RCA Corp.'s Research Laboratories in Princeton, N.J.

Clemens will begin the program with "Introduction and Systems Constraints on Video Disk Technology," a paper that highlights the similarities and differences of the competing technologies, and points out the constraints affecting all video disk technology. The second paper, "Mastering Technology for the Philips Optical Disk Systems," will be given by Hans F. Olijhoek of NV Philips Gloeilampenfabrieken's advanced recording department in Eindhoven, the Netherlands. This paper examines such issues as how the disks are made, how they are mass-produced, and how master recordings for them are made.

In the third paper, Tsuneyoshi Hidaka, senior project manager for Victor Co. of Japan Ltd.'s Yamoto Research and Development Center, will explore video disk pressing and processing for Victor's grooveless capacitive pick-up system. In the final paper, Willard M. Workman, director for RCA's player engineering in Indianapolis, will look at the design and manufacture of RCA's player. "The details of video disk technology will take many such sessions to discuss," notes Clements. Companies have been standardizing it, and it is being optimized now. "That's why such a session can now be held," he adds.

The so-called Mead-Conway approach to design of



C-MOS is coming on. For gate arrays, the density of C-MOS is becoming more attractive. Shown is Exar's new master chip for semicustom programs. The arrays from the Sunnyvale, Calif., company are compatible with those of Interdesign and Master Logic.

very large-scale integrated circuits, in which a design is a program rather than a data structure, is the major concern of session 12, "Recent Developments in VLSI CAD." Its organizer and chairman, Ted Kehl, professor of computer science at the University of Washington in Seattle, says it was requested by a number of high-level officials in the IC industry.

The new methodology was developed by Carver Mead of the California Institute of Technology and Lynn Conway of Xerox Corp.'s Palo Alto (Calif.) Research Center. The session will describe some of the more recent developments in the area and also some of the university-industry cooperative research taking place. The method may revolutionize the IC design process, Kehl points out, adding that there are presently about 1,500 IC designers in the U. S. with a need for 10 times that number. He notes that Hewlett-Packard Co. has already applied the new design experimentally with excellent results.

One of the most important and practical papers in the session is by Kehl himself. It describes how he has developed portable VLSI computer-assisted design software for the new type of design. As developed originally, the technique uses a high level language called Simula. Unfortunately very few commercially available computers use that software, so Kehl rewrote the programs in Fortran. This now makes the new CAD approach suitable to practically all of today's minicomputer and full computers. In addition, Kehl has structured his software differently by building a library amenable to gate-array evolved systems.

As there seems to be an infinite number of display technologies, the chairman and organizer of sessions 14 and 18, Ifay F. Chang, has chosen what he believes are the most promising and important. "The partition into two sessions is quite arbitrary," notes Chang, a researcher at IBM Corp.'s Thomas J. Watson Research Center in Yorktown Heights, N. Y. The first paper in session 14 is entitled "Electroluminescent Displays" and will be given by M. I. Abdalla, a member of the technical staff for GTE Laboratories in Waltham, Mass. In it, he will explore dc, ac, and thin-film electroluminescent displays, all of which have low-power requirements and may therefore be used in a variety of applications. The second paper will be given by Chang and will focus on electrochromic and electrochemochromic displays. Chang will describe display characteristics of these units in detail and will look at ECC devices currently under development. In "Liquid Crystal Displays," Allan R. Kmetz, supervisor for liquid-crystal-display development at Bell Labs in Murray Hill, N. J., will give an overview of current technology and what is being done to increase the size of LCDs. In the final paper of the first session, Keigi Ayoagi of Noritake Electronics Inc. of Torrance, Calif., will be looking at vacuum fluorescent displays, and their broad applications.

Session 18 begins with a paper on CRT displays given by Andre E. Martin, of Thomson-CSF's Electron Tube division in Paris. In it, he will talk about the mainstream development in CRT technology in phosphor cathodes and electro-optics. In "Plasma Displays," Thomas C. Maloney, manager of development engineering for Burroughs OEM Corp. of Plainfield, N. J., looks at several of the new dc plasma panels Burroughs has developed, including ones using thin-film technology to create a 480-character display. RCA Corp. is taking an electron-beam–guided approach for its largest CRT, and Thomas L. Credell, head of advanced display systems research at RCA Research Labs in Princeton, N. J., will discuss this technology in "Large-Screen, Flat-Panel Television: a New Approach."

"The application area for displays is so broad—from watches to football stadium scoreboards—that users will always find some technology to do whatever they have to. But if you look at the bulk business in television and information display, it's CRT-dominated, and CRTs will continue to take their own share," Chang sums up.

Computer graphics

Various uses of computer graphics will be covered in session 22. Organized and chaired by Charles W. Rosenthal of Bell Labs in Holmdel, N. J., the session is designed to discuss graphics and computer-aided design and manufacturing (CAD/CAM), the training of telecommunications operators and technicians, and the display of engineering and scientific data.

Timothy I. Ristine, product manager at Computervision Corp. in Bedford, Mass., will explain what CAD/CAM is, how it increases productivity, and how it has been applied in electronics. Edward A. Rousseau, John M. Thorson, Jr., and Leon B. Mitchell of Control Data Corp. in Minneapolis will describe a computer-based education system for training telecommunications operators and technicians.

Fritz E. Froehlich and S. Y. Chai of Bell Labs in Holmdel will discuss the telecommunications aspects of computer graphics, and, in an example showing many different ways that data from an experiment can be manipulated and displayed, James E. George of Mesa Graphics in Los Alamos, N. M., and Anders Vinberg of Integrated Software Systems Corp. of San Diego, Calif., will explain how different views of the same block of data can aid engineers and scientists.

Peripheral chips

The new peripheral chips to be discussed in session 15 will include two additions to the growing family of 68000 support circuits. Motorola Inc.'s (MCC68451) memory management unit (MMU) will be described in some detail, revealing the Austin, Texas, company's approach to handling large memory spaces. Its scheme uses a set of 32 segment descriptors, each of which contains the segment number, its corresponding physical address and size, and several protection bits indicating in what way the segment is protected. The segments can vary in length from 256 bytes to 16 megabytes, thanks to a special logical address mask register for each segment. Up to eight MMUs can be used simultaneously, so that a total of 256 segment descriptors may be on line, and with a 16-bit logical base address for each segment, a total of 64,000 segments may be supported. The MMU also has some unusual features, like a special address space number that allows a number of segments to be activated simultaneously for fast context switches that involve multiple segments. The protection bits in the 64-pin part also indicate which segment has been least recently used.

Motorola will also be discussing its special-purpose microcomputer, the intelligent peripheral controller (68120), which has provisions for serial input/output, custom protocols burned into the on-chip read-only memory, an integral timer, and a special dual-ported random-access memory with associated semaphore registers for fast interprocessor communication.

Another newcomer this season is a 4-bit microcomputer with an on-chip analog-to-digital converter from American Microsystems Inc. of Santa Clara, Calif. The S4200 is the company's latest addition to its stable of 4-bit processors and features 2-K bytes of ROM, 128 nibbles of RAM, an internal stack, and a dual-purpose counter/timer that can assist in serial communication or can wake the processor up from a time-out period. The most complex portion of the chip, however, is the power-failure–detection circuitry that can generate a nonmaskable interrupt whenever the power line drops dangerously low. In this way vital information can be loaded into RAM and the chip put in the idle state with a battery or a capacitor supplying standby current.

Another increasingly popular approach to peripheral control is being offered by Mostek Corp. of Carrollton, Texas, with its SCU-20, a preprogrammed MK3873 single-chip microcomputer. It serves as a serial communications controller in local network schemes, allowing the information distribution tasks to be offloaded from the system instruction processors.

Single-chip cathode-ray-tube controllers seem to be the wave of the future, and two such devices will be discussed. One, from AMI (68045), is very similar to Motorola's 6845 but has replaced that part's RAM with mask-programmable ROM. Die area is saved (and thus cost lowered) at the expense of programmability. However, the programmable functions that are controlled by the on-chip memory (such as the number of characters per line) are never changed anyway in many applications and two sets of parameters may be stored in part in case some flexibility is needed.

Standard Microsystems Corp. of Hauppauge, N. Y., will also discuss a CRT controller called the 9007. This part is highly programmable and has such unusual features as split-screen operation, variable speed scrolling, and double-height/double-width displays.

For those who would like to fight the high cost of development systems, session 23 offers several answers. Mostek will describe its CP/M-compatible Matrix-80 software development tool that includes a Z80 standard bus computer with an 8-inch floppy disk. AMI also has a CP/M-compatible system, the Phoenix, which supports more than 20 microprocessors and uses 5.25-in. floppy disks. Motorola will show its low-cost 6809-based development system, the EXORset, that supports an integral 9-in. CRT, dual minifloppy disks, and a Basic/M interpreter that can also function in a compiler mode. And Zilog will discuss its Z-Lab 80 development system that can distribute its cost across a network in which several user stations share expensive peripherals like line printers.

At Electro/81 an entire session—6b—is devoted to the 64-K dynamic RAM. And it's about time, since one of the speakers, Daniel L. Klesken of Dataquest Inc., a well-known market research firm in Cupertino, Calif., submits that the market for this part alone will exceed $1 billion by 1983 and $2 billion by 1984.

Klesken also has much to say about deteriorating dynamic RAM prices—the bane of the manufacturers. As the figure shows, he believes that the average selling price of a 64-K RAM could eventually tumble to about $2.50 (see curve on p. 144). More specifically, Klesken figures that by the second or third quarter of 1983, the cost of a 64-K RAM bit will equal that of a 16-K. At that

The IEEE: a global outlook

A pleasant spring walk across town from the Coliseum and Sheraton Centre will easily bring this year's Electro visitors to the Institute of Electrical and Electronics Engineers. Located in the shadow of the United Nations at 345 East 47th Street in the United Engineering Center, the IEEE headquarters serves the technical and professional needs of over 200,000 members worldwide.

More than 17% of the IEEE's membership is now located overseas—up to 37,470 members from last year's 34,788 members. Total U. S. membership is now 176,342, up 9.5% from last year's 166,885. Total worldwide membership is 213,812—6% above last year's. The largest subgroup in the IEEE is the Computer Society, numbering 52,427 members; the smallest is the Geoscience and Remote Sensing Society, numbering 1,500.

There is in fact some sentiment in favor of changing the name of the IEEE to reflect this large segment of computer members. The issue will be decided later this year.

Richard W. Damon, the IEEE president for 1981, sees the institute playing a large role in deciding issues on an international scale in the coming years. "I think high technology is going to spread around the world. The IEEE is a transnational organization and it has the opportunity and the obligation to transfer technology to all parts of the globe," he says. "Manufacturing and selling equipment won't be dominated by the U. S. in the future—it will be a worldwide effort."

The second area in which Damon sees engineers playing a significant part is in advising the Government on technical matters. "Engineers have a vital role in interfacing with national policy makers. They should be advising and informing these lawmakers what technology is all about. More engineers should find careers in policy making," he says.

Areas he cites as prime targets for such interest are in education and manpower questions, integrating technology with the environment or explaining it to society as in the case of nuclear power, and an overall interest in helping industry to remain healthy in the U. S. through automation and productivity gains. **-Pamela Hamilton**

time the 16-K RAM's average selling price will be about $2, and the 64-K will go for six times that, owing to reduced system costs resulting from the smaller power and area requirements of the 64-K RAM.

With RAM prices diminishing so rapidly, it will take a lot of chips to make up the huge market that Klesken foresees. Indeed, he feels that 5 trillion dynamic RAM bits will be shipped this year and, by 1986, a whopping 20 trillion bits will be consumed. In anticipation, the industry has added capacity that will exceed demand until 1983 or 1984, when annual unit volumes will amount to 100 million units. By 1984 or 1985, suppliers able to weather the pricing battle will begin to see some decent profit margins.

Other papers in session 6b provide valuable technical overview of 64-K RAM design considerations [*Electronics*, May 22, 1980, p. 119], but only one company, Mostek Corp., talks about its own part. And the audience will listen, because Mostek has been the leader in dynamic RAM design at both the 4- and 16-K densities. For its 64-K chip, Mostek opted for mid-level sensing to lower power consumption and reduce substrate noise, among other advantages. Its sense amplifier is shown on p. 145. Both sides of the sense amp are precharged or equilibrated to half the V_{DD} supply voltage, hence the name midlevel or mid-reference sensing.

At the end of an active cycle, active pull-ups replenish a stored 1 level but a stored 0 is held to ground. Then the sense amp is basically shut down while the equilibrate transistors short the two bit lines. The high side drops to $V_{DD}/2$ and the low side rises to the same voltage. As excursions from ground to V_{DD}—or vice versa—never occur, substrate bumping, as it is called, is minimized.

Session 16 is devoted to gate arrays, another product that will become ubiquitous in the 1980s [*Electronics*, Sept. 25, 1980, p. 145]. Fujitsu America Ltd. of Santa Clara, Signetics Corp. of Sunnyvale, and Exar Integrated Systems Inc. of Sunnyvale, Calif., discuss their specific arrays, and Robert Hartman, president of IC Cost Consultants of San Jose, Calif., will present an overview of array offerings.

Some C-MOS gate arrays

For the highest performance, emitter-coupled-logic arrays are the logical choice, whereas for density, complementary-MOS is gaining momentum. Fujitsu, for example, will describe a C-MOS unit measuring 9.72 millimeters on a side—almost 150,000 square mils—that contains 3,900 basic cells, each with two n- and two p-channel devices. Such a component can replace a mass of discrete packages. Exar's new series of C-MOS arrays are compatible with similar chips from Interdesign Inc. of Sunnyvale, Calif., and Master Logic Inc., also of Sunnyvale (see photo on p. 146).

VLSI technology is the subject of session 20, with an excellent cross section of papers. An overview of VLSI trends will be given by Texas Instruments Inc. of Dallas and the Massachusetts Institute of Technology will discuss VLSI design. MIT has been using sophisticated computer-aided design and layout systems, like those in use by the California Institute of Technology in Pasadena, Calif., to create some extremely interesting custom chips. Also in session 20, three experts will cover X-ray lithography, MOS technology, and bipolar technology. □

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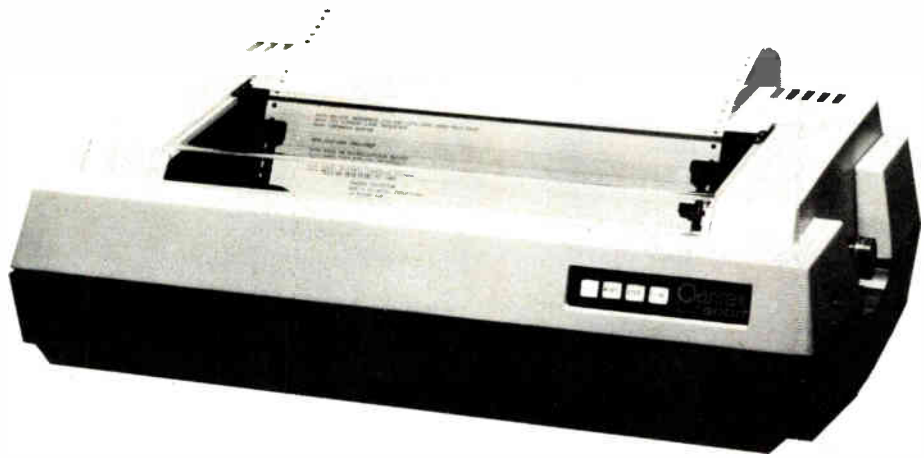

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C-MOS a-d converter interfaces easily with many microprocessors

With a span accommodation down to 180 mV, this 8-bit unit can also replace a 12-bit analog-to-digital device in some applications

by Thomas M. Frederiksen, *National Semiconductor Corp., Santa Clara, Calif.*

☐ To help meet the rising demand for easier interfacing between analog-to-digital converters and microprocessors, the complementary-MOS, 8-bit ADC-0801-04 has been designed to accommodate almost all of today's popular microprocessors. It requires only a single 5-volt supply and is low-power to boot.

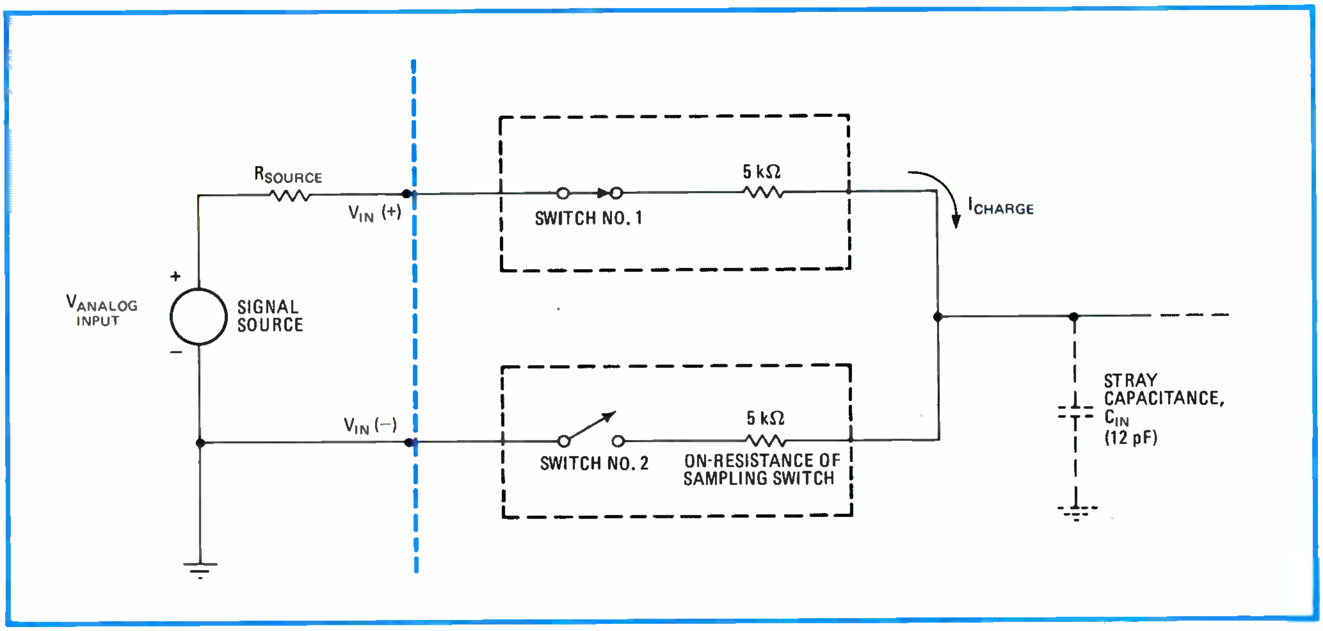
Housed in a 20-pin dual in-line package, the successive-approximation device includes a Schmitt trigger circuit that allows it to be driven from a system clock as well as an external RC network. At a clock frequency of 640 kilohertz, conversion time is 100 microseconds. What's more, its guaranteed linearity error of ±¼ least significant bit (typically ±1⁄16 LSB) can encode an analog-signal span as small as 180 millivolts—a performance that allows it to replace 9-, 10-, and even 12-bit converters in many applications.

Constantly decreasing converter prices raise the comparative cost of the interface electronics and increase the demand for simplicity of interfacing. The growing emphasis on simpler systems for higher levels of reliability has also pushed this demand, as has a trend toward lower levels of power dissipation. And with the success of the 5-volt power-supply standard of logic circuits, linear circuits have been pressed for 5-V operation. Supporting the ADC-0801-04 a-d converter are such special operational amplifiers as the LM358 dual and the LM324 and LM3900 quad op amps that run off 5-V supplies; also useful are voltage comparators such as the LM393 dual and LM339 quad devices. Perhaps the most versatile of such 5-V linear devices is the LM392, comprising an op amp and a comparator.

More complications

Complicating the interfacing are the ever higher levels of resolution in monolithic converters, with 8- and 10-bit types readily available and 12-bit devices ready to emerge soon. Yet, despite their greater resolution, 10- and 12-bit monolithic a-d converters are not only more expensive than 8-bit designs, but also require more careful attention to system noise problems and management of grounding.

For simple interfacing, an a-d converter must operate directly with the signals available on a microprocessor's control bus. The converter is generally given an address



1. Equivalent. Because it has a sampled-data-comparator input, the 8-bit ADC-0801-04 monolithic analog-to-digital converter looks capacitive to an input signal source. The sampling switches operate at one eighth the rate of the clock frequency.

that can be mapped into memory or input/output space, depending on the type of microprocessor employed. On 6800 microprocessors and their derivatives, no special input/output addressing or strobes are available, so the converter must appear as a memory location to these processors. Z80 microprocessors, on the other hand, not only provide special I/O interfacing but also automatically insert a wait state during I/O selection, to increase the width of the read and write strobe signals. This eases interface requirements considerably, since slower I/O devices can operate with much faster microprocessor units. The automatic wait state for I/O devices will loom larger in importance as the next generation of higher-speed microprocessors evolves.

Compatibility criteria differ

Microprocessor compatibility has a wide range of meanings—at least according to the various converter data sheets. True compatibility, however, involves meeting electrical specifications like proper logic voltage levels with adequate loading capability. For example, true TTL compatibility means the ability to maintain a 0.4-V low potential (or less) at the a-d converter logic outputs while sinking 1.6 milliamperes of current. And the high state must be maintained at a minimum of 2.4 V while supplying at least 360 microamperes.

Furthermore, all interface protocols must be met. This not only means operating with the proper signals but also meeting all necessary timing requirements, so the converter must have valid data on the microprocessor bus within the access time of the memory system with which it happens to be working.

The protocols for interfacing are not at all standardized. Some a-d converters make use of the standard chip-select signal ($\overline{CS}$) to start a conversion. But decoding-voltage glitches can cause an a-d converter to begin conversion when it is not desirable. Both the standard $\overline{CS}$ signal and a write strobe signal ($\overline{WR}$) must therefore be used, so that the former signal qualifies the latter and prevents unwanted conversions due to address-decoding glitches. Care must also be taken when using some a-d converters that are designed to act as bus controllers; problems can arise when the central processor is not in control of the bus.

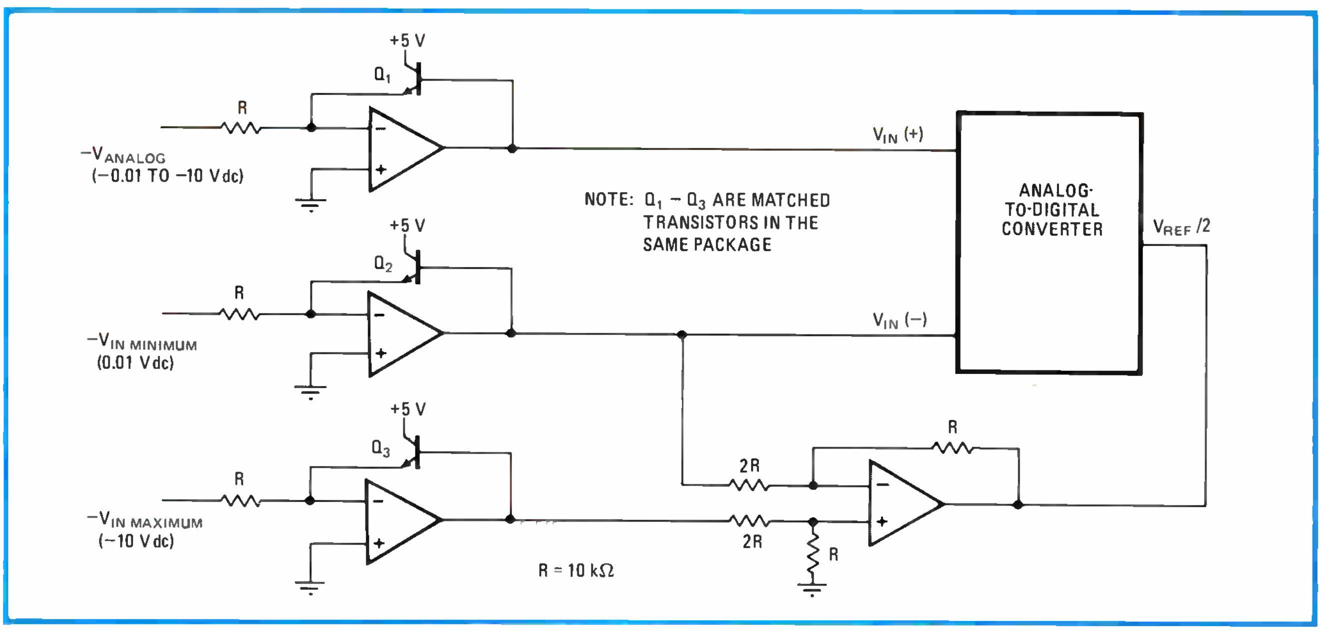
Different standards

The 8080 and 6800 microprocessors (and their derivatives) use different control bus standards. Microprocessors based on the 8080, for example, make use of read and write strobe signals to specify the operation (read or write) requested. Working with these microprocessors, a-d converters start the conversion cycle upon the microprocessor's issuance of a chip-select signal (decoded from the address bus) and a write strobe signal. At the end of conversion (EOC), the converter issues an EOC signal. When dealing with older a-d converters where the EOC signal is typically low during the conversion process and high at the end of it, microprocessors have difficulty because the EOC signal is not available on the data bus. Furthermore, the EOC signal does not reset when the converter is serviced by the central processing unit (that is, when data has been read).

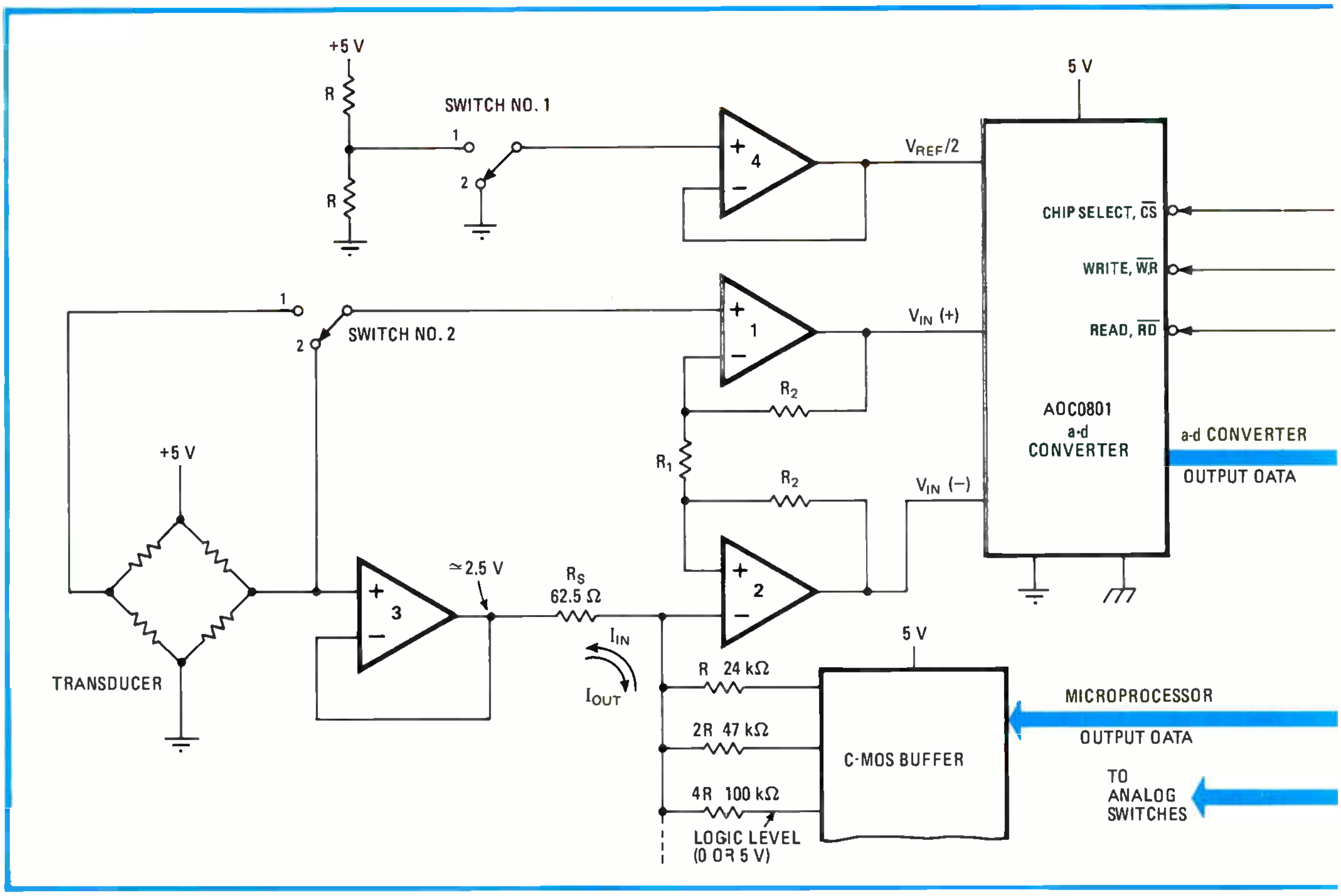
Complications can also occur when microprocessors interface with older a-d devices during read operations. For proper interfacing, such converters must have valid data on the bus within the memory access time.

Interfacing requirements differ for 6800-type microprocessors, like the 6502 and 68000, which use read/write (R/$\overline{W}$) control lines instead of read and write strobe signals and obtain timing information from the system clock signal. In addition, they include a valid memory address signal to qualify the address that is placed on the bus. Such features make interfacing for these microprocessors different from that for earlier 8080 types.

For an a-d converter to be most useful in a micropro-



2. Logarithmic. The ADC-0801-04 monolithic a-d converter's $V_{ref}/2$ pin allows its use as a three-decade logarithmic circuit. The three npn transistors in the feedback loops of the operational amplifiers give better accuracy with changing temperature than the diodes normally used.



cessor-based system, it must have such desirable analog features as differential inputs, and it should adjust to accommodate various analog input-signal ranges. The ADC-0801-04 offers differential analog inputs, but it is the converter's span accommodation that allows many unusual and useful analog applications.

The availability of differential analog-voltage inputs eliminates the problem of poor analog grounds, since both inputs can be connected directly across the analog signal source.

The negative (normally grounded) analog input lead can be referenced to any desired dc offset voltage to accommodate an input signal range that does not swing down to ground. A dc offset can thus be used at this input to cause a digital output of all 0s at any desired input voltage.

Flexible span

Finally, the ability to accommodate an arbitrary span or input dynamic voltage range is desirable in an a-d converter. This can easily be achieved in the ADC-080-04 by selecting the magnitude of the converter's reference input.

An example might be to permit an analog input voltage range of 0.5 to 3.5 V. This is accomplished by tying the converter's negative-input lead to a 0.5-V dc offset voltage and supplying a reference voltage that is equal to half the 3-V span. This application provides the 00_{16} output code for V_{in} = 0.5 V dc and the FF_{16} output code for V_{in} = 3.5 V dc.

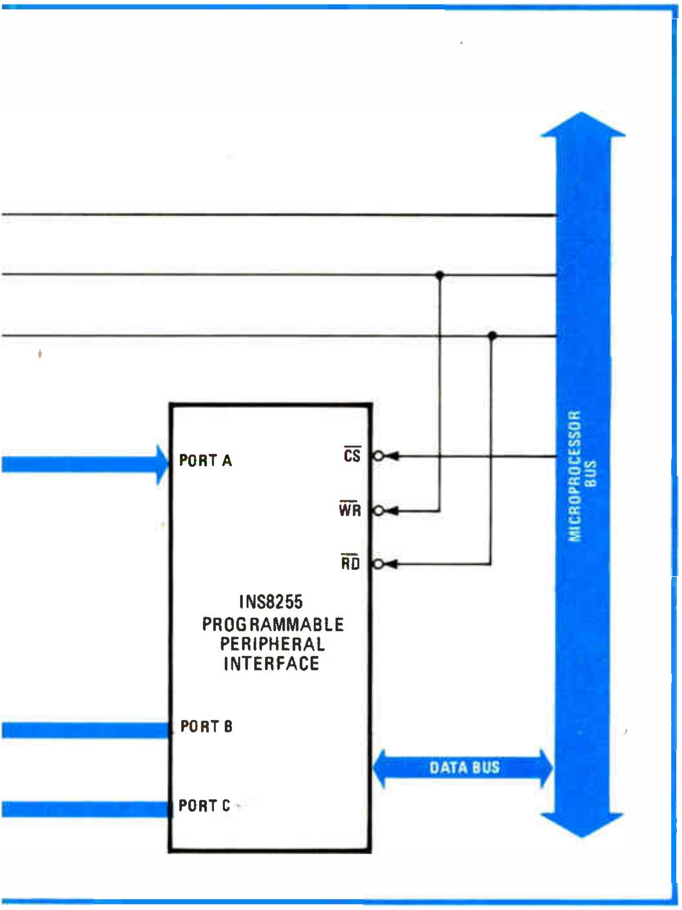
In many applications (such as weighing cans on a production line), 14- or even 16-bit converters are often called upon for the needed high levels of resolution. For those reduced-span applications, an 8-bit a-d converter can be used instead—at considerable savings.

A sampled-data input

The ADC-0801-04 makes use of a sampled-data comparator. Sampled-data circuits cancel the offset voltage, provide essentially temperature-independent performance, and cancel low-frequency MOS 1/f noise. They do, however, provide some differences in application, since there is an input stray capacitance to ground, as shown in Fig. 1.

When switch S_1 is closed, stray input capacitance C_{in} is charged to the input analog potential V_{analog}. Note that with a stray capacitance of approximately 12 picofarads and a 5-kilohm MOS switch resistance, the time constant τ is only 60 nanoseconds. Thus C_{in} becomes charged to the necessary accuracy level (within $\pm 1/4$ LSB) in 6.9τ, or about 0.4 microsecond. Since the input switches are operating at one eighth the input clock frequency of 640 kHz, there is ample time for C_{in} to settle, as comparisons are made only at the end of the clock period. Note that the switch at the (−) analog input discharges the stray capacitance; this event causes input displacement currents to flow.

Input bypass capacitors, when placed directly at the analog inputs, cause full-scale errors since they average the current, which will flow through the source resist-



3. Automatic. Adjusting the offset voltage of a differential-amplifier pair in a transducer bridge network can be done automatically. A microprocessor provides this adjustment through a programmable peripheral interface and a buffer integrated circuit.

ance of the analog input signal generator. Input capacitors are not required; but if they are used, a full-scale adjustment will eliminate any system errors.

The ADC-0801-04 monolithic 8-bit C-MOS a-d converter can be operated with a wide range of $V_{ref}/2$[9] voltages that facilitates its use in many different circuit applications. Inexpensive ratiometric transducers, such as potentiometers, can be tied across the converter's 5-v supply voltage with the wiper fed directly to the converter's $V_{in}+$ input pin. The $V_{ref}/2$ pin, which will now bias at 2.5 v, can be tied to a second potentiometer that is also hooked across the supply voltage to provide a full-scale adjustment.

When the $V_{ref}/2$ is grounded, the converter then functions as a comparator, yielding a digital output of all 1s when $V_{in}+$ is greater than $V_{in}-$ and of all 0s when $V_{in}+$ is less than $V_{in}-$. The $V_{ref}/2$ feature is also useful for low-level analog-voltage systems, where an operational amplifier is normally used to boost the input signal prior to digitization. In a circuit with an analog input voltage of 250 mV maximum, for example, the signal can be fed directly to the a-d device, saving the cost of the amplifier. The $V_{ref}/2$ pin would thus be biased at 125 mV.

Careful grounding

A minor drawback is that this extra analog resolution leaves the circuit more susceptible to noise, and the $V_{ref}/2$ voltage requires a low initial tolerance and must be stable over temperature changes. Grounding problems become more critical and careful grounding is a must.

The ADC-0801-04 can also be used as a logarithmic converter to extend the input voltage dynamic range to cover three decades. Three input-logging circuits (Fig. 2) are provided by the npn transistors in the feedback loops of operational amplifiers. With these at the same temperature (all three on a common chip), there are no thermal problems with this circuit. To keep costs at their lowest, the three transistors in the LM389 audio amplifier IC can be used.

The fourth operational amplifier in Fig. 2 is used to supply the proper $V_{ref}/2$ voltage to the a-d converter. Its dc output voltage is half that of the logarithmically compressed analog input voltage span.

Offset adjusting

Yet another application for the ADC-0801-4 is in automatically adjusting the offset voltage of an op amp, under microprocessor control. This is useful in transducer bridge networks, where a pair of amplifiers is normally used to amplify the differential signal. Such an output signal can be fed directly to the a-d converter's inputs, without requiring a more costly instrumentation amplifier. The bridge network's arms will thus be biased at approximately $V_{cc}/2$.

Figure 3 shows such a circuit, where the microprocessor takes the digital output of the a-d device and automatically adjusts the output voltage of operational amplifier 3. This amplifier is used to isolate the bridge network from the offset-adjustment circuit. The INS8255 programmable peripheral interface controls the offset-voltage adjustment and analog switches 1 and 2. The C-MOS buffer provides ideal analog level swings of either 0 or 5 V to the binary resistor network. The binary resistor network extracts and injects a current from and into op amp 3, causing a small voltage drop across R_S. This corrects for offset voltage that is introduced anywhere in the system.

Auto adjustment

Electrically actuated switches 1 and 2 allow the automatic adjustment of the offset voltage. It should be noted that op amp 1 is referenced to one side of the bridge network in order to cancel any common-mode offset-voltage effects.

The a-d converter acts as a high-gain comparator because a 0-V $V_{ref}/2$ is provided by the voltage-follower (amplifier 4) and switch 1 circuits. This allows the microprocessor to perform a successive-approximation routine to null the offset voltage of the system. Resolution is thus considerably better than the normal $+1$ LSB obtainable with a conventional a-d converter.

The ADC-0801-04 combines linear and digital features in an a-d converter that is flexible and easy to tie to microprocessor-phased systems. The benefits of a sampled-data comparator and an unusual ladder now make an a-d converter actually easier to fabricate than a digital-to-analog converter. □

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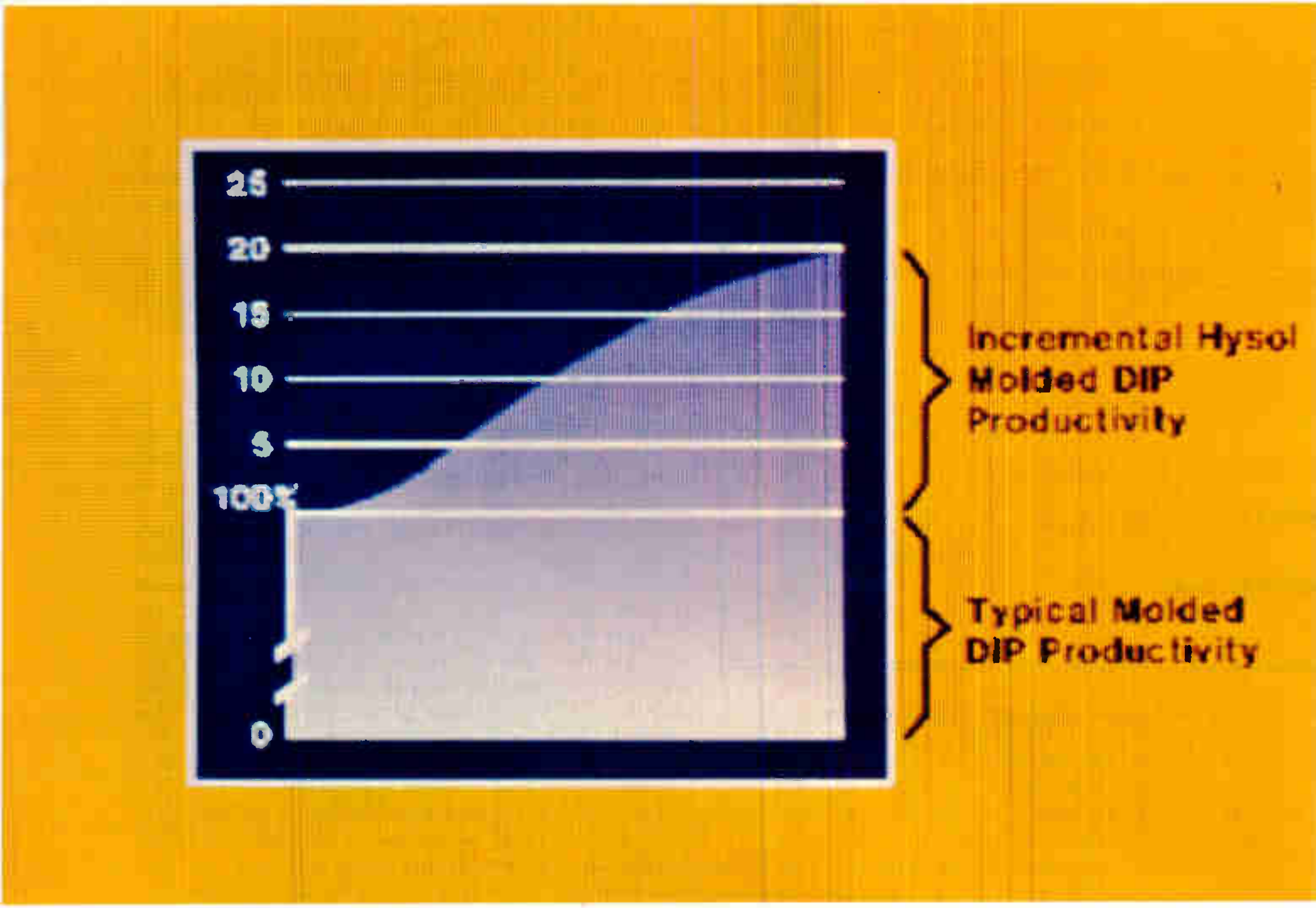

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Compact controller can run any Winchester disk drive

Small universal module with minimum external circuitry handles error correction, data buffering, and address verification at low cost

by Don Sumner, *Microcomputer Systems Corp., Sunnyvale, Calif.*

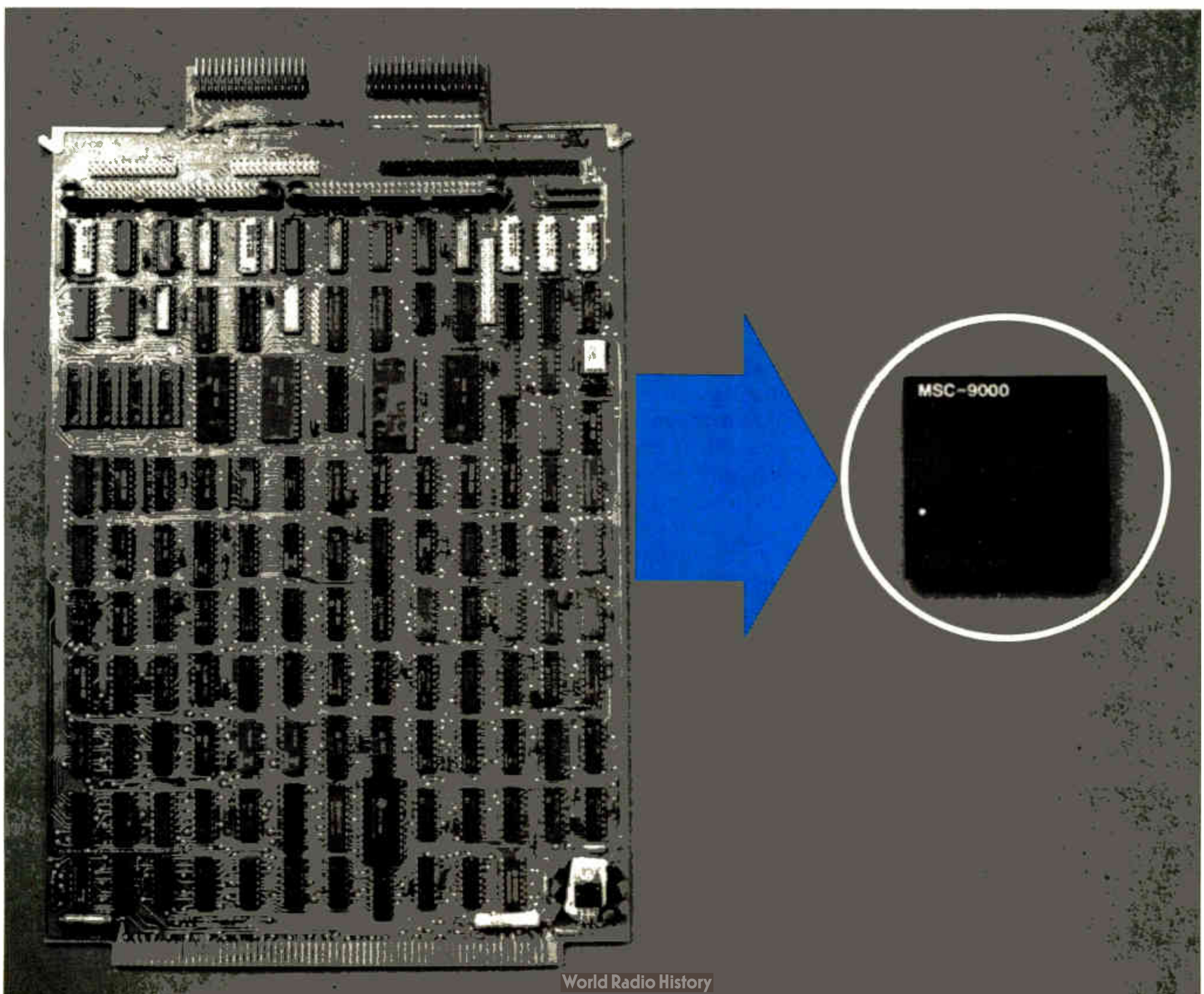
□ Small rigid-disk drives are beginning to give floppy disks a run for their money. Aimed at the small-computer market, which is increasing by more than 30% annually, they incorporate sophisticated Winchester technology at a comparatively low cost per function.

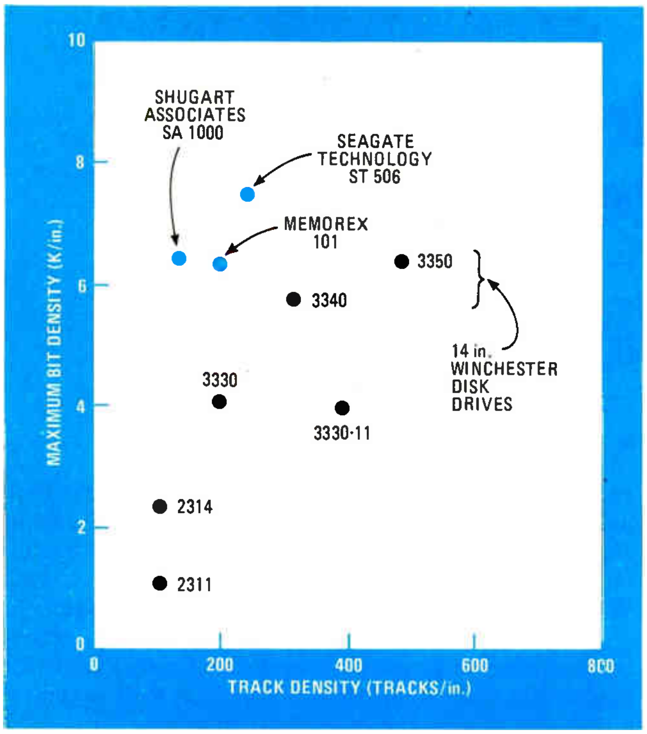
But the interfacing of the disks has presented a unique challenge to system designers, since the cost of compressing the available interfaces and controllers of large Winchester disk systems into limited volumes on a small-system budget is obviously prohibitive. The MSC-9000 controller module offers a solution to the problem. Truly universal and requiring only a little external custom circuitry on a small printed-circuit board, the module (Fig. 1) has all the features for controlling any small Winchester drive at a low cost of about $300 to $400.

It is the need for increased capacity that has pushed the development of low-cost, rigid-disk drives. Moreover, these disks, which measure from 5.25 to 8 inches in diameter, are more reliable than floppy disks.

The new drives borrow their technology from the

1. Disk control. The 3-by-3-inch potted module shown to the right contains over 75% of the functions needed to control most Winchester disk drives. The controller module replaces all of the small- and medium-scale ICs on the large printed-circuit board shown to the left.





2. Bit cramming. The new-generation 5.25- and 8-in. Winchester disk drives (shown by the colored dots) have a bit density equal to or exceeding that of earlier rigid-disk drives, and this density means that timing becomes extremely critical in their control.

earlier and more sophisticated 14-in. Winchester drives, which have sealed disk, head, and positioning assemblies; lubricated disk surfaces; and heads that rest on a disk surface when the drive is stopped. Like their predecessors, they have read/write heads that fly close to the disk surface, a thin magnetic oxide surface coating, and light head-loading force and weight.

The sealed—and hence clean—environment, the new head and loading designs, and the lubrication have improved reliability and reduced head crashes in the new drives. The disks have from 5 to 60 times the storage capacity of floppy disks in the same space and access data four times faster. They also weigh less, take up less space, and use less power than the earlier 14-in. drives of the same type and thus bring high-technology storage within the economic reach of the small-system designer.

The floppy-disk replacement market consists of small business and office systems, personal computers, process control systems, word processors, and intelligent terminals. The entire disk drive structure is designed for this market, from its physical size and mounting configuration to its interface protocol. Currently, the most popular Winchester drives have electrical interfaces that are very similar to those of a floppy-disk drive, with the controller supplying step pulses and a direction signal for the seek function and a head select and read/write enable for the data-transfer function.

It now remains to be seen if the popular drive manufacturers will switch to the soon-to-be-finalized interface standard of the American National Standards Institute, which will use a single 50-conductor flat cable, or if the ANSI standard is doomed to become a standard in name only. But regardless of interface electrical standards, the selection of controller functions depends primarily on the drive technology. The interface protocol is where the similarity ends between the floppy-disk and new generations of rigid-disk drives.

Keeping it small

Because of the control complexity required, it is not possible to design a Winchester-drive controller around a single large-scale integrated chip, as in some floppy-disk applications. But 75% of the controller circuitry required universally can be packaged in a 3-by-3-by-0.65-in. module such as the MSC-9000. LSI circuits permit its disk input/output processor to reach this small size, and a single-card controller can be designed by adding customizing circuitry.

Because of the compact simplicity of these drives, a system designer might assume that floppy-disk controller features would suffice. However, astute designers are now realizing that the controller functions of the small-system models must be no less sophisticated than those of the higher-capacity Winchester disk systems. Though drive manufacturers have significantly reduced cost by simplifying the head-movement mechanisms and reducing the number and size of parts, packing densities have approached or even exceeded densities (bits per square inch) of much larger disks (Fig. 2), so that the new drives are actually more complicated.

Slowing down the data

The new Winchester disk's high density gives it a data rate of about 600 kilobytes per second typically. Since these drives will most likely be attached to small computers with low-bandwidth I/O systems, the controllers must have data buffering to present the data at a rate acceptable to most host computers. A data buffer solves the problem of I/O bandwidth compatibility, but it immediately creates another.

Nothing can stop a rotating memory from transferring data at its desired rate—and while the controller is exchanging data between its buffer and the host memory at the acceptable rate, the disk keeps spinning. Additional blocks of data pass under the heads, unable to be accepted. Waiting for the next disk revolution would result in a significant and undesirable performance loss.

This highlights another requirement, sometimes called sector interleaving, which allows transfer of multiple sectors within one disk revolution while a slow host data rate is maintained (assuming the controller has the proper data buffer). Logical sequential sectors are not contiguous and the effect on access time of the disk motion can be cut by interleaving physical sectors so that the head comes close to the next logical one.

Another obvious result of the high-density disk is the necessity for error correction. In 1974, when Control Data Corp. first introduced its storage module drive (SMD) technology—applying IBM's 3330 technology—most system architects simply said, "I know the large systems have error correction, but this is a small system. I just can't afford such controller complexity, and besides, I'm getting good disk packs." And they had so far gotten good disks, but as production stepped up and disk packs got heavy use, the data bases turned up with unrecoverable errors.

The bit-per-inch density of the new drives demands controllers with sophisticated error correction—using, ideally, 32-bit polynomials capable of detecting burst errors up to 22 bits long and of correcting burst errors up to 11 bits long. Since the platters and heads are sealed and fixed, a bad disk pack cannot simply be thrown away. The controller, to increase yield and lower cost, should therefore allow defect skipping in the form of either spare tracks or spare sectors. The spare sector scheme is preferable, as it avoids performance losses inherent in the spare track method due to its seek delay.

In a moving-head system, the head might land on the wrong track (often called "seek error" and assigned a probability of 1 in 10^6). This error can be compensated for by having a controller generate a disk-identifying field (commonly called a header or ID field) to verify that the drive is on target before permitting the host to transfer data.

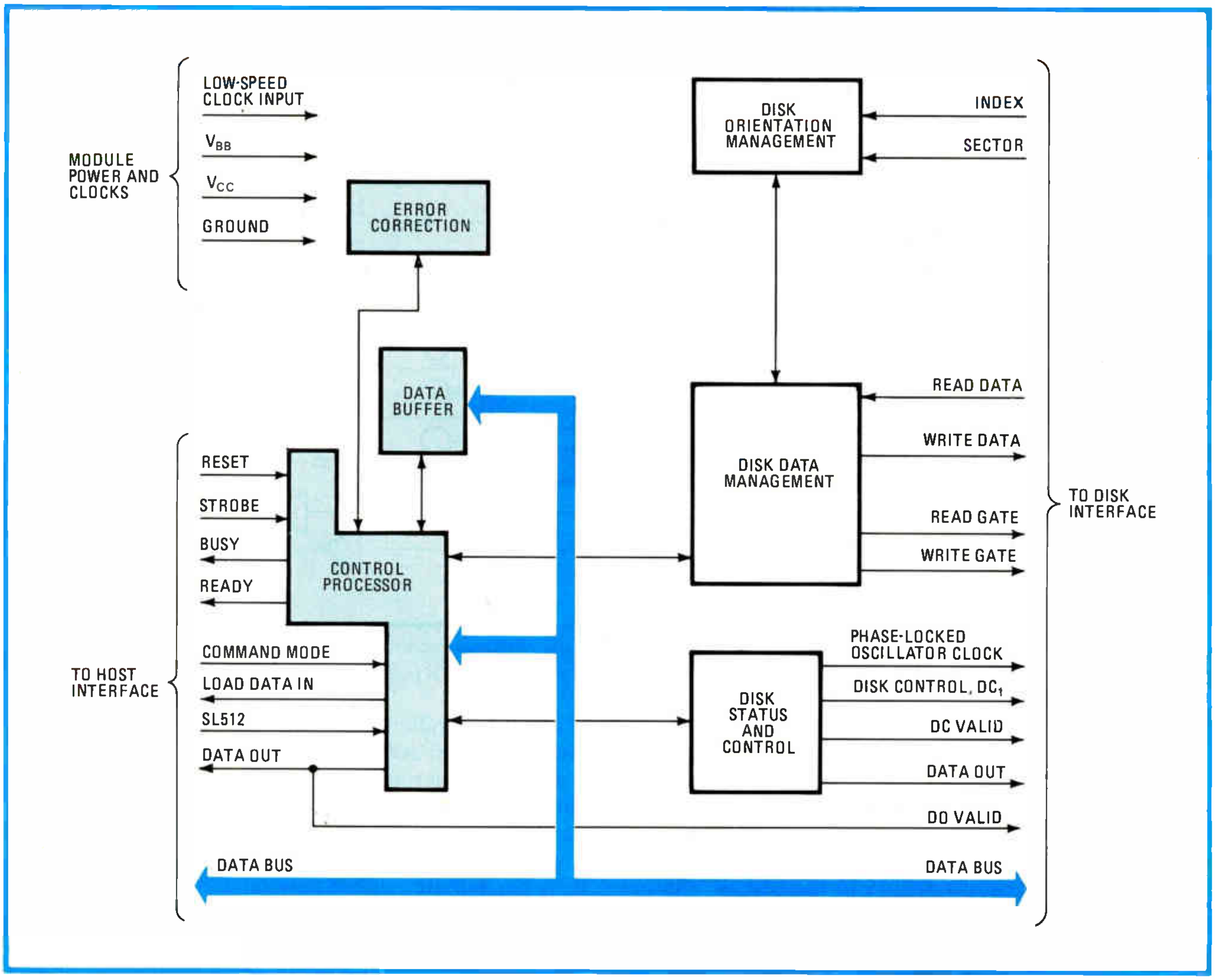
Another controller requirement is a high-level interface to allow simple communication between the host and the disk I/O processor rather than directly between the host and the device. The host computer is thus free of detailed disk control and able to handle more of its data-processing tasks, such as report generation and accounts payable and receivable. Like their mainframe predecessors, small computer systems should not be moving or selecting disk heads, calculating polynomials, making sure the one-in-a-million seek error did not occur, or even formatting the disk.

Since a cost-efficient Winchester-drive controller must have an on-board microcomputer, its excess computer power can also be used for various forms of module self-testing and diagnostics. The extra read-only memory space required for these routines is a small price to pay for improved system availability.

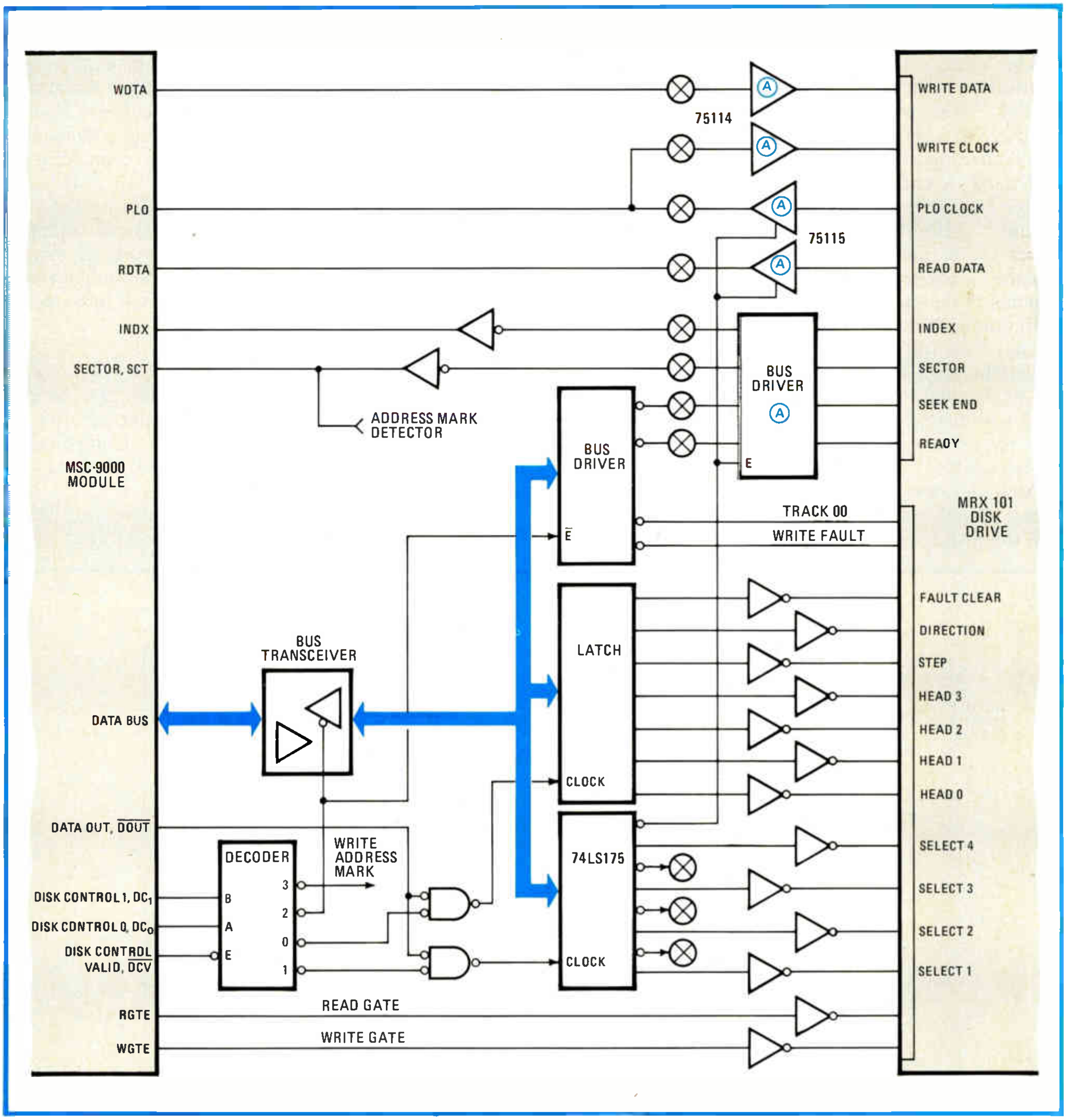
Developing a controller

Of the four ways to develop a Winchester drive controller, one might be to build the controller circuitry out of low-cost small-scale integrated logic. Unfortunately that requires the use of 300 to 400 integrated circuits—a size disadvantage.

Two approaches that are more up to date use either a high-speed bit-slice bipolar processor or an MOS micro-



3. Host to disk. This block diagram of the MSC-90000 controller shows its major components—MOS microprocessor, memory, and various LSI interface circuits. The module does most of the interfacing between the large host computer and the disk drive or drives.



4. Module to drive. Additional external circuitry is needed to interface the controller module with various types of rigid-disk drives. This interface is with a Memorex 101 disk drive. If the gates marked with an A are duplicated, it is possible to control four drives at the same time.

processor. The bit-slice technology has been applied to small-system disk controllers for the past several years. But since it requires 150 to 250 ICs (depending on host computer and system demands), it is not cost-effective for systems that use disk drives priced at even as little as $5,000 to $10,000.

Applying this type of circuitry to the new Winchester disk drives results in only minimal cost reductions, since all major functions are still absolutely necessary. The new drive's electrical interface may not require differential line drivers and receivers, but interface circuits would be the only savings. So a gross imbalance will exist—a controller that costs more than the drive and uses more room and even more power than the drive.

An MOS microprocessor used alone is undeniably a fine choice for controlling a sewing machine, a microwave oven, or a video game. However, in the real-time environment of the memory spinning at 3,600 revolutions per minute, with a new bit to contend with every 200 nanoseconds, it falls a bit short. In fact, it falls many bits short. Thus auxiliary circuitry must be introduced to augment the microprocessor with real-time, critical functions such as serial-parallel-serial conversion, polynomial generation, error detection, data synchronization, address verification, and overall system synchronization. This requirement can result in a board or boards with the microprocessor and its associated memory and at least 130 ICs.

Only the modular approach is practical in terms of package size and cost, and the MSC-9000 module represents a "best of both worlds" solution. An MOS processor and an LSI implementation of the added real-time functions can be combined on a single board, with the further addition of circuitry for interfacing with specific disk drives.

An example of such additional circuitry would be that needed to multiplex signals between multiple disk units and the controller module. In another case, the disk drive being controlled might require nonreturn-to-zero (NRZ) data. Then, a data separator to convert modified-frequency-modulation data into an NRZ format can be implemented on the controller board or in the disk drive.

The module itself features error correction, data buffering, address verification, and even automatic retry when the module detects an error, as well as the small size required for packaging in the new compact drives.

Keeping the host free

The host processor and the module communicate via an interprocessor communication link. The module goes busy until the task is completed and then the resulting status can be obtained. The command software set is organized to keep commands at a level of simplicity so that the host need not be involved in the disk mechanism characteristics.

For example, to read or write a block of data, the host simply sends the command and address. The module will locate the address, performing a seek if required, and wait for the proper rotation position before transferring data. On a read, the controller verifies accuracy and automatically corrects errors (up to 11 bits) before passing data to the host. Other commands, such as seek, track format, recalibrate, and write alternate sector, are included for utility and error management. Commands such as module self-test, write long, and read long ensure that the controller can be easily maintained.

A functional block diagram of the MSC-9000 disk I/O processor is shown in Fig. 3. The module has an 8-bit bidirectional data bus and some associated control signals for all communications with either the host or the disk drive or drives.

One disk interface

Figure 4 shows all external circuitry required to interface the control module with a single Memorex 101 disk drive. The decoder controls bus steering and defines what information passes over the module data bus. External latches strobe the drive select, head select, and motion control signals. Circuitry can be expanded to four disk drives by duplicating the A circuits (upper right in the figure) and enabling them from the select signals of the 74LS175. The Memorex 101 drive contains a data separator, but the function can also be included on the controller board.

To accommodate disk drives without sector pulses, the module generates a write AM (address mark) signal via the external decoder. External circuitry is needed to use this signal to generate address marks. When detecting an address mark, this circuitry routes the AM detect signal into the sector pulse input to the module. During the format operation, the module segments the disk into fixed sectors by using the address marks in place of sector pulses.

The module receives data in NRZ format synchronized with the PLO (phase-locked oscillator) clock input. During a write, the module generates NRZ data on its WDTA (write data) line, also synchronized with the PLO clock.

The host interface

The controller module can be thought of as a disk I/O processor. It can be given a task and, except for transferring the actual disk data, requires no further interaction with the host until it completes the task. Three groups of module signals provide the interface facility between the module and host computer.

The first group contains a busy signal and a command request signal. The busy signal signifies when the module begins performing a task; it remains active until a task is completed. The command signal can be given by the host (whenever the module is not busy) to cause the module to accept a new command.

The second group of signals initiates the transfer of information such as commands, drive status, or actual disk data between the module and the host. This group consists of:

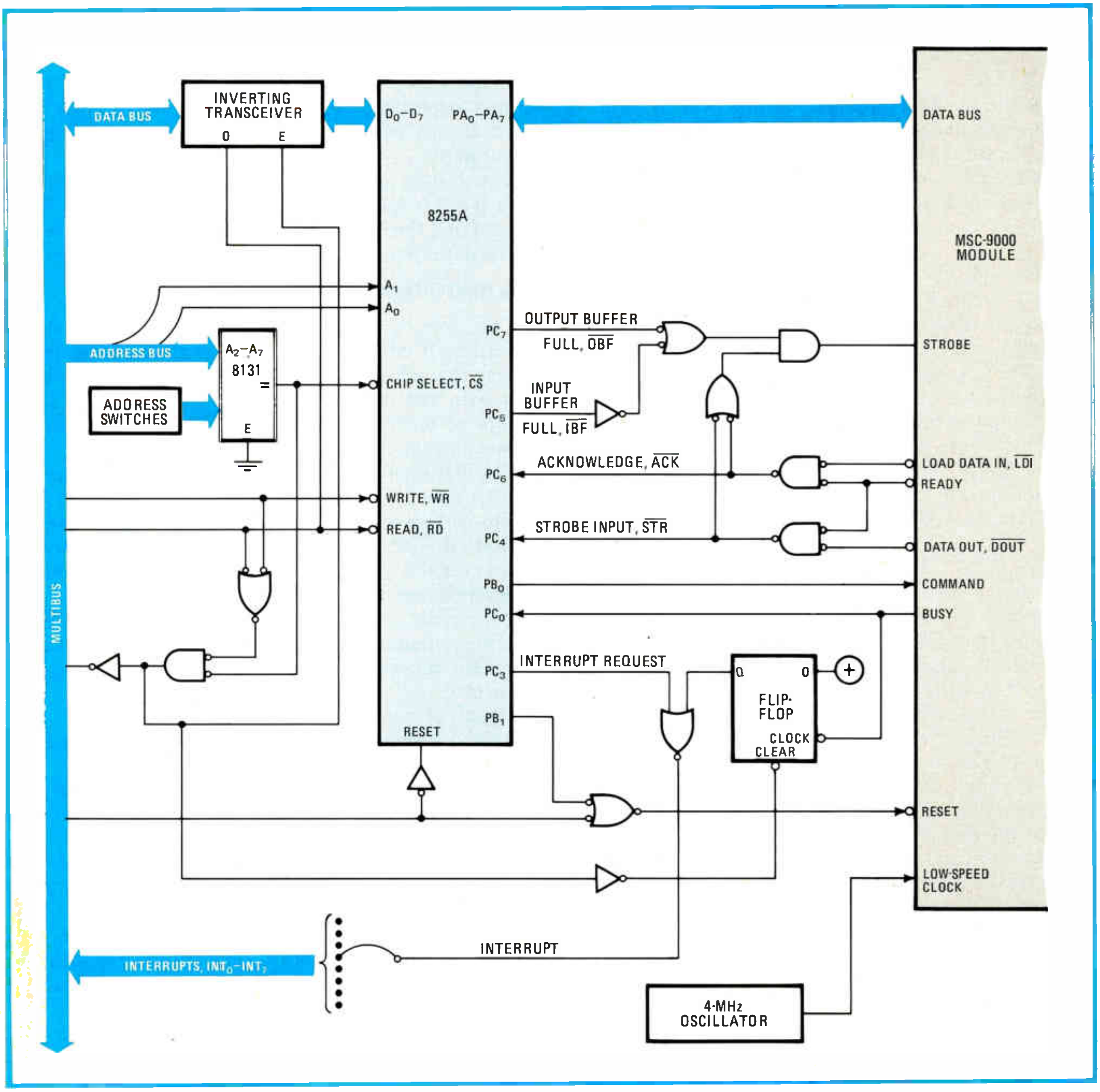
- Signals over an 8-bit, bidirectional data bus.
- Ready: a signal from the module that it is ready to transfer information to the host.
- Load data in: a signal from the module to be used with ready to enable the host interface to place information on the data bus for input to the module.
- Data out: a signal from the module to be used with ready to let the host interface receive information from the module.
- Strobe: a signal from the host interface to be put into the module whenever information is transferred with it.

The last group of signals, for general support of the module, consists of the following:

- Reset: a general reset input signal to the module.
- LCLK: a low-speed clock input to the module at 4 megahertz.
- Power: a +5-volt dc power source.

Figure 5 shows an interfacing example between the MSC-9000 module and a host system with a Multibus. The interface uses an Intel 8255A programmable peripheral interface (PPI) with three ports for communication between the host and the module. Port A is used to send data to or to receive data from the module. Port B is always an output port to generate control signals such as PBO, to request the module to accept another command, or PBI, a pulse to allow the host program to reset the module. Port C is a multifunctional port that handles various control signals, like the busy signal, PCO, or PC3, an interrupt signal.

Of course, by adding a direct-memory-access controller such as Intel's 8237, higher performance with less software overhead can be achieved. A floppy-disk controller IC can also be added on the controller board along



5. Bused disks. As illustrated, the controller module is interfaced with a host using the Multibus. An external 8255A programmable peripheral interface must be added to the controller card to make three ports for communicating data and control signals between host and module.

with the MSC-9000, creating a single controller for both Winchester and floppy disks.

Software for the Multibus application will talk mainly to the ports of the PPI rather than to the inputs to the module. Software requirements in other systems depend somewhat on the actual host-to-controller interface protocol. However, at a high level the structure is basically the same. The disk driver is entered whenever the system requires a transfer of disk data. The driver then invokes the command function and communicates the 6-byte command description to the module. After that, the DMA can be started and, upon leaving the disk driver, the system can proceed with its normal processing chores. An interrupt can easily be configured at the end of the module's busy cycle. Finally, the driver can be reentered to examine the status and signify a successful operation or ask for appropriate error-recovery procedures.

In some system architectures (notably single-task, single-user), the additional DMA circuitry may not be needed, since average seek delays account for the biggest portion of the data-access time. (Regarding average seek delays to the typical record, even non-DMA transfers of 5 microseconds per byte will contribute only a few percent.) So if the system has nothing else to do while waiting for transfer of the disk data, the software may as well perform the transfer in the driver. In either implementation (with or without DMA), software requirements to support the module stay compact and simple. □

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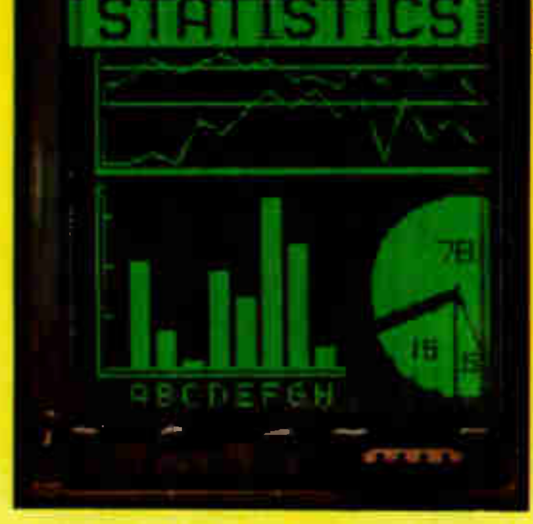

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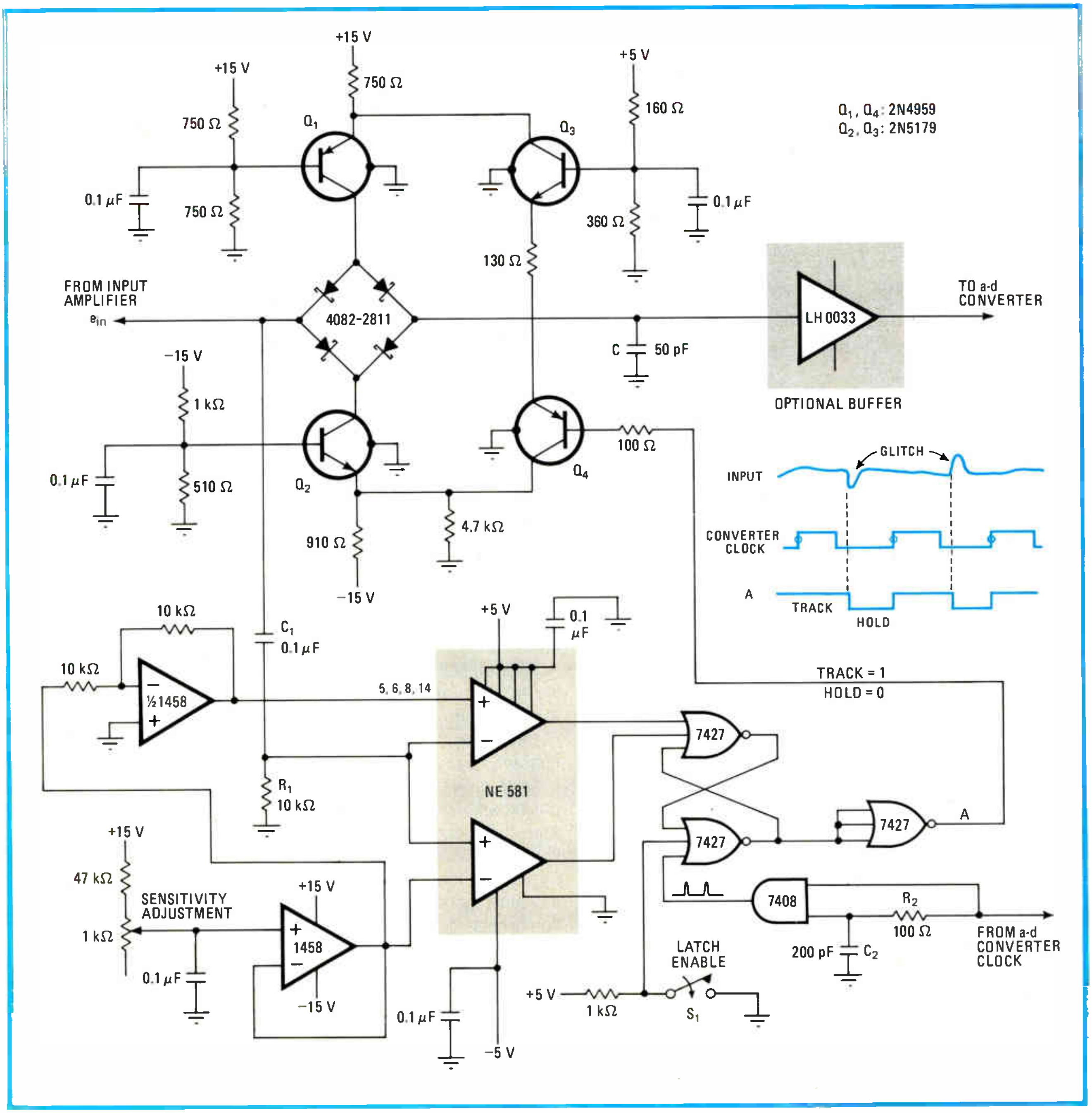
CIRCLE 161 FOR LITERATURE ONLY

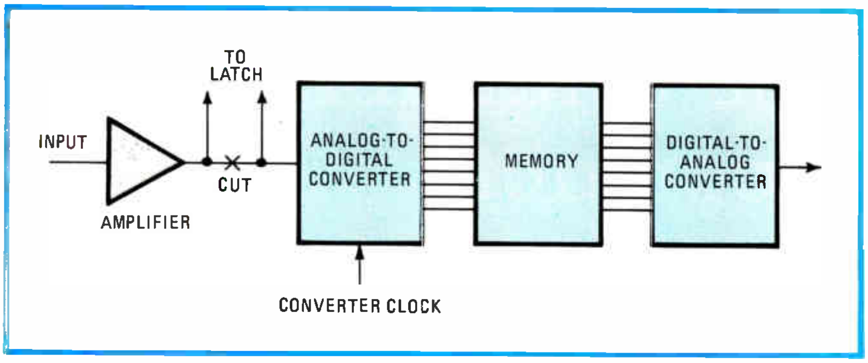
Latch grabs glitches for waveform recorder

by David M. Smith
Storage Technology Corp., Louisville, Colo.

Especially at low sampling rates, recorders that sample asynchronously are very likely to miss glitches. Digital recorders in such circumstances use a latch to catch transients. This circuit is the analog equivalent of a latch. It works with most waveform recorders and is particularly effective when united with the Biomation series of machines. Suitably modified, it can work at frequencies as high as 50 megahertz.

An RC differentiator, a window detector, and a track-and-hold amplifier make up the latch, which should be installed between the recorder's input amplifier and its analog-to-digital converter, as shown in the right-hand figure. In operation, input signals differentiated by R_1C_1





Capturing transients. Flip-flop–controlled sample-and-hold circuit adapts analog-waveform recorder for latch mode, permitting it to detect glitches despite a low sampling rate. With suitable logic-family substitutions and minimization of lead lengths, circuit functions of up to 50 MHz.

that exceed a preset amplitude will reset the R-S flip-flop formed by two cross-coupled 7427 NOR gates, as can be seen in the left-hand figure. Latch sensitivity is determined by R_1 and is adjustable from 0 to ±0.3 volt.

In the reset state, the flip-flop turns on transistor Q_4, thus open-circuiting the diode bridge so that the instantaneous potential appearing at point A will be stored across capacitor C. When the system clock from the recorder's a-d converter arrives to initiate the next sampling interval, the flip-flop is cleared by means of the one-shot multivibrator (formed by the 7408 AND gate and R_2C_2), the diode bridge becomes functional, and the voltage across capacitor C will follow the variations of e_{in} until the next glitch. Provision is made to disable the latch by means of switch S_1 to enable sampling of incoming waveforms in the traditional manner.

As for the circuit's operating limitations, the major factors determining its capture ability are the speed of the NE581 comparators and flip-flop and the turn-on times of Q_3 and Q_4. For the higher speeds, emitter-coupled-logic devices should be used and wiring lengths should be minimized. The 0.1-microfarad capacitor, C_1, should be reduced to 1,000 picofarads or so. Also, the addition of a high-speed, high-impedance buffer may be required, as shown, if the input impedance of the a-d converter is lower than 1 megohm at the operating frequency of interest. □

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 $75 for each item published.

Computer notes

Home computer displays inverse Laplace transforms

by Michael A. Wyatt
Honeywell Inc., Avionics Division, St. Petersburg, Fla.

Expanding upon the Gaver algorithm[1] for estimating the time value of a Laplace transform as described by Kinchu Woo,[2] this program provides the time-domain display of such functions on the popular Apple II personal computer. Utilizing the graphics capabilities allows a user to view a time-domain response almost as it would be seen on an oscilloscope. Also included is a feature not found on most scopes—the ability to scan the display with a cursor in order to extract measurements at any given point on the plot.

Taking the given Laplace transform, which is entered between lines 250 and 1000 of the floating-point Basic routine, the program finds the function's corresponding time value from:

$$f(t) = (\ln 2/t)\sum_{i=1}^{10} V_i F(i \ln 2/t)$$

where the set of constant V_i coefficients is entered at lines 160–170 and where it is assumed that f(t) is suitably bounded and well defined. Once the time increment, t_i, is specified at line 145, the program performs the inversion (lines 200–1170) until $t_f = 279t_i$, where the number 279 is the number of points that may be resolved on the Apple's screen. Lines 2000–3030 then automatically scale and plot the previously calculated data points using the Apple's high-resolution graphics.

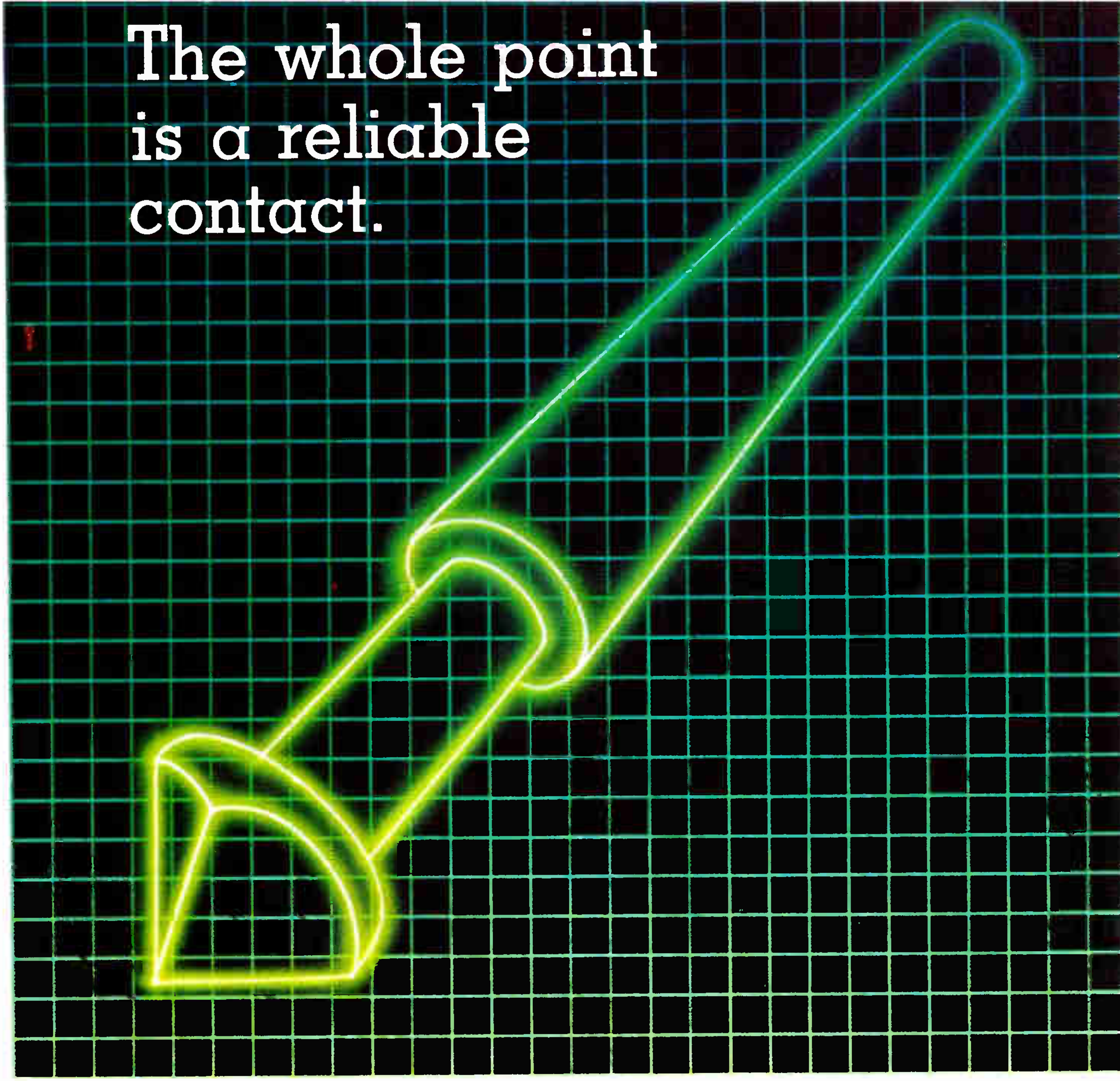
The cursor-scanning subroutine is implemented between lines 4000 and 7020. The user need only position the cursor on the curve by means of the left (L) and right (R) keys on the operator console. The value of the function will be displayed as a function of time at the lower f left portion of the screen as f(t) = A, where t will be expressed in seconds and A is a scalar quantity (a number).

Consider the example of the classic second-order system that is excited by a step function:

$$F(s) = \omega_n^2/s(s^2 + 2\zeta\omega_n s + \omega_n^2)$$

with $\zeta = 0.4$ and $\omega_n = 1$. Following initialization of the program, the routine will flash a message on screen instructing the user to enter the desired transform, to which the user responds: $F(n) = 1/s(s^2 + 0.8s + 1)$. Alternatively, he may specify the value of ζ and ω_n first and then enter the general (symbolic) equation.

TIME	CALCULATED	PLOTTED
0.1	0.0048653	0.0048661
0.2	0.0189122	0.0189238
0.5	0.1076671	0.1077150
1.0	0.3599150	0.3580033
2.0	0.9270844	0.9404786
5.0	1.0760872	1.0773478
10.0	1.01564972	0.9849304



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Circle 164 on reader service card

PROGRAM FOR DISPLAY OF INVERSE LAPLACE TRANSFORMS ON APPLE II

```
10  TEXT : HOME : VTAB (8)
20  DIM K(11),V(281),F(11),Y(281)

30  PRINT "          LAPLACE INVERS
    ION FOR
40  PRINT "          TIME-DOMAIN D
    ISPLAY"
50  VTAB (20)
60  GET U$
70  HOME : VTAB (8)
80  PRINT " ENTER EQUATION IN S B
    ETWEEN 250 & 1000"
90  VTAB (10)
100  PRINT "          USE F(N) AS VA
    LUE OF EQUATION"
110  VTAB (16)
120  INPUT "          HAS EQUATION BE
    EN ENTERED? Y/N";A$
130  HOME : VTAB (8)
140  IF A$ = "N" THEN 50000
145  INPUT "          INPUT TIME I
    NCREMENT";T: HOME
150  PRINT "          INVERSION COM
    PUTING"
160 K(1) = 1 / 12:K(2) =  - 32.08
    333333:K(3) = 1279.000076:K(
    4) =  - 15623.66689:K(5) = 8
    4244.16946:K(6) =  - 236957.
    5129
170 K(7) = 375911.6923:K(8) =  -
    340071.6923:K(9) = 164062.51
    28:K(10) =  - 32812.50256:K(
    11) =  LOG (2)
200  FOR I = 1 TO 279
210 F(0) = 0:S = 0
220  FOR N = 1 TO 10
230 S = N * K(11) / (T * I)
250 F(N) = 1 / (S * (S * S + .8 *
    S + 1))
1100 F(N) = F(N) * K(N) + F(N - 1
    )
1110  NEXT N
1120 V(I) = F(10) * K(11) / (T *
    I)
1130  IF V(I) < PHIGH THEN 1150
1140 PHIGH = V(I)
1150  IF V(I) > PLOW THEN 1170
1160 PLOW = V(I)
1170  NEXT I
2000  REM ----PLOT ROUTINE----
2010  HGR
2020  HCOLOR= 7
2030  IF PLOW < 0 THEN 2200
2050 Y(1) =  INT (156 - 155 * ((V
    (1) -  ABS (PLOW)) / (PHIGH -
    PLOW)))
2100  FOR I = 2 TO 279
2110 Y(I) =  INT (156 - 155 * ((V
    (I) -  ABS (PLOW)) / (PHIGH -
    PLOW)))
2120  NEXT I
2130  GOTO 3000
2200 Y(1) =  INT (156 *  ABS ((PL
    OW - V(1)) / (PHIGH - PLOW))
    ) + 1
2210  FOR I = 2 TO 279
2220 Y(I) =  INT (156 *  ABS ((PL
    OW - V(I)) / (PHIGH - PLOW))
    ) + 1
2230  NEXT I
3000  HPLOT 1,Y(1)
3010  FOR I = 2 TO 279
3020  HPLOT  TO I,Y(I)
3030  NEXT I
4000  REM ----CURSOR ROUTINE----
4010 I = 125
4020  GET C$
4030  IF C$ = "L" THEN 5000
4040  IF C$ = "R" THEN 6000
4050  IF C$ = "S" THEN 50010
4060  GOTO 4020
5000  REM ---DECREMENT CURSOR---
5010 I = I - 1
5020  IF I >  = 1 THEN 5040
5030 I = 1
5040  HCOLOR= 4
5050  HPLOT I + 1,Y(I + 1) - 1 TO
    I + 1,Y(I + 1) + 1
5060  HCOLOR= 7
5070  HPLOT I + 1,Y(I + 1)
5080  HPLOT I,Y(I) - 1 TO I,Y(I) +
    1
5090  GOTO 7000
6000  REM ---INCREMENT CURSOR---
6010 I = I + 1
6020  IF I <  = 279 THEN 6040
6030 I = 279
6040  HCOLOR= 4
6050  HPLOT I - 1,Y(I - 1) - 1 TO
    I - 1,Y(I - 1) + 1
6060  HCOLOR= 7
6070  HPLOT I - 1,Y(I - 1)
6080  HPLOT I,Y(I) - 1 TO I,Y(I) +
    1
7000  HOME : VTAB 22
7010  PRINT "          F(";I * T;")=
    ";V(I)
7020  GOTO 4020
50000  PRINT " ENTER EQUATION IN
    S BETWEEN 250 & 1000
50010  END
```

The return key is then depressed and the program will query if the equation has been entered. Depressing the Y key to indicate yes (or N to indicate no) triggers analysis of the equation.

As seen, the results of the tabulated analysis compare favorably with the analytical (mathematical) result for the time-domain equivalent, which is:

$$f(t) = 1 - [1/(1-\zeta^2)^{0.5}]e^{-\zeta\omega_n t}\sin[\omega_n(1-\zeta^2)^{0.5}t+\Theta]$$

where $\Theta = \arctan[(1-\zeta^2)^{0.5}/\zeta]$. To exit the program, the user simply depresses the S key on the console.

Modification of the basic program for other machines (TRS80, Pet, and so on) should pose no serious problem. The plot and cursor function will not be so easily implemented, however, and so this section of the program must be rewritten accordingly. □

References

1. D. P. Gaver, "Observing Stochastic Processes and Approximate Transform Inversion," Operational Research, Vol. 14, No. 3, 1966, p. 444–459.
2. Kin-chu Woo, "TI-59 inverts Laplace transforms for time-domain analysis," *Electronics*, Oct. 9, 1980, p. 178–79.

Engineer's newsletter

Make no mistake about microhms

A new digital ohmmeter uses a technique that should interest engineers who have to measure the micro- and milli-ohm resistances of wire, printed-circuit–board stripes, and relay and connector contacts. It employs the switched dc mode, in which the drive to the resistance-measuring circuit consists of alternating positive and negative square-wave pulses. Because switched dc eliminates any thermal electromotive force offsets generated in all connections to the unknown resistance, it is **the recommended mode for the accurate measurement of noninductive unknowns below 100 Ω**—a range in which thermal offsets can approach the millivolt level and cause unacceptable errors. For information on the model 1700, write to Electro Scientific Industries Inc., 13900 N. W. Science Park Dr., Portland, Ore. 97229.

Reducing the first cycle error in a keyed oscillator

A keyed oscillator can be configured from a TTL Schmitt trigger gate by placing a feedback resistor from the trigger's output to its input and by shunting a capacitor from input to ground. When the control line of the trigger goes high, the circuit oscillates. However, a timing error occurs during the first period of oscillation, for it is longer than it should be because the timing capacitor has to discharge from a higher voltage than the trigger's upper switching threshold voltage. Typically, upper and lower thresholds for this type of circuit are 1.6 and 0.8 V respectively. A solution is to **ensure that the capacitor starts with a voltage closer to the upper threshold**—perhaps by using a 2-V zener diode or a stack of diodes shunting the capacitor.

A. Bendeli of the Commonwealth Scientific and Industrial Research Organization's division of applied physics, Sydney, Australia, has a better approach. He simply ties a green or yellow light-emitting diode in parallel with the timing capacitor. These LEDs have a minimum forward voltage drop of 1.8 V at 2 mA. When the control line is off, the output delivers current to the LED, which lights and clamps the capacitor at around 2 V. A red LED (V_f = 1.5 V) would clamp the capacitor at too low a voltage for oscillation to occur. The illuminated LED also indicates that the oscillator is in a ready state. With a 1-kΩ resistor and a 0.1-μF capacitor, the low period of the waveform's first cycle is reduced from 220 to 124 μs, which is close to the 120 μs of the following low periods.

Learn about speech synthesis

With the availability of commercial hardware, speech synthesis is becoming a vital technology to engineers in all facets of electronics. In Santa Barbara, Calif., on June 1–5, a comprehensive tutorial seminar on speech synthesis will be given. These sessions will present the principles, techniques, and implementations of analytic synthesis systems, ranging from channel, format, and linear predictive vocoders to the newest vector quantization approach. Coverage will also include **phonetics, text-to-speech systems, waveform encoding, speech recognition,** and a comparative evaluation of achitectures and technologies for implementing speech processing algorithms. Sponsored by Signal Technology, the seminar will be available to a limited number of registrants. The registration fee is \$850. To register, write to Signal Technology Inc., 15 West De La Guerra, Santa Barbara, Calif. 93106, or phone (805) 963-1552. For further information, contact Allen Gersho of the Department of Electrical and Computer Engineering at the University of California, Santa Barbara, Calif. 93106, or call him at (805) 961-2037. **-Jerry Lyman**

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15V	3.4A	SD15-3.4
24V	2.1A	SD24-2.1
28V	1.8A	SD28-1.8
SIZE: 2"H X 4.88"W X 6.25"L		

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100 WATTS

VOLTS	AMPS	MODEL
5V	20A	SF5-20
12V	8.4A	SF12-8.4
15V	6.7A	SF15-6.7
24V	4.2A	SF24-4.2
28V	3.6A	SF28-3.6
SIZE: 2"H X 4.88"W X 10"L		

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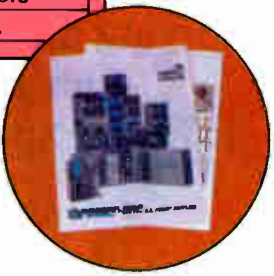

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Pasquale Pistorio
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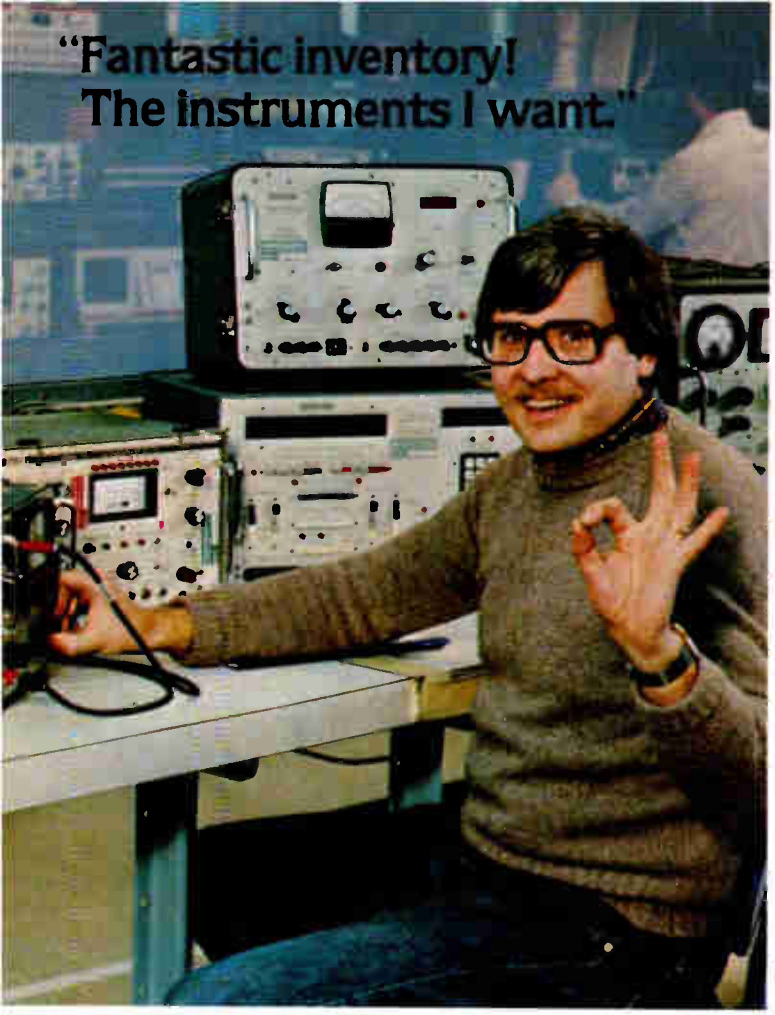
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Exhibitors at the IEEE-sponsored show April 7 to 9 will be showing at New York's Coliseum and Sheraton Centre new designs from evolving instrumentation to optoelectronics

Electro/81

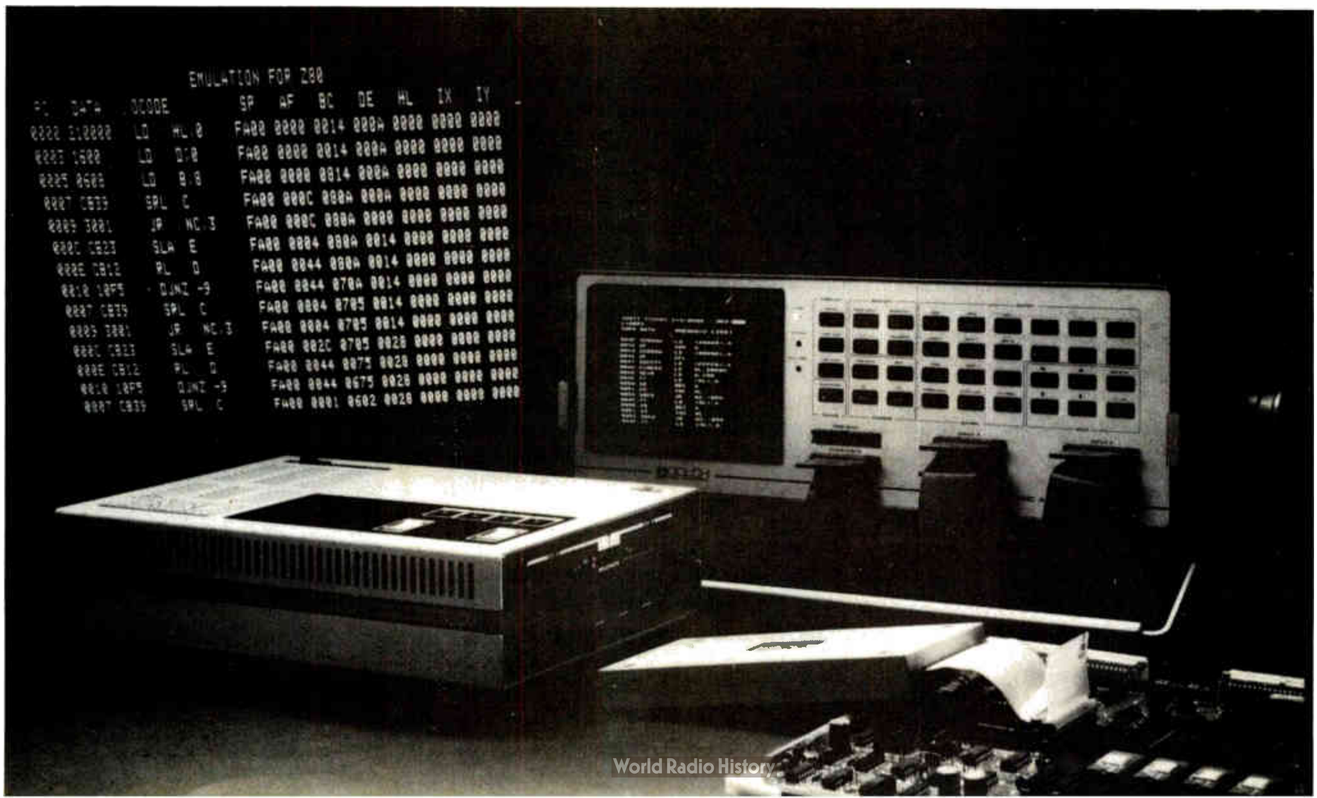
Instrument gives logic analyzer an emulating front end

A logic analyzer is no match for a microprocessor development system when it comes to software development. But when the development task turns to hardware debugging, a new hybrid instrument can turn a logic analyzer into a powerful competitor for an in-circuit emulator-analyzer. That hybrid instrument is the Dolch E 80A Emulyzer. Designed primarily as a front-end system for a 32- or 48-channel logic analyzer, it can also operate as a stand-alone emulator.

The E 80A attaches to the microprocessor socket the same way that a logic analyzer probe pod or in-circuit emulation pod does. Through another port, the Emulyzer can be attached to a logic analyzer, a development system, or even a dumb terminal with an RS-232 or 20-mA current-loop interface.

The E 80A, the first in a series of Emulyzers, is intended for emulation of a Z80A microprocessor. Some other series members under development and due out in the fourth quarter are units for the 8080, 8085, and 6809 8-bit microprocessors. Emulyzers for 16-bit processors should be available early in 1982. An upgrade of the E 80A able to accommodate a 6-MHz Z80B, as well as a 4-MHz Z80A, according to Dolch sources, will be available by the end of the summer.

The Emulyzer can map a 1,024-byte segment of program onto a target system. This function is handy for adding patches to a target system's programming, but it is not rec-



ommended for software development of the entire program. The reason is that the Emulyzer has no symbolic lookup tables, so that the user must rely upon absolute addressing instead of symbolic addressing. The Emulyzer does, however, have an in-line assembler.

With the assembler, the user can develop up to 6-K bytes of custom stimulus and test routines. Through an external probe, an attached logic analyzer containing a signature-analysis feature can then feed the target system's responses back to the Emulyzer.

Register tracing. The Emulyzer also gives a logic analyzer a capability that had previously been the domain of a development system with an in-circuit emulator. It allows the tracing of internal register activity on a processor under test during the full-speed execution of time-critical program segments. Even on development systems, the normal method of tracing such activity amounts to a single-step procedure because at least one wait state must be inserted after each program step. Some other Z80 emulators use non-maskable interrupts, which force a breakpoint every 100 ms.

The E 80A has two independent hardware breakpoints that can be used to break on memory reads, writes, accesses, or instruction fetches. The hardware breakpoints are set up so that the Emulyzer can break on either breakpoint (A or B), but not to perform sequential breakpoints of event A followed by event B. In recognizing the captured data, the Emulyzer has its own disassembler; thus it can display the Z80A's assembly-language mnemonics directly on a dumb terminal.

The Emulyzer, which will sell for approximately $5,000 and be delivered in 30 days, may be used as a front-end device for Intel and Zilog development systems. When the appropriate linking software is made available, the E 80A could also be linked to Z80 software developed on a minicomputer such as Digital Equipment Corp.'s PDP-11.

Dolch Inc., 230 Devcon Dr., San Jose, Calif. 95112. Phone (408) 998-5730 [380]

Low-cost fiber-optic receiver chips are versatile

Two fiber-optic receivers, each aimed at a specific application level in short-to-intermediate-range digital communications links, are key optical components in a succession of products planned for this year by Motorola Inc.'s Semiconductor Group. For high data rates, the MFOC600 monolithic fiber-optic receiver circuit provides a TTL output at up to 10 Mb/s. A smaller, less expensive receiver, the single-chip MFOD624F, fits in a standard three-lead ferrule package and operates at up to 500 kb/s.

"Both receivers are versatile enough to perform in a variety of applications now opening to fiber-optics technology," says Jim Herman, marketing manager for these products at Motorola's High-Frequency Optical Electronics division in Phoenix. High cost has been a barrier to the use of fiber optics in nontelecommunications jobs, but that is changing: the new units will sell for $10 or less in 1,000-unit quantities.

Housed in a 16-pin ceramic dual in-line package, the MFOC600 is used with an optical detector to form an entire receiver. For the input, Motorola's integrated detector-preamplifier, a p-i-n diode, or other low-current unit may be used.

Herman says the variety of output choices alone makes the IC one of the most effective fiber-optic receivers yet developed. In addition to 10-Mb/s TTL, the unit offers an output compatible with emitter-coupled logic at rates of up to 20-Mb/s and an analog output at up to 10 MHz. A relatively rare need to date, ECL-compatible output should be called for increasingly in large computer-to-computer links and in such peripherals as disk drives that dump data at high rates, says Herman. The analog output can serve an extra monitoring function—for example, as a flag that checks the digital mode, signaling when data is cut off accidentally or otherwise.

Internal decoding networks enhance the MFOC600 with optical data formats, including pulse bipolar, nonreturn to zero, and Manchester coding. As an option, a transimpedance amplifier on the chip adds this function to a system not using an integrated detector and preamplifier, he says. The receiver, which has an on-chip automatic-gain-control circuit with a 20-dB range, requires a single supply voltage.

The MFOD624F is Motorola's first complete fiber-optic receiver housed in a single ferrule package. This package fits into a standard receptacle, thus saving board space; in addition, it can be well shielded by the connector from radio-frequency interference and electromagnetic noise. It is compatible with such metal connectors as the AMP 227240-1 and Amphenol P/N 950-135-5000. Its sensitivity is 20 μW, typically, and it uses a single 5-V supply.

The single-chip light-in, TTL-out receiver is suitable for sensing jobs in

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both industrial and automotive systems in addition to computer and military applications, Herman says. It can serve, for instance, as a speed sensor in geared systems by counting teeth and delivering rotational speeds directly to a microcomputer and as a module in a multiplexed engine-control system.

Prices as of April 8, in volumes of 1 to 24 and 1,000, respectively, will be $18.30 and $10 for the MFOC600 and $14.70 and $8 for the MFOD524F. Small quantities may be delivered immediately from Motorola and distributors.

Motorola Seminconductor Group, High-Frequency Optical Electronics Division, P. O. Box 20912, Phoenix, Ariz. 85036. Phone (602) 244-4556 [381]

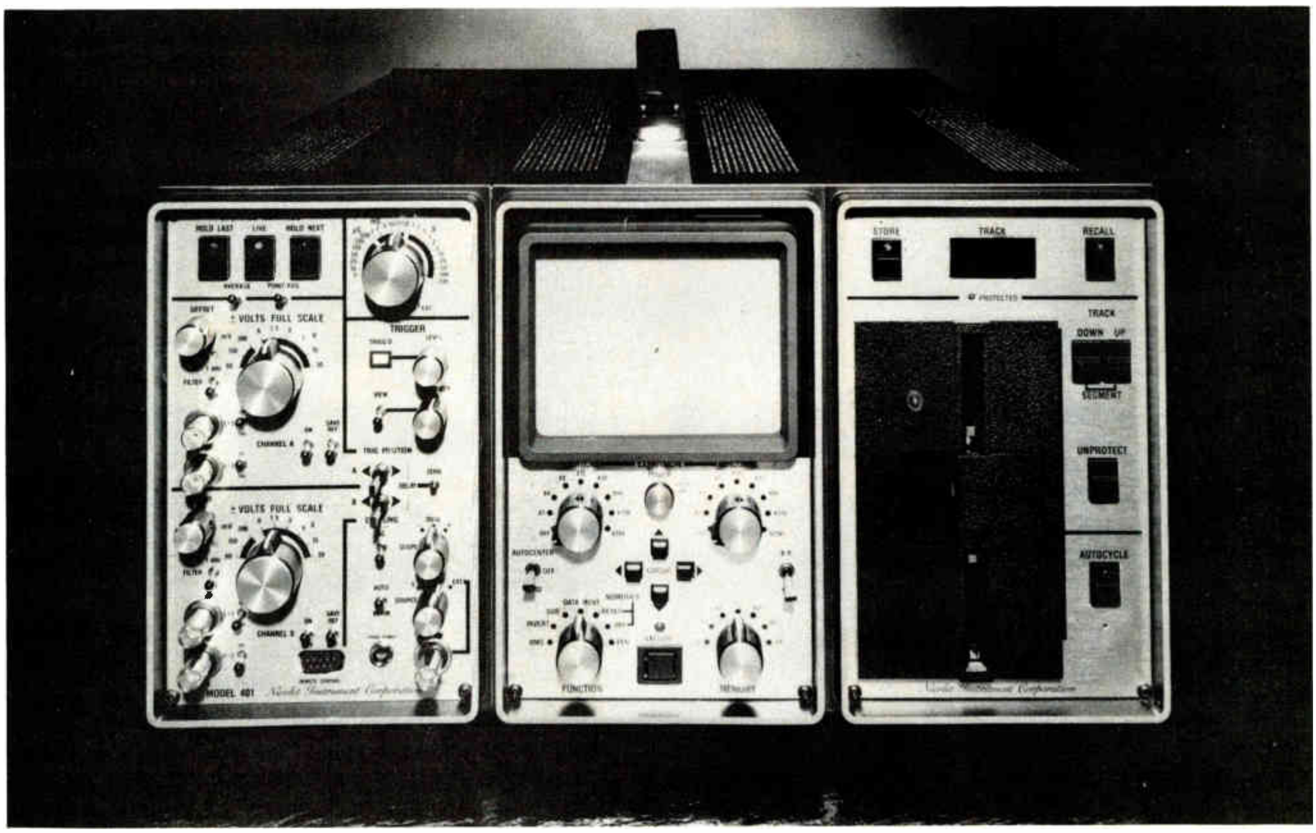
Digital oscilloscope gets floppy-disk plug-in

Experienced users of digital oscilloscopes employing them in widely different applications agree on a number of improvements they would like to see made in the instruments. Says Jeremy Wright, vice president of marketing for Nicolet Instrument Corp., "We had increasing requests from both our sales force and customers for capabilities beyond those of even our most sophisticated scope, the 2090-3C." They wanted greater resolution and dynamic range, more storage capacity, the ability to manipulate captured data, and more channels.

So Nicolet, inventor of the digital scope, set out to fill those needs by dividing the processing power between the mainframe and plug-in modules. While they retained the rugged mechanical aspects of their 2090-series mainframe, the 4094 mainframe is significantly different. The two–plug-in, dual-trace unit is built around a 16-bit processor and a large 16-K-by-16-bit random-access memory for waveform storage. The memory can be divided into halves or quarters to accommodate multiple waveforms and its density allows enlargement by up to 256 times of either or both displayed traces.

Each of the two two-channel plug-ins at present offered has its own processor and buffer memory. For highest resolution, the 100-kHz 4851 plug-in provides 15-bit digitizing for both channels; higher-frequency signals can be viewed with the 2-MHz 4562, which still provides a remarkably high 12-bit resolution. Each of the modules has its own trigger and time base, so by using both in the instrument at the same time, a user has the flexibility of two high-resolution scopes in one.

But adding the input/output card offered as an option really brings the processor's power to bear. With it, a user can plug an optional single floppy-disk drive module into one of the bays and add data-manipulation capability. With the floppy module



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installed—or with an optional floppy-disk drive on the top if both bays are full—all a user need do is select the root-mean-square button and push the enter button; the processor will call and run a data-manipulation program from the disk.

Software. Initial program offerings are fairly general in nature, such as software for multiplication, integration, and power-spectrum analysis. Nicolet will tailor programs for a specific application, and related programs will be gathered into suites for sale on diskette.

The I/O board also provides the instrument with IEEE-488 and RS-232-C interfaces. Further, it allows the scope to work with the optional X-90 digital plotter, which can produce plots up to 8½ by 20 in. in size at a speed of 1,000 5-mil increments per second.

A system comprising the 4094 mainframe, 4851 plug-in, the IF-44 I/O card, and the F-43 diskette plug-in is priced at $13,400; a minimum system (mainframe and 4562 plug-in only) is priced at $8,500.

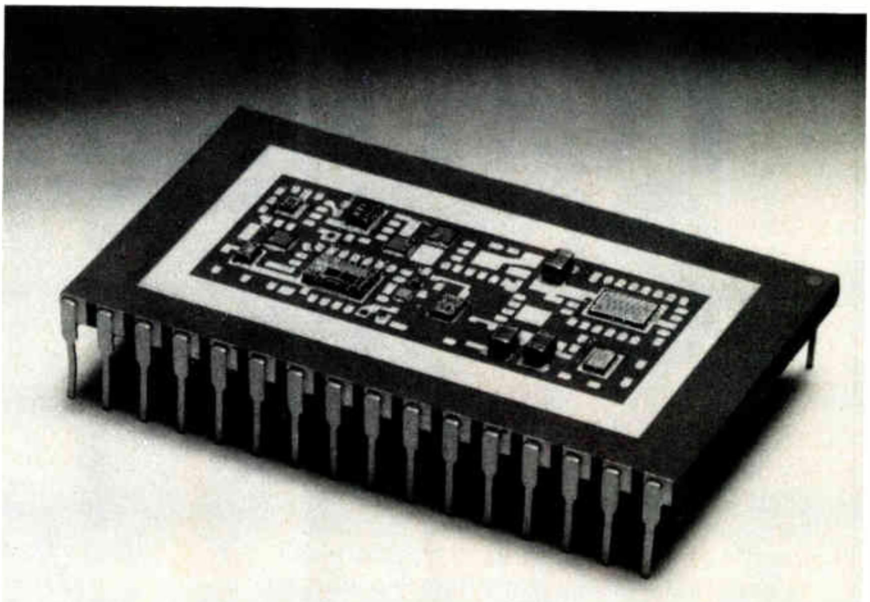
Nicolet Instrument Corp., 5225 Verona Rd., Madison, Wis. 53711. Phone (608) 271-3333 [382]

D-a converters have fewer parts for reliability

A lower parts count and fewer bonded connections make the AD-ADC84/85 series of hybrid 10- and 12-bit digital-to-analog converters from Analog Devices highly reliable as well as fast. A second source for Burr-Brown Inc.'s ADC84/85 line [*Electronics*, May 29, 1975, p. 135], the AD-ADC84/85 family has six models, each of which contains only five integrated circuits, one third the number in the Burr-Brown parts.

The lowered parts count, along with direct bonding of the chips to the floor of a ceramic package, cuts the number of bonded connections by as much as 60%, says Edward W. Soron, marketing manager at the Analog Devices Microelectronics division in Wilmington, Mass.

The SLAM (single-laminated-alloy-metal) package has lead connections embedded in its several layers of laminated ceramic. Thus it elimi-



nates the need for glass seals to protect leads to its 32 pins—seals that can crack and undermine the hermeticity of metal packages, Soron notes. And, he adds, the ceramic substrate is better than conventional thin- and thick-film substrates at insulating the chips from each other.

The converters will have many high-speed data-acquisition applications. Their enhanced reliability, Soron adds, should make them particularly competitive in military-system markets.

Over commercial and industrial operating-temperature ranges, the AD-ADC84/85 parts have conversion times of 6 and 8 μs for 10- and 12-bit resolution, respectively. Conversion in the military-grade models takes 8 and 10 μs. The 10-bit models are linear to within ±0.048% of full-scale range, while 12-bit linearity is to within ±0.012% of full scale. Differential nonlinearity for all models is less than ±½ least significant bit.

The converters accept bipolar input ranges of ±2.5, ±5, or ±10 V and unipolar ranges of 0 to +5 or +10 V. Settling time to within 0.01% for a 20-V step is 2 μs. Gain error is less than ±0.1% of full scale, and offset error is under ±0.5% (unipolar) or ±0.01% (bipolar). Both gain and offset errors are adjustable to zero. Monotonicity is guaranteed over the full specified operating-temperature range.

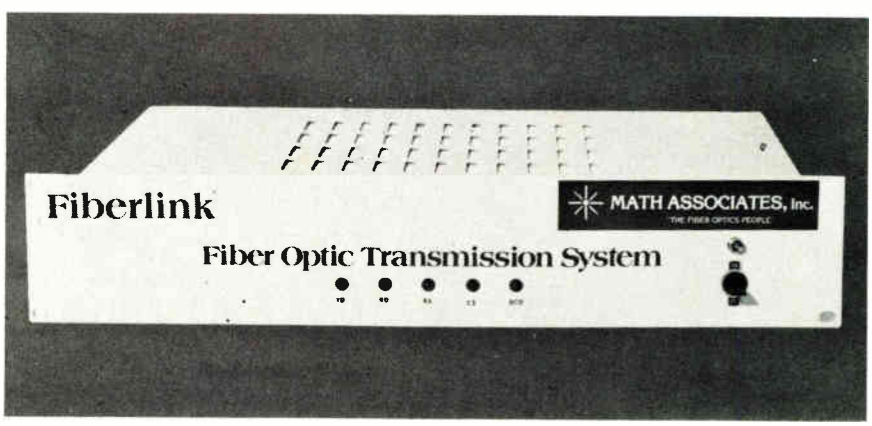
The AD-ADC84/85 operate from +5- and ±15-V (or, optionally, ±12-V) power supplies. Typical power dissipation is 880 mW. The units' operating temperatures range from 0° to +70°, −25° to 85°, or −55° to +125°C. Their epoxy-sealed or reflow-soldered ceramic packages have 32 pins brazed to the package sides, making the converters compatible with automatic handlers.

Prices in lots of 100 are from $70 to $135 each for 10-bit models and from $70 to $150 for the 12-bit models. Full screening to MIL-STD-883-B is available. Delivery is from stock.

Analog Devices Inc., Route 1 Industrial Park, Box 280, Norwood, Mass. 02062 [383]

Complete fiber-optic modem conforms to RS-232-C

Many system designers needing noise-immune RS-232-C communications in computer or industrial-control environments have turned to fiber optics, but have been forced to put the available components, connectors, modules, and circuit boards together themselves. Now a complete RS-232-C fiber-optic transmission system is available ready-built from Math Associates. It can be installed in a few minutes with simple plug connections to the computer or controller and peripheral equipment. A user with some other type of RS-232-C transmission system in



place can convert to the optical system with a minimum of fuss.

A complete system in a box, the XR-1000 sells for $975 without a cable and for about $1,500 with a 100-m cable. "The XR-1000 does the same thing a hardware modem does," says company president Irwin Math, "and it is priced like a comparable copper-wire modem."

The system can perform simplex or full-duplex asynchronous operation from dc to up to 100 kb/s over distances of up to 1,000 m. "We realize that the RS-232-C standard limits bandwidth to 56 kb/s and that the usual specification for transmission is 19.8 kb/s," says Math, "so the standard configuration of the XR-1000 that we offer is for 56 kb/s, though the system can easily go up to 100 kb/s."

Enclosed in a 3.5-by-19-in. cabinet for rack installation, the system includes its own 115-V ac (50-to-60-Hz) power supply. All RS-232-C control signals are on a standard 25-pin connector. Ruggedized fibers for interconnection are extra but, depending on length, cost only about $5 per meter. An additional feature of the XR-1000 is a panel with light-emitting diodes that indicates the status of the system's control signals—whether the system is ready to send, sending, receiving, and so on.

Says Math, "Of course, there are many applications where you don't have to have complete noise immunity, so there you don't need a fiber-optic system. But in those environments where electrical noise is a big problem, fiber optics is the solution." Coaxial cable may cost considerably less than a fiber-optic cable, but it is "useless in a noisy environment."

For that purpose, Math Associates is also offering a fiber-optic transmitter and receiver for color and monochromatic video applications—the XV- and RV-1100. The small units (each measures 4.75 by 2.5 by 1.5 in.) plug directly into any closed-circuit television camera at one end and into a TV monitor at the other end. "The only other equipment I know of that performs the same functions is physically very large and four to five times as expensive," says the company president. The XV/RV-1100 units require either 115 V ac, using a small transformer supplied by the firm, or 14 V dc, which in many cases can be had from the camera or the monitor.

Video link. The units take the output of a TV camera—1 V into 75 Ω—via a fiber-optic cable (not included in the $495 price tag of the two-part set) and transmit the signal to the video input of the television monitor. They transmit a dc-to-3.5-MHz composite video signal—both the video and the synchronizing pulses are transmitted over one channel rather than over two separate ones. Like the RX-1000, the XV/RV-1100 can transmit over distances of up to 1,000 meters. Delivery on the XV-1100 transmitter and RV-1100 receiver takes four weeks; delivery of the XR-1000 RS-232-C fiber-optic transmission system takes four to six weeks. The video transmitter and receiver set will be demonstrated at Electro/81 by means of a closed-circuit TV setup.

Math Associates Inc., 6 Manhasset Ave., Port Washington, N. Y., 11050. Phone (516) 944-7050 [384]

Master and slave drive four-level-multiplexed LCDs

Motorola is offering cost-conscious system designers a new choice in liquid-crystal-display multiplexing configuration with its MC14500 (master) and MC145001 (slave) LCD drivers. Both complementary-MOS devices have been designed to drive LCDs in a multiplexed-by-four scheme. The master unit has a 100-piece, plastic-package price of $10.41, while the slave's 100-piece, plastic price is $7.62. The master

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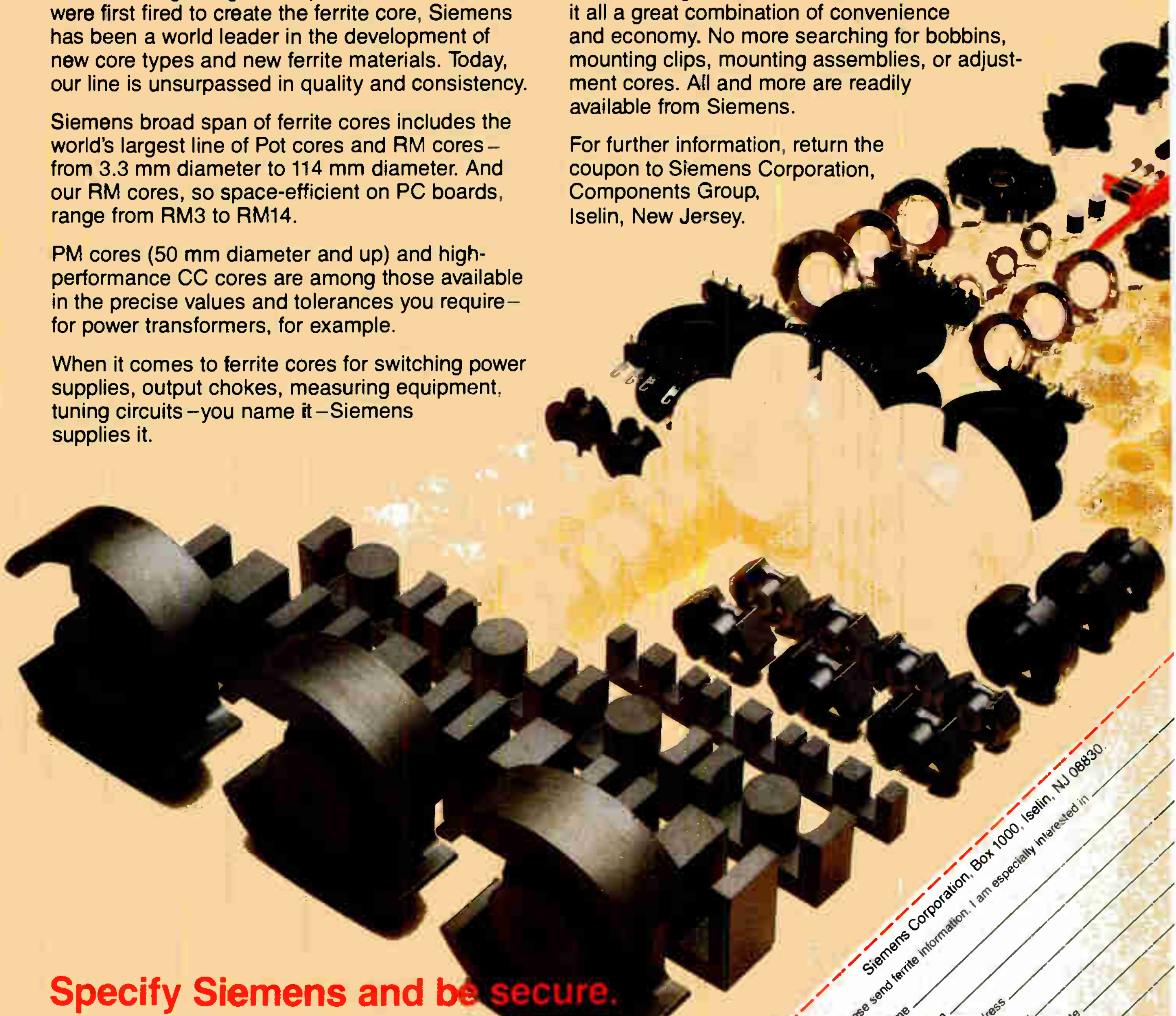

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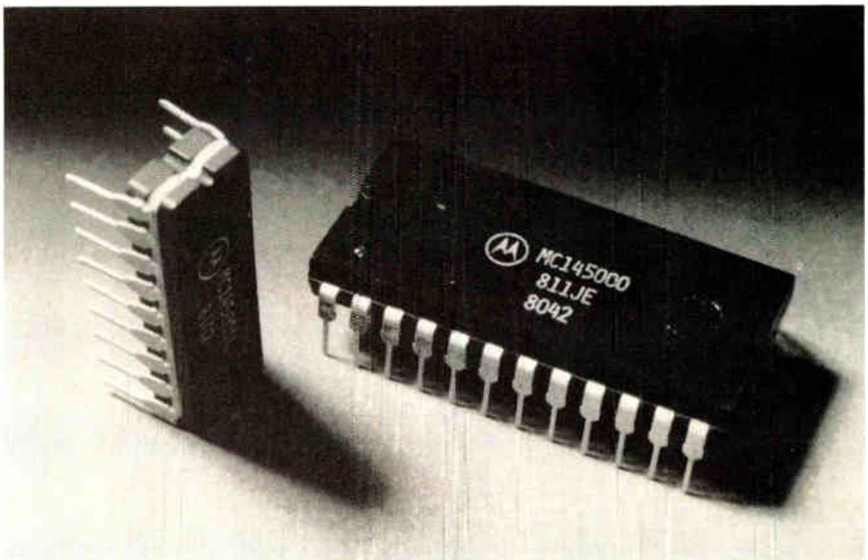

unit can drive up to 48 display segments. It generates both front-plane and backplane waveforms and is capable of independent operation. The slave unit generates only front-plane waveforms, for up to 44 segments, and is synchronized with the backplane signals from the master unit. Several slave drivers may be cascaded from the master to increase the number of segments that may be driven in a system.

The maximum number of front-plane electrodes depends upon the capacitive loading on the backplane drivers and the drive frequency. The input is serial data and a clock signal from a microprocessor or other source; the devices drive one segment per bit.

The master unit is housed in a 24-pin dual in-line package, and the slave comes in an 18-pin DIP. The chips can drive segments up to 1 cm² in area. They have a maximum display operating frequency of 250 Hz. The supply voltage range is set at 3 to 6 V. The net dc drive is less than 50 mV. The drivers operate at from 0° to 70°C; Motorola plans to introduce similar military-range parts in two months.

Motorola Inc., 3501 Ed Bluestein Blvd., Austin, Texas, 72721. [385]

Programmable relay bank makes system of panel meter

Surprisingly, no one has yet created an inexpensive interface that allows a low-cost digital panel meter to be used on the IEEE-488 bus in place of a more expensive programmable digital voltmeter. The model 4874 relay output from ICS Electronics makes this possible. It provides up to 24 single-pole, single-throw relays with a choice of standard or high-current relay contacts. Alternatively, it can handle 16 low-level single-pole, double-throw switches.

The unit has four programming modes, including individual relay programming, block programming of all 24 relays, sequential scanning, and scanning in a directed sequence, all under the direction of the bus controller. The 4874 can also channel an analog signal from any of its lines as an input to a digital panel meter, then interface the binary-coded-decimal output of the DPM with the rest of the IEEE-488 bus. The user can combine a $150 panel meter with the $1,295 model 4874 to make a data-acquisition system, for

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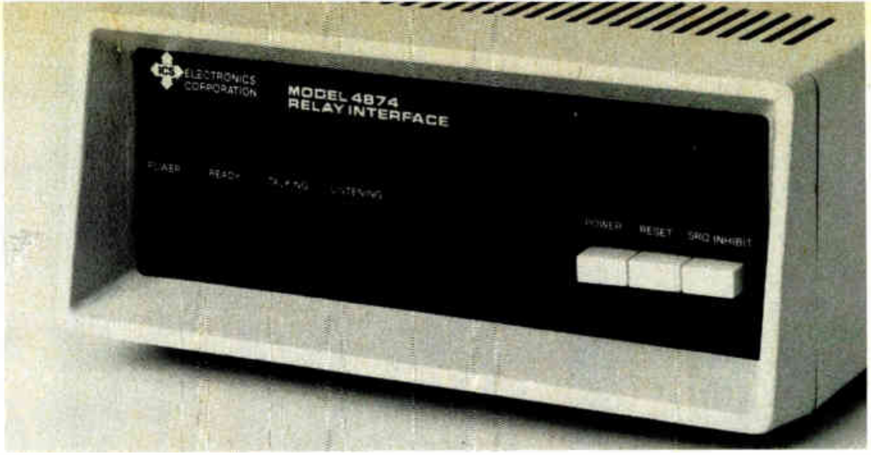


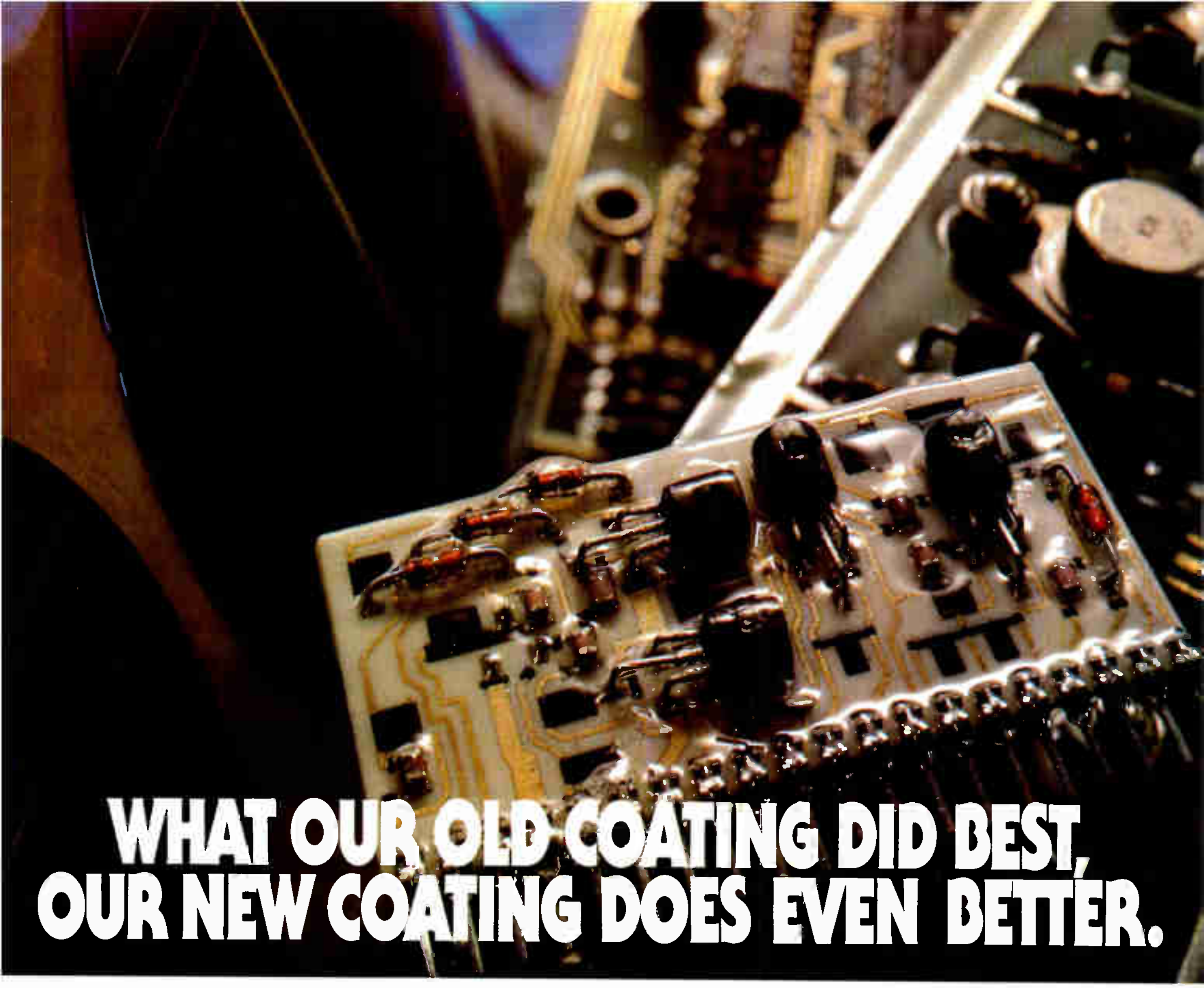
example. Because the relays are closed under the direction of the bus controller, this same arrangement can be used for process control as well as for monitoring a system.

The 4874 has a light-emitting-diode display that indicates which relays are currently energized for diagnostic purposes. Upon startup, an internal microprocessor performs a diagnostic routine on the relay unit. It can then generate and respond to several control signals: it can trigger a BCD-format instrument and send control pulses that can be held true for 20 ms in response to the universal device-trigger bus command. Relay status is available upon request via the IEEE bus. The response is in the form of six characters, each of which indicates the status of four relays in its 4 least significant bits.

Delays. The internal delays involved in closing the relays are held to under 1 ms, which means that in the scanning modes the settling time of the DPM and the response time of the controller become the determining factors in deciding how fast the channels are scanned. If the 4874 is used strictly as a monitor, it becomes a talker-only device that loads data into an input register after receiving the leading edge of an external data-ready pulse. Input data must be stable for 2 ms, typically, from the leading edge of the EDR signal to the end of the inhibit signal.

Some of the special functions available in the IEEE-488 standard are implemented in the 4874. It responds to a device-clear/selected-device-clear/IFC signal by de-energizing all relays and returning them to user-programmed startup patterns. It also resets all interface signals and puts out a reset pulse on the auxiliary control lines. An IFC pulse resets the IEEE bus interface.

The 4874 generates a service-request interrupt (SRQ) when external data is received and if the unit is not addressed as a talker. It also responds to a serial poll, placing an 8-bit character on the bus that indicates a process-status bits, whether or not it has external data ready, and



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Circle 189 on reader service card

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Dow Corning Corp., Dept. A-0023,
P.O. Box 1767, Midland, MI 48640

whether the service-request bus is active. A parallel poll command causes the unit to place the ready-status condition in the bit selected by the poll command.

Delivery is in 30 days.

ICS Electronics Corp., 1620 Zanker Rd., San Jose, Calif. 95112 [386]

D-a units are TTL-, C-MOS-compatible

A series of hybrid 12-bit digital-to-analog converters from Datel-Intersil maintains high performance and stability over commercial, industrial, and military operating-temperature ranges. The DAC-685 industrial models operate at from 0° to +70°C or from −25° to +85°C and cost from $59 to $81 in lots of 1 to 24. The military-grade DAC-687 models operate at from −55° to +125°C; their prices are $139 and $149, and screening of units to MIL-STD-883-B is available.

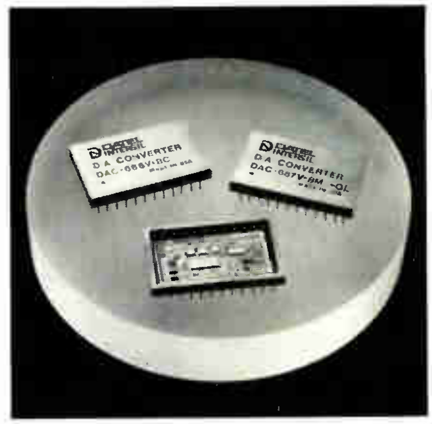
The 685 and 687 accept either 12-bit binary or 3-digit binary-coded decimal inputs; coding is either complementary binary or complementary BCD. The converters are compatible with both TTL and complementary-MOS—their 10-μA input current permits direct connection to C-MOS logic. Outputs with pin-programmable voltage or current are available. Voltage-output ranges are 0 to +5, 0 to +10, ±2.5, ±5, and ±10 V. Current outputs are 0 to −2 and ±1 mA for binary-model converters and 0 to −1.25 mA for BCD models.

All the converters are self-contained units that include a precision internal reference; voltage-output models also contain a fast-settling operational amplifier at the output. Voltage-output settling time is 3 μs to within 1/2 least significant bit; slew rate is 20 V/μs. Current-output settling time is 300 ns.

Maximum nonlinearity is 1/2 LSB in all binary-model 685 or 687 converters and ¼ LSB in BCD versions. Stability is good, with a differential

nonlinearity temperature coefficient of ±2 ppm/°C. Zero and gain temperature coefficients are ±5 and ±20 ppm/°C, respectively. Monotonicity is guaranteed over the converters' full operating temperature ranges.

The DAC-685/687 series converters operate using +5-V logic and ±15 V power supplies. Power supply



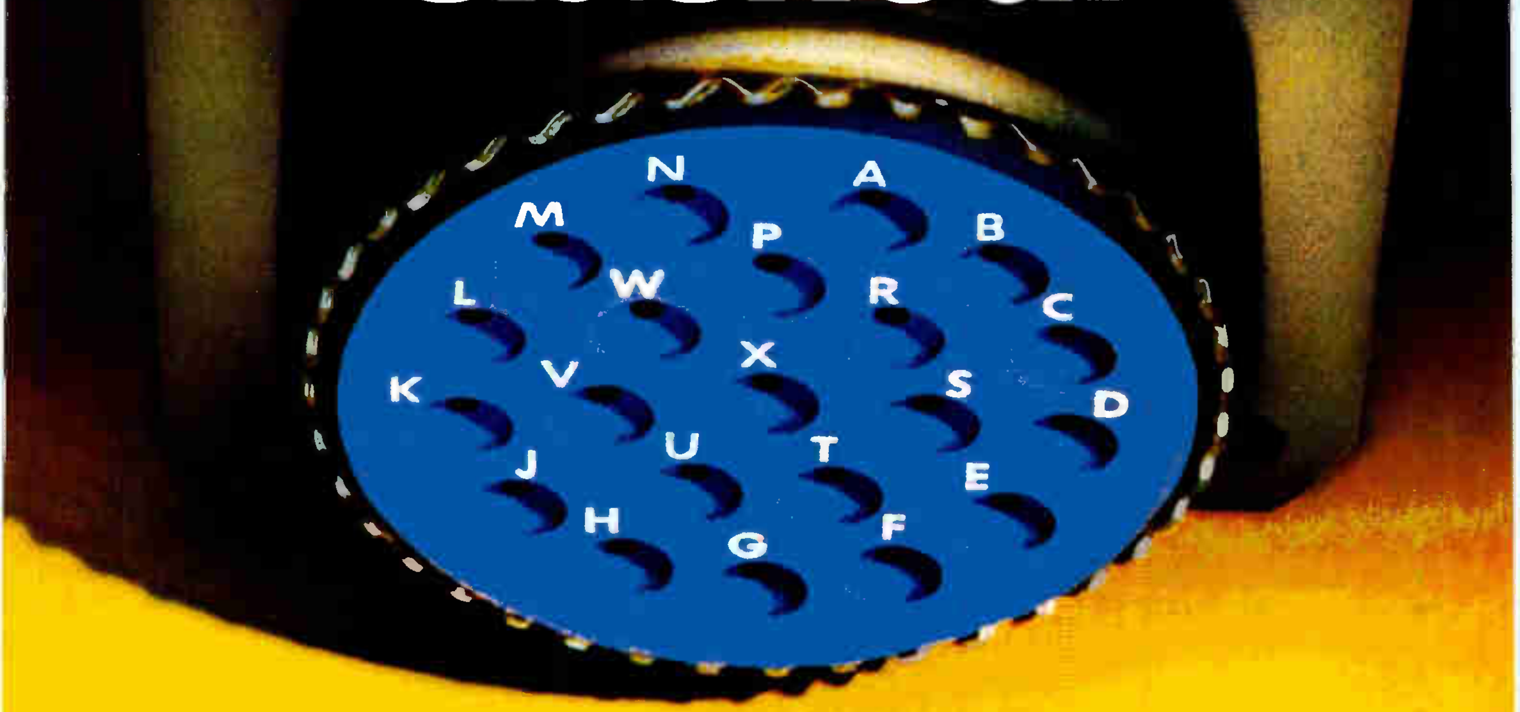
rejection is ±0.004% of full-scale range for a 1% change in supply level. Typical power dissipation is 770 mW. The converters come in hermetically sealed 24-pin dual in-line packages. Deliveries are from stock, and discounts are available to original-equipment manufacturers.

Datel-Intersil Inc., 11 Cabot Blvd., Mansfield, Mass. 02048. Phone (817) 339-9341 [387]

Switchers have low-ripple output

Elpac Power Systems has gone beyond the usual efforts to reduce noise output in the new top of its switching-supply line. Instead of testing for noise at frequencies up to 50 MHz, Elpac has checked for noise from dc to 300 MHz. High-frequency ripple that normally would not be detected can be eliminated this way, giving the user cleaner operation. The ES 100 achieves a noise output of less than 50 mV, peak to peak, measured to 300 MHz, a level comparable to those of competitive units measured to 50 MHz, according to

Lead time slashed!



Significantly improved deliveries on these industry standard Amphenol® connectors. Qualified to MIL-C-26482, MIL-C-38999, and MIL-C-83723. Preferred under MIL-STD-1353B.

Shown ½ actual size.

We've tooled up to give you super-fast delivery on most of these circular environmental connectors. You'll get them within weeks.

These connectors are manufactured to the highest class within the above MIL-Specs. They're used extensively in aerospace and avionics as well as military support equipment. So they're ideal for lots of other applications, too, wherever resistance to environmental threats is essential.

Each of these Amphenol connectors uses an all-polymer contact-retention disc with integrally molded contact-retention clips. It's our own advanced design and drastically reduces the number of connector parts needed.

These connectors are designated: Amphenol 118 Series (MIL-C-26482/Series 2); Amphenol 418 Series (MIL-C-38999/Series I and II); and Amphenol 518 Series (MIL-C-83723/Series III).

Tell us when you need them. Call your nearest Amphenol North America sales office for our new delivery schedule.

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Canada: Montreal (514) 482-5520 • Toronto (416) 291-4401 • Vancouver (604) 278-7636 • **International:** Oak Brook, Illinois TELEX 206-054

Circle 193 on reader service card

Edward Blackman, general manager of the firm.

The supply has a low components count, with less than 100 parts in the 100-W model. In addition to improving reliability, this aids in keeping the unit's profile low—only 2.38 in. high. Other dimensions vary depending on configuration, but the power-to-volume ratio is better than 1 W/in.^{3} in all cases. Open-frame models have provisions for easy and inexpensive mounting of covers.

Input voltage can range from 90 to 130 or 180 to 250 V; output will vary less than 0.1% within these input ranges. A variety of outputs are offered, including the common 5 V at 20 A. Others available are 12 V at 8 A, 15 V at 6.5 A, 18 V at 5.5 A, and 24 V at 4 A. Load regulation is better than 0.1% for all models. An overvoltage control automatically shuts off all power if control is lost and the power reaches 130% of desired output, to protect the supply. Output is also protected against reverse voltages.

Pricing for the 100-W unit is set at $136 in 1,000-unit purchases. In other configurations, the price is also $1.36 per watt. Delivery is in six weeks.

Elpac Power Systems, 3131 South Standard Ave., Santa Ana, Calif. 92705 [388]

Panel-mount unit prints 2 lines/s

The MAP-20S is a 20-column alphanumeric printer that mounts in the panel of a data-logging or -acquisition system. It is a thermal matrix unit that can physically replace Datel-Intersil Inc.'s popular APP-20

printer, offering higher printing speed and more standard features at lower cost, says Memodyne president Kevin Corbett. For instance, the MAP-20S has an internal self-testing program and an internal 115- or 230-V ac (switchable) power supply. The $725 unit weighs 4.2 lb and prints up to two lines/s, compared with APP-20's 1.2-line/s maximum.

The self-contained MAP-20S requires only a two-line serial interface with a system, accepting ASCII-formatted serial data from a 20-mA current loop or RS-232-C line. It prints a full 96-character set using a five-by-seven-dot matrix. Its microprocessor performs control, timing,

character-generation, print-head–drive, and motor-stepping functions. The processor also acts as a universal asynchronous receiver-transmitter with a 20-character buffer.

Input from a 20-mA loop is independent of current direction and optically isolated to 300 V rms to eliminate ground-loop noise in remote applications. The unit's RS-232-C connector has a standard control output to synchronize data loading from remote sources. An internal or external transmission-rate clock may be used, with 75-to-9,600-b/s rates jumper- or logic-selectable. Extended character sizes and inverted or normal list printing are also selectable. The printer automatically adjusts to 9-, 10-, or 11-bit incoming characters.

A front-panel switch activates

Why more engineers are switching to Beckman DMMs

Every day more engineers compare hand-held digital multimeters, then buy Beckman.

The reason: a unique combination of high-performance features designed to provide you with all the measurement capability and reliability you need. And the ease of operation you want.

Beckman Series 3000 DMMs give you an unbeatable combination:

Single center rotary switch lets you quickly and easily find and set the range and function you want.

10 amp current capability permits you to measure up to 10 amps ac or dc without adding a current shunt.

Insta-Ohms™ continuity indicator allows you to make continuity checks with the speed of analog VOMS.

2000-hour battery life typically keeps Beckman multimeters working up to ten times longer than other DMMs.

22 megohm input impedance increases Vdc measurement accuracy by reducing circuit loading.

Separate diode/transistor test function allows accurate measurement of forward voltage drops across diode and transistor junctions, even while in-circuit.

True RMS (ac + dc) measurement capability extends accuracy to non-sine waveform applications (Model RMS 3030).

Multimeters you can count on for a long time

To ensure that your multimeter keeps going, all Beckman DMMs provide you with superior RF shielding, custom-designed switch with gold contacts, 1500 Vdc overload and 6kV transient protection. Plus fewer electronic components for higher reliability.

The rugged case is sealed tight to keep out dirt and fluids, and designed strong enough to take a 6-foot fall onto concrete and still perform up to spec. The Model 3010 gives you 0.25% basic dc accuracy while the 3020 and 3030 deliver 0.1%.

When the comparisons are in, it's clear that Beckman DMMs really are head and shoulders above the rest – except in price. The Model 3010 is priced at just $140, the 3020 at $170 and the top-of-the-line 3030 – $210 (U.S. prices).

Isn't it time you switched to Beckman, too?

For information on the complete line of Beckman DMMs and accessories, call your local distributor today. For the one nearest you call: (714) 993-8803 or write Beckman Instruments, Inc., Electro-Products Group, 2500 Harbor Boulevard, Fullerton, CA 92634.

BECKMAN

Circle 197 on reader service card

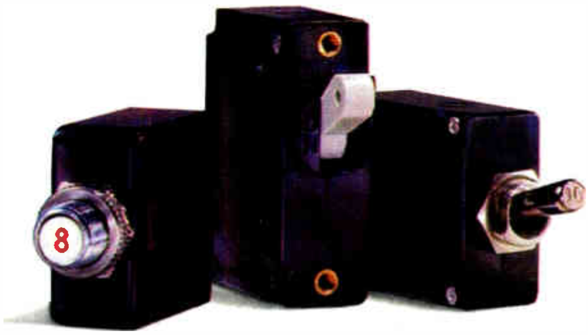
New products

either normal operation or the printer's self-testing full-character-set printout. An electronic end-of-paper sensor allows the unit to print to within the last inch or a paper roll; standard mechanical stop-print schemes can waste as much as 10% of the paper supply, notes Memodyne's Corbett. A flexible cable connection between the print head and electronics eliminates hard connections that can fatigue and break, thus increasing reliability. The MAP-20S is available from stock.

Memodyne will also be introducing a magnetic-bubble data recorder, the BMR8, which uses Fujitsu FMB31CA bubble-memory cassettes. The cassettes store 8-K bytes each in four 2-K-byte pages and are immune to the harsh conditions often found in remote data-logging or data-buffering systems. Data rates can be set as high as 19.2 kb/s. The recorder accepts RS-232-C, TTL, and 20-mA current-loop data,

converting it into 8-bit parallel format for storage at a rate of 2-K bytes/s. Special control characters can be written in a 9-bit code to differentiate them from other 8-bit inputs. The unit's operation makes it unnecessary to stop reading or writing at specific memory locations to prevent data loss. Memory can be recycled when full for continuous-loop recording. The BMB8 is priced at $1,495 and can be delivered in six to eight weeks.

Memodyne Corp., 220 Reservoir St., Needham Heights, Mass. 02194. Phone (617) 444-7000 [389]



When you use P&B circuit breakers, no one will blow a fuse.

Your customers certainly won't. They will appreciate the added value and convenience of circuit breakers. Especially when they're quality circuit breakers made by Potter & Brumfield. And you won't blow a fuse waiting for P&B circuit breakers either. They are available off-the-shelf from leading distributors backed by P&B's sizeable factory inventory. Available in thermal and magnetic hydraulic models from 0.25 to 60 amps. Potter & Brumfield Division AMF Incorporated, 200 Richland Creek Drive, Princeton, IN 47671. 812/386-1000.

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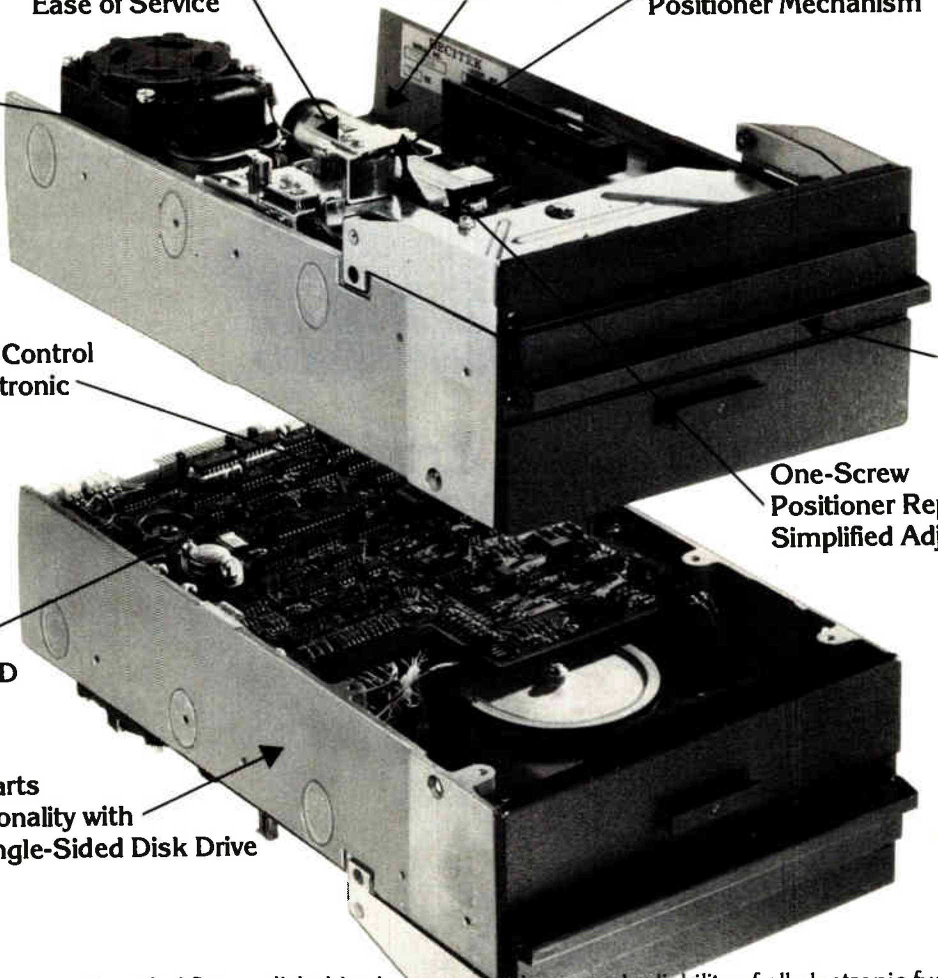
Shugart did it first. Decitek did it better.



Our new 8-inch double-sided floppy disk drive is everything that is great about Shugart's model. But that's where the resemblance ends.

100% Compatibility and More

Physically, electronically and cosmetically, our drive is 100% compatible with Shugart's—even right down to its standard color. Our holes are all in the right places. We're 100% interchangeable. Put their drive and our drive side by side in front of you and you wouldn't know which is which. Because it's what you don't see that makes the difference.

Our drive has 37% fewer parts. 50% greater reliability. A warranty that's twice as long as any other in the industry. A linear stepper motor that runs 50% quieter, takes less than 30 minutes to replace on site and can be installed and adjusted via one screw using one inexpensive tool. It uses microprocessor control providing optimum efficiency and reliability of all electronic functions. On-board diagnostics are a standard feature, as well as a LED fault indicator. And, unlike any other drive in the industry, our new double-sided model shares a 95% parts commonality with our single-sided drive. That means one set of spares serves both.

Better on the Bottom Line

And who says something better has to be either hard to get or more expensive. In fact, many of the improvements we've made to make our drive more reliable, more functional and more serviceable have also contributed to manufacturing efficiencies. Meaning our drive is available now, and available at prices that are equal to or less than those being quoted by the leader.

No. We weren't first. We're just better, any way you look at it. Decitek, 129 Flanders Road, Westboro, MA 01581 (617) 366-8334.

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Circle 200 on reader service card

100MHz, quad-input and dual time base... and that's just for openers!

B&K-PRECISION introduces the new standard for comparison in 100MHz lab scopes. With quadruple-input, *eight-trace display* and dual-time base operation, the 1500 is a no-compromise instrument. Moreover, this "new generation" scope utilizes a combination of new techniques never before applied to oscilloscope design.

The quad-input capability itself sets the 1500 apart from other scopes in its price class. The most common application for quad display is to use channels 3 and 4 as a "trigger view" for channels 1 and 2. Most competitive scopes offer only a single-channel trigger view. Another useful four-trace application is to display four digital signals, as found in microprocessor-based circuits.

Dual time base circuits permit independent operation of the A and B sweep circuits, allowing the 1500 to act like two 100MHz scopes. Signals unrelated in time can be applied to a combination of inputs.

Full delayed-sweep capability is built-in. The delayed signal from any input can be viewed as a second trace or superimposed on the non-delayed signal. Separate intensity controls are provided for the delayed and main time-base signals.

To speed and simplify operation, all function switching on the 1500 is performed by soft-touch lighted push buttons. When one of the function buttons is pressed, an LED illuminates the button confirming the change in scope operation. A non-volatile RAM retains the last function switch setting—even when power is removed.

A significant weight reduction was achieved by designing in a high efficiency switching power supply. Weighing only 16.5 pounds the 1500 is much lighter than other portable lab scopes. In fact, the most nearly comparable scope weighs 50% more!

Like other B&K-PRECISION products, the 1500 is available for delivery at local distributors. For the name of your nearest distributor or complete product specs, call 800/621-4627 toll-free.

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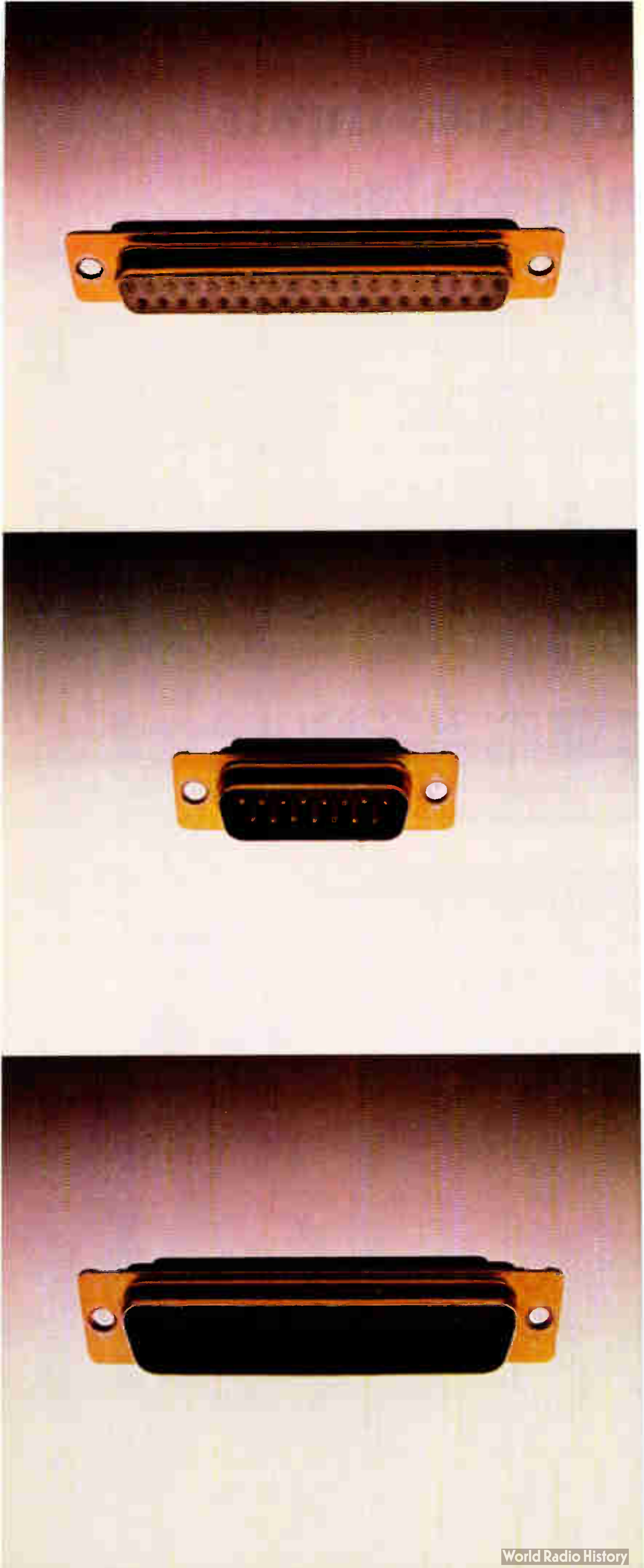
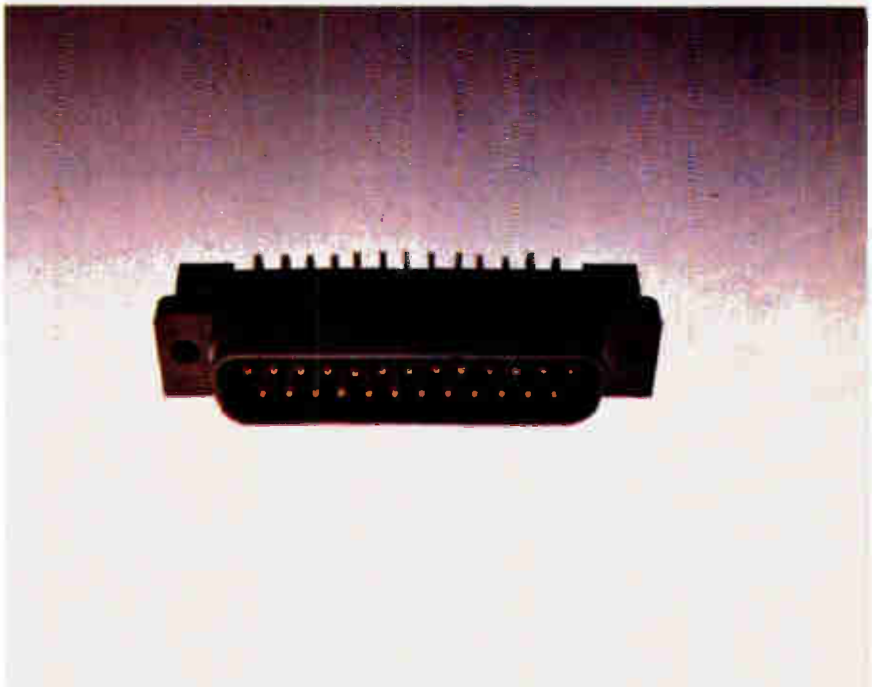
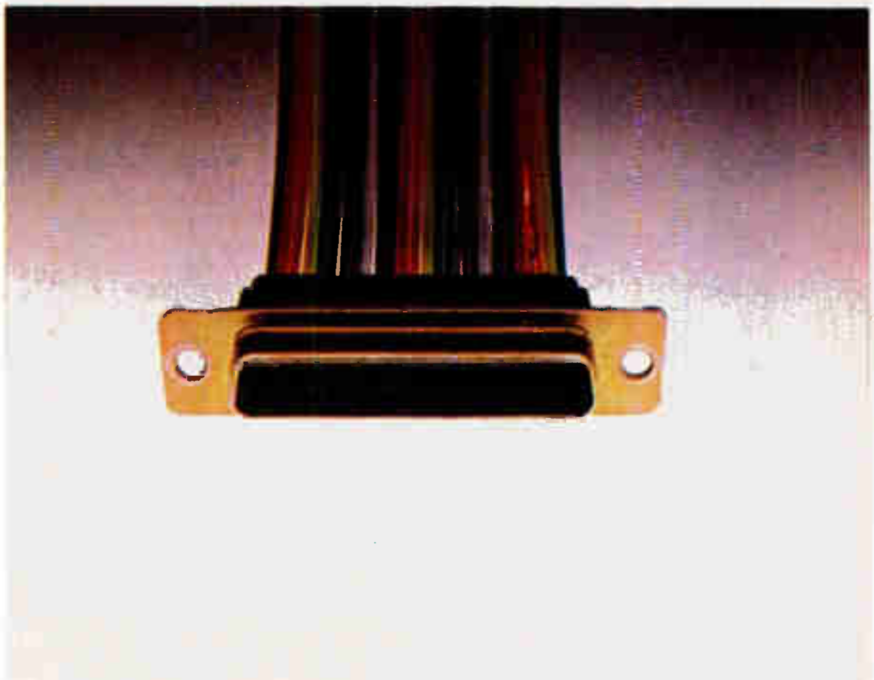


THE OLD STANDBY THAT WON'T STAND STILL.





In the beginning, there was the ITT Cannon Electric Original D connector with solder pot contacts in a two-piece insulator. But as technology leapt forward, so did we. With our BURGUN-D, ROYAL-D and long line of designs that answered new needs and became industry standards.

Now our latest technology can be seen in our Mas/Ter™ D pin-and-socket connectors designed for mass-terminating flat cable or individual wires. Our Mas/Ter D contact design provides 25% more wire-to-contact surface area to give you increased reliability and conductivity. And for added flexibility, they are intermateable and intermountable with our entire D Subminiature line.

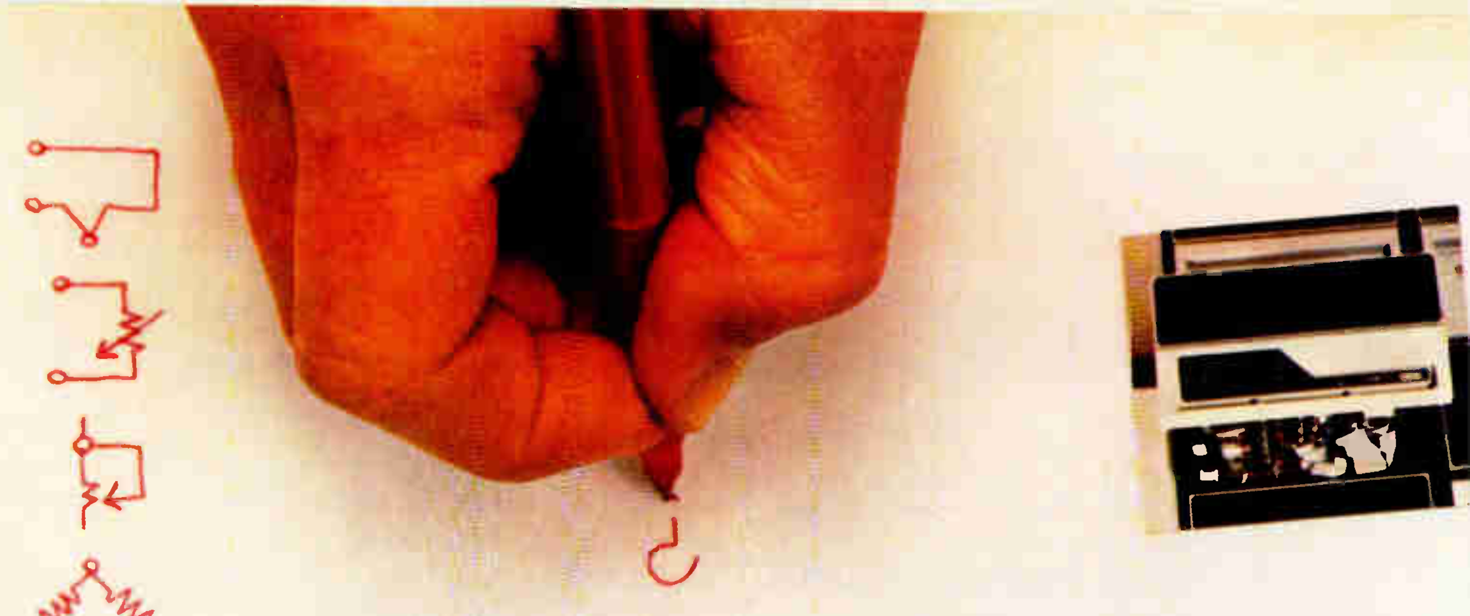
If you're not content to let technology pass by, look into the Cannon D Subminiature and Mas/Ter D connector evolution. You'll find a huge selection of low-cost connectors and accessories available right now through our worldwide distributor network. For immediate information refer to our pages in EEM. For literature, the name of your local Cannon distributor or other information contact Rectangular Division Marketing Manager, ITT Cannon Electric, a Division of International Telephone and Telegraph Corporation, 10550 Talbert Avenue, Fountain Valley, CA 92708. (714) 964-7400. In Europe, contact ITT Cannon Electric, Avenue Louise 250, B-1050 Brussels, Belgium. Phone: 02/640.36.00.

CANNON ITT

You can always connect with Cannon.

Circle 203 on reader service card

Circle 203 on reader service card



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The parameters involved in data acquisition applications are seldom the same. They vary in the quantity and types of transducer inputs and discrete I/O signals, speed and accuracy required, local or remote operation...and so on. When choosing hardware, you may feel that you must compromise your unique requirements for the sake of convenience...availability, integration, etc. You may buy an analog front end from a computer manufacturer...limited performance, at best. Or, you may take a chance with custom hardware from a "systems house"...expensive and poorly supported. Neff offers an alternative.

Our System 620 is a family of data acquisition products that can be configured to *exactly* meet your requirements...and because it's a family, integration is built in. A custom system built for you with standard...and *existing*...Neff products.

System 620 can handle a few channels or thousands of channels. It offers signal conditioning...and throughput rates to 50kHz, even with remote operation. Plus many sophisticated options...automatic transducer calibration and automatic zero offset, for example. And, of course, we have a standard interface to your computer and software drivers to your operating system.

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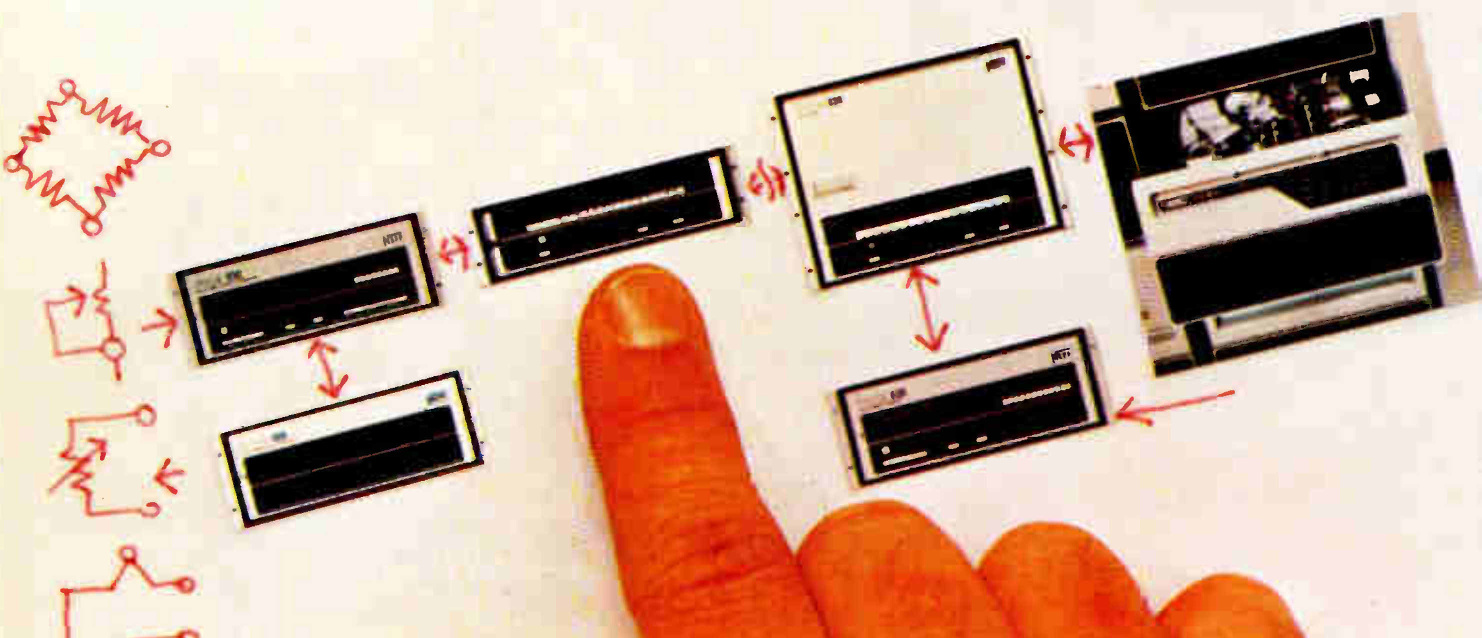

Circle 206 on reader service card

System performs complete SLIC tests

Tester automates direct transmission measurements of interface circuits to be used in PCM communications systems

by Harvey J. Hindin, Communications & Microwave Editor

Using its AMS-950 automatic-test-system technology as the base, W&G Instruments has brought to market what is said to be the first automatic tester for subscriber-line interface circuits. Known as the AMS-954, the system performs a complete range of pulse-code-modulation measurements for SLICs, including balance and return loss, common-mode rejection, intermodulation and harmonic distortion, and transhybrid loss. The system's capabilities include tests for: signal level, gain versus frequency, gain versus level, idle channel noise, out-of-band noise, and discrimination against out-of-band inputs and outputs.

SLICs are analog devices with two primary activities in a telephone system: they provide the battery and signaling voltages to subscriber lines and perform two-to-four- and four-to-two-wire conversion. They perform other functions, known in the telephone trade as Borsht functions [*Electronics*, June 5, 1980, p. 126].

As important as the measurements listed above are to the proper characterization of a SLIC's performance in PCM systems, Bob Handrahan, W&G's director of marketing, says that the AMS-954 SLIC tester is the first automatic tool ever available to make these tests "correctly and practically."

"Most automatic test equipment people just haven't been able to relate to the telephone transmission world," Handrahan notes. "The test requirements for telephone technology are very special to that technology." Explaining the W&G approach, Handrahan notes that "it is natural for us to apply traditional analog-transmission measuring techniques to solve the problems related to telecommunications. This is not the case with digital-oriented designers. The semiconductor people are finding themselves playing a vital role in telecommunications, but traditional measuring techniques are alien to those outside this telephone-oriented domain. Therefore, there has been a void in the marketplace for this necessary but very specialized test equipment."

The AMS-954 can handle both discrete and integrated-circuit SLICs, and can make its measurements according to either Bell System or CCITT recommendations for PCM equipment. It is remotely controllable and interfaces directly with the IEEE-488 bus.

The AMS-954 is delivered as an operational test facility for SLICs. However, Handrahan says that the SLIC testing capability can be added to the AMS-952 codec tester. Conversely, the 954 SLIC tester can be equipped to provide full PCM capability for testing codecs and filters.

Delivery of the SLIC tester is 120 days after receipt of order. Prices start at $85,000. Clearly the 954 is not for those with a casual interest in SLICs; but for semiconductor companies and others producing both hybrid and monolithic SLICs [*Electronics*, Feb. 24, 1981, p. 163]—and their telephony customers—the system offers repeatable results that telephony network designers can understand. Final costs depend on the hardware configuration and both the number and type of tests that will be run on the system.

W&G Instruments Inc., 119 Naylon Ave., Livingston, N. J. 07039. Phone (201) 994-0854 [338]

Introducing digital

NUMBER 116

NATIONWIDE MICROWAVE LINK FOR LIBYA

The Socialist People's Libyan Arab Jamahiriya has completed a nationwide microwave communications network that covers all major cities and towns in the country.

Since 1978, NEC has been working to complete spur microwave links to blanket Libya's cities and towns off the trunk systems so as to form a nationwide microwave network for both telephone and television.

The spur links completed throughout the country include a total of 100 terminals and repeater stations extending over 53 hops. The links are equipped either with 7.5GHz or 4GHz microwave equipment, and can provide 300 or 960 telephone channels.

NEC completed the country's trunk microwave system in 1974. A trans-horizon tropo-scatter link was installed in 1975, and an inland microwave system across deserts was opened in 1978.

A microwave communication repeater station in operation at Mrassas, Libya.

SECURITIES COMPANY GETS C&C FACSIMILE NETWORK

The Daiwa Securities Co., Ltd. of Tokyo is to have a high-speed integrated facsimile system by June 1981. NEC will design, manufacture and install the system in a typical application of the company's "C&C" capability—full integration of computer and communications technologies.

Together with the existing data processing system, the new message switching, store, and forward exchange system will form an on-line network. This will consist of a host computer subsystem, a pattern processing subsystem and a multiple switching subsystem, with 3 transmitting stations and about 130 receiving stations throughout Japan.

Each receiving station can have the stock price information—stored in the host computer in the center—fed out on its high-speed facsimile receiver in the form of graphs and tables merely by keying on the data terminal at the station.

The facsimile transceiver to be used is the high-speed digital NEFAX-6200. This machine can transmit a typical business document in 40 seconds or less.

NEW LSIs TO DRIVE LCDs.

Now available from NEC are two types of new LSIs.

The µPD7502G is a CMOS 4-bit single-chip microcomputer with a built-in liquid crystal driver. The µPD7225G, also a CMOS LSI, is designed to be interfaced with a microcomputer requiring an external circuit for driving liquid crystal.

A liquid crystal driver is normally an independent circuit. In the past, a single-chip microcomputer like the µPD7502G was considered impractical because of the very intricate control circuit required.

The µPD7502G also features: (1) A standby mode to minimize power consumption; (2) Ability to use its program fully for control and operation. (3) A "serial interface" capable of transferring data in series; (4) General-purpose microcomputer capability.

The µPD7225G is designed to be used in conjunction with another microcomputer. Features of the µPD7225G include: (1) Low power consumption; (2) Ability to increase its display digits; (3) Built-in character generator to display a total of 48 alphanumerics; (4) Programmable blinking.

NEC
Nippon Electric Co.,Ltd.
P.O. Box 1,Takanawa,Tokyo,Japan.

Packaging & production

Unit aids uniform wafer exposure

Exposure-intensity profiler helps in adjustment of optics in wafer-aligner equipment

For high-yield photolithography it is vital to adjust aligner optics for uniform exposure across the plane of a resist-covered wafer. An instrument from Optical Associates Inc., the 311 intensity profiler, is designed for this purpose.

The system uses a bar-graph display composed of nine columns of light-emitting diodes, each column presenting a graphic portrayal of the intensity levels at a single site. The nine-sensor probe employed by the profiler enables the user to measure light intensity at nine points on the wafer plane continuously. The optics for a contact or proximity aligner can thus be adjusted for uniform intensity over the entire wafer plane.

The optical probe must be positioned so that its nine sensors lie in precisely the same plane as will the surface of the wafer. The profiler measures ultraviolet-light intensity via the sensors in the probe and compares each measured value with a reference level. Deviations are displayed simultaneously on the nine bar graphs. The light source of the aligner is then adjusted for maximum intensity (indicated in milliwatts per square centimeter) at the center of the probe. The final step is to adjust the light source to establish a profile of uniform intensity over the entire wafer.

In the center mode, the intensity sensed by the center sensor serves as the reference level. In the select mode, the user can select any of the nine sensors as reference with nine buttons. In the float mode, the system computes the average of the nine sensed values and uses that as the reference level.

The display is calibrated in three ranges: ±50%, ±20%, and ±10%. In the autorange mode the instrument switches to the range necessary to include the sensed value that deviates the most from the reference level.

As the user adjusts the aligner's

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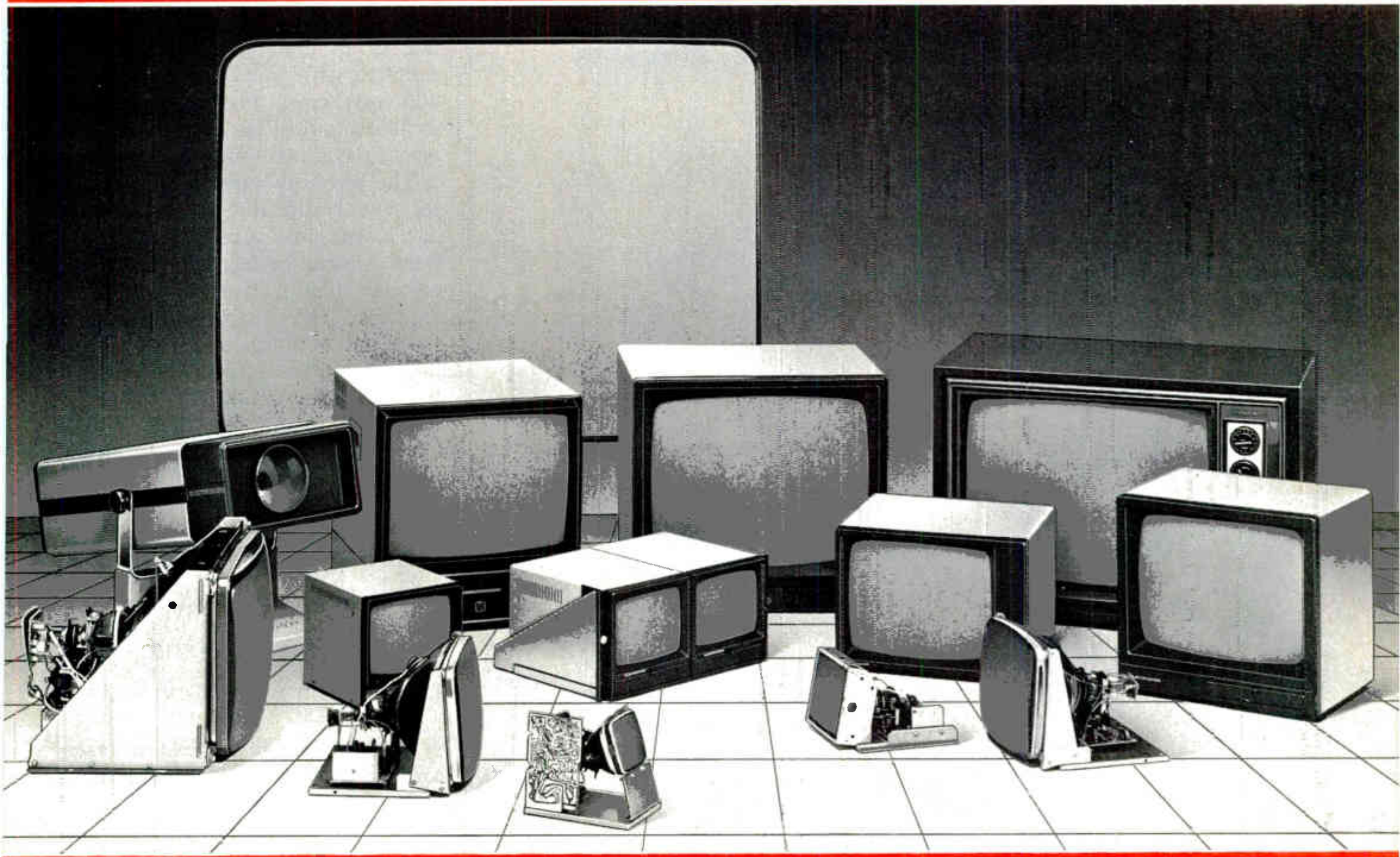

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809 Wellington St. N., Kitchener, Ontario, Canada N2G 4J6. Telephone (519) 744-7111. Telex 069-55449

Circle 213 on reader service card

optics so that the intensity levels approach a common value, automatic range-selection circuitry narrows the range accordingly. A digital panel meter indicates intensity values in mW/cm². Full scale is 40 mW/cm², but as an option, the 311 can be supplied with a maximum range of 400 mW/cm². The DPM can be switched to read the average value or one of the nine sensor values.

The intensity profiler is specified to have National Bureau of Standards–traceable accuracy of ±7%. Sensor-to-sensor relative deviation is no more than ±1%, the manufacturer says. The instrument operates from line voltages of 90 to 130 or 200 to 260 V ac, 50 or 60 Hz. A battery pack is optional.

Pricing is not yet firm, but is expected to be approximately $4,000 per unit. Deliveries will begin in May or June.

Optical Associates Inc., 3300 Edward Ave., Santa Clara, Calif. 95050 [391]

Laser scriber is programmed for engraving or cutting

Numerical control makes the Laserscribe model 604-NC user-programmable for scribing, engraving, and cutting a wide variety of materials. The operator enters data directly on a teletypewriter keyboard or by means of a punched tape. The data directs the model to cut patterns, either singularly or repetitively in any desired sequence. Not limited to software patterns stored in a memory, the operator can program any combination of straight lines or circular patterns. The instruction format is a subset of the standard Elec-

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Circle 215 on reader service card

tronic Industries Association's numerical-control instructions.

The scribing and cutting process of the 604-NC is performed by overlapping pulses of a switched neodymium–yttrium-aluminum-garnet laser that heats the material above the vaporization point. The beam is nominally less than 1 mil in diameter. The depth of the kerf can be precisely controlled for either a high-yield cracking of the wafers or a complete cut through with multiple passes.

Quantronix Corp., 225 Engineers Rd., Smithtown, N. Y. 11787. Phone (516) 273-6900 [395]

Sockets attach leadless carriers to boards

The Zebra 7000 series of sockets provides a solderless way of mounting leadless ceramic chip-carriers on printed-circuit boards. The chip-carrier is inserted in a plastic socket containing four Zebra connectors, and the socket is then attached to the pc board with a single No. 2-56 screw. Electrical connection is made by closing the socket lid and thus applying pressure to the contact-socket assembly.

The series 7000 has a low electrical resistance and assumes the board and carrier's tolerances and warpage as well as their different thermal coefficients of expansion.

The sockets are available from stock. In original-equipment–manufacturer quantities, they sell for 5¢ to 6¢ per contact.

Tecknit Inc., 129 Dermody St., Cranford, N. J. 07016. Phone (201) 272-5500 [393]

Quad in-line adapter mates with pc boards

The 680-QUIL-15 adapter is custom-designed to mate a user's own hybrid module with a standard printed-circuit board configuration. It converts contact configurations from an 80-position quad in-line pattern into a standard 0.300- and

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0.600-in. universal in-line spacing.

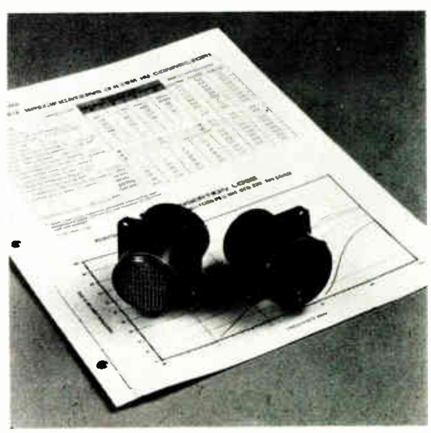
The adapter's socket features precision Swiss screw machine contacts with a four-tine beryllium-copper gold-plated spring clip and a gold- or tin-plated brass body and can be supplied with dip solder or wrapped-wire terminations. The 680-QUIL-15's body is 0.062-in.-thick laminated glass epoxy and conforms to Underwriters Laboratories' specification 94V2.

Garry, a Division of Brand-Rex Co., Box 94, North Brunswick, N. J. 08902. Phone (201) 846-5280 [394]

Filtered connectors replace hardwired filters

The 418F series of filtered connectors meets all the performance requirements of MIL-C-38999G except those involving temperature-shock and voltage at altitude. The circular devices have a radio-frequency current-grounding capability that is 12 times better than that of standard circular connectors for a contact-current rating of 5 A dc. They can simultaneously pass 3 A of rf current to ground. The Defense Electronics Supply Command has approved their use in environments where electromagnetic-interference and electromagnetic-pulse problems may exist.

The 418F can replace the discrete filters in black boxes that are hardwired to equipment requiring protection from emi or emp. The connectors eliminate the threat of equipment failure associated with hard



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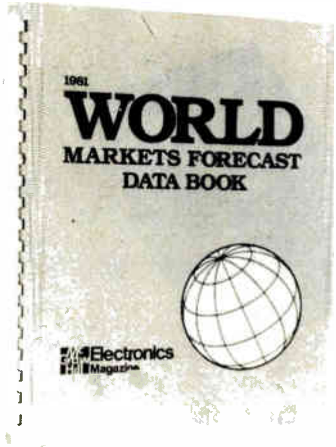

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wiring and occupy up to 70% less space. Four standard filter contact types are available with cutoff frequencies of 9 and 2.5 MHz and 400 and 60 kHz.

The complete 418F series consists of eight high-density insertion configurations from 13 to 128 contacts. The 128-contact connector sells for approximately $300. At the present time, delivery is in about 26 weeks.

Amphenol North America Division, Bunker Ramo Corp., 2122 York Rd., Oak Brook, Ill. 60521 [396]

Laser system welds dissimilar metals

A laser welding system joins dissimilar metals such as copper, aluminum, stainless steel, Kovar, titanium, and Waspalloy in a wide variety of configurations. The SS-484 solid-state laser produces conduction welds of over 0.050-in. penetration and hermetic seam welds at a rate of over 6 in./min. It comes with a laser head, power supply, and monocular lens, as well as controls for the pulse length, rate, and energy.

The SS-484 is used to spot-weld parts where no heat distortion can be tolerated, for positioning prior to vacuum brazing, to weld parts that are mechanically inaccessible or near heat-sensitive components, and for solder-reflow work.

The SS-484 laser welding system has a maximum average power output of 100 W, a variable pulse rate of up to 30 pulses/s, and a spot diameter of 0.010 to 0.081 in. It has an input power requirement of 440 to 480 V ac at 60 Hz in three phases. It is priced at $49,850. Delivery is usually three months after receipt of order.

Raytheon Co., Laser Center, Fourth Avenue, Burlington, Mass. 01803 [397]

Four-set tool kit aids work on optical connectors

The HFBR-0100 set of kits provides easy installation of Hewlett-Pack-

The new Spectra-Strip 817 is the IDC D-subminiature connector for those of you who've become disenchanted with D-Sub's.

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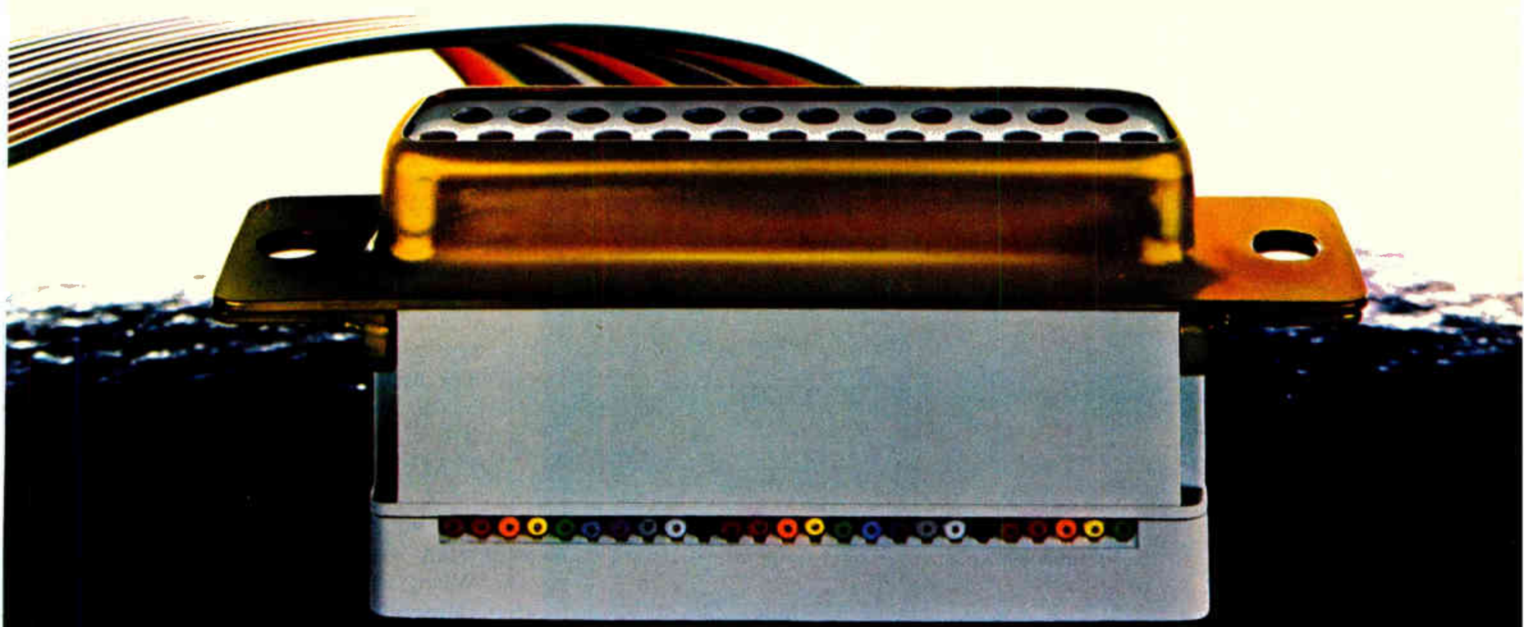

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Circle 221 on reader service card

ard's HFBR-4000 connectors onto HFBR-3000 through -3400 series of 100-to-140-μm optical-fiber cables. Included in the kits is a set of common connecting tools. The HFBR-0101 kit is available for assembling 10 fiber-optic connectors; the HFBR-0102 contains a set of custom tools; the HFBR-4000 has a set of connector parts for terminating 10 connector ends; and the HFBR-3099 kit includes adaptors for making connector-to-connector junctions. Also included with each kit is a step-by-step illustrated user's manual. All of these kits are included in one complete kit, the HFBR-0100. The HFBR-0100 fiber optic connector kit makes factory-quality connections (1.58 dB typical loss). An experienced user can join a connector to fiber-optic cable in less than 20 minutes. The collective kit is priced at $1,200.

Hewlett-Packard Co., 1507 Page Mill Rd., Palo Alto, Calif. 94304 [398]

Antistatic carriers protect static-sensitive devices

Static-sensitive semiconductor devices can be protected through handling, processing, testing, and shipping with Welcon antistatic carriers. All Welcon standard carriers, for dual in-line packages, medium- and large-scale integrated circuits, and TO-5 devices and flatpacks, are molded in a special antistatic and semiconductive plastic compound. The antistatic material has a nominal surface resistivity of 10 GΩ and will withstand temperatures of up to 125°C. The carriers will not contaminate semiconductor lead materials, will not flake or peel, and are free from particulate contamination. When subjected to common cleaning solvents used in the aerospace and electronics industries, they require a brief reorientation period to restore surface properties, says firm.

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Wells Electronics Inc., 1701 S. Main St., South Bend, Ind. 46613 [400]

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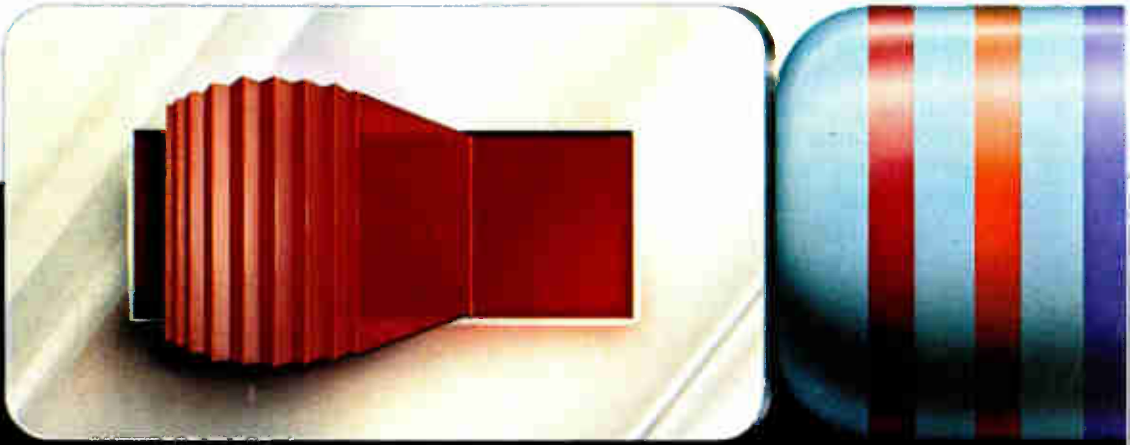

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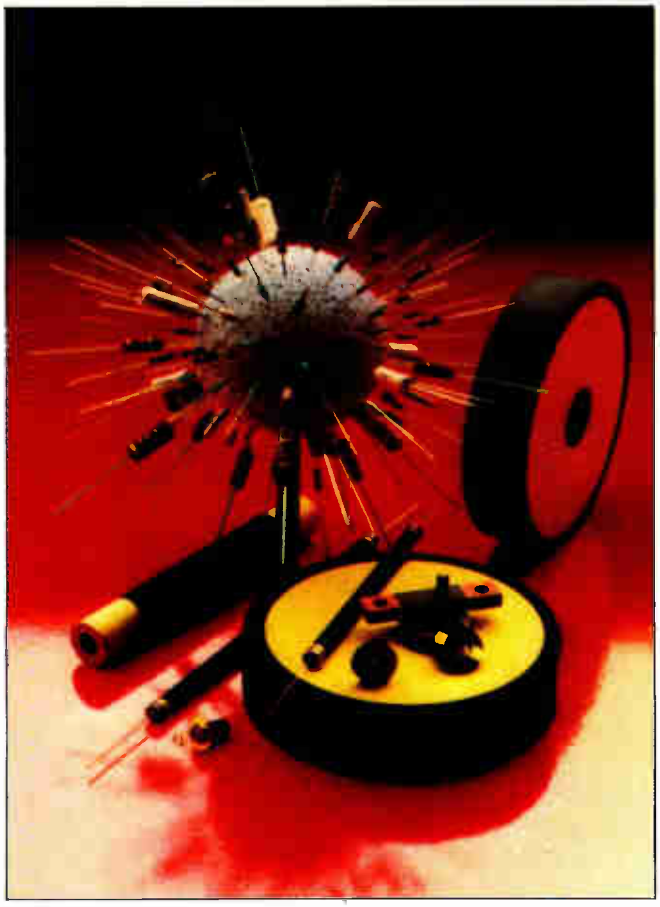

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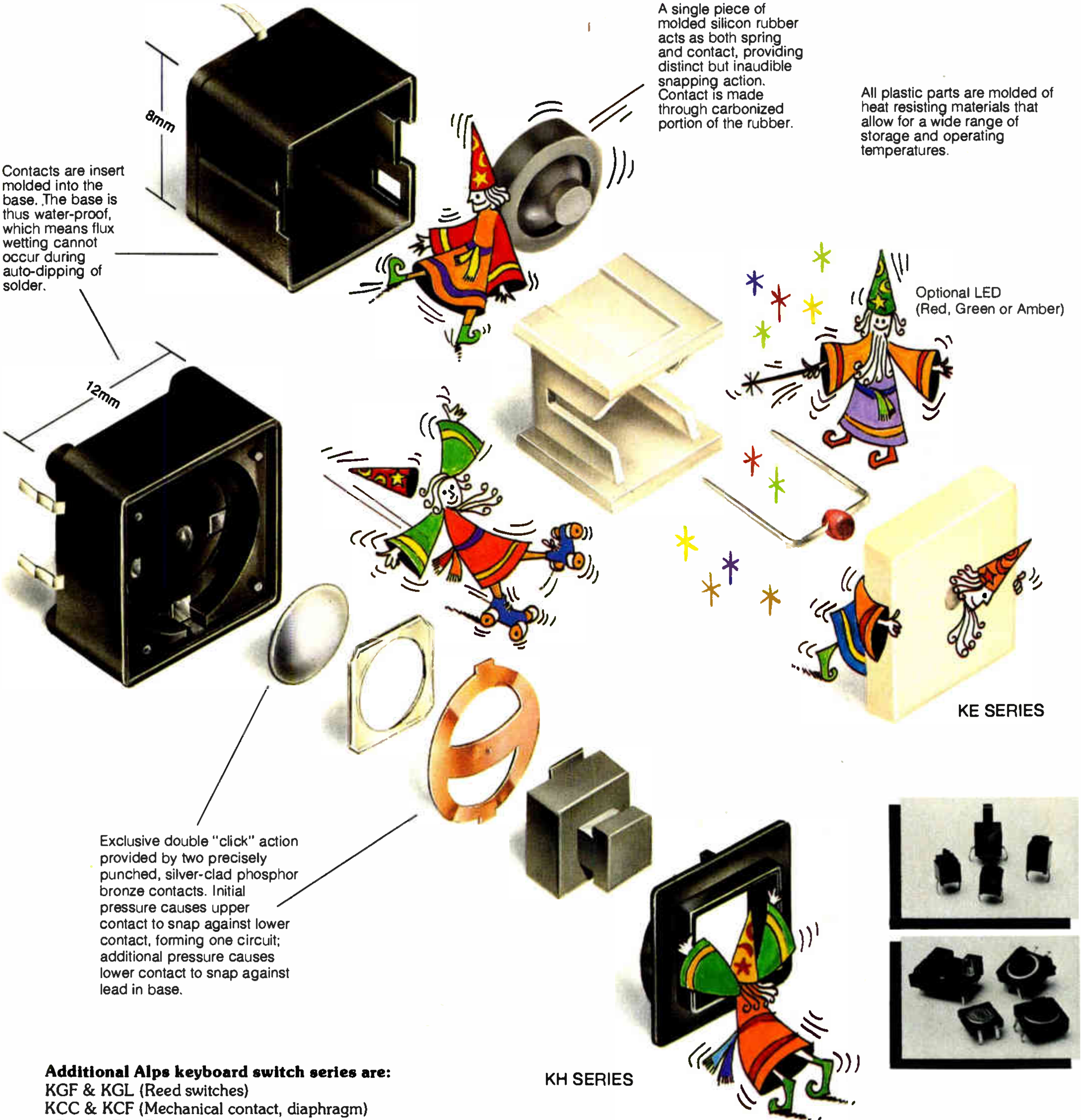

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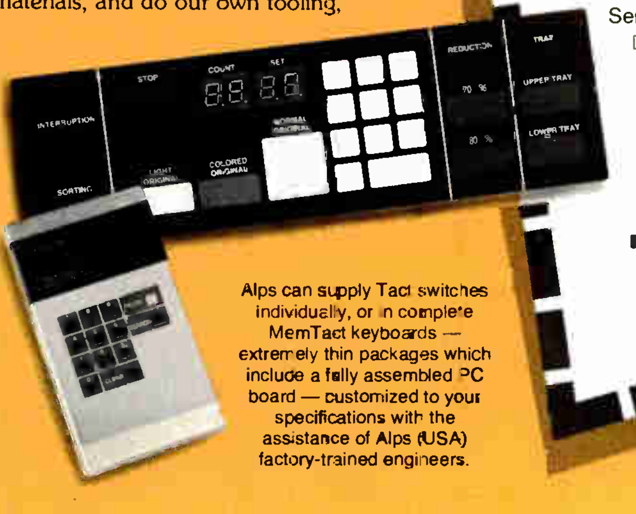

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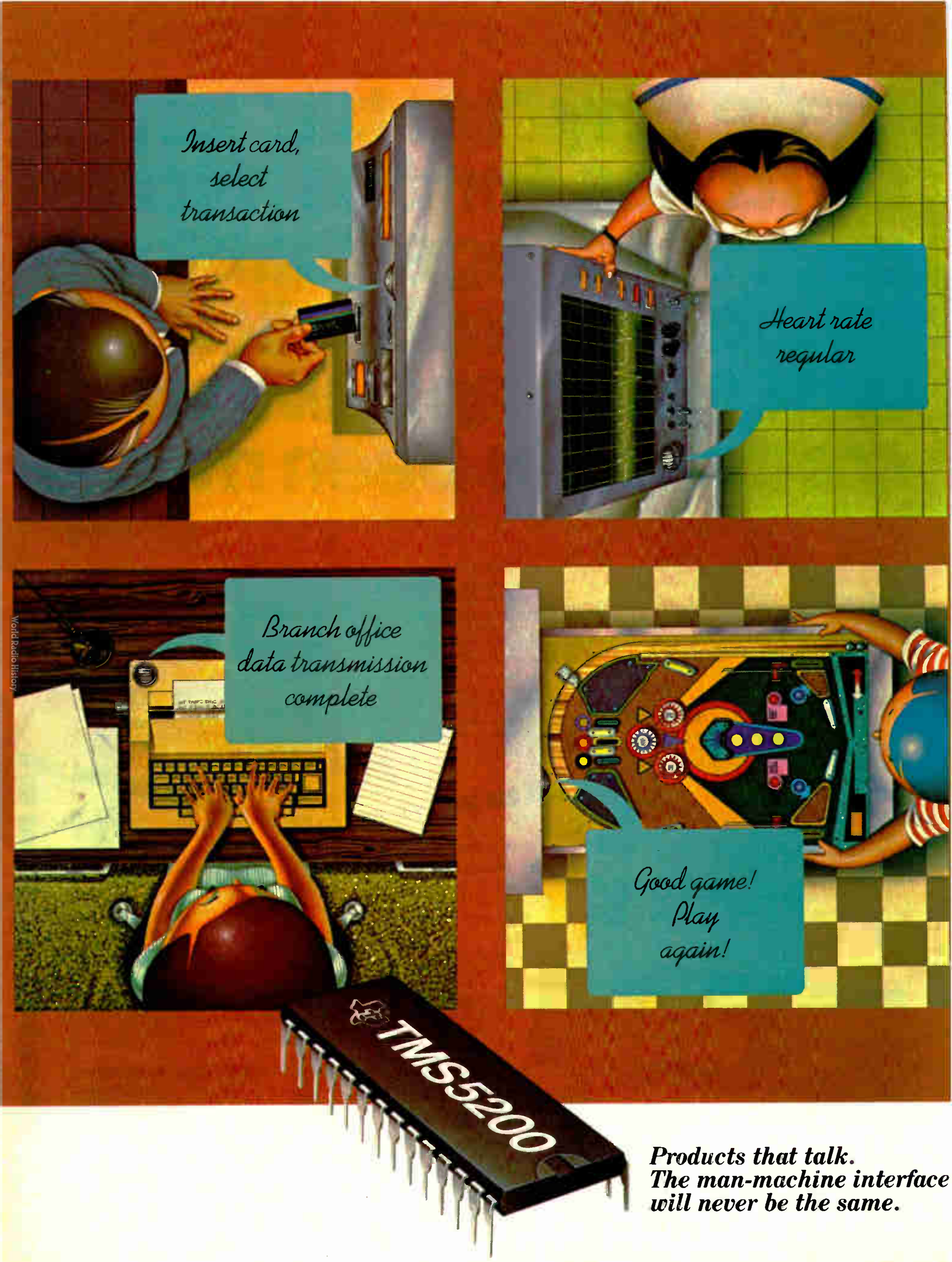
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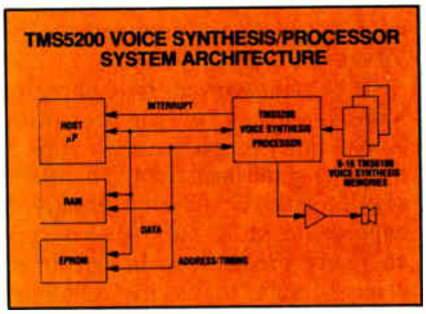
Choose from the industry's broadest, most cost-effective line of speech products. A growing line of integrated circuits, evaluation kits, OEM boards and a capability for the design and development of complete custom modules incorporating microprocessors, display and interface functions. A good example of our commitment to this technology: ROMs made especially for speech applications.

TI's LSI Voice Synthesis processors (VSP) and Voice Synthesis memories (VSM) are in volume production, now.

The TMS5200 single chip VSP produces high quality speech at a very low data rate (1200 bps), easily interfacing with 8 and 16-bit microprocessors. The on-chip FIFO buffer allows speech data to be stored in either the host microprocessor system, or off-line on bubble memory or floppy disk. Also, speech data may be stored in a custom ROM, such as the 128K-bit TMS6100. You can use TI VSPs with TMS6100 Series VSMs for storage of up to 3,000 words of speech.



The TMS5100 single chip VSP produces high-quality speech at data rates of 1200 bps and interfaces with 4-bit microprocessors. TMS5100 VSP directly addresses up to 16 TMS6100 VS memories for up to 30 minutes of speech.

For evaluation of TI's voice synthesis capabilities for 4, 8 and 16-bit microprocessors, complete speech evaluation kits are available for TMS5100 and TMS5200.

So, what are we talking about? We're talking about quality, flexibility, cost/performance effectiveness and right now delivery — only from the voice synthesis leader — only from Texas Instruments.

There's more. We're also talking about custom modules and boards. Like the TM990/306 speech module without standard vocabulary for applications using customer-specified words and shipped without EPROMs, allowing users to install Solid State Speech* vocabularies developed specifically for their own applications.

For high-volume applications, user-developed vocabularies can be implemented on mask-programmed ROMs.

The benefits of the custom module approach are both time and cost related. TI's experience in the design and production of electronic modules means quick cycle times, substantial savings, and, of course, getting your product to market faster.

Let's talk support

Like the development of production vocabularies at any of TI's Regional Technology Centers. Custom vocabularies can be synthesized at the RTCs at low cost with quick turnaround (so quick in some cases that you can walk out the door with your program) and delivered on EPROMs for use with either TI's TM990/306 speech board or TMS5000 Series VS processors.

And like tapping the resources of TI's word library where natural sounding speech is pre-recorded and readily available for specialized vocabularies.

And like an intensive one-day RTC seminar covering TI's Solid State Speech technology and its applications, including acoustics, phonetics, waveform analysis and LPC. Systems architectures as well as hardware and software design techniques and a demonstration of several speech products round out the day.

And like the Design Service assistance rendered by the RTCs for the application of cost-effective, state-of-the-art technologies to your specific product and program needs.

Let's talk now

About a total systems solution capability for voice synthesis technology. About low-cost, high-quality, quick turnaround Solid State Speech applications for your products.

Talk to your nearest TI field sales office, or write to Texas Instruments Incorporated, P.O. Box 225012, M/S 308, Dallas, Texas 75265.

TEXAS INSTRUMENTS
INCORPORATED

*Solid State Speech is a trademark of Texas Instruments Incorporated.

85904

Circle 229 on reader service card

Communications

Transceiver handles 10 Mb/s, hooks to Ethernet

Notwithstanding all the publicity about it, products that hook into the Ethernet local network are hard to come by. But 3Com Corp. has accepted orders from more than twenty customers for preproduction models of its 10-Mb/s Ethernet transceivers. It is the second of the company's projected series of hardware and software products that will enable users to connect to the 10-Mb/s Ethernet system.

"The transceiver is compatible with chapter 7 of the DEC-Intel-Xerox Ethernet physical-layer specifications published Sept. 30, 1980," says Ronald C. Crane, director of engineering at 3Com. "We have taken many precautions in our transceiver design to ensure reliability. For example, the transceiver's front-end circuitry tolerates coaxial-cable transients. Also, the transceiver supports controller time-domain reflectometer functions for use in Ethernet cable maintenance."

3Com was founded in 1979 and recently introduced its first product, the Unet communications software package for Unix, the Bell system computer operating system. It enables Unix version 7 users to build a communications network implementing the recently adopted Department of Defense IP and TCP communication standards. Unet software is designed to communicate over a variety of physical media, from RS-232-C to Hyperchannel, and permits file transfers, electronic mail, virtual terminals, and interprocess communication. The software package is available under a licensing agreement.

Each 3Com Ethernet transceiver has standard N-series connectors for coupling to the coaxial Ethernet cable and comes with a 50-ft transceiver cable.

Prices are $550 each for the first 10 units and $365 each for larger orders. Further volume discounts are being made available to original-equipment manufacturers.

3Com Corp., 3000 Sand Hill Rd. No. 1, Menlo Park, Calif. 94025 [401]

20-MHz video receiver and transmitter use fiber optics

The system 8211 fiber-optic receiver and transmitter set can transmit composite color or monochromatic video signals in closed-circuit television applications as far as 2 km without equalization or repeaters.

The model 8211T transmitter uses as its optical source a gallium-aluminum-arsenide light-emitting diode. It can handle composite video input of 0.5 to 2 V peak to peak supplied from such sources as closed-circuit TV cameras and video tape recorders. The depth of modulation on the LED can be internally adjusted although it comes preset for a 1-V p-p input. The model 8211R receiver

Our special designs...
for your special designs.

Special Precision Potentiometers

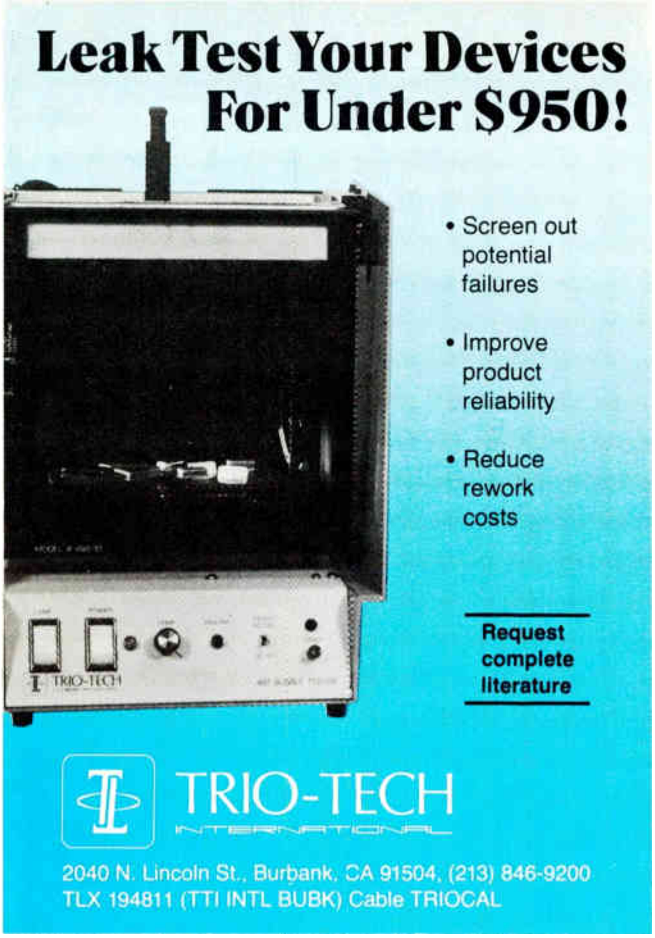
Our customers have discovered that Spectrol's special designs often help make their special designs superior. If you have applications for unique potentiometers, here's why you should consult Spectrol: 25 years experience making both standard and special potentiometers...a strong applications engineering department...expertise in all technologies, wirewound, cermet, and conductive plastic...worldwide design and manufacturing facilities, backed up by UTC, one of the world's largest international companies. Let us quote your special designs – non-linear, sine-cosine, sectors, and linear position models. Let us help you meet "impossible" environmental operating conditions. Start with your local Spectrol representative, or call our applications engineering manager today.

Spectrol

SPECTROL ELECTRONICS GROUP

UNITED STATES **Spectrol Electronics Corporation** P.O. Box 1220, City of Industry, Calif. 91749, U.S.A. • (213) 964-6565 • TWX (910) 584-1314
UNITED KINGDOM **Spectrol Reliance Ltd.** Drakes Way, Swindon, Wiltshire, England • Swindon 21351 • TELEX: 44692
ITALY **SP Elettronica SpA** Via Carlo Pisacane 7, 20016 Pero (Milan) Italy • 35 30 241 • TELEX: 330091
GERMANY **Spectrol Electronics GmbH** Oberauerstrasse 15, 8000 Munich 70 West Germany • (089) 7145096 • TELEX: 52/3014
PUERTO RICO **Spectrol Caribe Corporation** Las Marias Industrial Park, Anasco, Puerto Rico • (809) 826-3012 • TELEX SCC PR 3452012

Circle 231 on reader service card



Circle 232 on reader service card

converts the optical signals back into a 1-V p-p signal into a 75 Ω load, using a silicon p-i-n photodiode. The receiver's bandwidth is typically 20 Hz to 20 MHz.

The compact 6-by-3-by-1-in. units are ac-powered, and a remote power supply is included with the set. A set with a 1-km fiber-optic cable with connectors sells for $2,595. Delivery can be from stock or may take up to six weeks.

Lightwave Communications Inc., 57 Glen Hills Rd., Meriden, Conn. 06450 [403]

Broadband antenna measures emi, rfi in 1-to-18-GHz range

The model 3115 double-ridged-guide antenna measures and radiates electromagnetic and radio-frequency-interference signals in the 1-to-18-GHz frequency range. The antenna has performance characteristics that are not usually found in a broadband antenna. Not only do two or more antennas usually cover this broad frequency range, but the 3115 offers an average gain well over 10 dB, says the manufacturer. It has been engineered to meet present and proposed military standard specifications for electromagnetic interference. The antenna sells for $1,885 in single units. Delivery is from stock but may take up to 45 days.

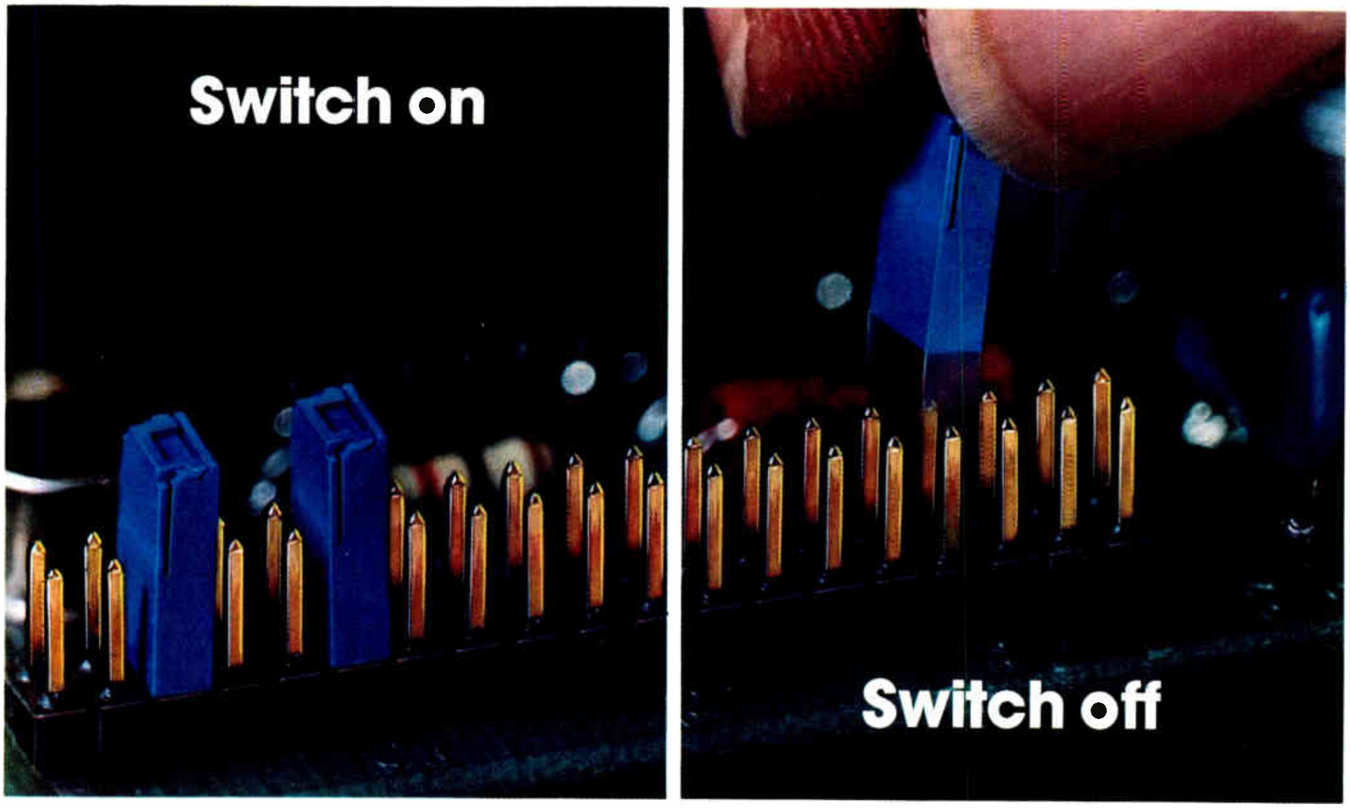
The Electro-Mechanics Co., P. O. Box 1546, Austin, Texas 78767. Phone Mike Brennan at (512) 451-8273 [404]

Optical fiber has 100-μm glass-clad core

A series of partially graded-index optical-fiber cables have a 100-μm–diameter glass-clad core that combines the installation advantages of step-index fibers with the stability associated with all-glass graded-index fibers. The series 2260 cables carry attenuation ratings of 9 dB/km maximum at 850 nm. They use a Corning fiber with an outer diameter of 140-μm including the cladding. The overall diameter of the cables,

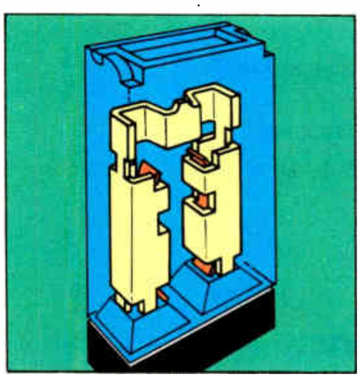
Circle 102 on reader service card

DIP switches can deprogram. Berg's Mini-Jump™ can't. Our design guarantees it.



Far more reliability. Far less field service. Accidents, vibration — anytime you'd expect a DIP switch to fail, you can count on Mini-Jump* to stay programmed. Careless fingers can't deprogram it because there's no switch to hit. Only a deliberate action can change the circuit.

The interior spring of the "Mini-Jump" maintains a high normal contact force for reliability during vibration — even severe vibration. And, because you install the "Mini-Jump" after soldering, you avoid contamination which can lead to corrosion.



Inside the "Mini-Jump", dual metal PV† contacts provide excellent electrical and mechanical performance.

Permits higher density packaging. The "Mini-Jump" is available in single position, stackable on 0.100", 0.125", 0.150" and 0.200" centers. Also in two positions on 0.100" centers and three and five positions on 0.150" centers.

Write for literature. The Du Pont Company, Berg Electronics Division, New Cumberland, PA 17070. Telephone (800) 223-7581. In PA call (717) 938-6711.

*Du Pont trademark for its .025" disconnect jumper.
†Du Pont trademark for its .025" dual metal female disconnect.

An electronics company. DU PONT REG US PAT & TM OFF including an acrylate coating, is 250 μm. Numerical aperture is 0.3 and nominal bandwidth is 20 MHz-km.

The series of cables is available with 1, 2, 6, 12, or 18 fibers. The price of a single-fiber design is $1.68 per meter in 1-to-5-km lengths. They are available from stock to four weeks.

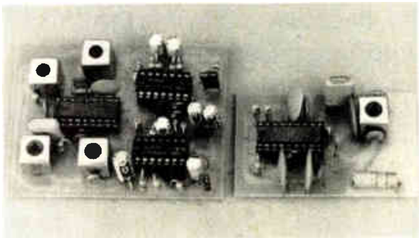
Belden Corp., Fiber Optics Group, 2000 S. Batavia Ave., Geneva, Ill. 60134. Phone Charles Pater at (312) 232-8900 [405]

Kit forms 4-channel analog, digital remote controller

A kit that includes a transmitter-and-receiver printed-circuit board has all the components necessary for developing a four-channel remote-control system, except the antenna and battery clips. The model AAS-1871 can control two analog and two digital channels with a pulse-code-modulation technique.

The transmitter in the kit modulates a radio-frequency carrier (also included in the kit) with a series of pulses. The modulated carrier produces a pulse train of one long pulse for synchronization, followed by two shorter pulses containing the analog information for the first two channels and then one, two, three, or four short pulses for the two digital inputs. The receiver decodes the pulses and generates appropriate analog and digital signals for the devices being controlled.

A regulator keeps the transmitter's radiated output power constant even under varying supply voltages—a useful feature when operating from a battery. Maximum output power is achieved when the transmitter is operated from a 9-V battery. The digital outputs of the receiver card can sink 100 mA—

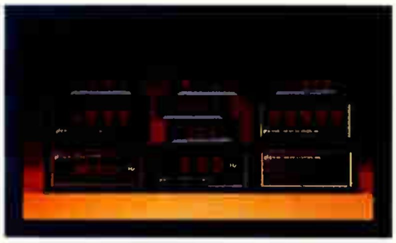


If Non-Linear Systems' bestselling PM-349 doesn't solve your DPM problem, one of our other 1,999 models will.

Wundermeter™ Combining top performance and versatility, the PM-349 DPM and its LCD counterpart, the PM-351, work wonders in a wide range of industries, applications and configurations.

For three decades, Non-Linear Systems had designed a full range of innovative digital panel meters for OEM and replacement use. None more successful than the PM-349. A low-cost, miniature 3½-digit, 2,000 count, fixed-range, bipolar DC voltmeter. Why? Because the PM-349 and its LCD counterpart, the PM-351, work wonders in a variety of industries, applications and configurations.

PM-349. The universal link. Many OEMs harness the PM-349 with linear voltage transducers to get a digital display of parameters such as temperature, angular position and pressures. Others use it as a readout for signal conditioning circuits which translate the outputs of virtually any transducer or sensor. Working in clusters PM-349s accurately measure a host of physical qualities such as light flux, concentricity, strain, weight, sound intensity, displacement, phase angle and power.



We offer over 2,000 DPMs—AC/DC voltmeters, DIN/NEMA frequency monitors, DIN/NEMA temperature meters and digital counters.

PM-349 at a glance.

Volt Ranges	0.2,2,20,200,1000
Accuracy	±0.05% Reading ±0.05% Full scale
Update Rate	3 Readings/sec
Power	+5VDC @ 200mA
Readout	0.3" LED
Size	15/16" H x 2½" W x 3¼" D
Price	$55.65

Workhorse in industry, manufacturing. As a monitor of electrical quantities, the PM-349 is matchless. Flexible, stackable design makes it a natural for bench-top, in-process testing. Replacement's a snap, too. The PM-349 is completely interchangeable.

If you're working with DIN/NEMA sizes, the RM-350 with LED readout, or the RM-351 with LCD readout, can deliver the same value.

Great design. Great performance. The PM-349 features modern LSI unichip construction. The result is maximum performance from fewer components. One microprocessor chip handles all A-D conversion functions in a miniature size case.

Over 1,999 other DPMs. One commitment: dependability. The same foresight that distinguishes our PM-349 is built into every other Non-Linear DPM, too. You pick the configuration that's right, we supply a peerless performer.

Standard features on most models include control signals for reading hold, polarity inhibit, display inhibit and display dimming. They offer busy/done and multiplexed BCD outputs, ratio, special scaling, overload indication and automatic zero. And accept AC or DC input, 5VDC, 12VDC, 24VDC, 115VAC or 230VAC power.

What's more, our DPMs combine a variety of other useful features. Like automatic polarity indication. So there's no need for reversing leads or a reversing switch. A clear, bright plus or minus sign shows the polarity.

Likewise, a programmable, illuminated decimal point eliminates the need for memorizing scale factors and the mental arithmetic to apply them.

We offer LED and LCD style readouts. And either terminal blocks or edge connectors are available for input and output connections in our RM series meters.

Non-Linear's DPMs are faster, easier to use and more accurate than outmoded pointer meters. What's more, our lineup of 3, 3½, 4 and 4½-digit DPMs offer an extremely wide range of choices and sensitivities.

If your needs are specialized, we offer DIN/NEMA or miniature temperature meters and event counters.

So if your problem calls for an accurate, dependable DPM, Non-Linear Systems has over 2,000 ready solutions. One to fit your need.

Get the word on us. Our full lineup of competitively-priced OEM and replacement equipment is available from top electronic distributors worldwide.

Of course, we also offer a complete range of digital multimeters, oscilloscopes, frequency meters, line frequency monitors, counters and temperature meters.

To get the product you need, contact your local distributor today.

For further technical information, or the names of your nearest distributors, contact Non-Linear Systems, Inc., 533 Stevens Ave., Solana Beach, CA 92705. Telephone (714) 755-1134. TWX 910-322-1132.

Non-Linear Systems, Inc.
Specialists in the science of staying ahead.

enough to drive relays and small lamps. Applications include remote switching, data monitoring, temperature sensing, and motor control.

The AAS-1871 is priced at $115 per kit in quantities of one to nine, and at $59 for 100 or more. Delivery is from stock and may take up to six weeks.

Advanced Analog Systems Inc., 790 Lucerne Dr., Sunnyvale, Calif. 94086. Phone Robert Frostholm at (408) 730-9786 [406]

Compact unit provides data encryption for only $1,400

The Secre/Data BU data-encryption device comes in two compact versions for synchronous operation—a stand-alone unit that includes its own power supply and a plug-in module for mounting in a rack. The BU 102 series features automatic cipher synchronization, nonlinear coding, 200 million code settings, and can both clear and encrypt data. The unit may also be used with asynchronous data sources when employed in conjunction with asynchronous-to-synchronous converters available from the manufacturer.

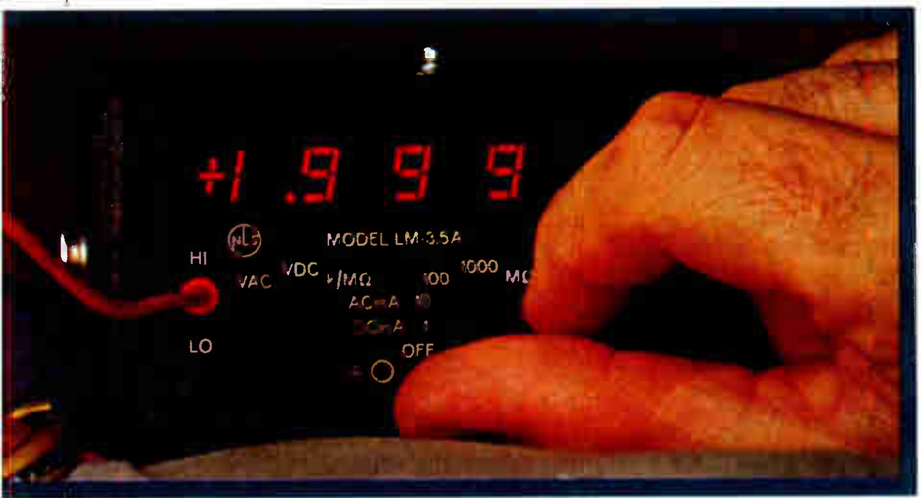
The BU 102 stand-alone version is priced at $1,400; the plug-in card version is $1,120. A power supply for up to six modules sells for $350, and the rack-mountable card cage for up to 12 modules is $300.

Com/Tech Systems Inc., 505 Eighth Ave., N. Y., N. Y. 10018. Phone C. M. Mengani at (212) 594-5377 [407]

Asynchronous modem has 2- or 4-wire operation

The model 6200 limited-distance modem is for asynchronous operation over private two- and four-wire nonloaded metallic conductors at speeds of up to 19,200 b/s and distances of up to nine miles. It features internal strap selections for receiver impedance and equalization. Its six front-panel light-emitting diodes monitor key EIA RS-232-C, and CCITT V.24 interface signals. A 20-

Light-torque rotary switches make the LM-3.5A DMM as easy to operate as it is to carry.



On a benchtop or a belt, over a shoulder or in a tool kit, the LM 3.5A DMM, and its LCD counterpart, the LM-350, are ready to go when you are.

Convenience. That's the key to Non-Linear Systems' best-selling LM-3.5A. A high-performance, competitively-priced, all-purpose mini DMM. Convenience from light-torque rotary switches. So operation's a cinch. Convenience from bold, bright LEDs. For instant, accurate, numeric answers. Unlike some competitive meters, the LM-3.5A features both vertical and horizontal readings. And an optional leather carrying case with belt loops and shoulder strap assures hands-free operation.

At 9.2 oz., the LM-3.5A is portability at its best. There's more. The LM-3.5A is a 3½ -digit DMM. Features 2,000 counts per range — 100% over-ranging. Result? Increased accuracy and resolution between readings of 999-2,000. It also reduces the amount of range shifting when measuring near 1,000.

Troubleshooters swear by it. Repairmen find the LM-3.5A works wonders on tvs, business machines, even cameras. Checks all quiescent AC and DC voltage values. Spots current drains. Measures the resistance of suspect components. Quickly and precisely.

Other DMMs to match your needs. The LM-3.5A is just one in a full series of 3 to 4-digit DMMs. If you need LCD convenience for measurements outdoors, we market the LM-350, among others. You don't pay for true RMS capabilities you don't need. But if you do need true RMS readings, Non-Linear Systems can oblige.

FM-7. The bantam frequency meter. Portability teams with performance in the FM-7. The smallest, 7-digit, 60-MHz, battery or AC line-operated instrument available.

LM-3.5A at a glance.

DC Volts	1 to 1,000, 4 ranges
AC Volts	1 to 750, 4 ranges
Kilohms	1 to 10000, 5 ranges
AC/DC Current	1 mA to 1A, 4 ranges
Polarity Selection	Automatic
Readout	0.3" Red LED
Size	1.9" H x 2.7" W x 4.0" D
Weight	9.2 oz (batteries installed)
Power	3 type AA rechargeable Nicad batteries and charger
Price	$165.85

LT-3 Digital Temp Meter. Featuring 0.1° resolution and high accuracy, the 3½-digit, 2,000 count full scale LT-3 is indispensable for home or industry. Checks everything from thermostats to appliances. Even monitors critical operations like photoprocessing and electroplating.

The LT-3 can be supplied with any of eight thermistor and RTD temp sensors to read ranges of 0-100°C, 32-199.9°F, or 0-199°C or F.

Work outdoors? Then the LT-31 (LCD format) is the ticket.

Operator convenience is the key to our line of frequency and temperature meters, too. Pictured left to right, SC-5 prescaler, FM-7 frequency meter, LED format LT-3 digital temp meter, and its LCD cousin, the LT-31. Top, the MLB-1 digital logic probe.

Hobbyists, radio and tv studios, phone companies and the military all depend on the versatile FM-7. Whether the job calls for calibrating fixed, variable frequency or voltage-controlled oscillators, checking flowmeters, high-speed photocell counters, or setting the IF or heterodyne frequency in communications equipment, the FM-7 is a standout performer.

SC-5 Prescaler. Top range booster. This 512-MHz, battery or AC line-operated prescaler was developed to extend the frequency range of the FM-7 from 60 to 512 MHz. Adapts to most other frequency meters, too.

Get the word on us. We offer a full lineup of convenient, competitively-priced products. From DMMs, frequency and temp meters to miniscopes and DPMs.

For further technical information or the names of your nearest distributors, contact Non-Linear Systems Inc., 533 Stevens Ave., Solana Beach, CA 92705. Telephone (714) 755-1134. TWX 910-322-1132.

Non-Linear Systems, Inc.
Specialists in the science of staying ahead.

New products

mA teletypewriter current loop interface is also available.

The modem's diagnostic capability is provided by an analog loopback mode that verifies the system's performance and helps isolate equipment failures in the communications link.

The IDS modem is priced at $225.

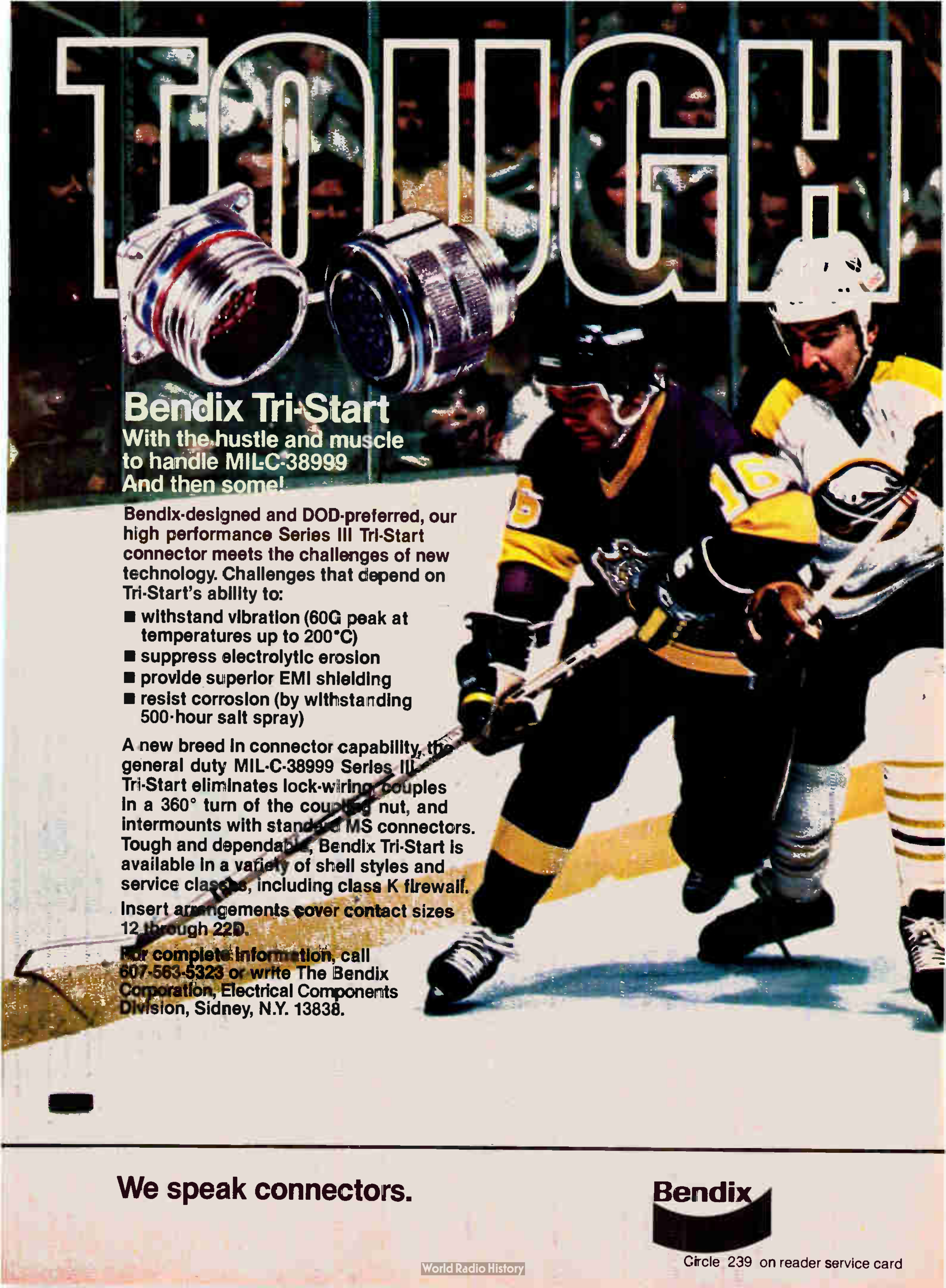
International Data Sciences Inc., 7 Wellington Rd., Lincoln, R. I. 02865. Phone (401) 333-6200 [408]

High-speed modem is for minicomputer use

The Micro8000 concentrator modem is a high-speed modem that includes a built-in data concentrator and automatic retransmission of errors. It operates at speeds of 2,400, 4,800, or 9,600 b/s on standard telephone lines and permits 2, 4, 8, and 12 asynchronous data terminals to share the line error-free and with maximum efficiency, without requiring any changes to existing hardware or software. For Digital Equipment Corp., Data General, Hewlett-Packard, and other minicomputer users, the modem operates as a multidropped cluster-controller with built-in modem. It is suited for minicomputer users with two or more terminals in locations that are remote from the computer.

Weighing only 12 lb in an 8-channel configuration, the Micro8000 modem ranges in price from $1,750 for a 2,400-b/s model with built-in 2-channel concentrator to $7,100 for a 4,800-b/s model with built-in 16-channel concentrator. Quantity and original-equipment–manufacturer discounts are available. Delivery is 60 days after receipt of order.

Micom Systems Inc., 9551 Irondale Ave., Chatsworth, Calif. 91311. Phone (213) 882-6890 [409]


TOUGH
Bendix Tri-Start
With the hustle and muscle
to handle MIL-C-38999
And then some!
Bendix-designed and DOD-preferred, our high performance Series III Tri-Start connector meets the challenges of new technology. Challenges that depend on Tri-Start's ability to:
■ withstand vibration (60G peak at temperatures up to 200°C)
■ suppress electrolytic erosion
■ provide superior EMI shielding
■ resist corrosion (by withstanding 500-hour salt spray)
A new breed in connector capability, the general duty MIL-C-38999 Series III Tri-Start eliminates lock-wiring, couples in a 360° turn of the coupling nut, and intermounts with standard MS connectors. Tough and dependable, Bendix Tri-Start is available in a variety of shell styles and service classes, including class K firewall.
Insert arrangements cover contact sizes 12 through 22D.
For complete information, call 607-563-5323 or write The Bendix Corporation, Electrical Components Division, Sidney, N.Y. 13838.
16
We speak connectors.
Bendix
Circle 239 on reader service card

Rockwell. Your

There's more than one way to skin a microprocessor spec. Examples? Rockwell has moved customers targeting at 16s to 8s and others from 8s to 4s to save costs. Just as often customers have been shown how a more powerful device was the better fit for performance reasons.

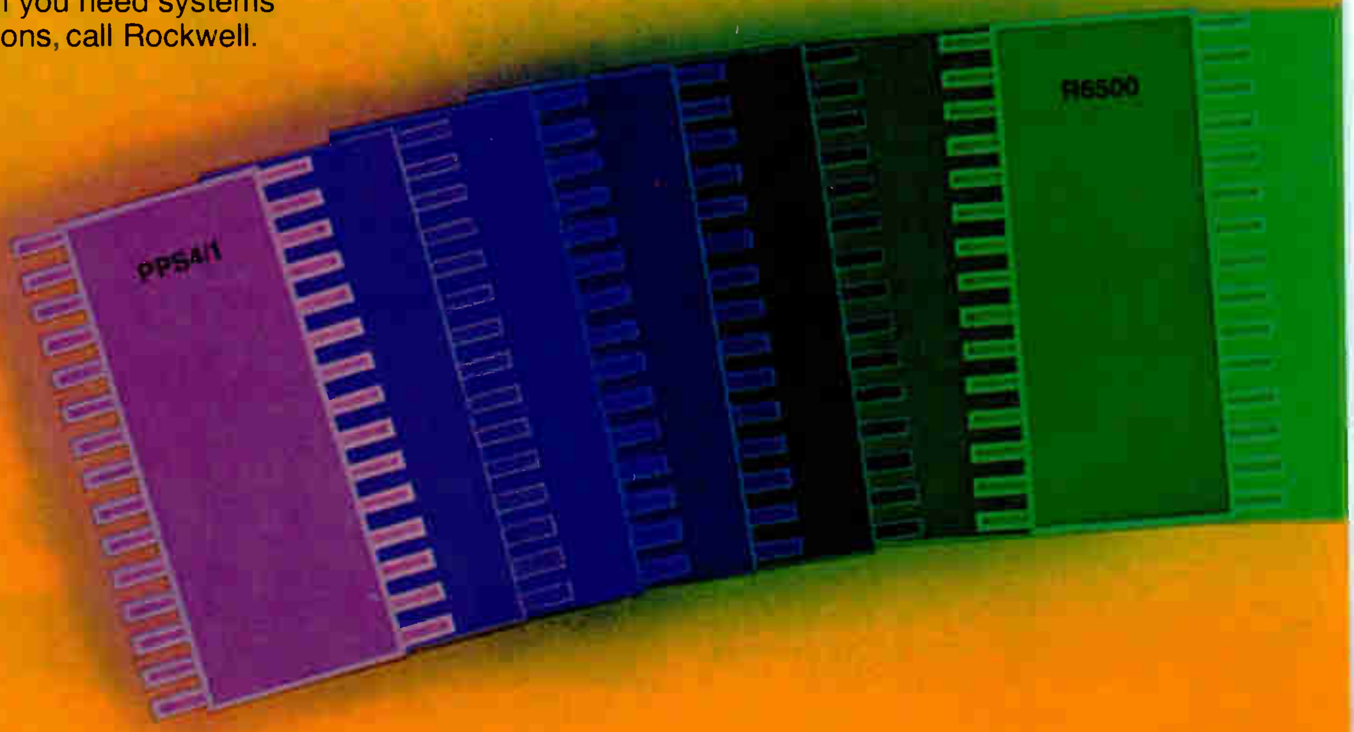
Fact is, since we make all three families (4s, 8s and 16s) we can truly optimize cost/performance tradeoffs. All because we think systems not devices.
When you need systems solutions, call Rockwell.

The Rockwell 4s

This single-chip microcomputer family is so efficient, it's more akin to 8s than other 4s. Ninety percent of PPS 4/1 instructions are executed in a single byte. That makes PPS 4/1 memory and control operations a quick fit for microcontrollers where there's a man/machine interface: appliances, thermostats, telephones, sequencer timers and more.

The Rockwell 8s

R6500 microprocessors, support devices and R6500/1 single-chip microcomputers are the throughput champions. Most instructions execute in as little as 1 microsecond. Which should you use in your high throughput application? Rockwell will help you optimize a multi-chip R6500 system or put together a single chip R6500/1 design. They use the same software so you can't lose.



PPS 4/1 R6

systems source.

The Rockwell 16s

When you need the muscle and sophistication of 16-bit machines, Rockwell has the system components that open up a world of options. R68000 microprocessor peripheral devices give you strong support in implementing the 16-bit CPUs. And there's a dozen 8-bit support units. Compare that to any other 16-bit menu.

Memories

Rockwell supports the microprocessor families with a full spectrum of compatible memory devices: Bytewide static RAMs, ROMs, and devices with onboard timers and I/0 to help reduce chip count in complex systems.

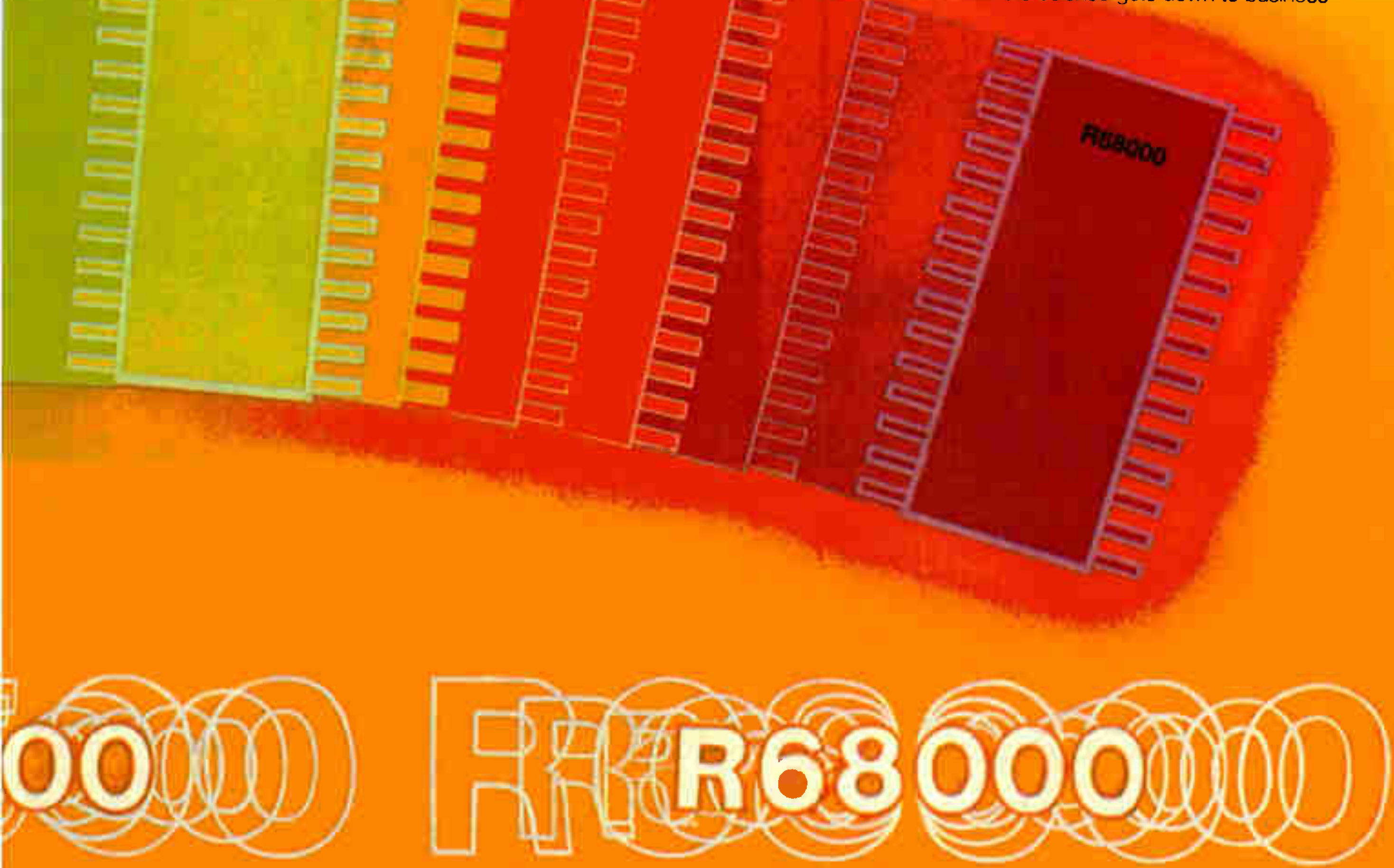
Rockwell. Your systems source.

Our SYSTEM 65 Development System and AIM 65 microcomputer are another reason to call Rockwell. Far and away, they're the lowest cost, fully-functioned development tools in the industry.

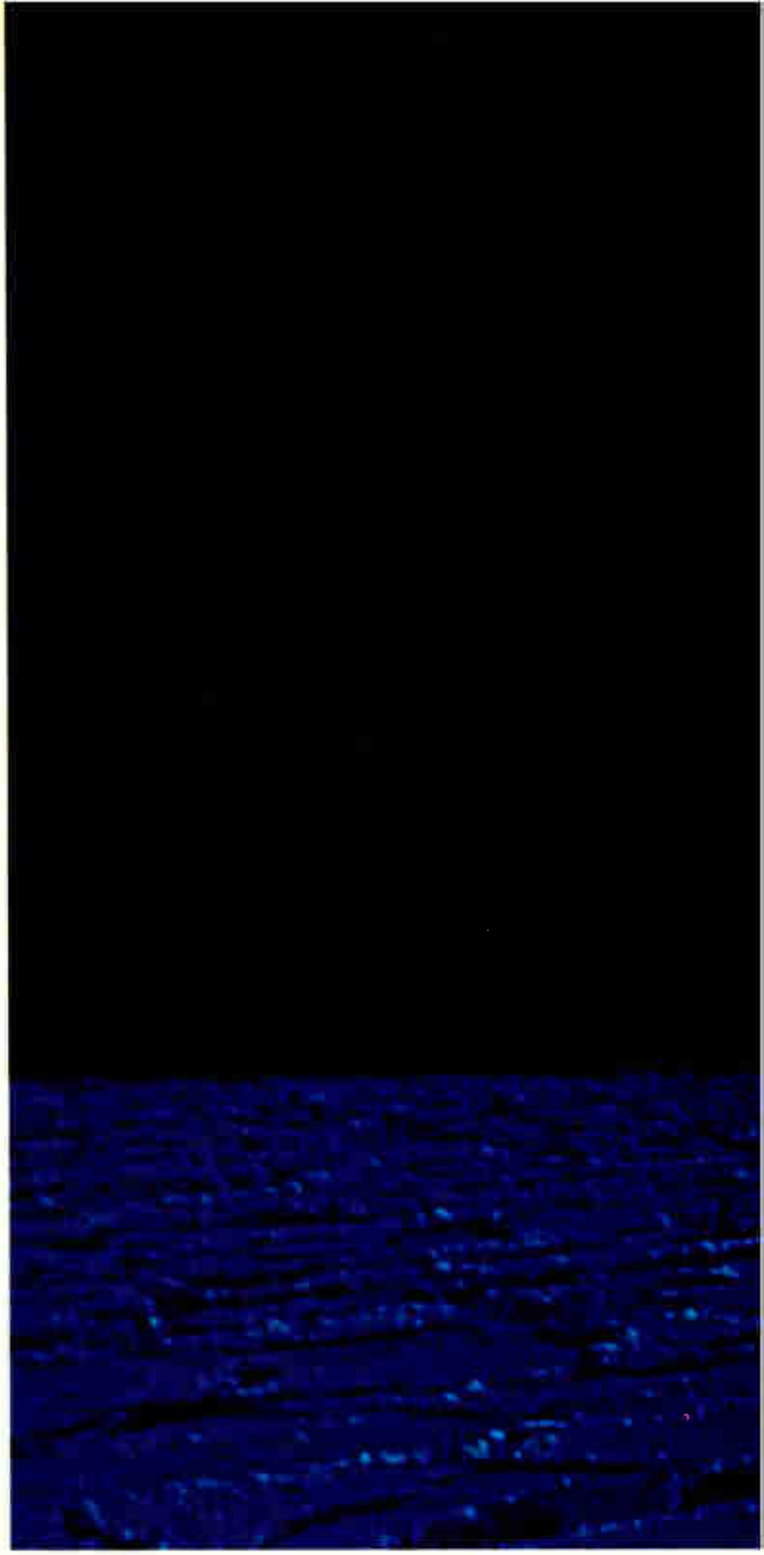
Get the facts about Rockwell International. For more information call (800) 854-8099, (in California 800 422-4230.) Rockwell International, Electronics Devices Division, P.O. Box 3669, Anaheim, California 92803

Rockwell International

...where science gets down to business



Circle 241 on reader service card



The future belongs to those who explore it farthest.

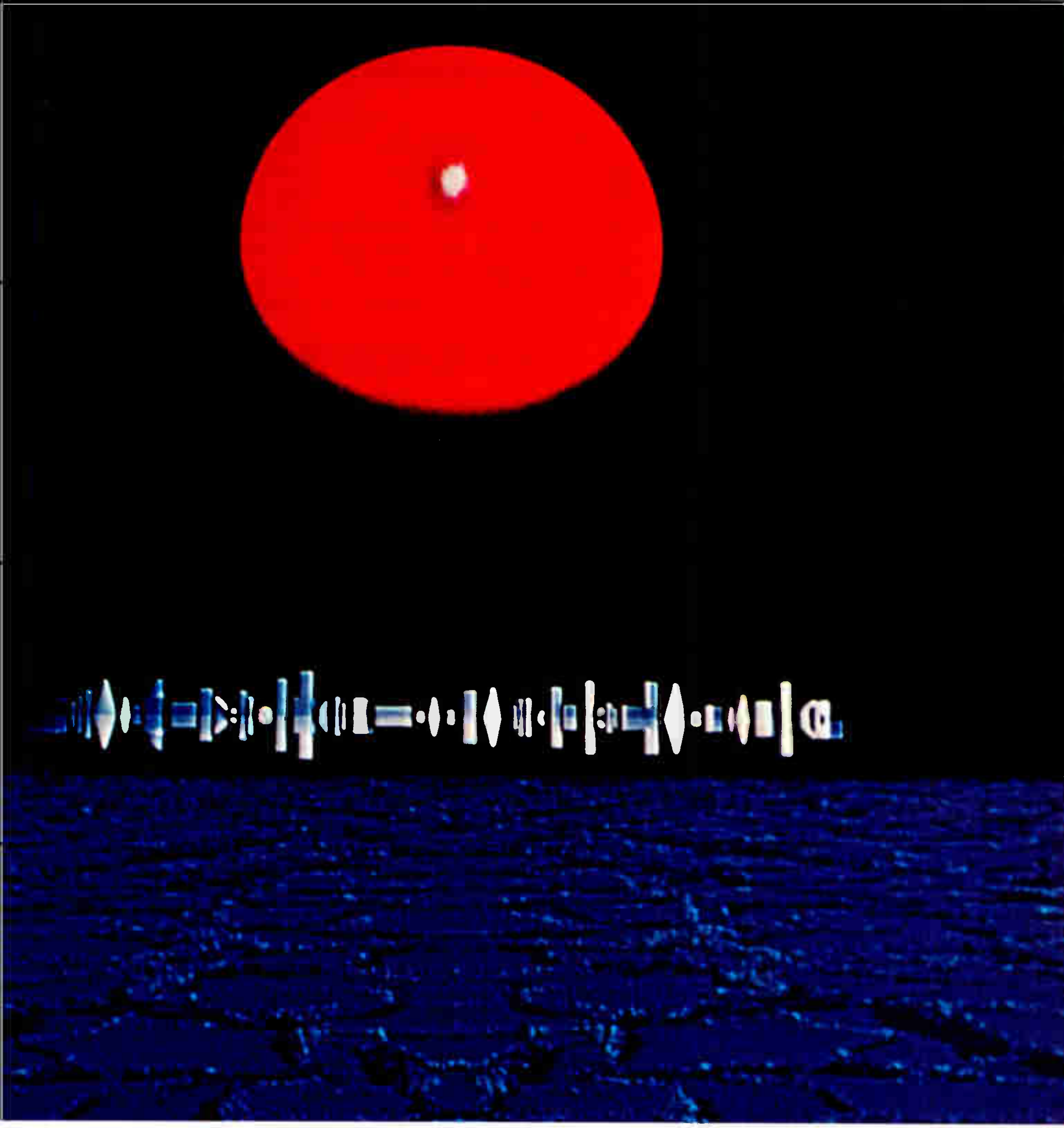
The future is there for the taking, if you take action for it now.

Your company must find better ways to do what you're doing today to assure its survival. And you must find the best ways to do things tomorrow to assure its success.

With the aid of CAD/CAM, computer-aided design and manufacturing, all manner of ways to advance your company are made possible.

Ways that will improve quality. Cut costs. Eliminate errors. Speed throughput. Boost productivity.

That's why the lea ing semiconductor manu facturers are using Calm computer-aided design sy tems. We're helping them



ake significant advances
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chnology, because we
ake the most advanced
omputer-aided design sys-
ms available today.

And we're committed
making even better com-
uter-aided design systems
r the future.

As a Computer Group
ompany of United Telecom-
unications, Inc., we're the
supplier with the strength
and resources to do it.

United Telecom's
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Circle 245 on reader service card

Microcomputers & systems

N-MOS 8048L draws 25 mA

Low-power chip made with short-channel n-MOS process costs less than C-MOS 8048s

National Semiconductor Corp. has boasted that its INS8048 series of single-chip 8-bit microcomputers consumes the least power of the many n-channel MOS versions available. Soon they will be dislodged from that position by a new low-power family of 8048 microcomputers from the same firm.

The new family includes the 8048L with 1-K byte of masked read-only memory and 64 bytes of random-access data memory on board; the 8049L with 2-K bytes of masked ROM and 128 bytes of on-chip RAM; as well as National's proprietary 8050L, with four times the program and data memory of the industry-standard 8048 [*Electronics*, Oct. 9, p. 194]. Members of the family without ROM—the 8035L, 8039L, and 8040L—will be available.

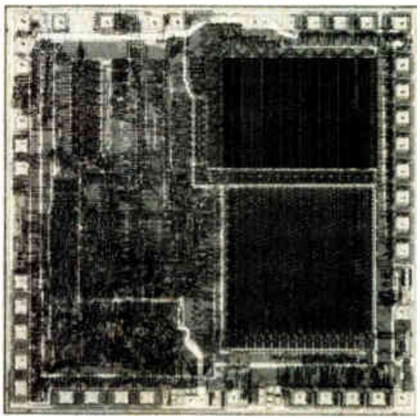
Previously, National's 8048 series consumed about half the power of competitive single-chip n-MOS offerings. The total supply currents for the 8048 and 8049 are 65 and 70 mA maximum, respectively, while competitive devices from Intel Corp., for example, are specified at maximums of 135 and 170 mA, respectively.

However, thanks to the capabilities of National's short-channel X-MOS process and improvements in circuit design, "the new 8048L devices consume approximately one third to 40% less power," states Tom Dugan, the firm's product marketing manager for single-chip microcomputers. For example, the new 8048L and 8049L are rated at a maximum power supply current of 40 and 45 mA, respectively (25 and 30 mA, typically). Similarly, the 8050L's maximum supply current of 50 mA is a one-third reduction from the 75 mA maximum current of the 8050.

National claims the 8048L will dissipate only 200 mW at 6 MHz, whereas the 8049L and 8050L will consume a maximum 225 and 250 mW, respectively, at that speed. The reduction in chip temperature within the package will also mean longer life for the chips, Dugan claims.

Admittedly, the maximum power-supply current offered in the 8048L series is not as low as the 10 mA expected of new 80C48 complementary-MOS versions of the industry-standard single-chip 8-bit microcomputer, soon to be available from suppliers such as Intel, Intersil, Nippon Electric, and even National. However, "C-MOS versions of n-MOS devices typically end up two to three times as expensive and start out even higher in price," states Dugan.

The very small chip sizes produced by the X-MOS process reflect in the high manufacturing yields of the 8048L family. Thus the new devices are expected to be available



in large quantities at no more than a 10% to 20% premium over the older devices, which will continue to be available. At present, in lots of 10,000 pieces, National's version of the 8048 sells for $4.50 to $5 each, its 8049 for $5.50 to $6.50 each, and the 8050 for about $14. Delivery of members in the 8048L family is in 30 to 60 days after receipt of order. They are housed in 40-pin dual in-line packages.

For expansion of input/output on the 8048L series, National is introducing the 8243 I/O expander, a 24-pin device with 16 I/O lines that attaches to one of the ports on the single-chip microcomputers. To further reduce power in the system, National is advocating its COP498 low-power C-MOS RAM timer. When used with the 8048L, the timer can provide a "wake-up" signal to turn the microcomputer off and on. The COP498 dissipates a mere 50 mW.

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif. 95051
Phone (408) 737-5000 [371]

Speech chip carries UART

Synthesis module can be operated by relay or switch without a microprocessor

Security, fire-alarm, car-park and other low-volume industrial systems, are the applications a new British company foresees for its first product, a speech-synthesizer module. Working with Stynetic Systems Inc. of Long Island, N. Y., it is introducing a low-cost printed-circuit module that connects to a customer's hardware through reed-relay or other switch contacts, a telephone line, or an 8-bit data bus [*Electronics*, March 10, p. 67].

The TDS910, built around a 40-pin large-scale integrated speech circuit of the company's design, comes programmed with the spoken numbers 0 to 9 as well as "point" and other key words. For example, it could say "four point eight two nine volts." To the standard vocabulary, encoded in an 8-K erasable programmable read-only memory, can be added a vocabulary of the customer's choosing: typically up to 70 words of reasonable speech quality can be stored on a standard board using the two ROM sockets provided, and a total of 255 words can be called up from external ROM boards.

The TDS910 board also carries an

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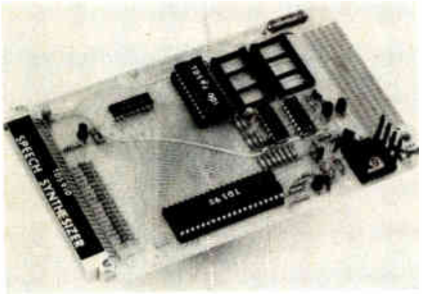

amplifier with enough power-handling capability to drive a small loudspeaker directly, working from a single power-supply line. There is also a matrix to which components like an on-card power supply can easily be added.

The board gives a customer hands-on experience with speech synthesis. Triangle Digital Services Ltd. will tailor it to a customer's system by encoding his or her chosen vocabulary. The quality of speech, which is somewhat machinelike, can be adjusted according to the data rate chosen, and particularly difficult words can be encoded at a higher data rate. Typically a 25-word vocabulary fits into a 32-K ROM.

"We can provide a turnaround time of one week, plus a further two weeks for each 10 words to be analyzed," Triangle's Peter Rush claims. He says that one reason behind this fast service is a method of speech encoding that reduces the computational task to one that can be handled by a 16-bit microprocessor—in this case a General Instrument Corp. CP 1600.

Rush was formerly a marketing engineer at General Instrument's London office; Jeff Stein, founder of Stynetics, designed the CP 1600, one of the industry's first 16-bit microprocessors. Rush points out that there is no connection between his and General Instrument's synthesizer modules. "I got the idea for my synthesizer while working on ways of generating sounds for electronic toys and games," he remarks. Since establishing Triangle Digital Services, he has been busy implementing these ideas in silicon, personally designing and laying out the chip in order to retain commercial confidentiality. For the same reason he will not enlarge on his speech synthesis techniques apart from explaining that the resulting coding density is somewhere between that employed by Texas Instruments and National Semiconductor in their modules.

By applying solder bridges to selected input pins, the speech chip can be made to operate in one of three input modes. At the most rudimentary level, sentences, phrases, or words can be triggered by closure of 1 of 16 relay contacts or switches. The feature could be useful in a fire alarm or on a lathe to warn that a limit stop had been reached. But with this approach its vocabulary is limited to 16 phrases or words.

The TDS910 can easily be controlled over a telephone line or any two-wire connection, since a universal asynchronous receiver-transmitter that will accept ASCII data at 300 or 1,200 b/s is integrated on the synthesizer chip. With this mode of operation, up to 96 utterances can be triggered electronically, or—by disabling the parity-bit check feature—a full range of 255 utterances. The technique could be used in remote data-gathering equipment or public-address systems. More conventionally, the board can accept an 8-bit parallel input with full handshake facilities when controlled by a microprocessor.

Concatenates. The vocabulary can be accessed at the sentence, word, or phoneme level, says Rush, giving the user great freedom in constructing his speech output. "It's like peeling the layers off an onion," he remarks. Two types of data are stored in ROM: the constituent utterances, be they phonemes, words, or even phrases, plus the utterance-assembly information. A ROM's vocabulary might include "five," "fif," "for," "ty," and "two." The utterance-assembly data can ensure that both "five fifty five" and "two forty five" are each triggered by a single code or switch closure. No external microprocessor is required to achieve these concatenations.

Though the TDS910 synthesizer board can be used for very small production runs, Rush thinks users will prefer to buy the chip set for production runs of 100 or more. In these volumes the synthesizer chip costs $76 and the ROM encoded with standard numbers costs $48. There is also a tooling charge of $214 per word to be amortized over the production run. "In a typical 100-up run," says Rush, "a chip set comprising the synthesizer and 32-K ROM encoded with a 25-word vocabulary would cost in the region of $122." At these prices, he reckons, speech synthesis can now be considered for lower-volume industrial applications.

The one-piece price of the board is around $330, plus $70 for the standard ROM encoded with numbers and key words.

Stynetic Systems Inc., Flowerfield Buildings 1, Saint James, N. Y. 11780 [372]

Triangle Digital Services Ltd., 23 Campus Rd., London E17 8PG, England [379]

46-K-byte bubble memory operates on S-100 bus

A magnetic-bubble memory system claimed the first to be compatible with the S-100 bus gives mass storage where rotating floppy- or hard-disk drives are not satisfactory, as in industrial environments. The system consists of two boards: a single printed-circuit controller module (the MBC-100 Bubbl-Board) and one or more bubble memory modules (the MBB-100 Bubbl-Pac). Since all the modules have the standard S-100 dimensions, they can plug directly into any S-100 system or be housed in an external chassis.

The controller contains its own 8-bit microprocessor and can control up to 16 MBB-100 Bubbl-Pacs. The microprocessor handles the bubble device's formatting, error checking, and control and also interfaces the complete system with the S-100 bus. The MBC-100 Bubbl-Board controller is also fully compatible with the popular CP/M operating system; a CP/M type of software driver comes with it. Each MBB-100 Bubbl-Pac contains 46-K bytes of mass-storage capability. It can access data in less than 4 ms on the average, 7.27 ms

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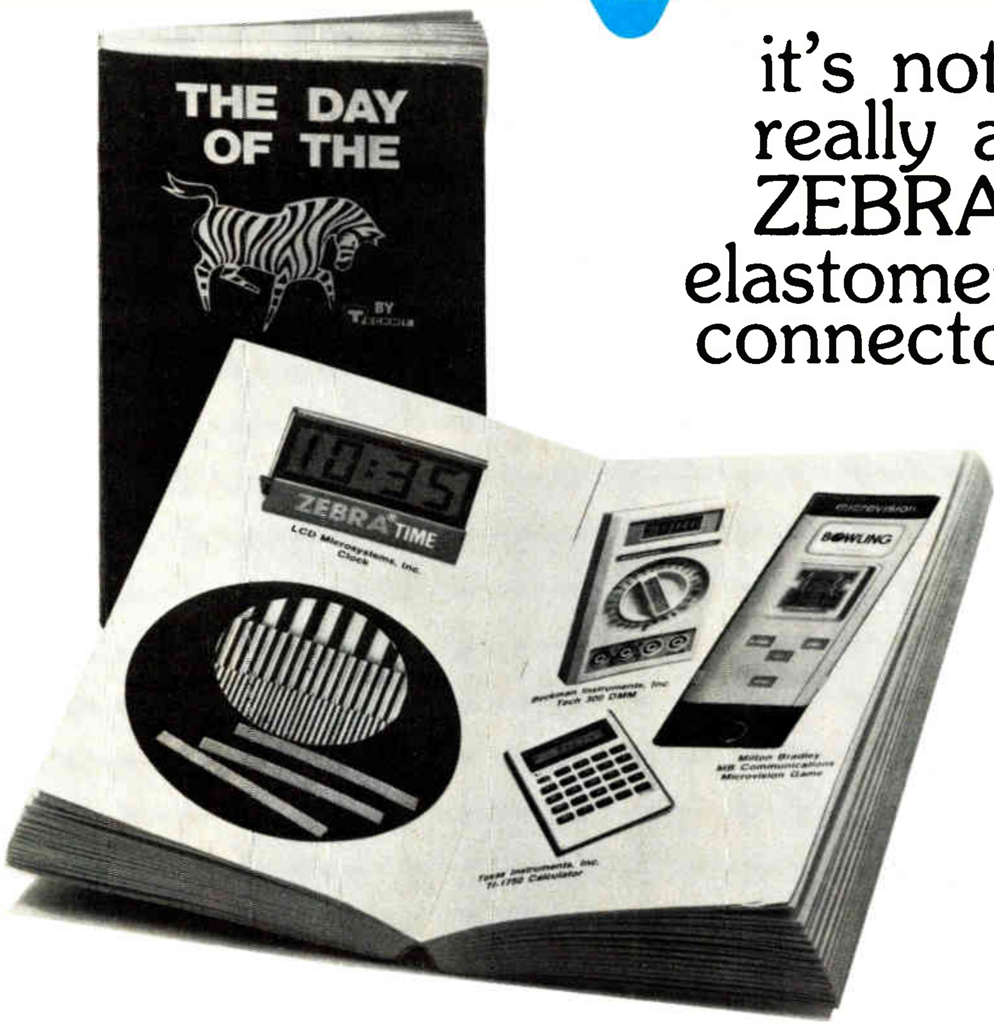

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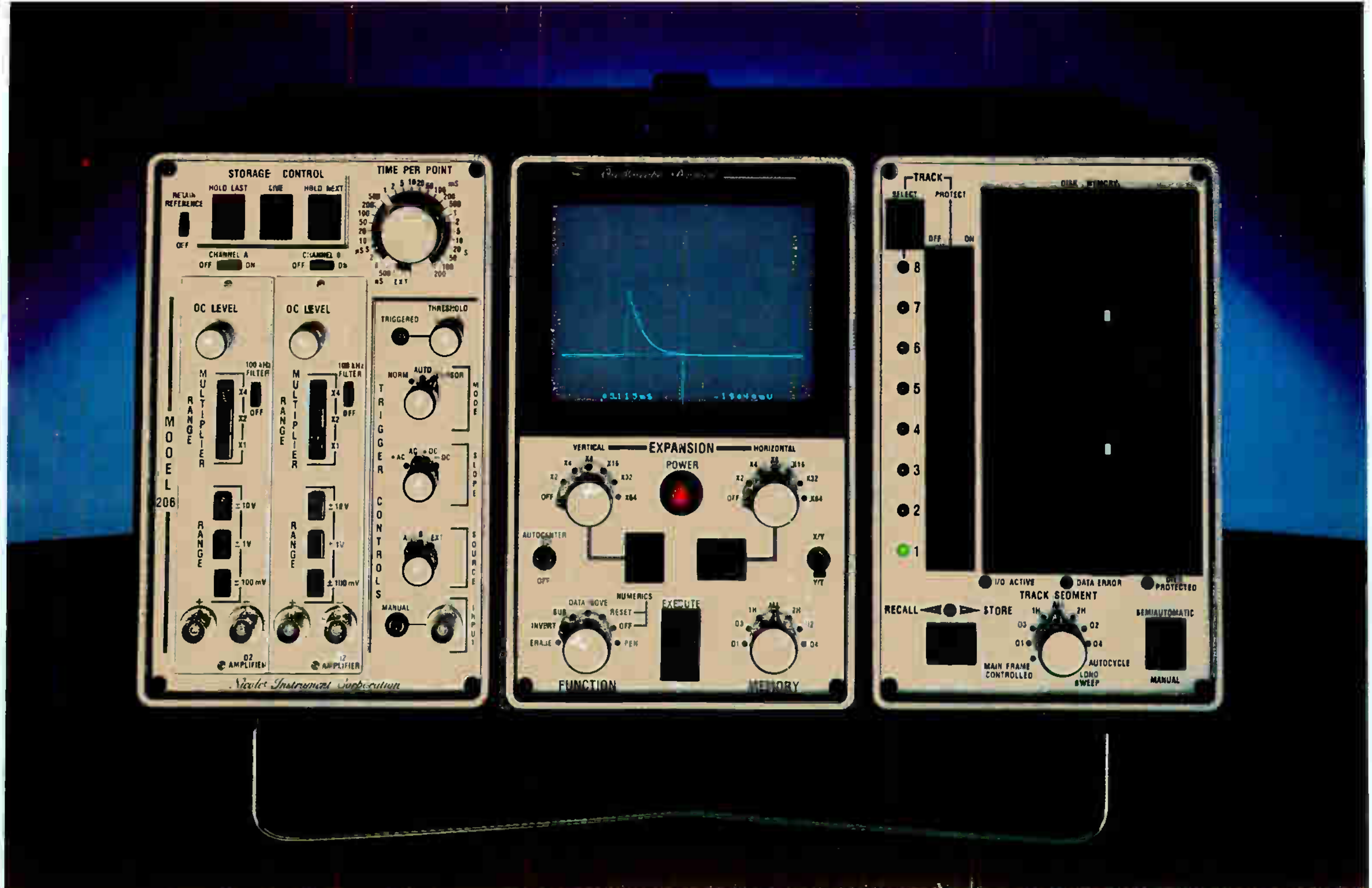

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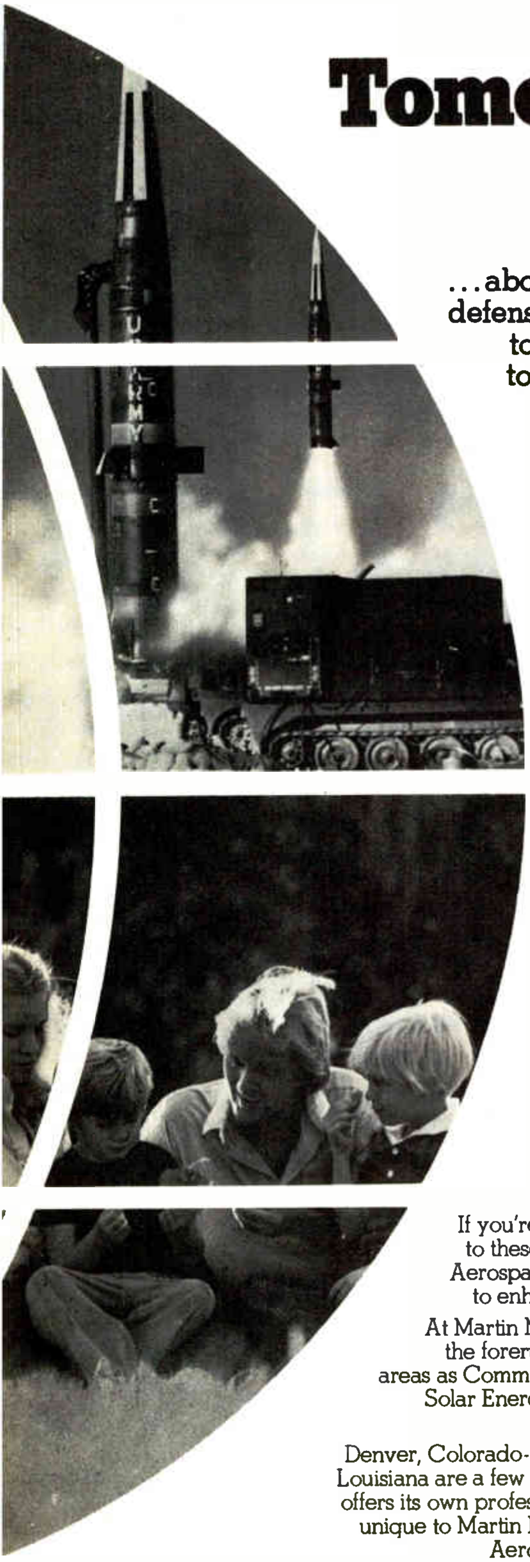

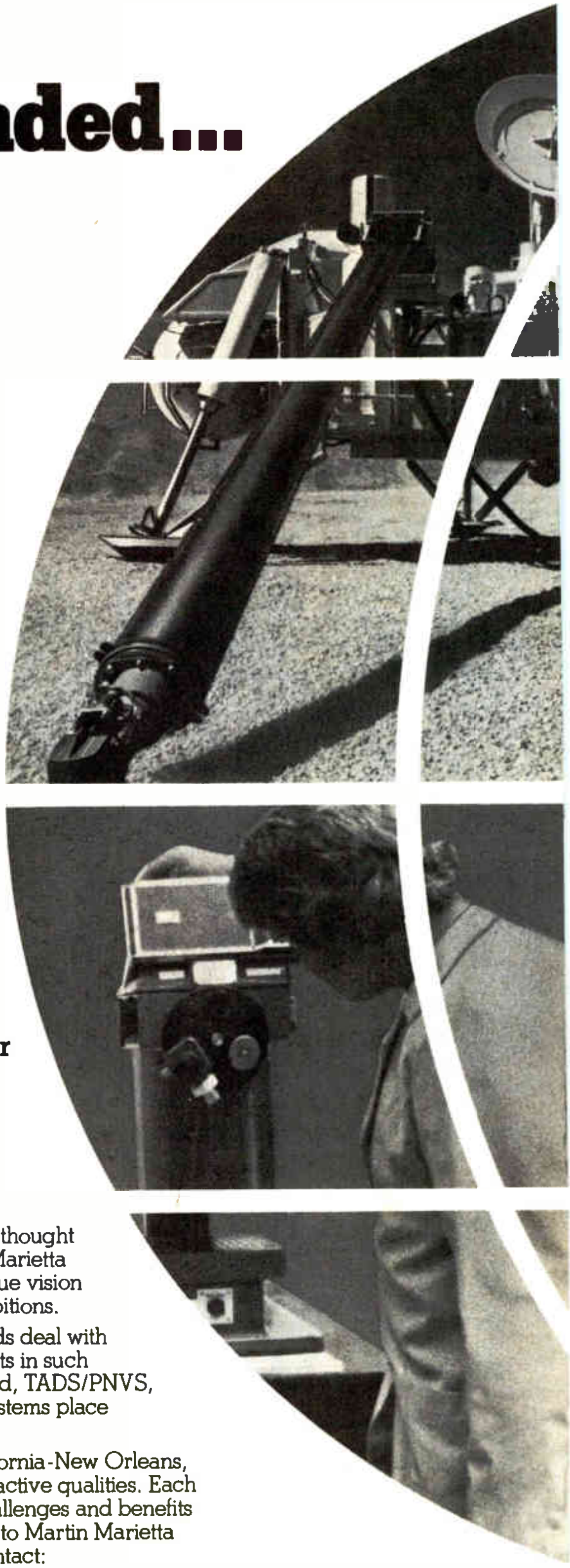

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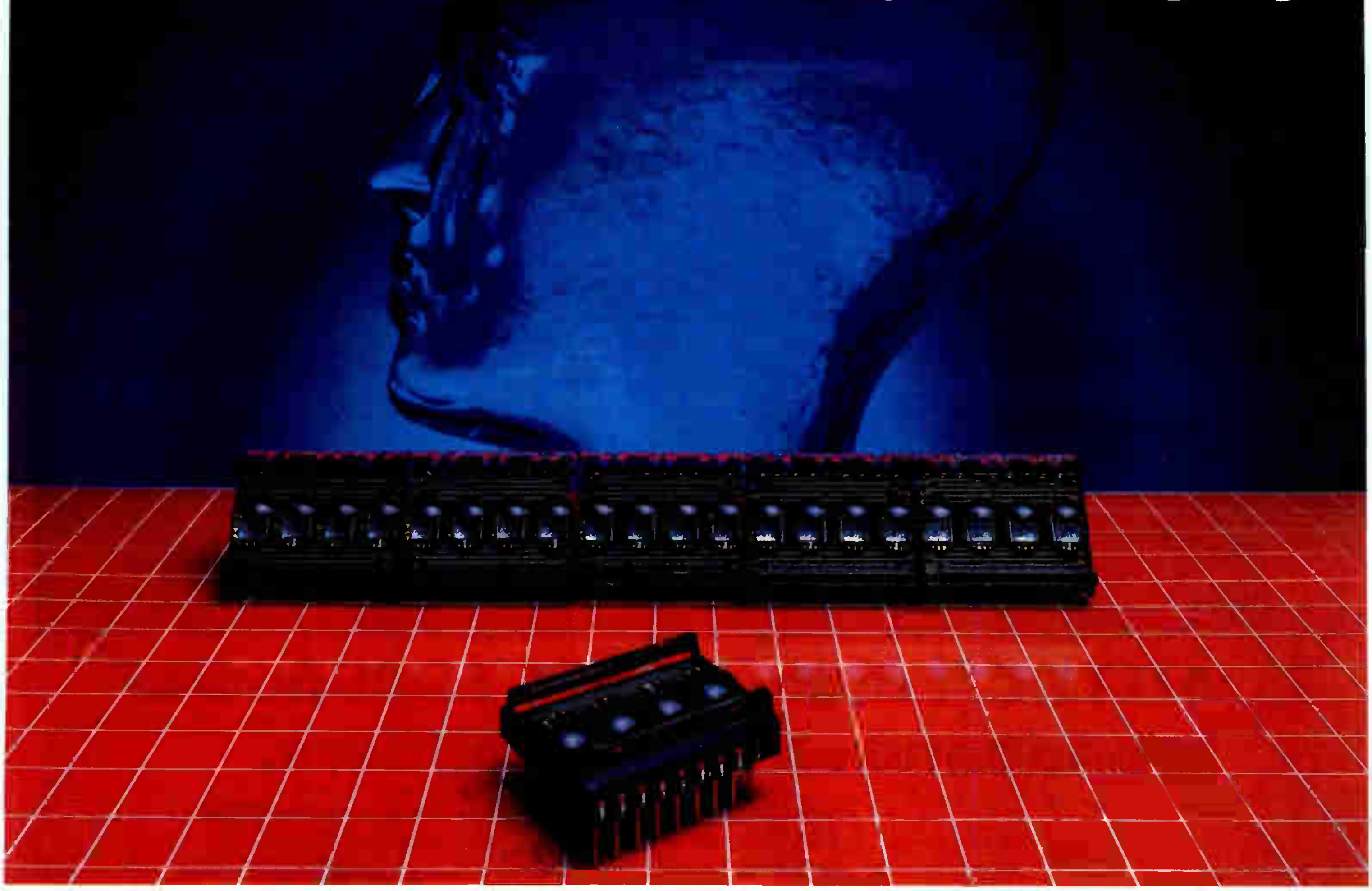

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IDA-2416-16, Intelligent Display Assembly, 16 characters IDA-2416-32, Intelligent Display Assembly, 32 characters						

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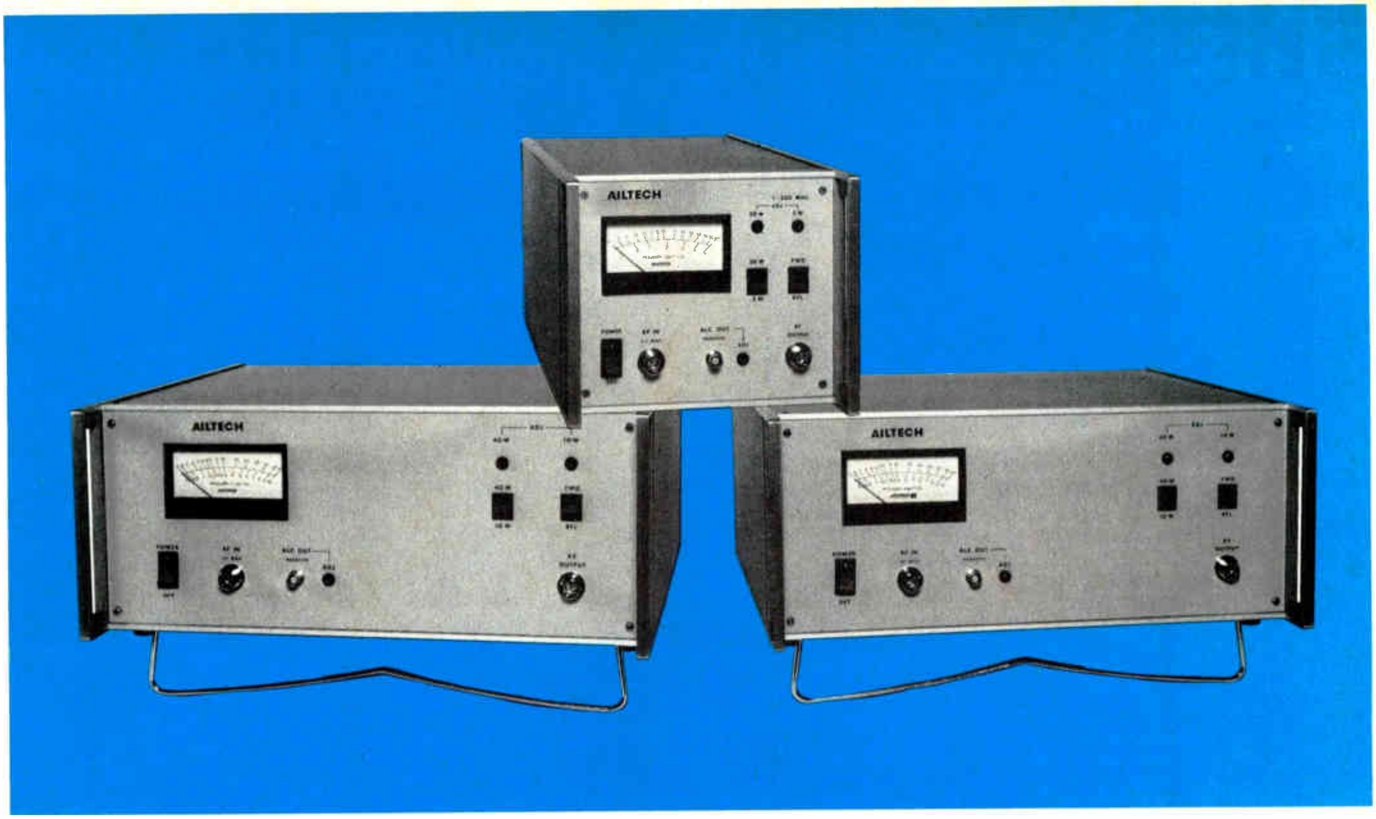

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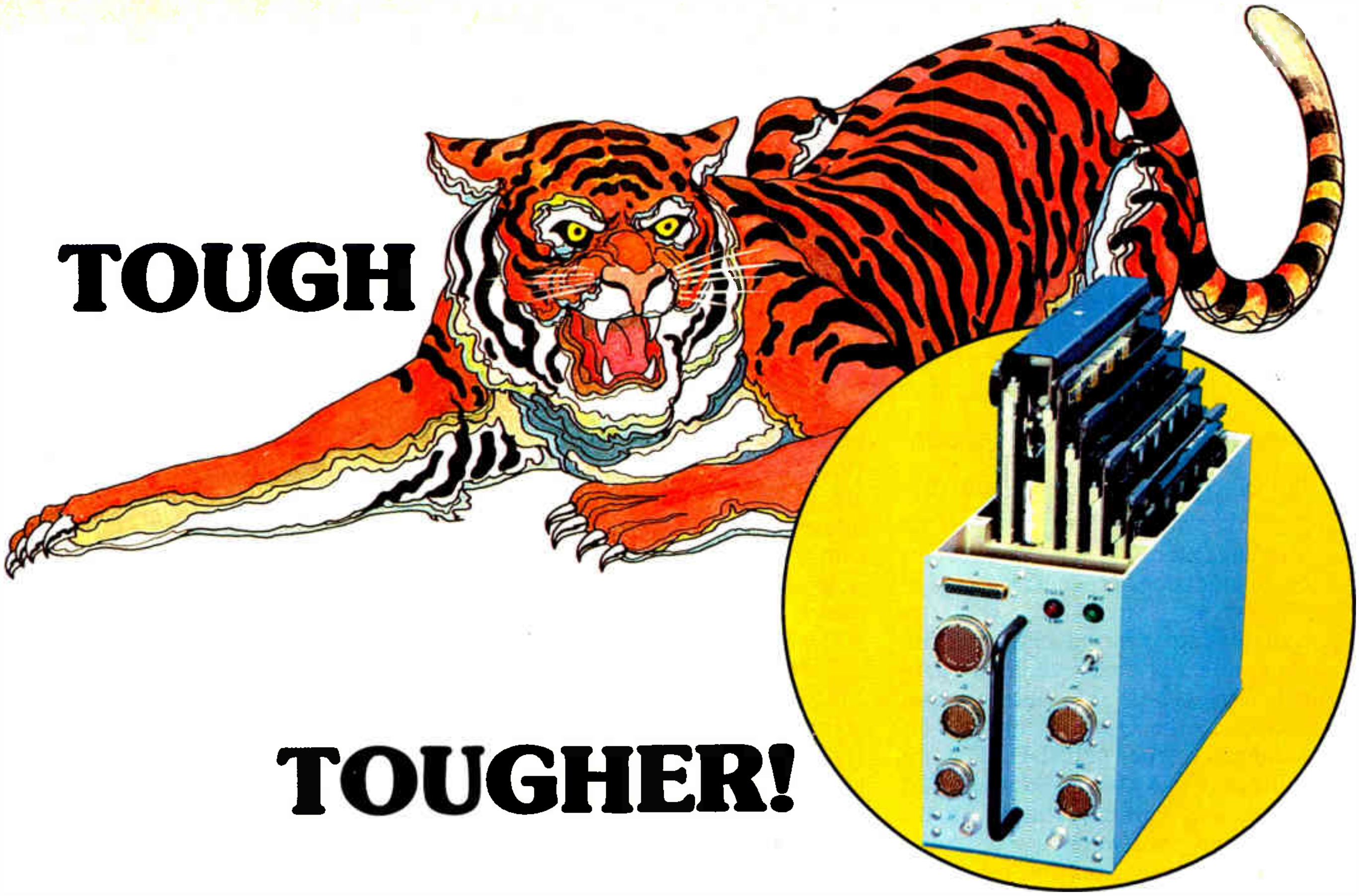

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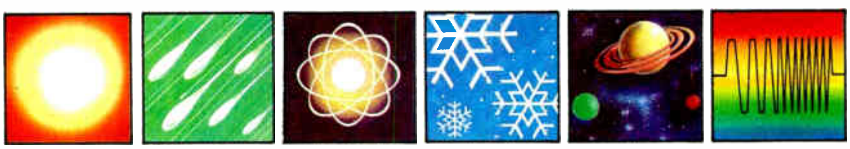

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Computers & peripherals

Multiplexer plugs into LSI-11's Q-bus

Eight-channel RS-232-C unit uses bit-slice microsequencer, fits on one quad-sized board

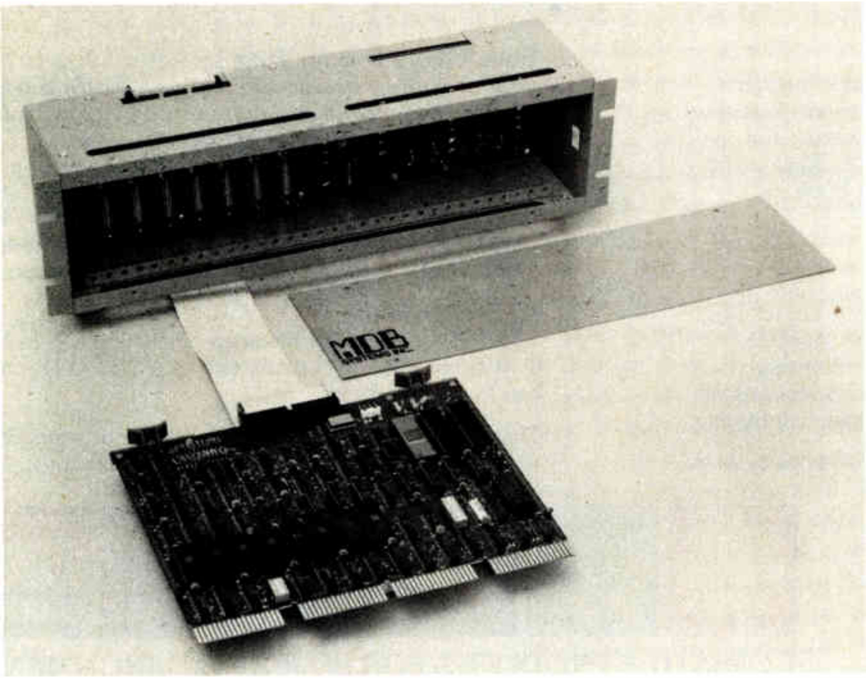
Tapping more of the market for communications products for Digital Equipment Corp. hardware, MDB Systems Inc. is introducing on a single quad-sized board an eight-channel (RS-232-C) multiplexer that plugs into the Q-bus of an LSI-11. Designated the MLSI-DZ11A, it replaces two four-channel DEC boards and thus saves a slot in the backplane. Software compatibility with DEC's DZ11 multiplexer for the PDP-11 gives LSI-11/23 users the ability to use programs written for the DEC multiplexer.

MDB introduced last year a similar product—the DZ11AC, a hex-sized board for the PDP-11 [*Electronics*, July 31, 1980, p. 130]. Transferring similar functions to the quad-sized board and maintaining Unibus compatibility required two design iterations. The compact unit was made possible by using a bipolar bit-slice microsequencer made up of 2900-family devices from Advanced Micro Devices. A 2910 and a 2901 control the board and handle the firmware.

The multiplexer allows character length to be programmed to 5, 6, 7, or 8 bits and data-transfer rates to be programmed from 50 b/s up to 19.2 kb/s. Start-stop bits and parity are also programmable. A four-level interrupt scheme assures software compatibility. Translation circuitry is mounted on a distribution panel that is connected to the board by a 50-lead ribbon cable.

Three of the four members of the MLSI-DZ11 family include this distribution panel. The MLSI-DZ11AC, a quad-sized board, can program its eight channels to either RS-232-C or 20-mA current-loop formats in any configuration and is priced the same as the RS-232-C–only model A—at $1,750 in single units.

The two-board model E communicates with 16 terminals through one panel and costs $2,800. The $1,350 model B, the multiplexer without a distribution panel, is designed to upgrade one of the 8-channel family members to 16 channels, and it uses the panel already in place.



Quantity discounts are available; delivery is in 60 days.

MDB Systems Inc., 1995 North Batavia St., Orange, Calif. 92665 [361]

Cartridge tape system has editing function

The Kennedy model 6450 cartridge tape system, using a 6,400-b/in., 30-in./s cartridge drive, can edit prerecorded data without disturbing adjacent blocks. The editing function is derived from the firmware and control circuits on the 6450's microprocessor-based embedded formatter. The formatter has a common interface bus that allows the user to design an inexpensive controller capable of handling both the 6450 and an 8-in. Winchester disk. The system has on-line self-testing, off-line test routines, signature analysis that permits troubleshooting, and a mean time to repair of less than 30 minutes. The same tape may be edited 6 to 10 times before a new cartridge must be recorded.

The tape system has an unformatted capacity of 23 megabytes with a 600-ft cartridge, 17.3 megabytes with a 450-ft cartridge, and 11.5 megabytes with a 300-ft cartridge. The drive and formatter require +5 V dc at 5 A and +24 V dc at 1 A.

In 100-unit quantities, the 6450 is priced at $1,520 each. Delivery is 45 to 60 days after receipt of order.

Kennedy Co., 1600 Shamrock Ave., Monrovia, Calif. 91016. Phone (213) 357-8831 [363]

Intelligent memory system is partner to host computer

Designed to relieve a host computer of numerous tasks related to diagnostics and the control of memory, errors, and power supplies is the iQX intelligent memory system, part of Intel's series 90 family. According to the company, the iQX is the first standard general-purpose memory system that features built-in intelligence, memory-fault tolerance, ad-

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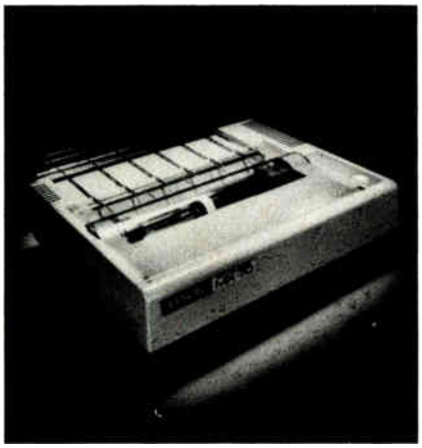
vanced diagnostics for the controller and memory modules, and off-the-shelf solutions for maintaining quality service. The error-correcting circuitry corrects single-bit errors and detects double-bit errors. The 90/iQX's built-in diagnostic software is executed by its iAPX 86 processor without burdening the host computer. Service personnel can communicate with the iQX by using an optional hand-held alphanumeric terminal. A remote diagnostic station is also optionally available to system users who wish to have remote diagnostic service.

Configurations for the memory system are a vertical-mounting module housing up to 16 memory modules and a horizontal-mounting version for up to 4 modules. A typical fully tested system, with chassis, power supply, service communicator terminal, and a 1,024-K-by-64-bit configuration sells for $142,770, or $17,850 per megabyte. The remote diagnostic system is sold in a system-kit package for $16,590; a software-only package is $5,600. First shipments will begin next month.

Intel Corp., 1302 N. Mathilda Ave., Sunnyvale, Calif. 94086. Phone (408) 734-8102 [364]

Dot-matrix impact printer sells for under $450

Selling at a low price of under $450, the Epson MX-70 dot-matrix impact printer features a disposable print head with a life expectancy of



between 50 million and 100 million characters. A new print head can be purchased for less than $30 and installed in less than a minute. It also features Graftrax II, a 60-dot/in. function that makes the bit-image graphics free from jitter, wander, and walk.

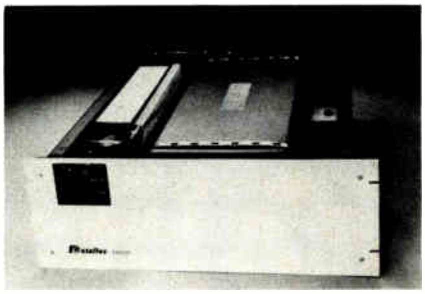
The MX-70 prints in one direction on a five-by-seven-dot matrix at 80 characters/s and offers a choice of 40- (double-width characters) or 80-column printing. It has programmable line-feed and form lengths, a self-test mode, and an adjustable tractor feed.

Epson America Inc., 23844 Hawthorne Blvd., Torrance, Calif. 90505. Phone (213) 378-2220 [365]

Winchester disk system has 10- or 20-M-byte storage

The 9800R is a ruggedized Winchester disk system designed to be used in seismic data gathering, process control, and military vehicles.

The 9800R has a shock-mounted



8-in. Winchester disk, power supply, embedded Z80-based controller, and a minicomputer interface and cabling. Tested to meet MIL-STD-810C standards, the system is available with either 10 or 20 megabytes of unformatted storage. It can be operated by installing the appropriate interface board, supplied by the company, into a computer and then attaching the 9800R. The disk system features a self-locking movable-head cartridge that gives added security during transport, a patented brushless dc drive motor, a closed-loop servo and air filtration system, and a linear voice-coil actuator. It has a mean time between failures of 10,000 hours and a mean time to repair of 30 minutes.

The 9800R, with minicomputer interface and 10 megabytes of storage, sells for $9,000. Dataflux offers a one-year warranty on all parts and labor. Delivery is 45 days after receipt of order.

Dataflux Corp., 1050 Stewart Dr., Sunnyvale, Calif. 94086. Phone (408) 732-7070 [366]

Intelligent terminal comes in parts for OEM assembly

The ergonomically designed series 8000 intelligent terminal allows the original-equipment manufacturer to custom-build his own terminal system. The terminal consists of separate modules for either a 12- or 15-in. cathode-ray tube, typewriter or keypunch keyboards, and logic that can be switched for a wide range of performances. The 12- or 15-in. CRT has a monitor and power supply with the necessary power levels for the CRT and the logic. The detached keyboards are microprocessor-controlled and prevent n-key rollover. The logic box, 18½ in. wide by 14 in. deep by 2¾ in. high, accommodates up to three snap-in printed-circuit boards for a total of 300 in.^{2} of logic.

The 8000 is configured with 16, 32, or 64 K of random-access memory, and 4, 6, 8, 12, or 16 K of read-only memory or programmable ROM. A 2-K test chip is standard. Communications may be asynchronous or synchronous at up to 19.2 kb/s. Each terminal comes with two RS-232 ports or, optionally, one RS-232 port and one current loop.

The logic box with standard pc board consisting of microprocessor, 16-K RAM, 8-K ROM, RS-232 ports, and communications controller is priced at $826 each in 100-unit quantities. The 12- and 15-in. CRTs are $488 and $777, respectively, in quantities of 100. The standard typewriter-style keyboards are $266, also in lots of 100. Shipments will begin in July.

Zentec Corp., 2400 Walsh Ave., Santa Clara, Calif. 95050. Phone (408) 727-7662 [367]

MDB makes synchronous communications interfaces for Q-Bus* and Unibus* that handle both bit and byte protocols.

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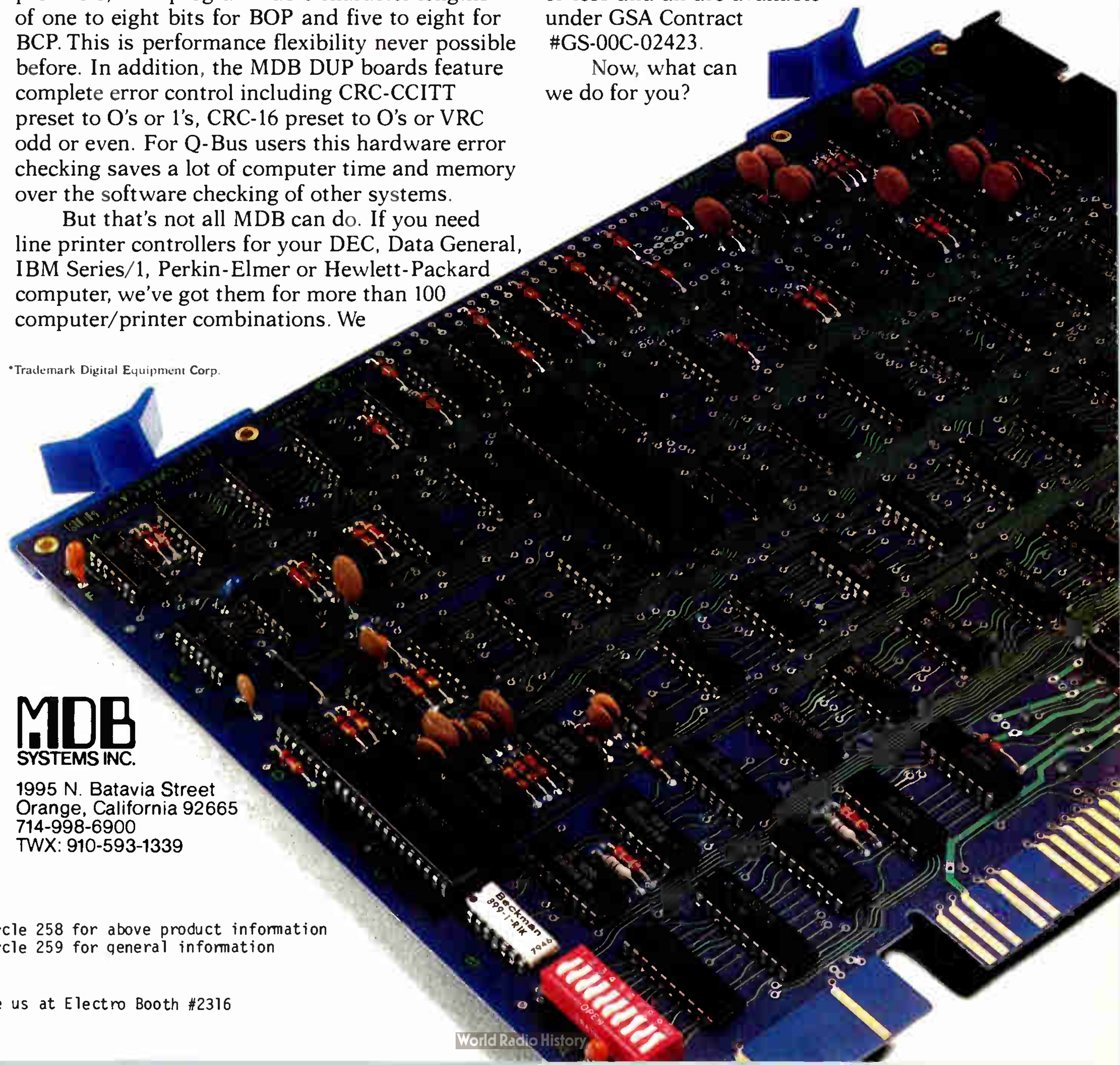

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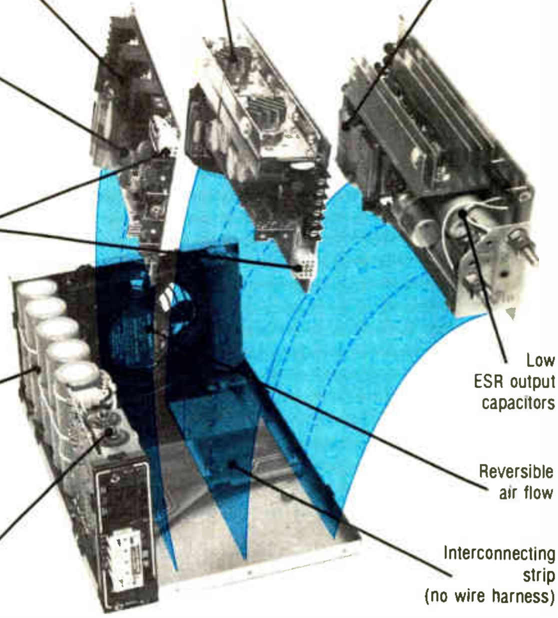

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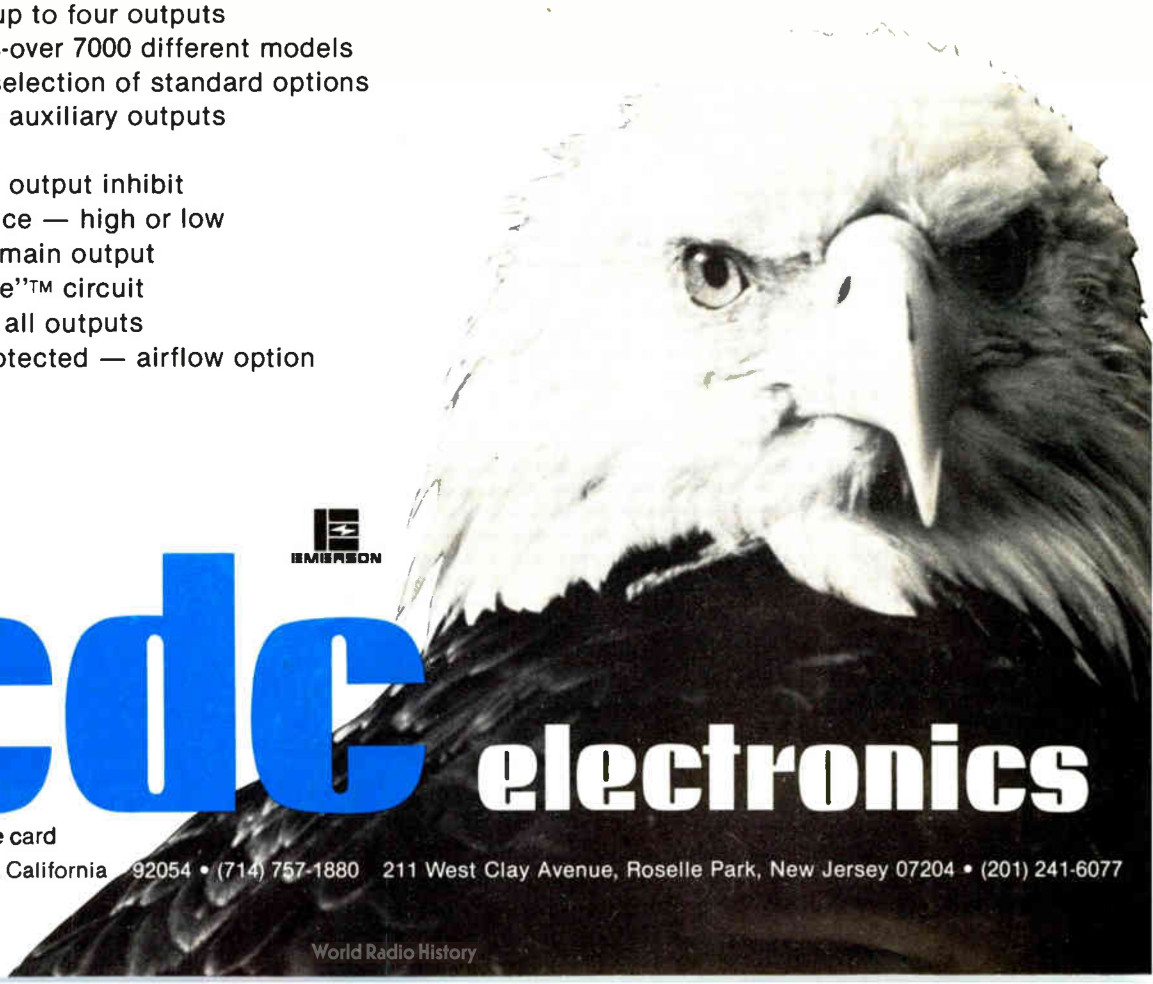

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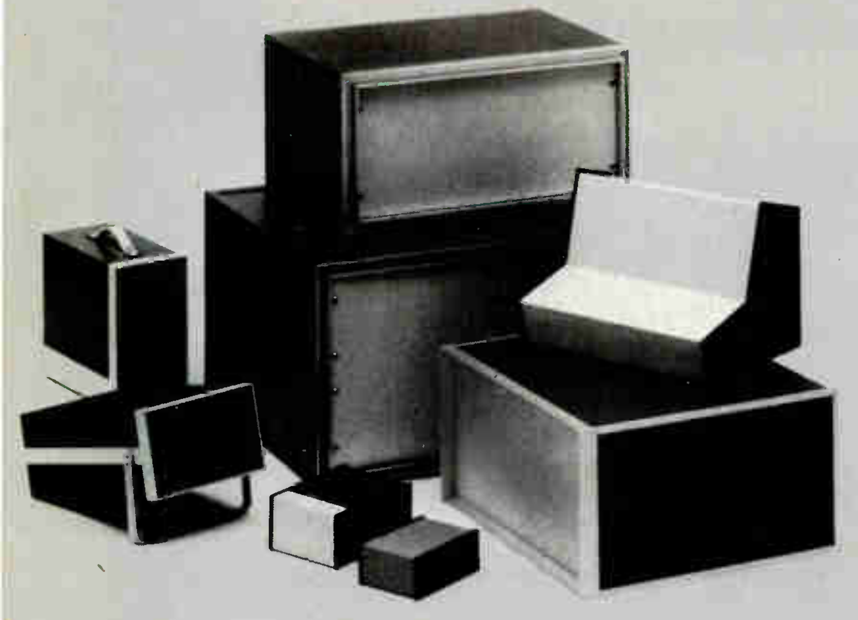

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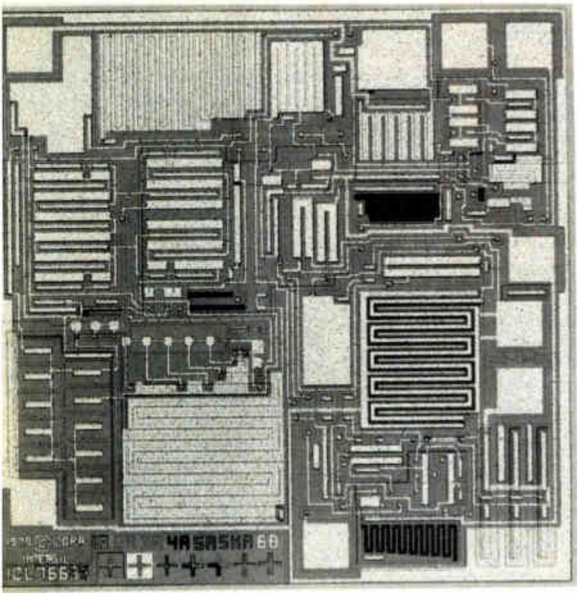
Components

C-MOS regulators use only 10 μA

Low-drift monolithic parts regulate small currents of up to 20 mA at 15 V

Maintaining the momentum it established two years ago with the introduction of complementary-MOS technology to standard linear functions, Intersil Inc. now has developed two C-MOS voltage regulators. Like the C-MOS operational amplifiers and voltage converters pioneered by the firm [*Electronics*, Jan. 18, 1979, p. 39], the new single-chip devices combine very low power-supply drain with many of the same features as their bipolar counterparts.

The ICL7663 positive-series voltage regulator and its counterpart, the ICL7664 negative-series voltage regulator, operate over a wide power-supply input range—1.6 to 16 V—and feature extremely low current consumption: 7 μA typically, 10 μA maximum. Intended primarily for low-voltage, power-efficient applications, the C-MOS regulators accurately control output voltages as low as 1.2 V and as high as 15 V for



output currents up to 20 mA, claims Jules C. Farago, Intersil's product manager for linear ICs. According to Farago, these devices will be especially attractive where low power consumption, low drift, and excellent regulation are important. Line and load regulation are 1% maximum, he notes, and the temperature coefficient is a low 100 ppm/°C. Maximum standby current is a mere 3.5 μA. Thus, battery power is not eaten up while the device is in an idle state.

Believed to be the first C-MOS voltage regulators, the 7663 and 7664 each have an internal bandgap reference (1.2 V) that is compared with an applied external voltage. If the external voltage is less than the internal bandgap voltage, the device's outputs are turned on. In the case of the 7664, there are two outputs only, each having essentially the same capabilities. For high current-output drive these two outputs can be used in parallel, Farago notes.

The ICL7663 has three output voltages. The first is intended for low-current applications (up to 300 μA) where the input-to-output voltage difference must be small—less than 0.5 V. The second output is targeted for applications requiring high output currents. The third output on this device, Farago says, is intended for generating output supply voltages (from the other two outputs) having negative temperature coefficients. "This is particularly suitable for driving multiplexed liquid-crystal displays," he states.

Inhibitable. Among the more significant features of the C-MOS voltage regulators are a programmable current-sensing circuit for output-current limiting and an interrupt terminal that allows both outputs to be inhibited. The latter feature, Farago explains, is a logic control function. "The devices take a standard TTL input, and limits are set. If there is a malfunction at either the input or the output," he continues, "a logic-level input signal is triggered, which disables the outputs."

Of course, like other C-MOS implementations of classical linear functions, the ICL7663 and 7664 are not subject to the dropout characteristics that are common to their bipolar counterparts. Such characteristics are related to on-resistance, which is relatively low in C-MOS technology, Farago notes. For example, the LM330 positive voltage regulator from National Semiconductor Corp. has a drop-out voltage in excess of 300 mV, with an output current of 150 mA. "In low-current applications with a 1-mA load current, the 7663 and 7664 regulators have a dropout voltage of 50 mV, and they have an almost infinitesimal 50-μV dropout voltage with small loads of 1 μA," says Farago.

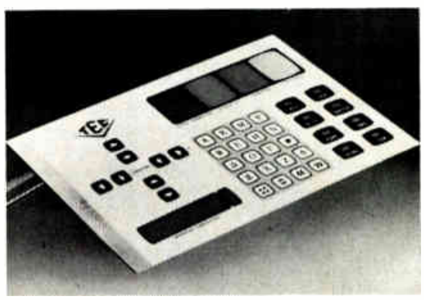
"Both the LM330 and these devices are very good state-of-the-art voltage regulators in their own right," Farago states. "However, the National device is less useful at low currents, where ours shines; and it is more useful at high currents, where our device isn't applicable."

Fabricated in Intersil's proprietary Max-C-MOS process, the 7663 and 7664 are available in either a plastic mini-dual-in-line package, or in an hermetic TO-77 package. They may be used over the temperature range of −20° to +85°C. In 100-piece quantities, the devices will list for under $2. Delivery is in 30 days.

Intersil Inc., 10710 North Tantau Ave., Cupertino, Calif., 95014. Phone (408) 996-5000. [341]

Flat-panel keyboards feel natural to the touch

The low-profile Custom Data-Panel keyboard has been designed to feel natural to the touch. Light pressure of 6 oz (±1 oz) on the surface of the flat-panel keyboard is enough to close the unit's switch contact. The



keyboard is sealed completely in the front to prevent moisture contamination and can also be sealed in the back for more protection. The units have a contact life in excess of 5,000,000 cycles and parallel output. They come in a large number of colors and a variety of configurations, including units with ASCII encoding, serial output, and light-emitting-diode indicators in keys that have special functions.

Contact resistance for the keys is less than 4 Ω with TTL or MOS, and the maximum contact rating is 50 mA at 28 V dc resistive. The switches travel a maximum of 0.020 in. and the contacts bounce back in less than 1 ms. The Data-Panel meets or surpasses the shock, vibration, humidity, and salt-spray specifications of MIL-STD-202.

Prices are quoted upon the receipt of a customer's specifications. The company says that they are "considerably lower than for conventional keyboards."

TEC Inc., 2727 N. Fairview Ave., Tucson, Ariz. 85705. Phone Dale Marthaler at (602) 792-2230 [343]

Low-power audio indicators put out 2.8-, 4.6-kHz tones

Piezoceramic transducers allow the series AI-420 and AI-430 audio indicators to consume little power while at the same time offering a higher output and a longer operational life. The AI-420 comes in a 7-g white plastic case and operates on an input of 3 to 24 V dc, producing a 4.6-kHz tone. Its typical sound-pressure level is 50 to 87 dBA at 1.0 m over its voltage range, and it drains an average current of 12 mA. The series AI-430 operates on a 3-to-28-V dc input, producing a 2.8-kHz tone with a typical sound-pressure level of 60 to 79 dBA at 1.0 m over its voltage range. Its average current drain is 15 mA. It comes in a black plastic case and weighs 15 g. Both units operate efficiently within a temperature range of −20° to 60°C. They offer continuous-mode operation and can be flange-mounted with wire leads.

The AI-420 series sells for $2 each in small quantities; the AI-430 sells for $2.53 each. Delivery takes six to eight weeks.

Projects Unlimited Inc., 3680 Wyse Rd., Dayton, Ohio 45414. Phone Greg Kimpton at (513) 890-1918 [344]

Vacuum-fluorescent display has 32 oversized characters

A microprocessor-based vacuum-fluorescent display module has 32 alphanumerical characters that are 0.21 in. high and 0.12 in. wide. The display also offers an additional 8 characters per line in its 40-character buffer. The display module is fully compatible with both the ASCII and Baudot codes and provides all necessary control, memory, and refresh circuitry. Only a single 5-V power source and parallel-logic compatible data are required for immediate operation.

The letters on the display are blue-green on a high-contrast dark background. The unit can operate as a moving display from left to right or from right to left with cursor. It provides a full 69-character ASCII character set and all of the symbols and letters of the 64-character Baudot code.

The single-quantity price is $250, but original-equipment-manufacturer discounts are available. Delivery is from stock and shipping within two days of an order's receipt.

Micon Industries East, 8 Blanchard Rd., Burlington, Mass. 01803. Phone (617) 273-3384 [345]

Ac capacitors virtually eliminate shorts

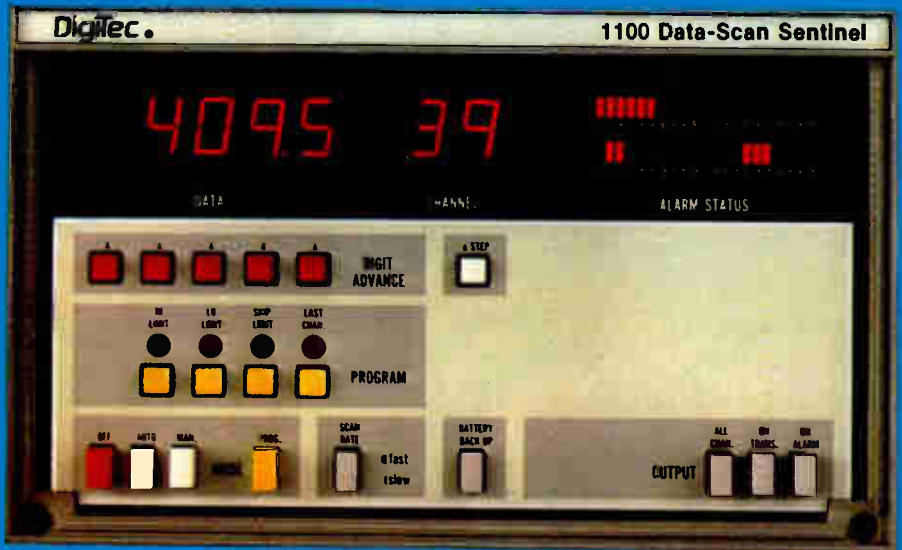
A line of ac capacitors, designated Aeromet, are to be used in the air-conditioning and high-intensity-discharge-lighting industries. They are constructed with metalized polypropylene film for a high dielectric strength and low energy losses. The Aeromet units rid themselves of dielectric defects in microseconds

Introducing The New Digitec Data-Scan Sentinel

It's Faster... It's Smarter... It's More Versatile

The Data-Scan Sentinel is a highly versatile multi-point measuring system. Multiple analog inputs are sequentially scanned, converted to digital values and processed by the internal microprocessor as preprogrammed by the user.

By itself, the Data-Scan Sentinel is a multi-point ALARM MONITOR; with the addition of a peripheral printer, it provides the classical DATALOGGER FUNCTION; when interfaced with a computer system, it functions as a low cost intelligent A/D front end. The Data-Scan Sentinel offers a combination of versatility function and cost effectiveness previously unavailable.



...as an Alarm Monitor

The Data-Scan Sentinel Features

- Greater than 40 channels per second measurement rate
  Standard
- Individual High and Low Set Points for each measured input
  Standard
- Front Panel Alarm Annunciators and a common alarm relay output
  Standard
- Over 25 Signal Conditioners to select from: RTD, T.C., Thermistor, Resistance, Voltage, Current, Offset and Scaled, Millivolt, etc.
- Battery Backup of limit values
  Standard
- Optional I/O interfaces RS-232C/20mA or GPIB/IEEE-488

The Model 1100 becomes a low cost, yet highly versatile Datalogger by simply connecting a low cost printer to one of the optional I/O interfaces. A printed output of alarm status channel number, data, label, date, and time is provided. Output of data is conditional on alarm status, alarm transition, periodically (interval timer-time out) or any combination selected by the user.

...as a Datalogger

Used as an Intelligent A/D Front End, the 1100 brings a new dimension to traditional Data Acquisition Systems (DAS).

Operating as a real time, on line Alarm Monitoring System, the Data-Scan Sentinel presents a minimum overhead burden to the "Host Computer System" or terminal. This minimum overhead is achieved by transmitting only required data to the "Host." Seven different conditions of exceptional data as well as individual channel data can be selected and output via the optional bi-directional interfaces.

The GPIB (IEEE-488) provides the capability of interfacing as many as 15 Model 1100's to a "Host System."

...as an Intelligent A/D Front End

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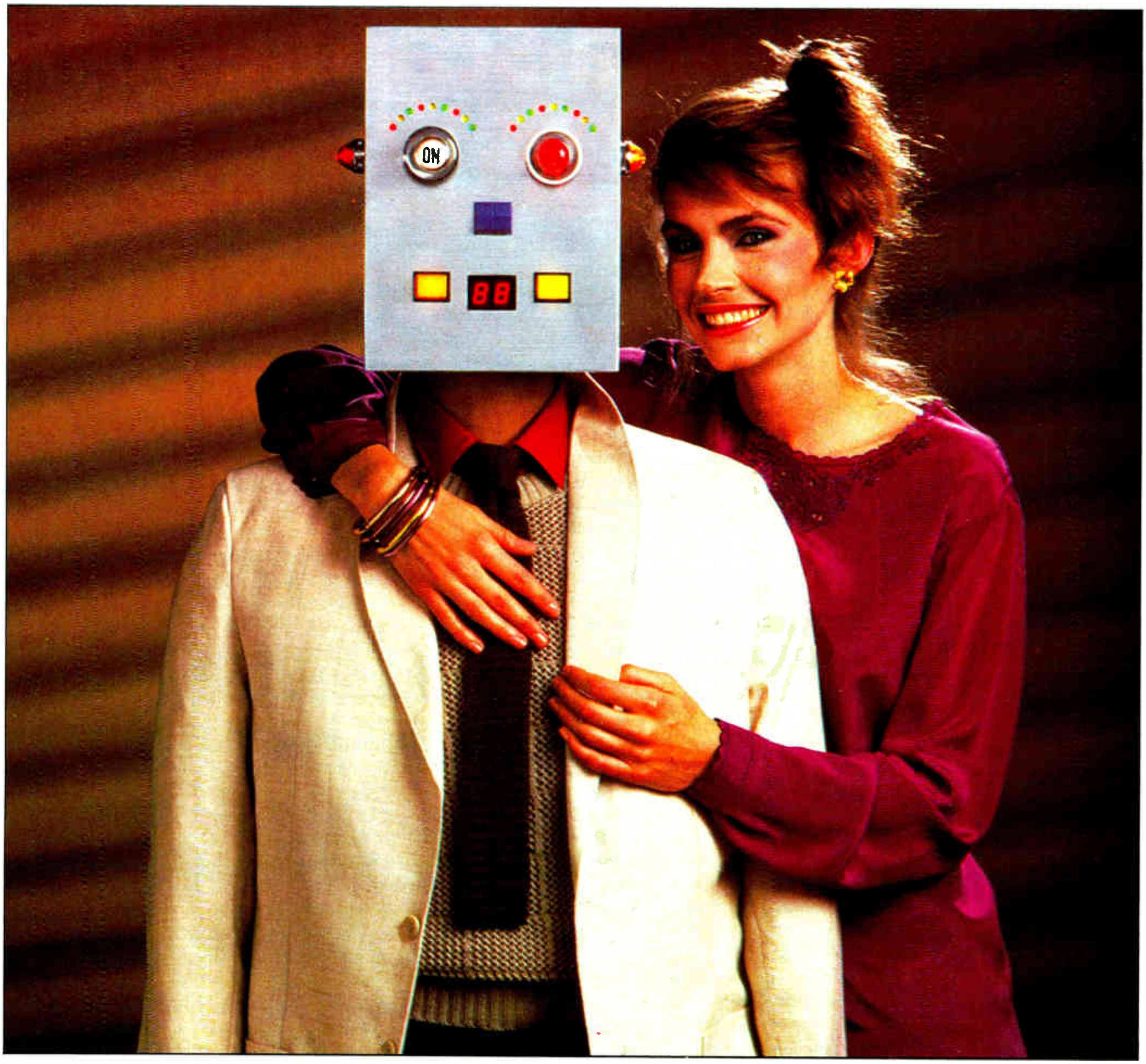
THE DESIGNER LOOK.



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DESIGN IN ***DIALIGHT***

without any effect on their normal operations, virtually eliminating shorts. The capacitors occupy 50% less space than conventional units and have a low energy dissipation that keeps their internal operating temperature lower for a longer life.

Aeromet capacitors come in flat, oval, or round metal cases for easy mounting in existing conventional designs. They have voltage ratings from 115 to 480 V ac and capacitance ratings from 1.0 to 80 mF, depending upon operating voltage and temperature ratings.

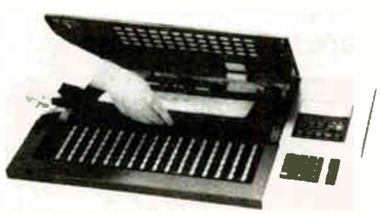
Aerovox Inc., New Bedford, Mass. 02741 [346]

One-touch panel has 96 customized keys

Designed to simplify data entry and automated equipment control, the one-touch Key-Mat from Panasonic is approximately the size of a standard keyboard and consists of one switch panel and one removable cartridge mechanism. The switch panel has 96 variable keys, 24 page-select keys, 12 function keys, and 48 fixed indicators with status lights. The operator using the key mat does not need to be an experienced typist as he or she is not using a standard keyboard. Instead, legends displayed on the keys define their functions, and the user need only press the appropriate keys.

The Key-Mat, with its 96 custom-made legends per page and 24 pages per cartridge, has 2,304 legends for each cartridge. It uses a maximum of 15 interchangeable cartridges for a total of 34,560 legends for any application.

Panasonic Industrial Sales Division, One Panasonic Way, Secaucus, N. J. 07094 [347]



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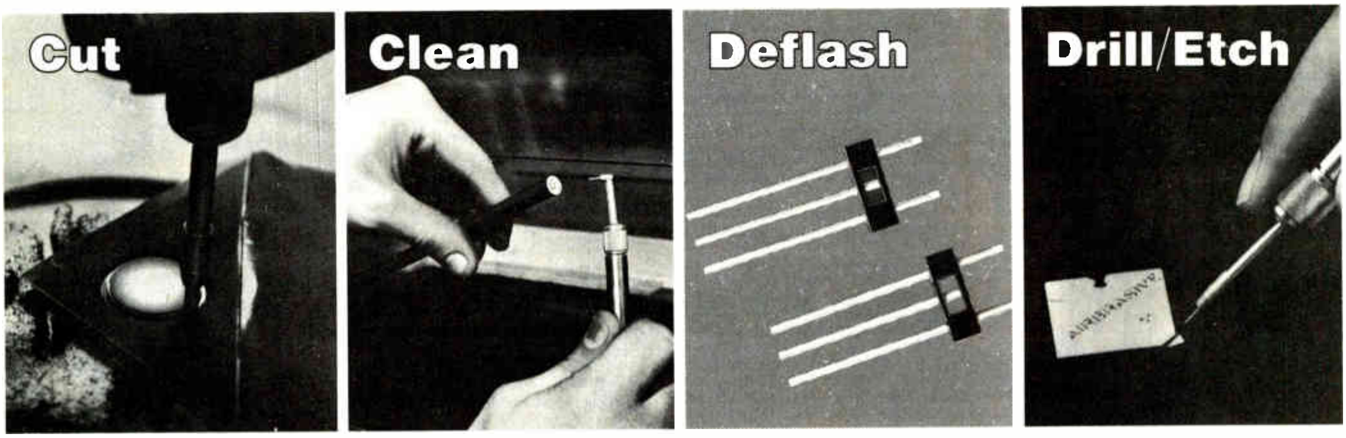

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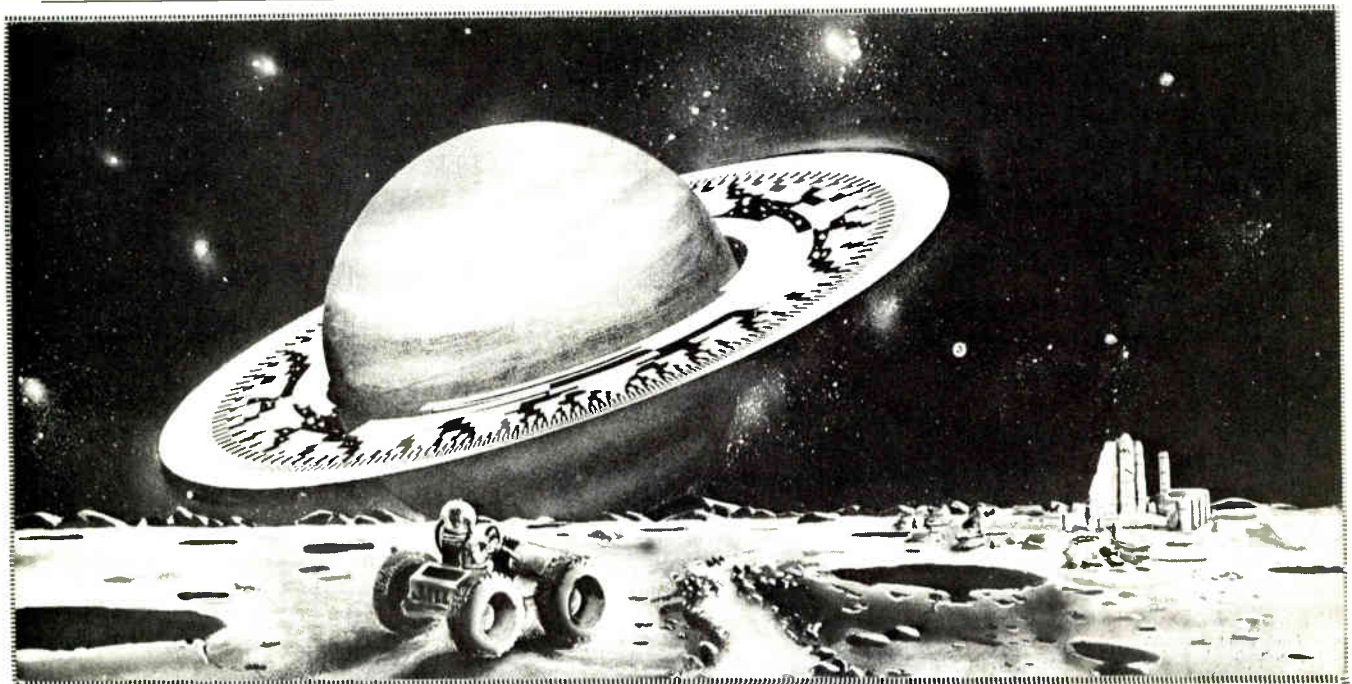

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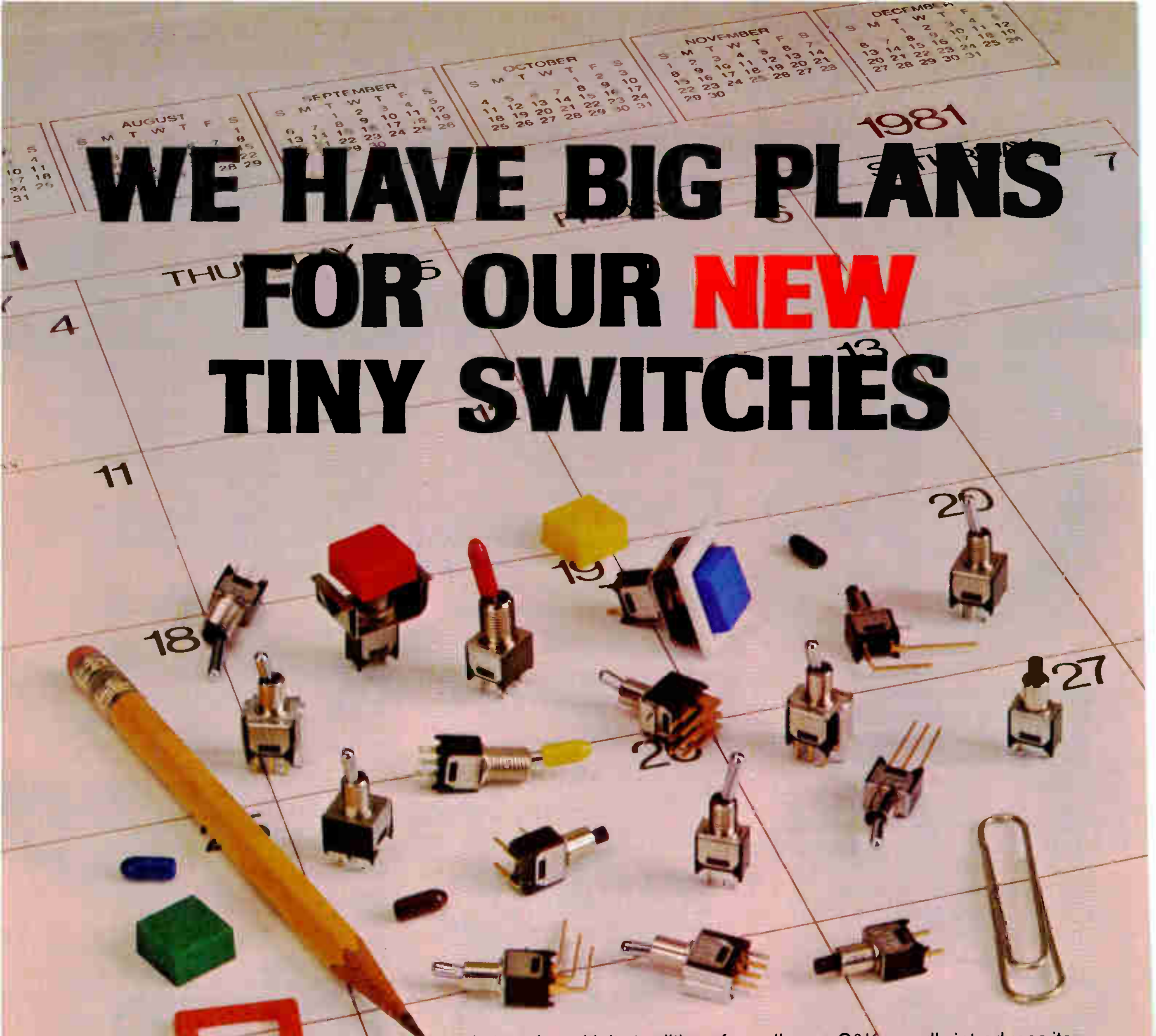

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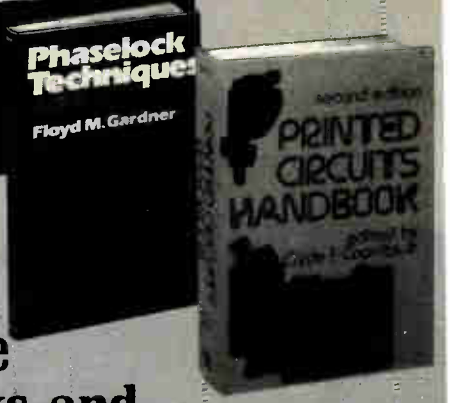

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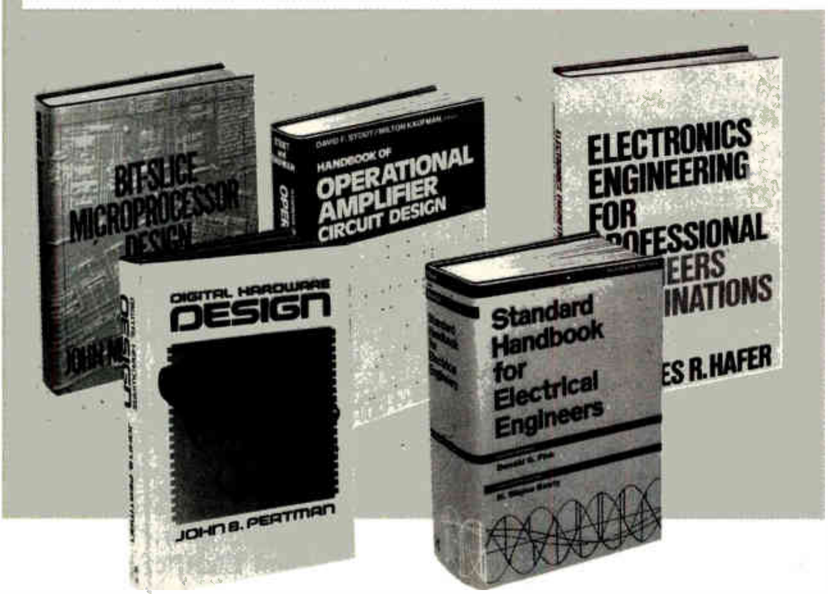

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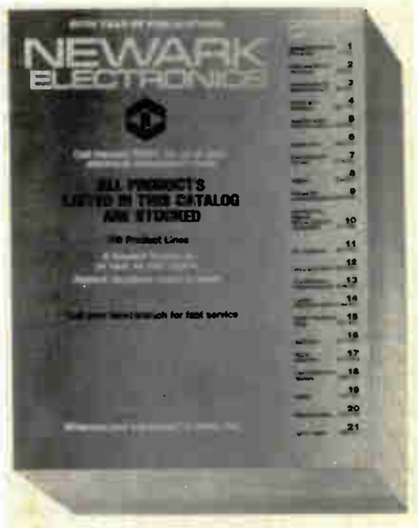
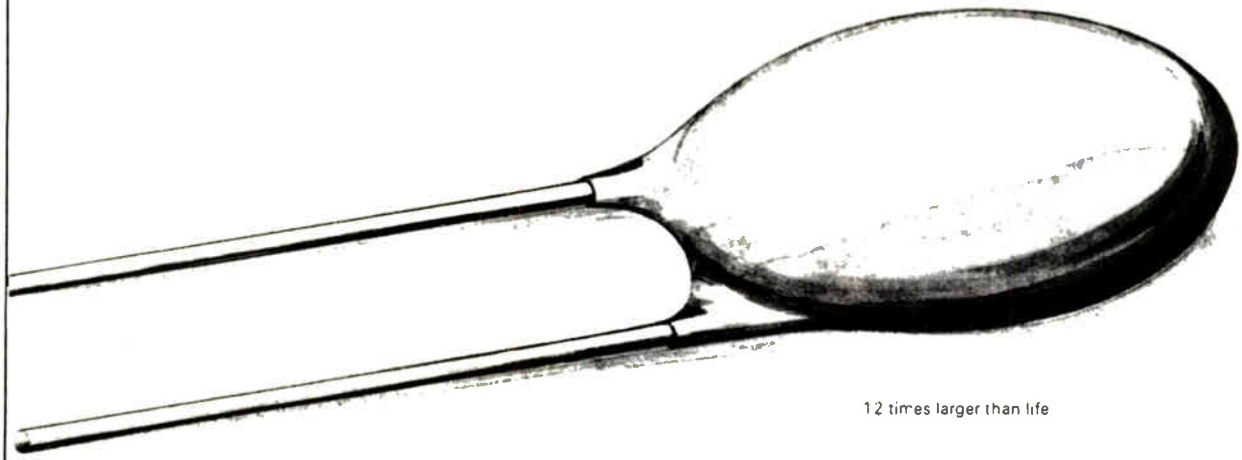
Component manufacturers. The products of leading electronic component manufacturers are described in a 756-page catalog. Among the 190 products displayed in the catalog are the new lines of Beckman, C&K, Globe Union Batteries, Heinemann, Intersil, OK Tool, and TRW/IRC. The established products are those of Allen-Bradley, Alpha, Amphenol, Augat, Belden, Bourns, Bud, Centralab, Cherry Electric, TRW/Cinch, Chicago Miniature Lamp, Cornell-Dubilier, Cutler-Hammer, General Electric, Interna-





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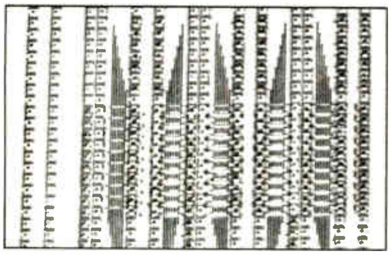
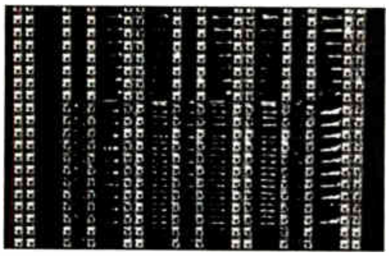
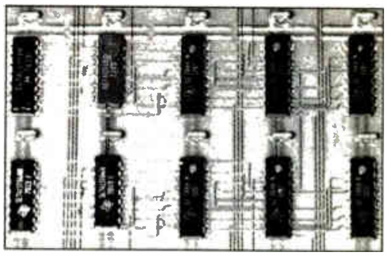


Detail of a K6 wired board.



A K6 board wired on both sides, ready for component insertion.



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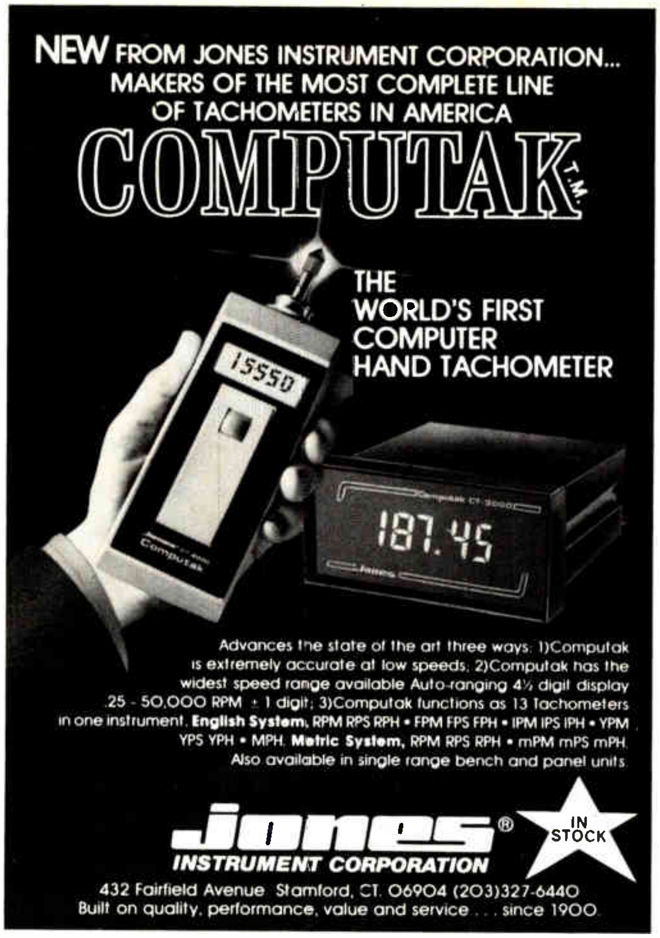

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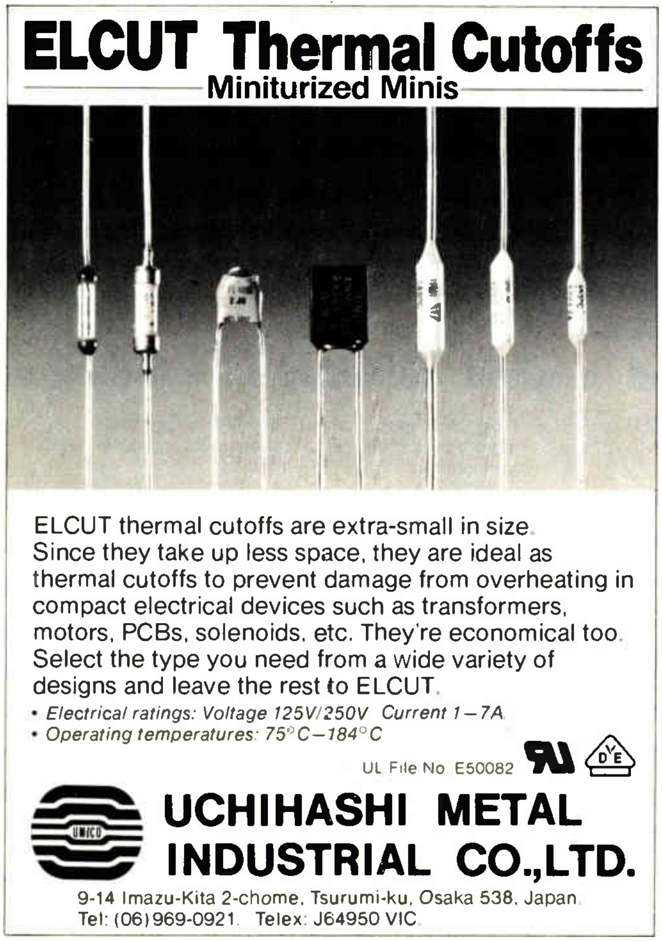

tional Rectifier, Mallory, Motorola, Ohmite, Potter & Brumfield, RCA, SPC Technology, Sprague, Switchcraft, Texas Instruments, and many others. Descriptions, electrical and physical specifications, and illustrations are provided for semiconductors, resistors, capacitors, potentiometers, controls, switches, relays, fuses, circuit breakers, transformers, connectors, sockets, wire, cable, lamps, lights, and other products. Catalog No. 105 features a product index and an index by manufacturer to help select the desired product. For a copy, write to Newark Electronics, 500 N. Pulaski Rd., Chicago, Ill. 60624. [422]

Signature analysis. "A Manager's Guide to Signature Analysis" provides information for determining the cost and feasibility of using signature analysis for testing and servicing microprocessor-based products. The 12-page application note 222-3 is divided into seven sections and lists eight assumptions that may affect the economic analysis of a product. The simplified rules for estimating incremental costs and savings and for calculating returns on investments are clearly stated. Hewlett-Packard Co., 1507 Page Mill Rd., Palo Alto, Calif. 94304 [423]

Modular manufacturing. A 94-page brochure describes the Honeywell manufacturing system, whose major features are product and process structure control, inventory control, cycle counting support, order release, and performance measurement. Each of the six HMS modules—inventory record management, manufacturing data control, materials requirement planning, master production scheduling, capacity requirements planning, and statistical forecasting—is described through photographs, flowcharts, and computer-printout samples. They also each rate a chapter of detailed discussions. A copy of the publication may be obtained by writing to Honeywell Information Systems, 200 Smith St., Waltham, Mass. 02154. [424]

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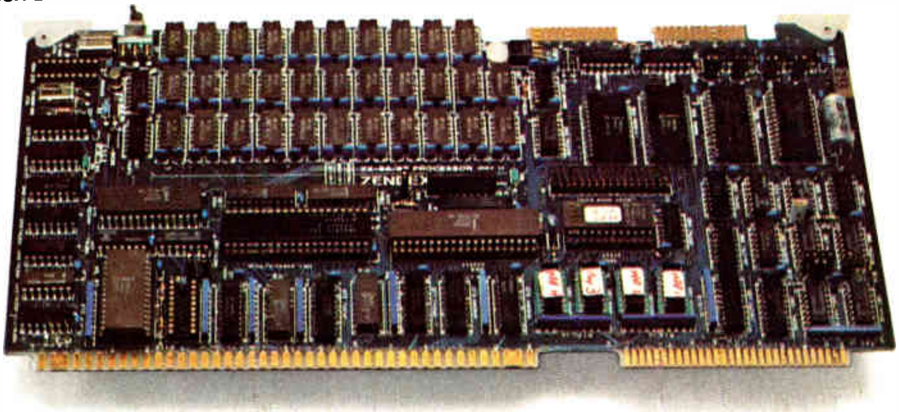

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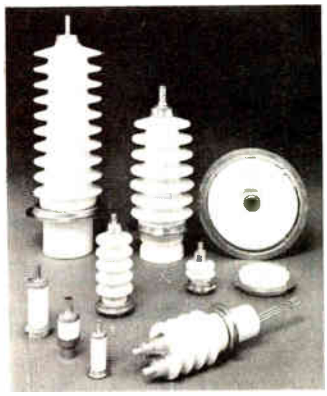

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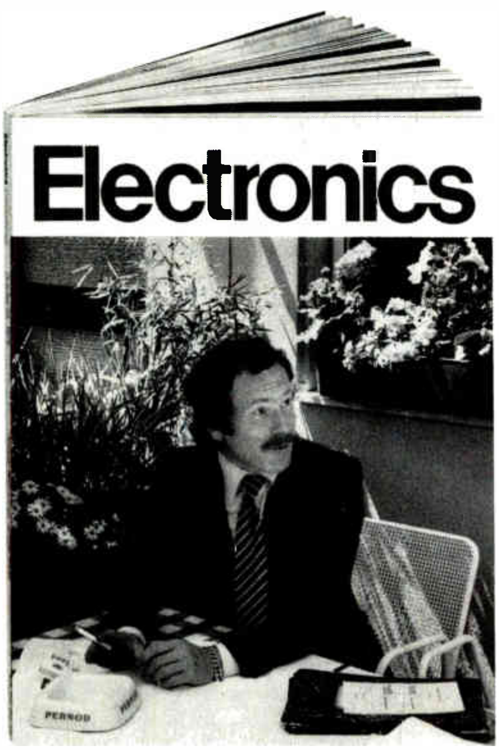

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The place to be in Europe is Redditch, England

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Source: 1981 Mackintosh Electronics Yearbook

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Circle 36 on reader service card

Products Newsletter

Entry error eliminated in Oak keyboards

The possibility of entering an error by striking more than one key simultaneously on a keyboard has been essentially eliminated in membrane-based full-travel FTM keyboards produced by Oak Switch Systems Inc. [*Electronics*, Aug. 14, 1980, p. 44]. With software, the Crystal Lake, Ill., division of Oak Technology Inc. has overcome what is usually termed n-key rollover and has at the same time licked the problem of the phantom key, the output of a key that hasn't been pressed. **Using a microprocessor to scan individual key-switch positions at a faster rate than a typist can strike the keys,** the software reads the keyboard and determines which keys are actuated and in which order, even 3 to 5 ms apart. Until the breakthrough with the Entry Error Elimination (E^3) software, more than 80 diodes and 160 solder connections were needed to do the same job. E^3 will be available as an option on all FTM keyboards.

Software defines chip personalities

What is perhaps the first universal programming system to **apply software techniques instead of personality modules to all programmable semiconductor devices** is about to be introduced by Citel Inc. The system 37 will program programmable read-only memories, erasable PROMs, and field-programmable logic arrays, among others. According to its developers at the new Sunnyvale, Calif., manufacturer, the system 37 can be used for complementary-MOS, n-MOS, or bipolar memory devices.

AMD pushes MOS products

Advanced Micro Devices Inc.'s MOS division, which accounts for slightly less than half of the Sunnyvale, Calif., firm's production volume, is planning an aggressive thrust with **an array of memories, a microcomputer, and peripheral devices.** Already being shipped as samples are two 4-K static random-access memories (the 4-K-by-1-bit 9147 and the 1-K-by-4-bit 9148) and a 2-K-by-8-bit and a 4-K-by-8-bit ultraviolet-light–erasable programmable read-only memory (the 9716 and 9732, respectively). Additionally, AMD is offering samples of an AmZ8016 direct-memory-access transfer controller for the AmZ8000 microcomputer family, as well as its version of the 8049 single-chip 8-bit microcomputer (Am9049) and 8041 universal peripheral interface (Am9041A). Among several proprietary n-MOS peripheral devices that will soon surface are the 9513 system-timing controller and the 9518 data-encryption chip.

C-MOS multiplexer handles video signals 10 MHz wide

The Semiconductor Products division of Harris Corp., Melbourne, Fla., is announcing **a four-channel monolithic complementary-MOS multiplexer capable of handling signals with bandwidths as great as 10 MHz.** The HI-524 therefore should be suited for use in video, radar, and telemetry applications. It switches among its four single-ended inputs in 150 ns. Prices range from $7.73 to $31.99 apiece in lots of 100 or more, depending on whether it is a standard or military configuration.

Intel development systems to get low-cost competition

After developing a line of Intel-compatible single-board computers, Zendex Corp. of Dublin, Calif., is taking direct aim at the market for Intel development systems. It will announce this month its family of Intel-compatible development systems, **including the $9,406 Zendex model 835 and the $18,656 model 845.** The 835, with dual 8-in. floppy disks, is to compete with Intel's $15,000 model 235 but lacks the 235's cathode-ray tube and keyboard. The 845, which will compete with the Intel 245, adds an Intel iSBC-206 hard-disk controller and a type-5440 disk drive. Both systems directly run all Isis software that can operate on comparable Intel systems and both include CP/M version 2.2 software, as well as a ZX-85 (8085) central processing unit with, among other things, 64-K bytes of random-access memory. A ZX-88 CPU board containing an 8088 microprocessor may be substituted for the ZX-85 board.

5½-digit DMM offers five standard functions

A microprocessor-controlled 5½-digit five-function portable multimeter will be privately previewed at Electro/81 to select customers of Racal-Dana Instruments Inc. Based on a Motorola 6802 8-bit microprocessor, the instrument **measures ac and dc voltage and resistance, plus ac and dc current.** The current functions are not usually standard in a 5½-digit DMM. Like the Irvine, Calif., firm's earlier μ5000 series, the new DMM accomplishes digital calibration without internal adjustments by having the front-panel buttons pressed until the display matches a correction factor stored in the instrument's battery-powered random-access memory, along with all calibration constants. It will be priced in the $1,000 range.

VLSI tester checks 288-pin assemblies at 40 MHz

The big brother of Genrad Inc.'s GR-16 test system for very large-scale integrated circuits has just been unveiled by the firm's Genrad-STI subsidiary in Milpitas, Calif. Called **the GR-18, the 40-MHz system can access three times more pins than the GR-16—288 versus 96** [*Electronics*, Jan. 13, p. 187]. Other key differences include the GR-18's capacity for independent dc parametric measurements, high- and low-voltage levels at all pins simultaneously, and a 50-Ω switching matrix at each pin for adding external instrumentation, signal generators, and analyzers to boost test capabilities. The GR-18 is much costlier than the GR-16, ranging from $1 million to $2 million.

Printer adds extra features for same price

A revamped version of the model 1201 dot-matrix printer will be announced soon by Computer Devices Inc. The Burlington, Mass., firm's printing terminal now offers as standard features **a 2-K-byte random-access memory buffer, polling, self-testing, serial interface, and 50-to-60-Hz international power compatibility.** Fifteen data-transfer rates—from 50 to 9,600 b/s—are selectable by switch, as are 80- and 132-column printing and a plotting feature with 0.017-in. resolution. Pricing for the new 1201 is the same as for the old: $1,094 in 100-unit lots.

Price changes

- **Mostek Corp.,** Carrollton, Texas, is cutting prices on 43 STD bus microprocessor boards by an average of 30%, ranging from 50% on floppy-disk controller cards ($350, down from $695) to 22% on parallel input/output cards ($195, from $250).
- **Precision Monolithics Inc. of Santa Clara, Calif.,** has reduced prices as much as 50% on its OP-07 series of ultralow-offset-voltage operational amplifiers. For example, the OP-07AZ, with a typical offset voltage of 10 μV in an eight-pin hermetic dual in-line package, has gone from $35.70 to $18.70 each in quantities of 100 to 999, and the same device with MIL-STD-883 class-B processing (OP-07AZ/883) has dropped from $42.85 to $22.40 each in like quantities.


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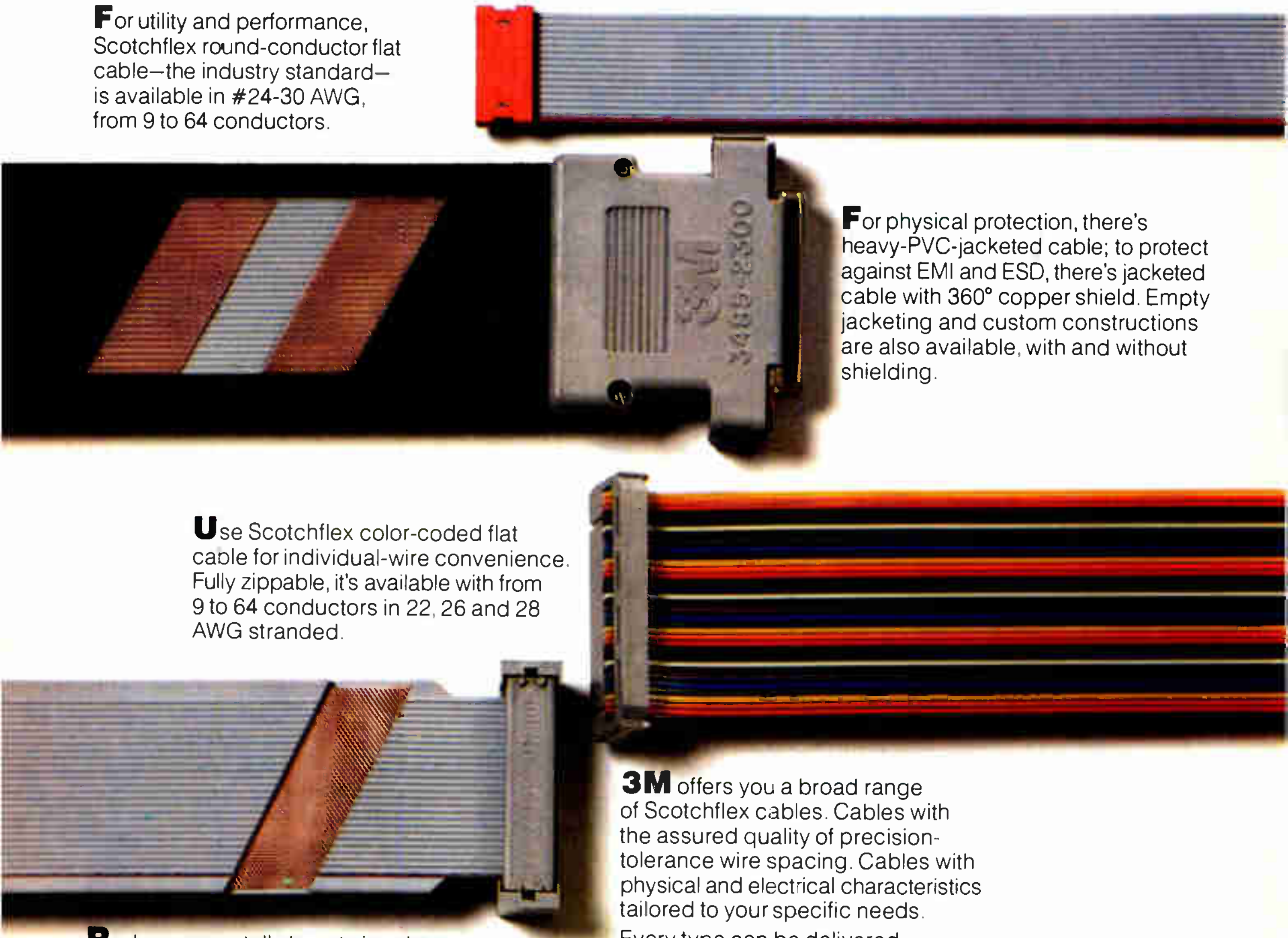

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Career outlook

Electro eyes career maintenance

■ Keeping abreast of technological advances is a concern of most engineers, and session 13 at this year's Electro in New York, April 7–9, will consider the various means available to engineers for career maintenance. Entitled "Maintaining Your Career—The Importance of Keeping Up with the State of the Art," it has been organized by Nina T. Kurtis, dean of continuing and independent programs for the Brooklyn, N. Y.-based Pratt Institute.

"The technology of the electronics industry is moving at such a rapid pace that the best route for keeping up is continuing education, rather than degree-granting programs," Kurtis says. "Continuing education provides flexibility and a variety of programs at many locations."

She has put the panel together from business, academic, and professional society circles and will be using editorial representatives to provide an overview. William Stack-Staikidis, dean of engineering at Pratt, and Cathy Figorito, associate editor at the Electronic Engineering Times, Manhasset, N. Y., will preside jointly over the session.

The first panelist is Joseph Biedenbach, director of continuing engineering education at the University of South Carolina's College of Engineering in Columbia, S. C. Of Biedenbach, Kurtis says that "he's Mr. Continuing Education in the engineering field. As an educator, he will look at the place of a university in the continuing education field."

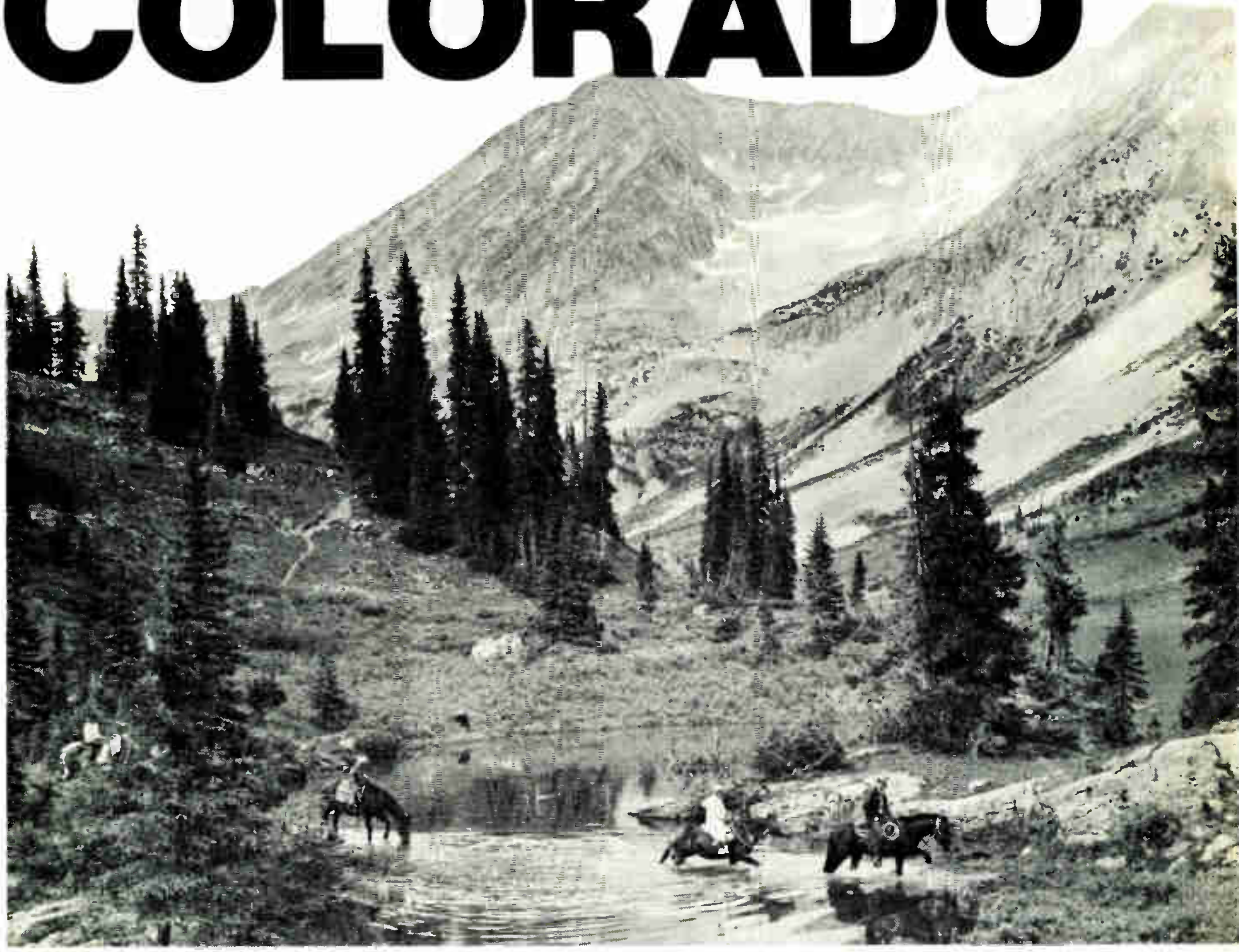
The second paper—which gives its name to the session—will be presented by James Hanlin, manager of educational services for the Instrument Society of America at Research Triangle Park, N. C. He will explore the role of a professional society in offering continuing education opportunities for the engineer.

Alice Morrison, manager of recruiting programs for Hewlett-Packard Co., Palo Alto, Calif., will deliver the third paper, "Student Work Experience Programs at Hewlett-Packard." She will outline those programs, as well as the company's faculty loan and visiting professor programs. She will also explain the environment for employee continuing education and what HP is doing to promote precollege interest in the sciences.

The fourth panelist is Ray Pryor, whose consulting business in Oak Park, Ill., specializes in adapting microcomputers for cars. "Specialized engineering consultants will be the wave of the future," Kurtis believes, "and to specialize, engineers must remain up to date."

The final paper, "Continuing Education—Commitment to a Way of Life," will be given by William Tucker, market development manager of Machine Design magazine, Cleveland, and examine means for staying current. **-Pamela Hamilton**

COLORADO



The state that offers engineers jobs with a future and a Rocky Mountain high quality of life

The career opportunities in the truly beautiful state of Colorado have never been better for professionals in avionics, aerospace, electronics, computer science and data processing. Already a hot spot for high-technology companies because of its favorable economic and environmental climate, the Centennial State is also expected to benefit from the new Reagan Administration's announced determination to increase the military muscle of the country's armed forces.

Because of the growing demands of high technology companies, experienced professionals and entry-level engineers in the disciplines mentioned above are badly needed in Colorado. The state is noted for attracting engineers and their families who are looking for career opportunities and concerned about the quality of life.

"That's the message we receive from people once they decide to live here," says an executive of a major electronics firm.

According to Colorado Governor Richard D. Lamm, "Colorado holds recreational, educational, and business amenities for all who live here.

"We are blessed with moderate temperatures and sunny days for the tennis player and jogger, snow-covered hills for the skier and snowshoer, and miles of lakes and rivers for the fisherman and water skier.

"Colorado universities and colleges are known nationally and internationally for the students they produce and the research they conduct.

"As a business center, Colorado is known as the cable TV capital and a leader in the energy industry.

"Truly, Colorado holds the best of all worlds for its residents."

The 38th state to join the union in 1876, Colorado offers a number of advantages to engineers concerned about their careers. For example, the Centennial State is the home of 30 top-flight colleges and universities for engineers who want to advance their careers.

In addition, most of the high-technology companies encourage their employees to take in-house training courses, many of which are piped in through closed-circuit TV from nearby colleges.

Another Colorado advantage is the cost of living, including housing, which is below the average for other desirable areas in the country. This also holds true for the cost of utilities.

Colorado is also noted for its outstanding recreational facilities that include skiing, fishing, hiking, backpacking, camping, and mountain climbing.

Colorado has always been popular with vacationers and outdoor enthusiasts. The Centennial State is a magnificent 104,000 square miles of pure physical beauty. This, plus its unusually high quality of life, is the major lure to incoming engineers.

To give you and idea of what we're talking about, let's take a look at the cities in which high-technology companies are concentrated.

Boulder is a city of 200,000 thrust against a scenic backdrop called the Flatiron Mountains. The firms that seek engineers in Boulder include aerospace, computer, word processing, and electronic companies. Government research is also conducted in this lovely city, one of the leading scientific communities in the state.

Colorado Springs has everything going for it. The city of 250,000 looks out on majestic Pikes Peak. At an elevation near 6,200 feet, the sun shines on Colorado Springs 310 days a year. The metropolis, which one enthusiast calls a city of the 21st century, boasts 13 major museums and galleries, the Broadmoor International Center, Colorado Springs Symphony, Civic Theater, Fine Arts Center, and Cheyenne Mountain Zoo.

Because of its beauty and cleanliness, Colorado Springs has attracted top-notch electronic firms. Some of the reasons include low-cost housing, multifamily apartment residences with rentals typically in the $200 to $300 range and low-cost utility rates nearly 40% below the average city in the United States.

Fort Collins, located in the north central part of the state, is another city that has attracted electronics firms. In addition, Fort Collins is the home of Colorado State University with 100 buildings on 400 acres of beautiful campus. The city has a population of 79,860 with flat to rolling terrain and an altitude of approximately 5,004 feet.

Fort Collins has a pleasant four-season climate. The city also features 17 public parks, 30 private swimming pools, three lakes, three public golf courses and 56 tennis courts.

It is adjacent to 790,000 acres of Roosevelt National Forest and the Rocky Mountain National Park, several ski areas, Horsetooth reservoir, Boyd Lake, and Poudre Canyon.

Loveland is located about ten miles south of Fort Collins. Dubbed the Sweetheart City, it sits 4,986 feet above sea level and has a population of about 36,000. Loveland is one of the industrial centers in Colorado with more than 50 industries located in its area.

Richard D. Lamm, Governor of Colorado, is known for championing new business in the Rocky Mountain state.

Loveland is considered the gateway to Rocky Mountain National Park through the scenic Big Thompson Canyon. The city receives approximately 302 days of sunshine.

State and retail taxes are low, and the average selling price for a house in 1979 was $57,246, lower than most other parts of the country.

Denver is the capital city of Colorado and situated on the plains to the east of the towering and beautiful Rocky Mountains. It is the home of aviation, computer, and electronics manufacturers.

Denver also offers Colorado's unique quality of life. The city boasts a mild, pleasant climate. Its 1,600,000 people (2.6 million live in Colorado) are close to the mountains for recreational facilities. The city has a metropolitan atmosphere of art, music, and theater, and a wide variety of shops and restaurants.

An interesting statistic is that Denver is second only to Washington, D.C. in terms of the level of educational attainment of its population.

Because it has become the distribution center of the Rocky Mountain and High Plains regions, Denver has a highly developed transportation system. Stapleton International Airport is the seventh busiest commercial airport in the United States and is served by 17 major airlines, several area airlines, and various charter services.

Denver is also the center of railroad traffic in the Rocky Mountain region because large wholesale and distribution businesses use Denver as a shipping point for distribution of their products.

Boulder, Colorado Springs, Fort Collins, and Loveland are all within an hour and a half of Denver.

The city boasts both college and professional sports, and the Denver Symphony Orchestra, which performs in the new Boettcher Concert Hall, a unique in-the-round structure that has drawn raves from music critics around the world.

Housing in Denver is also relatively low in cost. The average value of a home in Denver in 1978, for example, was $54,000.

Add up all of Colorado's advantages and you can understand why the state has become so popular with high-technology companies. Many of these companies have moved their corporate headquarters to the Centennial State. And many of them are enlarging their facilities.

Consequently the need for engineers in a state where the mountains are outside your back door, the climate is dry, and rainfall averages about 15 inches a year, is becoming more acute.

In addition to its noted quality of life, Colorado offers engineers excellent salaries, a nice environment in which to live and work, and the opportunity to advance in one's career.

If you are an engineer who can't wait to settle in Colorado, consult the following Colorado Career Opportunities Section that follows. It is made up of companies that are seeking engineers with your talents to take a job with a future.

—John Brand.

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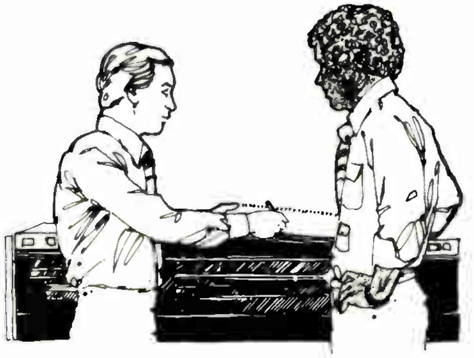

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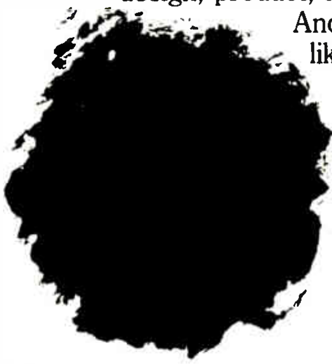

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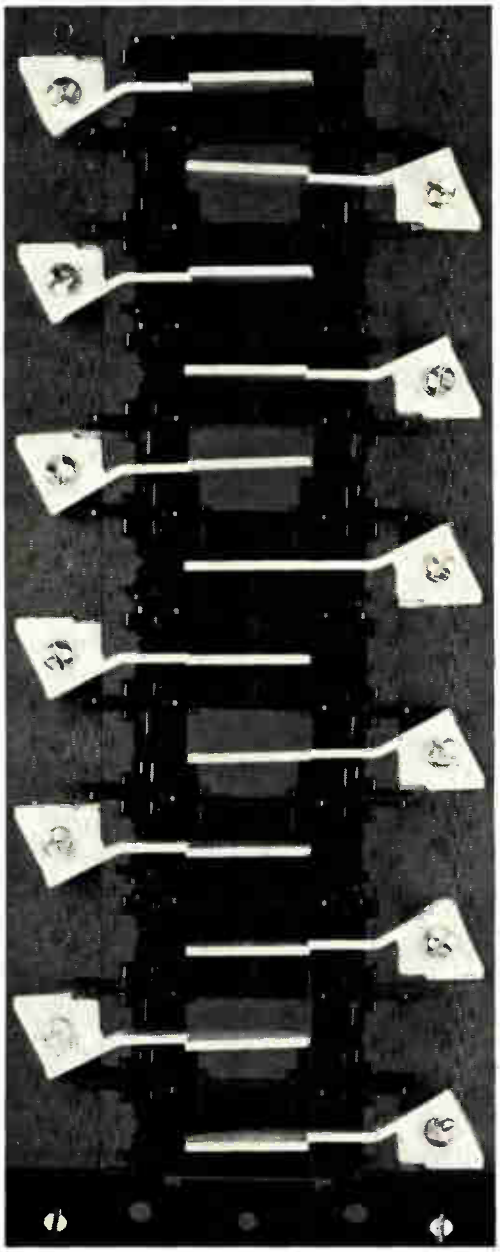

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	Advertiser	Page
	ACDC Electronics	262
‡	Acme Electric	46
	Acurex Corporation	80
	ADAC	216
□	Adelsy	16E-B, C, D, E
•	Adret Electronique	32E
	Advanced Micro Devices	10, 11
■	AEG Telefunken	183
	Airpax Division North American Philips	191
■	Alco Electronic Products	236
	Alps	226, 227
•	Altos Computer Systems	116, 117
	American Magnetics Corporation	288
	AMF/Potter & Brumfield	199
■	AMP, Inc.	18, 19
■‡	Amphenol North America	193
	A.P. Products	57
	Axiom	174
	Bafco, Inc.	310
	Bausch & Lomb Scientific Optical Products	179
■‡	Beckman—Electro Products Group	197
■	Bendix Electrical Components Division	239
	Berg Electronics	223, 233
■	B & K Precision	201
■	Bud Industries	264
	Burroughs	70
	Calma	242, 243
	Cambion	179
	The Carborundum Company	182
■	CELCO (Constantine Engineering Labs Co.)	187
	Ceramaseal, Inc.	286
■	Chesterfield Products	180
	CIT ALCATEL	283
•	Citel	29E
■	C & K Components	276
■	Clairex Electronics	4C
	Computer Products, Power Products Division	26
	Condor, Inc.	311
	Converter Concepts	218
‡	Convergent Technologies, Inc.	116, 117
	Coto Corporation	238
	Cromemco	2
■	Custom Electronics	312
	Data General	272
	Data I/O Corporation	275
■	Data Precision	83
	Data Systems Design	32
■	Data Translation	101
	Dataproducts	244, 245
	Datatron, Inc.	295
	Datum, Inc.	192
	Decitek	200
■	Delevan Division American Precision	190
	Deltron, Inc.	282
■	Dialight	270, 271
	Disc Instruments, Inc.	274
	Dolch Logic Instruments	17
‡	Dow Corning Resins & Chemicals	189
	Eastern Air Devices	238
‡	Eastman Kodak Company	64
‡	Eaton Corporation, Cutler Hammer	177
	Eaton Corporation, Electronics Instrumentation	256
	EDAC Connectors	294
	E-H International	277
	Electrohome, Ltd.	213
	Electronics & Controal Engineers Book Club	278-281
	Electronic Development Corporation	47
‡	Electronic Measurements, Inc.	59
■	Electronic Navigation Industries	6
	Elevam Electronic Tube Company, Ltd.	138
	Elpac Power Supplies	138
•	EMI SE Labs Data Products	193
■	EMI Technology	234
	EMM Sesco	257
□	ESE	16E-F
	Everett/Charles Test Equipment, Inc.	164
•	Feme S.P.A.	189
■	Ferranti Packard, Ltd.	220
■	First Computer Corporation	15
•	Fivre S.p.A.	177
	John Fluke Manufacturing Company	107, 109
	Foundation Electronic Instruments, Inc.	232
‡	Gates Energy Products, Inc.	69
	GCA Corporation	28, 29
•	GEC M-O Valve	64
‡	General Electric Instrument Rental	172, 173
	General Instrument Microelectronics	114, 115
	Genisco Technology Corporation	250
■	GenRad	293
	Georgia Power Company	268
	Germanium Power Devices Company	130
	Global Specialties Corporation	38
	Gould Inc., Instruments Division	98, 170, 171
	Gould Inc., Instruments Div., SC Operations	22, 23
■•	GTE Microcircuits	197
■	Hewlett Packard	1, 20, 21
□	Hewlett Packard Italiana	24E-A&B
	Hughes Aircraft Company, Solid State Products	249
	Hybrid Systems	87
	Hysol	154
	INCO	60
	Information Handling Services	76, 77
•	Inland International, Inc.	28E
■	Integrated Circuit Engineering Corporation	196
	Interdesign, Inc.	251
	International Microcircuits, Inc.	43
‡	Intersil	62, 63, 68
	Intertek	215
•	Italtel/SIT	111
■	ITT Cannon Electric	202, 203
••	ITT Capacitors	185, 26E
•	ITT Intermetall	68
‡	ITT Semiconductor	105
•	ITT Standard AG	1E

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Model	Output 1	Output 2	Output 3	Output 4	Output 5	Case	1-9 Pr.
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FCBB-89	+5V@6A	+24V@1.5/4.5A PK	+12V@.8A	-5V@.8A	-12V@.8A	CBB	130.00
FDBB-148	+5V@15A	+24V@2/4.5A PK	N/A	N/A	-5V or -12V@1.2A	DBB	149.00
FNBB-120	+5V@7A	+24V@3.5/5.5A PK	N/A	N/A	-5V or -12V@1.2A	NBB	120.00
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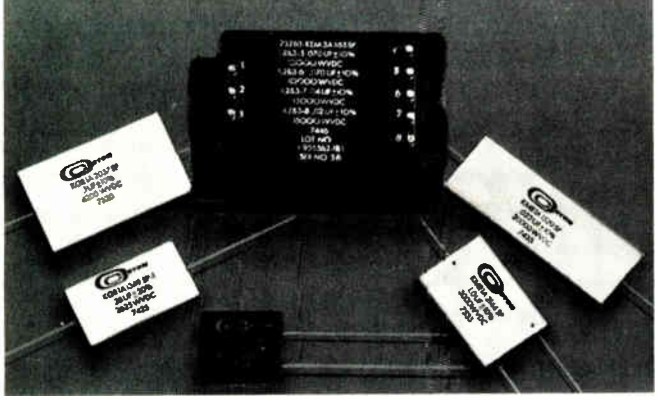

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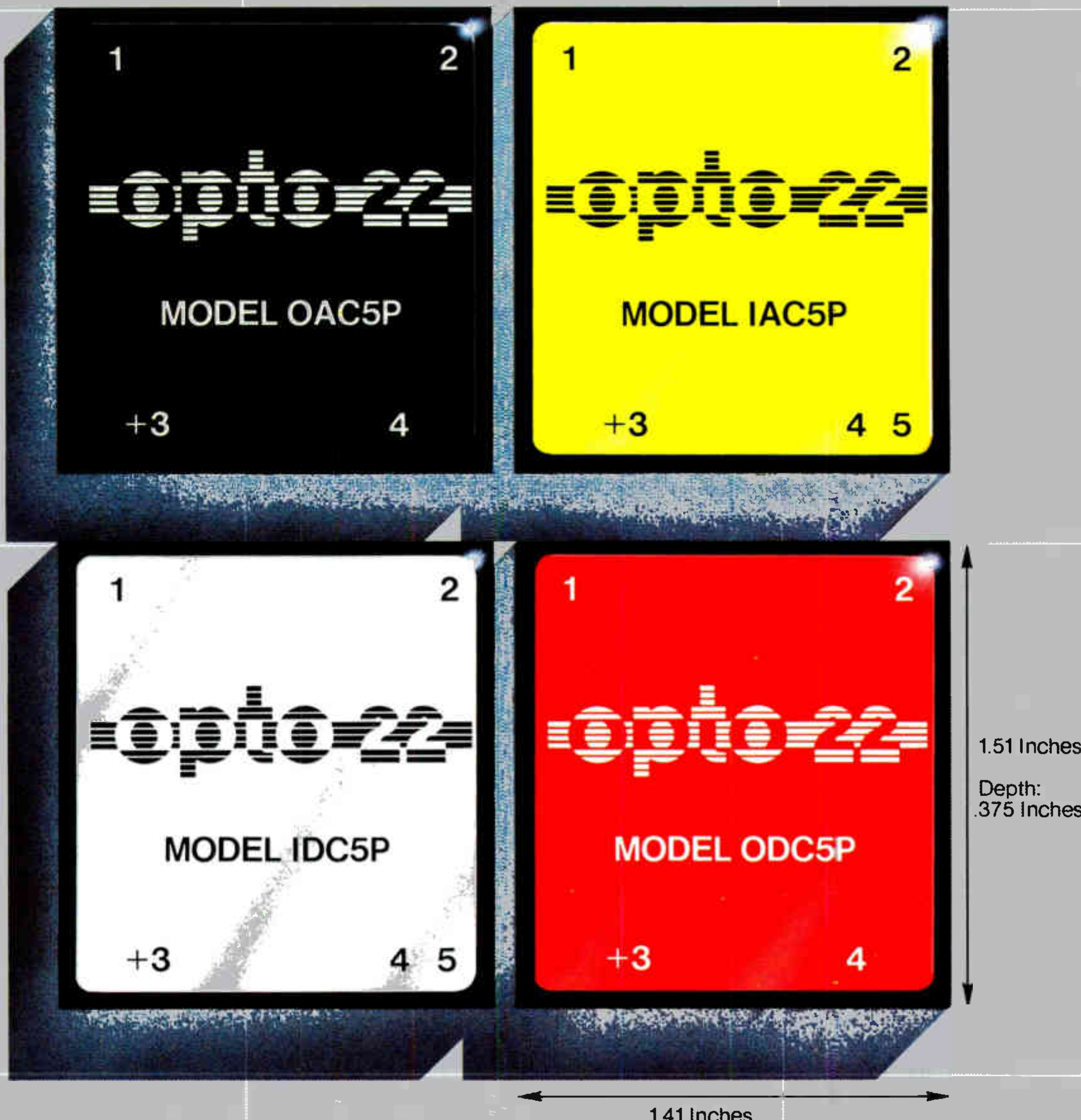

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