

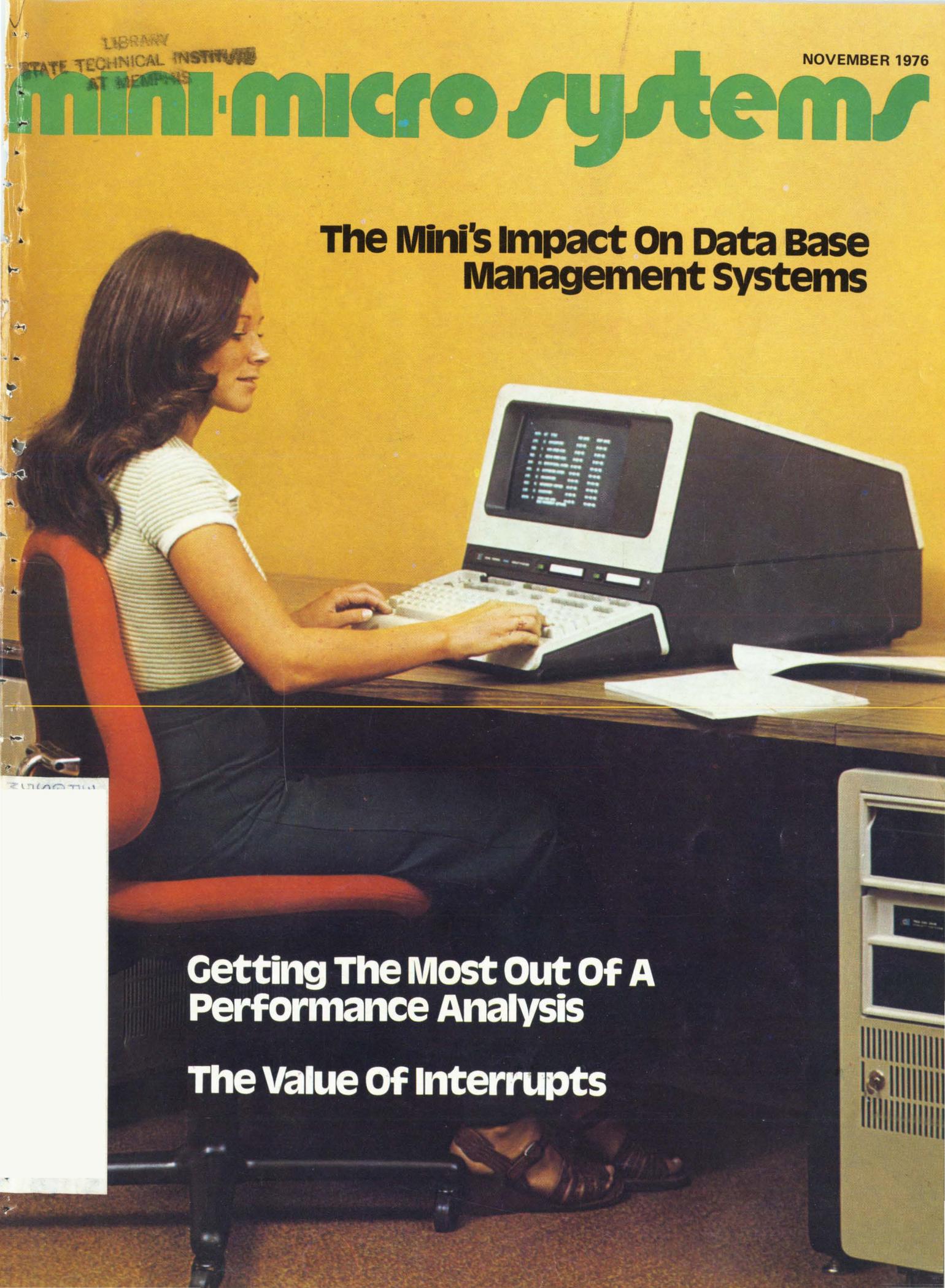
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NOVEMBER 1976

mini-micro systems

The Mini's Impact On Data Base Management Systems

A woman with long brown hair, wearing a white and black striped short-sleeved shirt and a dark skirt, is seated in a red office chair at a wooden desk. She is looking at a vintage computer terminal with a CRT monitor displaying text. Her hands are on a keyboard. To the right of the terminal is a large, dark, wedge-shaped computer case. In the foreground, a vertical stack of computer hardware is visible, including a floppy disk drive and a power supply unit. The background is a plain, light-colored wall.

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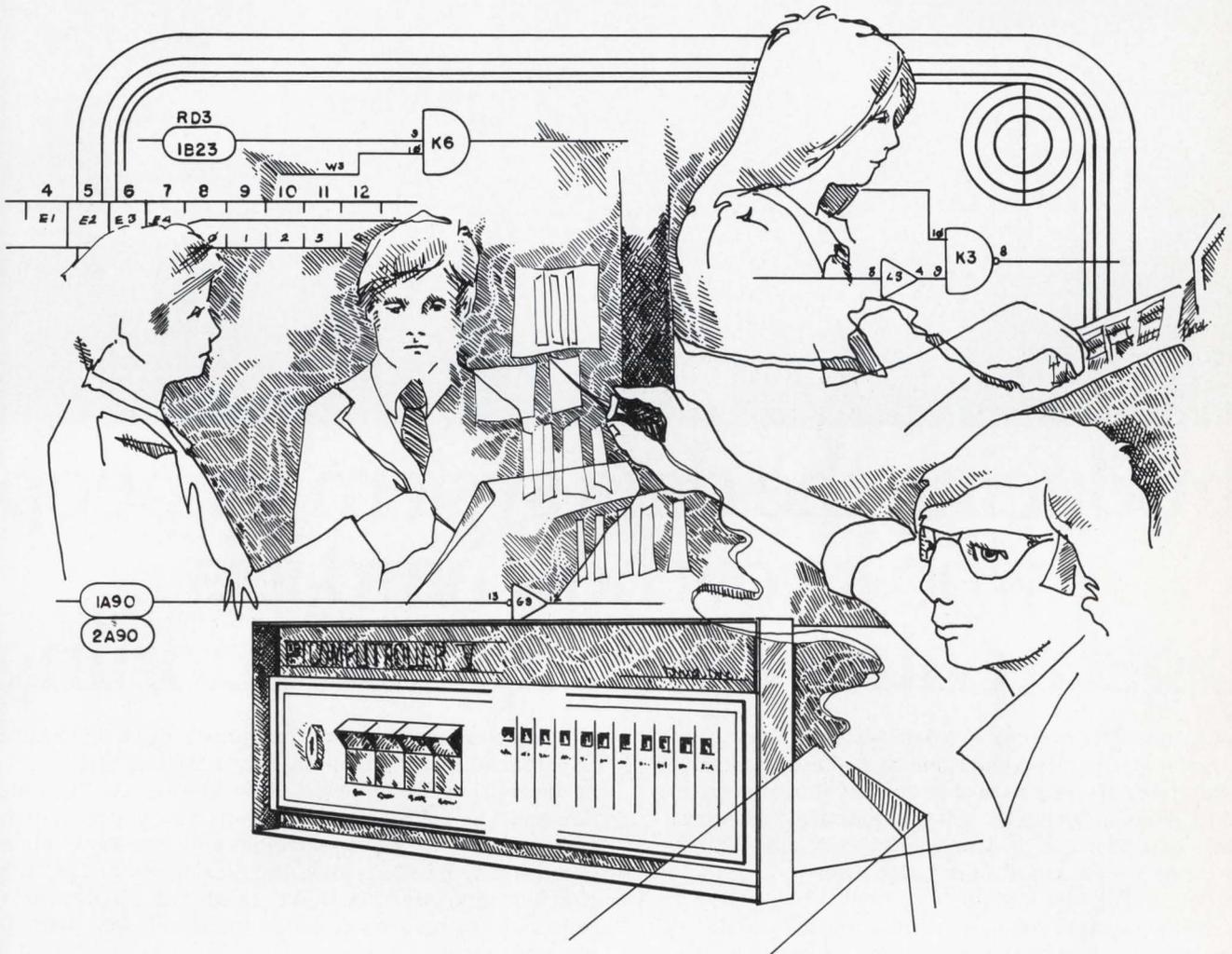
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mini-micro systems

20 PRODUCT FOCUS
HEWLETT-PACKARD'S NEW IMAGE

The system 1000, recently introduced by H-P, ties into the company's new Image/1000 data base management system. The 1000 mini system also doubles as H-P's entry in the hotly competitive, dedicated control market.

26 THE MINI'S IMPACT ON DATA BASE MANAGEMENT SYSTEMS

DBMS, once applicable to \$1 million mainframes, can now be employed on a mini-computer to reduce the cost of developing computer programs, manipulate a data file, and simplify the computer's use by non-data processing experts.

31 GETTING THE MOST OUT OF A PERFORMANCE ANALYSIS

The trade-off between processing load vs. processing delay, though often ignored, is key to determining how many functions a microprocessor should handle.

34 DATA COMMUNICATIONS
DATACOMM NEWS

38 THE VALUE OF INTERRUPTS

The proper use of interrupts in a microcomputer can eliminate hardware, protect against damage, and speed up transaction processing, among other gains.

42 HOW MAINTAINABILITY PAYS OFF

Both designers and buyers of data processing components and systems frequently do not take into account how readily a product can be repaired. The oversight can be serious.

46 WESCON ABSTRACTED

Presenting abstracts on some of the more systems-oriented papers given at this year's WESCON conference.

COVER: Hewlett-Packard's new 1000 minicomputer system strikes at two emerging markets — instrument control and data base management. (See article on page 20 and companion piece on DBMS on page 26.)

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A POINT CLARIFIED

To the Editor:

Shugart Associates wants to clarify a small, but important, point made in the July international news section. It is true that Tealtronix Nederlands B.V. manufactures Shugart floppy disk drives under a license arrangement. However, Tealtronix does not market the drives as the article says. In fact, all Shugart products are marketed in

Europe by the company's own European sales manager, and he, in turn, directs the European distributors.

Glenn Lutat
Marketing Communications
San Jose, CA

WANTED: MORE INFORMATION

To the Editor:

I found the article "A Microprocessor-Based Packet-Switching System" (May)

on the New England Regional Computing Program (NERCOMP) to be particularly interesting with regards to the use of a microcomputer as the switch/interface. I would like to obtain as much information as possible concerning the technical aspects of the NERCOMP project.

S. Kelly
Central Computer Agency
Millbank London

Editor's Note: For additional information, contact:

Jeff Jaffarian
NERCOMP
40 Grove St.
Wellesley, MA 02181
(617)235-8071

To the Editor:

The "Forth" software discussed in the August issue sounds great. Please send additional information, such as a Forth user's manual, instructions on how to write Forth language, and the like.

B.L. Chen
Lexington, KY

Editor's Note: More information on Forth can be obtained by writing directly to:

Elizabeth Rather, President
Forth, Inc.
815 Manhattan Ave.
Manhattan Beach, CA 90266
(213)372-8493

AN OMISSION

To the Editor:

Your fairly complete Technology Profile on microprocessors (July) omitted the HM-6100 CMOS 12-bit microprocessor manufactured by Harris Semiconductor.

Ron C. Pittenger
Manager, Marketing Communications
Harris Semiconductor
A Division of Harris Corporation
Melbourne, FL

KUDOS

To the Editor:

I have found the recent metamorphosis of Modern Data to MINI-MICRO SYSTEMS quite exciting.

Robert P. Goldberg, Vice President
BGS SYSTEMS, INC.
Lincoln, MA

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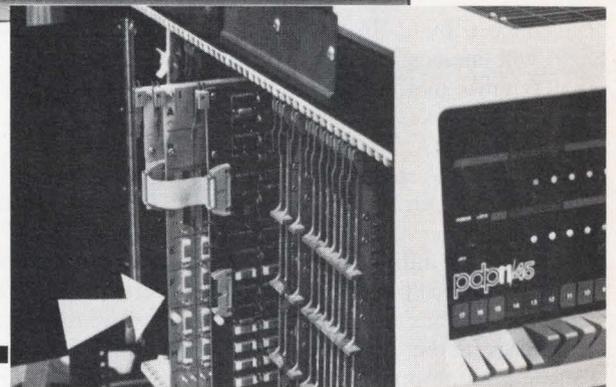
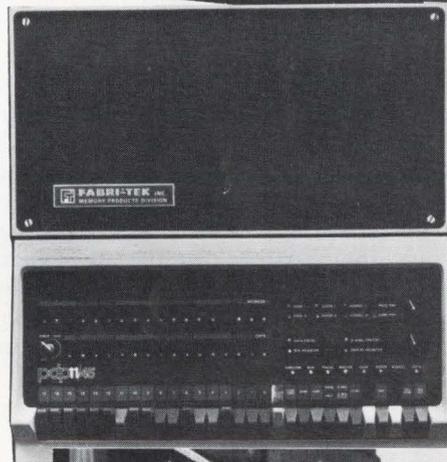
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DEC TACKLES AUTO INDUSTRY HEAD-ON

Digital Equipment Corp. has formed an automotive industries marketing team devoted to computer system development for manufacturers of passenger and transport motor vehicles, construction equipment, and vehicle parts. The team, a part of the company's Industrial Products Group, will concentrate on design and configuration of systems for factory management, such as production scheduling, press machine monitoring, labor reporting, and engineering/product testing, which includes structural evaluations.

SMALL WHOLESALERS: A BIG COMPUTER MARKET

Small wholesalers represent another big potential market for data processing equipment and services, according to the market research firm, Small Business Systems in Palo Alto, CA. Such businesses theoretically comprise a \$7.8 billion market for data processing equipment, a \$3.1 billion market for data processing services, and a \$1.6 billion market for word processing systems. The biggest applications are in inventory control and in sales analysis. "Wholesalers are most receptive to automating applications that enable an increase in the number of inventory turns," the market research firm says.

HOBBY MARKET: NO PASSING FANCY

The market for hobby computers at 7500 "units" sold last year will increase by 150 percent in 1976 to more than 18,600 units sold, according to a study on "the home computer" by market researchers Venture Development Corp. in Wellesley, MA. The study identifies more than 100 clubs, nearly a dozen computer hobbyist publications, and more than 50 retail stores that serve some 20,000 hobbyists at present.

The study indicates that the interest in personal computing is no passing fancy. On the contrary Venture Development emphasizes that the hobby computer market "promises to be nothing less than the leading edge of a consumer computer revolution." Nor is it limited to sophisticated hobbyists with previous computer or electronics experience. "The term 'computer hobbyist' encompasses many types of individuals that have different backgrounds and interests," the study finds. At one extreme, "home brew" experimenters use IC packages to develop hardware/software systems. At another extreme, dilettantes use a microcomputer simply as an instrument for playing games.

\$500 HOLOGRAPHIC TERMINAL STORES UP TO 100 MILLION BITS

Holofile Industries Ltd., whose parent, Canada-based Holofile Technology Inc., is listed on the Vancouver Exchange, has announced a data terminal that contains a built-in holographic memory capable of storing up to 200 million bits of data. This means that every word in the Los Angeles central telephone directory could be stored on a single 4" x 6" so-called holofiche. The system, developed for Holofile by TRW's Defense and Space Systems Div., interfaces with minicomputers, tape drives, CRT displays, disk drives, plotters, line printers, plasma panels, and page printers. Cost: Less than \$500 in production quantities.

MICRO MARKET TO GROW SIX-FOLD THROUGH 1979

Microprocessor sales will rise 48 percent a year on average through 1979, according to Santa Clara (CA)-based American Microsystems, Inc. Metal-oxide-silicon (MOS) integrated circuits used as memories will undergo an even greater growth — at a 113 percent a year increase on average through 1979.

AMI's director of research, Sam Wauchope, estimates worldwide microprocessor sales at \$64 million in 1975 will rise to \$298 million in 1979, with U.S. firms by then accounting for 87 percent of the total. Ancillary memories will jump from \$11 million to \$190 million over the same period, with the U.S. accounting for 80 percent of the market. The total microprocessor and associated memory market will reach \$488 million by 1979, AMI predicts, or more than six times the \$75 million sales level in 1975.

INDEPENDENT SOFTWARE VENDORS TO GET TOUGH ON CUSTOMERS

Independent software, an estimated \$450 million business this year, will grow to a \$1 billion business by 1980, according to Walter F. Bauer, president of Informatics Inc., a big software vendor. The impact on users, however, will be disproportionately greater. Bauer estimates that some 10 to 15 percent of all computer executions today are carried out by purchased software as opposed to programs developed in-house, but that the proportion will rise to 80% by 1985. Such a dramatic shift will prompt vendors to price software according to the number of commands executed or according to the time used in mainframe operations — rather than to sell the products outright or by lease as they now do. Vendors will also eliminate support on software that cannot be sold at a \$10,000 price per copy at least, Bauer also projects. Typically a product will not be profitable unless a vendor can get this price, he says, unless he markets it via direct mail and without providing any support.

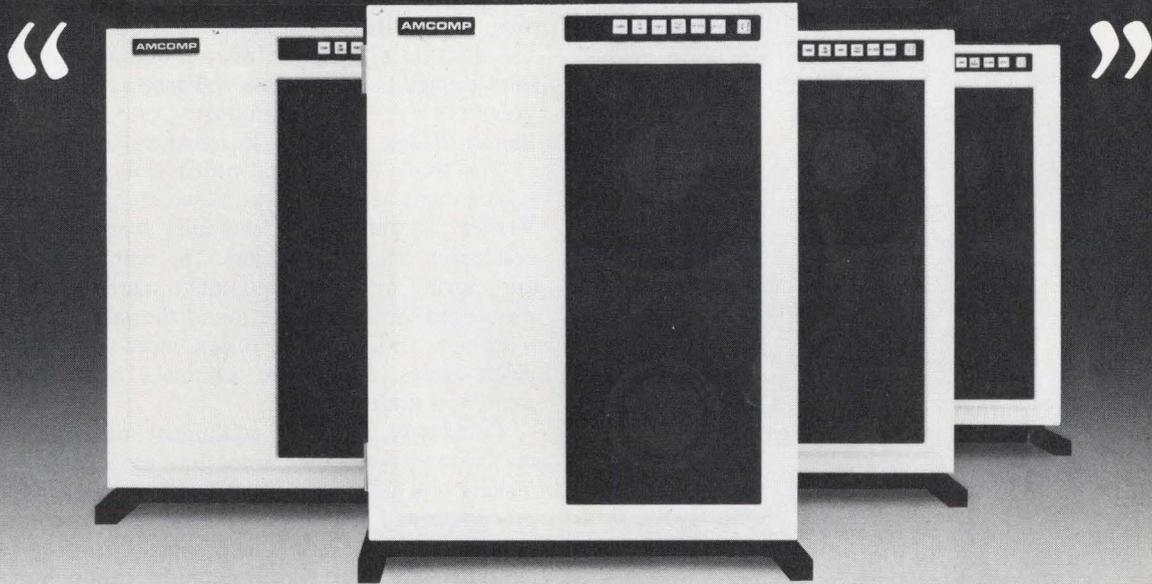
SMALL MANUFACTURERS ARE A \$2 BILLION COMPUTER MARKET

Small manufacturing firms represent an annual \$2.6 billion market for data processing equipment and a \$130 million market for data processing services in the automation of applications related to production control, according to *Small Business Systems Industry Report* in Palo Alto, CA. The firm reaches the conclusion based on the fact that at least 65,000 manufacturers are in business, each with 20 to 499 employees. Small manufacturing firms also represent more than a \$2 billion market for in-house word processing machines, the firm estimates.

A JOINT VENTURE UNFOLDS

Modern Data Services Inc. in Hudson, MA, publishers of *Mini-Micro Systems*, and Dataquest Inc., minicomputer market research company, in Menlo Park, CA, have announced a joint venture. The two companies will jointly sponsor the 1977 minicomputer-microprocessor market survey that is conducted annually by Modern Data Services. Modern Data uses a proprietary data base that contains nearly 40,000 users of some 120,000 minicomputers.

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news & comment

PROFITS OUTLOOK DOWNBEAT ON MICROPROCESSORS AND MEMORIES

Market research publisher Frost & Sullivan Inc. has proven uncanny in forecasting electronics markets. Past studies by the company have predicted the profits erosion that has taken place in electronic calculators and digital watches and also the market comeback of liquid crystals as a watch display.

Now, in a new study on semiconductors, Frost & Sullivan is downbeat again. It foresees an "uncertain outlook for short-term profit in microprocessors and memories," even though these products will pace a phenomenal revenue growth as semiconductor industry sales climb from \$2.2 billion in 1975 to \$3 billion this year and \$5.1 billion in 1984.

The study doubts that profits will parallel this kind of sales growth because of the fierce competition in the field. Vertical integration, for example, is rampant among semiconductor vendors and users. The semiconductor suppliers are moving into end equipment markets because microprocessors form a big portion of the value added in pin-ball machines, traffic lights, scales, word processing systems, video games, appliances, terminals, and scores of other items now under design.

Conversely, some end equipment manufacturers are taking on semiconductor production, especially the computer makers who are increasingly using in-house produced microprocessors and memories. And even the auto companies instrumentation makers, and camera manufacturers can be expected to add semiconductor production facilities, "though it is still not clear what percentage of requirements they will turn out by themselves," the Frost & Sullivan study says.

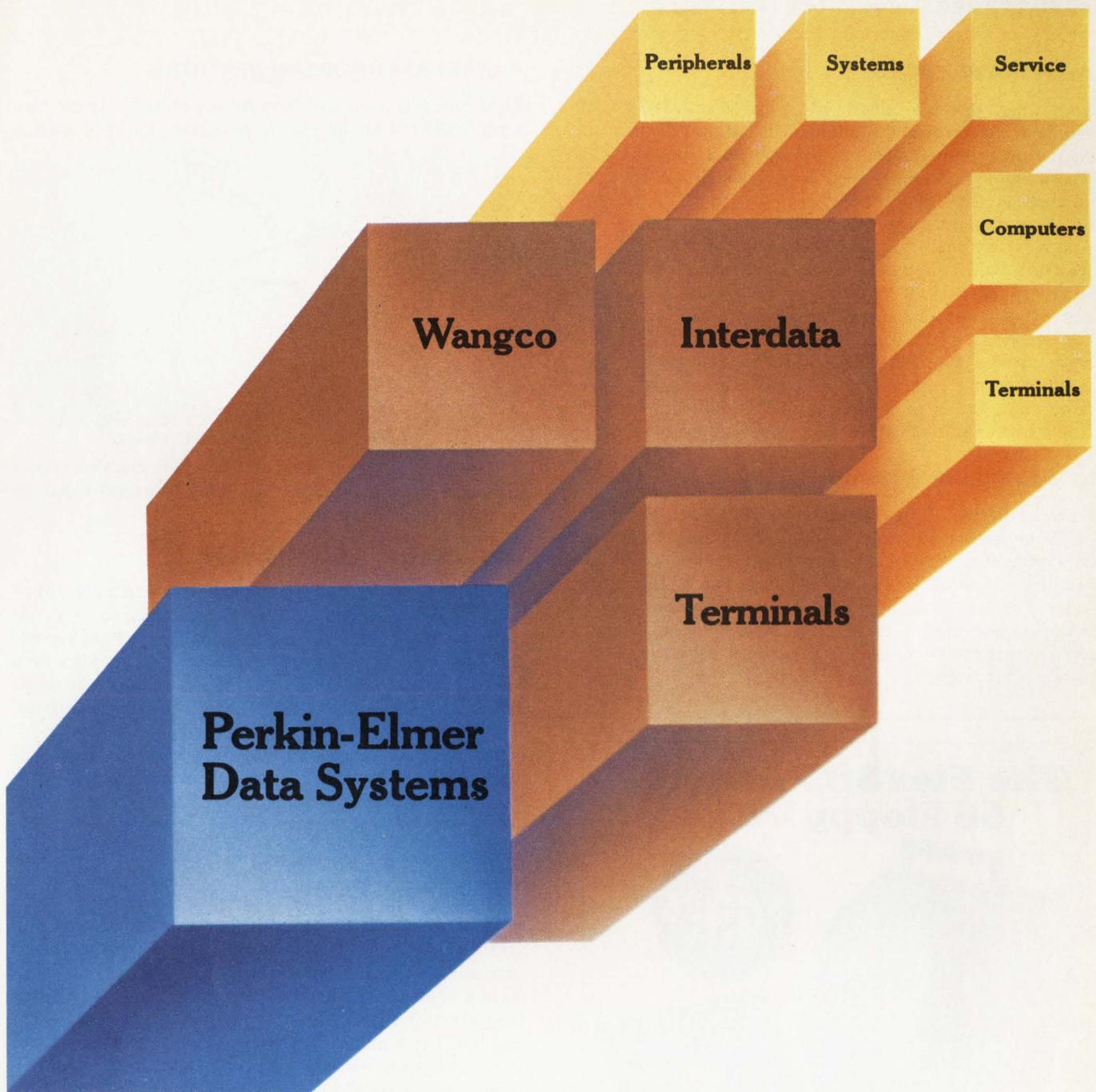
"Overnight obsolescence" is yet another major problem to cause a profits erosion. Semiconductor houses are introducing the 16K RAM at just about the same time that the 4K RAM is going into volume production. And there's still more market uncertainty ahead as European and Far Eastern producers invade the U.S. marketplace, "though producers abroad tend to be technically far behind in MOS integrated circuits and other new technologies."

MORE GROWTH FIGURES

Here's another set of statistics, this time on the market for terminals in Western Europe. According to PA International Management Consultants Ltd. in London, some 420,000 terminals are currently in operation in Europe, up from about 125,000 terminals in 1972. Moreover, the consulting firm projects that nearly 2 million computer terminals will be in operation either on networks or within user facilities by 1985.

TWO-TONE PRINTOUTS

Red error messages could be a new printout feature if a University of Western Ontario student finds an interested manufacturer for his invention. Impact printers can use Douglas Logan's dichromatic pressure sensitive printing sheet to overprint certain messages, which brings out a second color on the printout. Those with money should write *Lawrence Peska Associates, Ltd., 2 Bloor St., Toronto, Ontario, Canada.*



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CIRCLE NO. 33 ON INQUIRY CARD

AUSTRIA PERKS UP

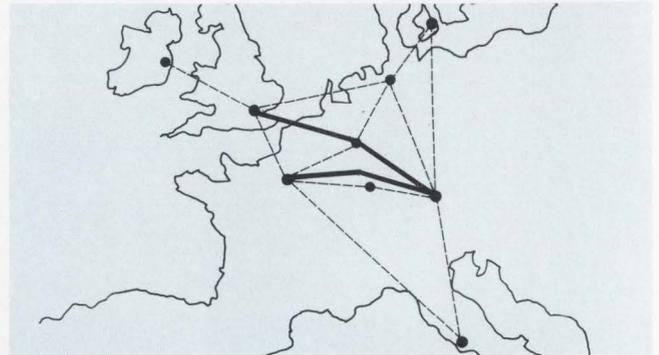
Like other countries, Austria had a bad year in 1975. GNP dropped 2 percent and production fell almost 50 percent. At the same time, foreign imports were up 15 percent. This year things look better and economists predict a 2.5 percent increase in GNP. Since Austria imports most of its computers and peripherals, this could mean extra change for Austria's two main suppliers — Germany and the U.S. Of Austria's \$63 million data processing market, the U.S. has about 17 percent. West Germany leads with 39 percent and the UK and France take up the slack with 12 and 11 percent, respectively. West Germany's specialty is small business systems, which is what Austrians looked for last year. As the economy gets back on its feet, Austrians will be even more interested in the complete small business system with applications reports the U.S. Dept. of Commerce.

HITACHI'S BIG BUBBLE

Japan's Hitachi Ltd. is working on bubbles a lot these days to try to replace the magnetic disk. The company's newest development is a bubble device with a 6000-kilobit chip measuring 6 x 6.4 millimeters, reports *Japan Computer News*. The bubble memory's smaller size, lower power consumption and higher stabilization make it the next logical replacement for the disk, Hitachi believes, especially as the price per bit drops.

A UNIFIED EUROPEAN NETWORK

Eight European countries have formed an Information Network (EURONET) and plan to go online soon. The central-



Planned European Information Network

ized European network will cost \$4 million less than would individual national systems, according to a recent analysis by the Diebold Group, Inc.

ENGLISH DATA COMM SHOW

England's data communications market is about 2 percent of the U.S. \$5 billion market. Even then, foreign sources control about 90 percent of the \$150 million market reports the U.S. Dept. of Commerce. And the U.S. supplies over half the imports. By 1980, the market will grow to \$175 million says the Commerce Dept. so it's throwing an exhibition January 10-14, 1977 at the U.S. Trade Center in London to help U.S. manufacturers. The Commerce Dept. will help with promotion and agent/distributor search. For more information, contact Anita Brownstein, Dept. of Commerce, OIM, UK, Washington, DC 20230.

PLASMA DISPLAY PANEL TO GET A BIG PUSH

Computer Terminals of Iran, a recently formed joint venture between Control Data Corp. and Iran Electronics Industries, will specialize in the design, development, and manufacture of advanced computer display terminals, with initial production of a plasma display terminal expected to begin in 1978. The terminal, now under development at Control Data's Roseville, MN, plant, will be manufactured eventually in Shiraz, Iran. The new venture has a \$25 million capitalization with 70 percent invested by Iran Electronics and 30 percent by Control Data.

FOOTHOLDS ABROAD

Milgo Electronics will sell its data communications equipment in Japan through its subsidiary, ICC Far East, Inc. The Japan branch of the subsidiary has supported ICC products in Japan since 1975.

Western Peripherals (Anaheim, CA) is moving its controllers around the world with distributors in Austria (Austro-Data), England (Sintrom Electronics, Ltd.), West Germany (Barton Automation GmbH), The Netherlands (Datacare BV), Spain (hardware and Software), Sweden (Comex) and Switzerland (Datacare, AG).

Syscom Computer Engineering Co. will sell and service Centronics Data Corp. printers in Taiwan.

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Interdata 7/16, 7/32	32K Bytes	\$5,000	\$ 2,000
General Automation SPC-16	16K Words	\$4,600	\$ 2,000
DEC PDP-11 Core Add-On Unibus	32K Words	\$9,800	\$ 5,190
DEC PDP-11 NMOS Add-On Fast Bus	64K Words	Not Avail.	\$19,000
DEC PDP-11 Core Add-In	16K Words	\$4,500	\$ 1,825
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book review

ENCYCLOPEDIA OF COMPUTER SCIENCE AND TECHNOLOGY edited by Jack Belzer, Albert G. Holzman and Allen Kent. Marcel Dekker, New York. 20 volumes, \$88 per volume individually, \$75 per volume by subscription.

This series covers not only data processing, as its title implies, but also the mathematics, operations research and engineering that form the background of computerized problem solving. In addition, individual articles on computer manufacturers and data processing-related research provide detailed coverage of the history and technology of the industry. No special knowledge of data processing is required of the reader, but the mathematical articles appear to presuppose college-level math courses. The engineering articles apparently assume little more than general knowledge.

Perhaps due in part to the measured pace of the work (the series is emerging at a rate of four volumes per year; four are out so far) the articles in this encyclopedia are substantial and well-written. There is an occasional lapse into silliness, such as the following description of the introduction of data processing into Belgian industry: "Thus, no revolution, but a hardly noticed change. And owing to this unobtrusiveness, a lasting change."

No encyclopedia would be complete without good bibliographies, and on this point the *Encyclopedia of Computer Science and Technology* is particularly strong. If the quality of the series continues and if the series continues for its forecast five years, it would be an important acquisition for any technical library.

— Ernst Barlach

THE AUTOMATED MULTIPHASIC HEALTH TESTING MARKET

The need for an advanced system to enable physicians to handle physical exams and clerical transactions on a semi-automated basis is potentially a billion dollar market. Presently, larger and more sophisticated multiphasic health testing centers are in limited use throughout the U.S., performing a relatively small number of annual physical examinations.

Frost & Sullivan has completed a 200-page report which analyzes and projects over the next ten years the market for automated multiphasic health testing systems and determines the potential for the use of an advanced system for physical examinations and clerical transactions (ASPECTS) in physicians' offices. Market forecasts are furnished for the equipment subsystems, supplies and accessories to be used in ASPECT. Various ASPECT configurations are proposed. Factors which will both stimulate and limit the growth of AMHT's and ASPECT are explored. Emphasized are: the prospect for increased annual physical examinations over the next 10-15 years, the ability to handle these increases, and the likely approaches. Responses to a questionnaire survey of physicians, multiphasic health testing operators and suppliers document the results.

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Data Processing Digest called this book "the timely revision of a widely used and popular text that imposes a welcome structure on the foundation of computer programming . . ." 634 pp, 44 illus, \$20.95

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Nuclear Science and Engineering commented: "The high degree of readability, which has been accomplished by the use of a sense of humor not often found in such technical works, along with the excellent technical content, should insure that this work will find wide acceptance and usage." 624 pp, 29 illus, \$20.95

3. Volume III: *Sorting and Searching* (3803)

Here is a quote from *The American Mathematical Monthly*: "The most nearly complete reference to date on sorting and searching . . ." 722 pp, 140 illus, \$20.95

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Written on the advanced undergraduate-graduate level, this book examines various elements of programming (program structure, data structure, parsing, sorting) from the point of view of expressions rather than mechanisms. 277 pp, \$15.95

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The papers in this book represent a written and edited version of a one-week seminar held at the University of Southern California entitled "Modern Techniques for the Design and Construction of Reliable Software" with some additional material to round out the coverage. 240 pp, \$11.95

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While at the GSA, Mr. Miller authored many solicitation documents and reviewed RFPs submitted by other Federal agencies. He was the project officer for various mandatory requirements contract procurements including ones for tape and disk drives, plug-compatible memories and remote computing services.

Mr. Miller is the President of Government Sales Consultants, Inc., a firm that offers consulting services and seminars to computer-related companies and Government agencies seeking help in ADP procurement.

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The federal government maintains 18 files on every man, woman and child in the U.S., according to the *Privacy Journal*. This includes 6723 data banks that contain information on 3.8 billion persons. Three agencies account for most of the records: The Defense Dept. with 2141 data banks, the Treasury Dept. with 932, and Health, Education and Welfare with 831. More than 80 percent of the files are computerized, and while the Privacy Act of 1974 gives an individual access to his own file, 13 percent of all files are exempt because they involve law enforcement and central intelligence.

LAWYER'S DATA BASE

The lawyer's main tool - the library - continues to be replaced by a terminal and a data base. New York City-based Mead Data Central, Inc. LEXIS legal data base contains U.S. federal cases, laws of 10 states and securities tax and and trade laws. The company also plans to build computer libraries on international law.

OCR FORMS GUIDELINES

Designing OCR forms is made easy with the National Bureau of Standards *Guidelines for Optical Character Recognition Forms*. Form definition, design verification and specifications are covered. A special ANSI-developed glossary of OCR terms is included and most commonly used OCR devices are listed. To obtain a copy of FIPS PUB 40, write the *Supt. of Documents, U.S. Govt. Printing Office, Washington, DC 20402*. Enclose \$1.80, SD Catalog No. (C13.52:40) and Stock No. (003-003-01466-4).

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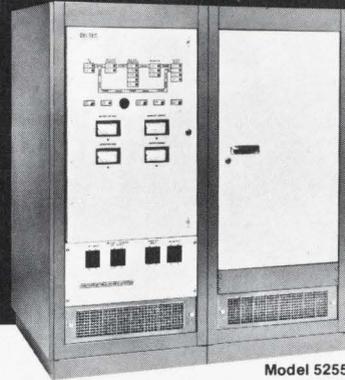
A Review of Network Access Techniques with a Case Study by Robert Rosenthal. SD Cat. No. C13.46:917, Price \$.85. In 36 pages, NBS discusses its approach to network access via a minicomputer-based system that enables users to specify network command sequences.

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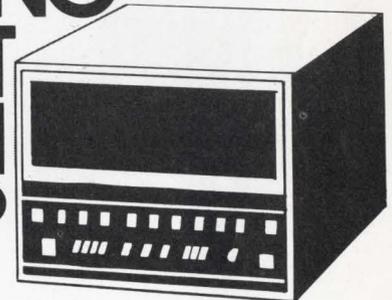
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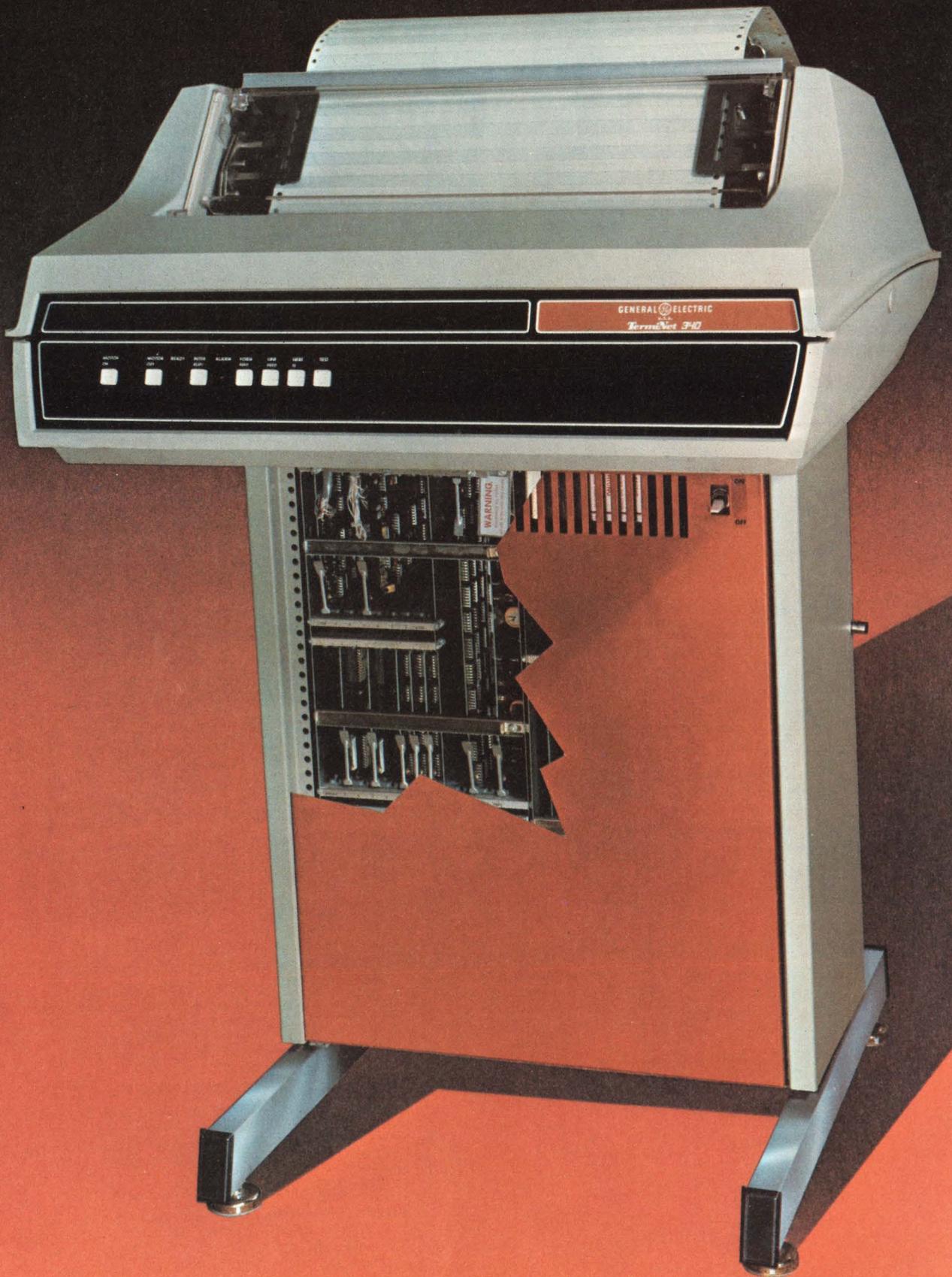
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Incoterm (Wellesley Hills, MA) will offer U.S. customers one and two-year rental plans and United Kingdom customers one, two and three-year rental plans. The company will sell its intelligent terminals directly to the participating financial institutions of Credit Lyonnais Group of France, Transamerica Computer Co. of San Francisco, CA, and Continental Leasing of London, England. The institution will then lease to the customer. By letting another party hold the tab, Incoterm can use its capital for growth and new product design.

INFOREX PRODUCTS CITED AS AN ARMY STANDARD

The U.S. Army Computer Systems Support and Evaluation Agency has awarded Burlington, (MA)-based Inforex Inc. a requirements contract for key-to-disk data entry systems. Now, every Army facility in the continental United States, needing a data entry complex of 16 keystations or less, is obligated to order Inforex's standard System 1303-II if the equipment meets its needs. Estimated value to Inforex: \$4.6 million over several years.

PCS TO DOUBLE WORK FORCE

Following a \$650,000 infusion of funds from Citibank, industrial micro manufacturer Process Computer Systems Inc. in Flint, MI, plans to move operations to a 24-acre Ann Arbor site. The move will double the company's space to 54,000 sq. ft., and accommodate expansion up to 200,000 sq. ft. Another indication of PCS' pell mell growth: Employment should increase from 130 currently to 250 persons by the end of next year. PCS' sales have more than doubled this year, up from \$2 million in 1975.

ANOTHER COMPANY CLIMBS ON VERTICAL INTEGRATION BANDWAGON

As another step toward vertical integration in the systems business, Randal Data Systems in Torrance, CA, has begun to manufacture the microprocessor and memory used in the company's LINK 100 and LINK 200 business computer systems. The RDS 605, a 16-bit general purpose microprogrammed microprocessor, consists of four bipolar LSI 4-bit microprocessor units, the associated bipolar LSI PROMs, and standard TTL support devices. Randal Data Systems already markets CRT, printer, and floppy disk terminals.

GAINS AND SETBACKS

Ampex Corp. (Redwood City, CA) increased net earnings for its first quarter by 16 percent over the same quarter last year. The company earned \$1,812,000 or \$.17 per share for the quarter ending July 31, 1976, compared with \$1,559,000 or \$.14 per share for the first quarter of the prior year. Net sales and other revenues for the quarter totaled \$65.4 million, an increase of \$1.8 million over the previous year. Ampex expects a further increase in the second half of the current year as it begins to ship recently announced audio visual products.

Basic/Four small business systems and Sorbus maintenance contracts helped parent company **Management Assistance, Inc., (New York, NY)** increase its third quarter net income 63 percent over the same quarter last year. Quarterly earnings were \$3,200,000, or \$.11 per share, compared to last year's \$1,960,000 or \$.07 per share. Revenues for the quarter were \$31,629,000, a 30 percent increase over 1975 revenues of \$24,272,000.

Centronics Data Computer Corp. (Hudson, NH) increased its earnings for fiscal year 1976 to \$9,763,897, compared to last year's \$7,281,018. Centronics wrote off \$1.8 million in receivables from the company's former European distributors that it was unable to collect. Earnings per share of \$2.02 were still up 33 percent over last year's \$1.52. Revenues increased 26 percent, from \$41.5 million to \$52.1 million.

Computer Automation, Inc. (Irvine, CA) increased its 1976 fiscal net earnings by 161 percent despite high startup costs for the SyFA distributed processing system. Net earnings were \$3,098,000 or \$1.60 per share, compared to last year's \$1,185,000 or \$.70 per share. Revenues increased 42 percent to \$30,398,000 from \$21,372,000.

New products helped **Digital Equipment Corp. (Maynard, MA)** increase its fourth quarter earnings by 60 percent over the same period last year. Net income in the fourth quarter was \$26,814,000, compared to \$17,420,000 for the last quarter of Fiscal 1975. Earnings per share for the period were \$2.11 compared to \$1.46 for the comparable period a year ago. Fourth quarter operating revenues were \$231,995,000, compared to \$160,542,000 for the same period last year.

Four-Phase Systems, Inc. (Cupertino, CA) increased second quarter earnings before an extraordinary credit to \$1,011,705 or \$.35 per share on revenues of \$15,037,359. Last year's earnings were \$339,319 or \$.18 per share on revenues of \$12,366,633.

NEW STOCK ISSUE

Rolm Corp. in Cupertino, CA, manufacturer of general purpose, rugged computers and computer-based PBXs, made a first public offering of 410,336 shares of common stock at \$14 each on Sept. 16. The company sold 270,000 and insiders unloaded the balance. Rolm will use some \$680,000 to pay existing bank debt. Of more importance: About 800,000 shares of the 1.3 million shares outstanding, or nearly two-thirds, are eligible for immediate sale in the open market in accordance with Securities and Exchange Commission Ruling 144 that governs the sale of restricted stock.

Financial highlights: Sales at \$17.5 million in fiscal 1976, compared to \$2.4 million in fiscal 1972; net income at \$1.1 million, or \$0.87 a share, in fiscal 1976, compared to \$220,000 or \$0.22 a share (plus a \$119,000 special credit equal to \$0.12 a share) in fiscal 1972. Balance sheet as of Sept. 16: Current assets: \$10 million. Current liabilities:

\$3.2 million. Long term debt: \$77,000. Shareholders equity: \$8.2 million.

Rolm's first rugged computers intended for use in severe environments, such as military aircraft, were based on Data General Corp.'s Nova minicomputer technology and software. Newer computers based on Rolm's own design employ both its own and Data General software. Rolm made the first customer installation on a computer-controlled PBX in April 1975 as a move to diversify business. The company had shipped 130 Rolm "CBXs" and 60 others were on order as of July 2.

Total backlog on that date was \$10.6 million, up from \$3.9 million a year earlier, and equally split between orders on rugged computers and the CBX. Approximately 53 percent of the computer backlog was attributed to two customers and approximately 48 percent of the CBX backlog to two other companies who purchase the systems to resell to their own customers.

Slowing international calculator orders lowered **Hewlett-Packard Co.'s** (Palo Alto, CA) third quarter earnings by 9 percent, compared to a year ago. Sales for the third quarter ended July 31 totaled \$277,477,000, compared with \$245,880,000 for the corresponding quarter of fiscal 1975. Net earnings amounted to \$18,472,000, or \$.65 per share, compared to \$20,286,000, or \$.73 per share during last year's third quarter.

Dumb terminal maker **Lear Siegler, Inc.** (Santa Monica, CA) had the best quarter in the company's history. Fourth quarter sales of \$192,269,000 were up 13 percent from \$170,442,000 in the same quarter a year ago. Net earnings of \$9,860,000 increased 43 percent from \$6,898,000 and earnings per share of \$.72 were up 50 percent from \$.48 in the fourth quarter last year.

Mohawk Data Sciences Corp. (Parsippany, NJ) had lower revenues and net earnings for its first quarter ended July 31, 1976. Including gains for translation, net income for this year's quarter was \$1,436,000 or \$.19 per share, against \$2,158,000, or \$31 per share in the 1975 quarter. Foreign net operating loss carryforwards amounted to \$545,000 this year, compared with \$685,000 for the first quarter last year. Revenues for the first quarter totaled \$38,948,000 versus \$41,732,000 last year. Chairman and President Ralph O'Brien attributed the loss to the effects of translation of foreign currency amounts into a stronger U.S. dollar, rental base reductions resulting from conversion sale activity last year and lower OEM sales. Sales to end-user customers were well ahead of the comparable period last year.

Systems Engineering Laboratories, Inc. (Fort Lauderdale, FL) is in the black this year. During this year's fourth quarter, SEL had a net income of \$403,285 or \$.15 per share, which includes an extraordinary gain of \$197,860 or \$.07 per share, on revenues of \$6,317,095. For the comparable period a year ago, SEL had a net loss of \$32,732 or \$.01 per share, which included an extraordinary gain of \$135,871 or \$.05 per share, on revenues of \$4,224,238. The extraordinary gain in the fourth quarter of both years results from the utilization of net operating loss carryforwards.

Tektronix, Inc. of Beaverton, OR increased its first quarter earnings by 46 percent over the same period last year. Earnings per share were \$.96 from earnings of \$8,419,000, compared to last year's \$.66 and \$5,760,000. Sales in the first quarter were \$89,543,000, up 20 percent from \$74,858,000 a year ago.

MICRODATA BUYS INTO PRINTERS

OEM peripheral maker *Microdata Corp.* (Irvine, CA) has agreed to buy matrix printer manufacturer, Applied Computing Technology, Inc., also in Irvine. Over half of Microdata's business is in OEM processors, disks, tape transports and CRT terminals with the remainder in the Reality end-user systems. Applied Computing Technology manufactures a line of matrix printers operating up to 120 characters per second and selling for about \$2500.

MERGERS AND ACQUISITIONS

Commodore International Ltd. (formerly Commodore Business Machines) is buying **MOS Technology** (Norristown, PA). This saves the six-year old semiconductor house from impending disaster. MOS Technology recently lost a suit to Motorola with \$200,000 in damages and had to then withdraw its microprocessor from the market. Sales

for the last fiscal year had dropped to \$11 million from the previous year's \$17 million. Commodore will continue with calculators and together the companies will go after the TV game market.

Tymshare, Inc. (Cupertino, CA) is buying **Unitax, Inc.** (Anaheim, CA), a tax processing service. Under the agreement approved recently by both companies, Unitax shareholders will receive one share of Tymshare for every four shares of Unitax stock.

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CIRCLE NO. 16 ON INQUIRY CARD

HEWLETT-PACKARD'S NEW IMAGE

The system 1000, recently introduced by H-P, ties into the company's new Image/1000 data base management system. The 1000 mini system also doubles as H-P's entry in the hotly competitive, dedicated control market.

The name, Image/1000, seemed inappropriate when Hewlett-Packard announced a data base management system at the NCC in June — inappropriate because the "1000" designation did not tie into what was supposedly the host computer for the mini data base, the 21MX. But now, the mystery is cleared up. Hewlett-Packard introduced last month a disk-based 1000 system that handles Image/1000. The system high point: A dramatically new, high speed processor that facilitates microprogramming.

The new 1000 system is aimed at two markets. Models 80, a desk-mounted unit, and 81, an upright style, that come with the Image/1000 DBMS are geared to data processing applications. Models 30 and 31 that employ the standard interfaces bus co-developed by IEEE and H-P apply to dedicated, control-type applications. All of the units are priced up to 14 percent less than the disk-based 9600 mini-computer line that the 1000 system now replaces, though H-P will continue to market the memory-based 9600s as satellites in 1000 system installations.

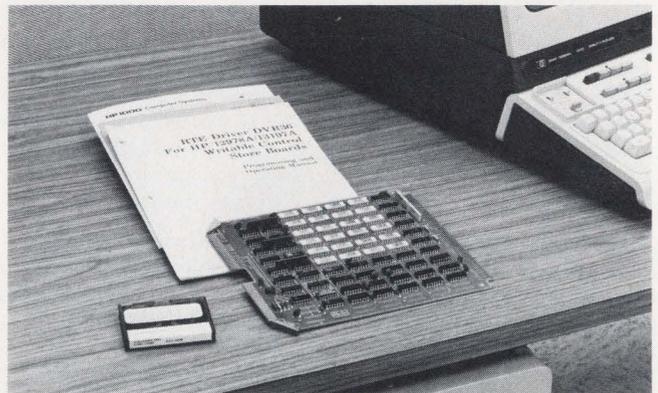
HIGH POINT

H-P plans to market the new 21MX-E processor on an OEM basis as well. It contains a cornucopia of features. The 16-bit processor executes instructions at a rate 60 to 100 percent faster than does the 21MX-M processor. An add instruction on the M series, for example, takes 1.9 microseconds to execute, compared to 1.12 microseconds on the E series. And the E processor whips through floating point operations 250 percent faster.

Within H-P's fast processor is an intelligent MSI/SSI control processor that manages the primary registers, arithmetic logic unit, MOS main memory, and the I/O structure. The control unit can also vary the microcycle timing. Instead of setting the timing for the slowest instruction time, as other processors do, the 21MX-E control processor sets the timing for the best case — 175 nsec — and then, when necessary, lengthens the window setting to 280 nsec. This technique has another advantage: The processor can be interfaced to higher-speed memories other than the 550-nsec 4K RAM that H-P now incorporates into the machine.

EASY MICROPROGRAMMING

The machine speeds up processing in other ways, too. The control processor, having a 24-bit word length, is easier to microprogram than any other mini now offered, so a DP user



MICROPROGRAMMING TOOLS. Users program the writable control store on H-P's 2645A terminal. Each 1K WCS board plugs into one slot on the system backplane.

can quickly microprogram a software sort routine or a control user can handily microprogram any number of math routines. Only two other minicomputers, the Varian V 70 series and the Data General Eclipse, have a microprogrammable control store. But both use a longer word length — 56 bits for the Eclipse, 64 bits for the V 70.

H-P's control store is also larger than competitive systems. The H-P machine has 8.5K words, compared to 256 for the Eclipse and 1536 for the V 70, and of that, the user can



User-defined management information keys on the Image/1000 data base systems enable users to load or compile a program, query the data base, or monitor the status of multiple tasks.

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Nashua has been developing and refining the technology behind magnetic media since the turn of the century (through our pioneering work with ultra-fine particles, and making them behave on various surfaces). This longtime technological capability now enables Nashua to follow closely behind drive manufacturers, to offer drive users an independent alternate source of supplies right from the start.

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CIRCLE NO. 17 ON INQUIRY CARD

UNDERSTANDING SDLC

A 12-page reprint collects and *updates* the series of five articles on IBM's Synchronous Data Link Control (SDLC) line protocol which appeared in MODERN DATA between February and September, 1975. *Not included in the published series but contained in the reprint* are several pages on the derivations of the equations used in the articles. Taken together, the series provides a comprehensive, independent explanation and appraisal of this most important line protocol, *written in the working language of computer-communications users*. SDLC subjects covered include:

1. General Concepts and Structure
2. The Control Field
3. Supervisory and Non-Sequenced Control Field Formats
4. Throughput Calculations
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alter 3K of that large memory store online. In one moment, a sort microprogram can reside in control store, and in the next instant, a trig routine can occupy that space.

H-P has made microprogramming "friendlier" in other ways, too, adds H-P 1000 product manager, Peter Palm. The system offers as options, a complete microprogramming software package that contains a microassembler, micro-codebug editor, utility for loading microcode, writable control store driver, and PROM tape generator. Users can do the programming on a terminal in the background mode of

DO IT YOURSELF MICROPROGRAMMING

On the H-P 1000 system, users can speed up processing time by microprogramming frequently used software routines, such as a data base sort function or a trig function. Here's how:

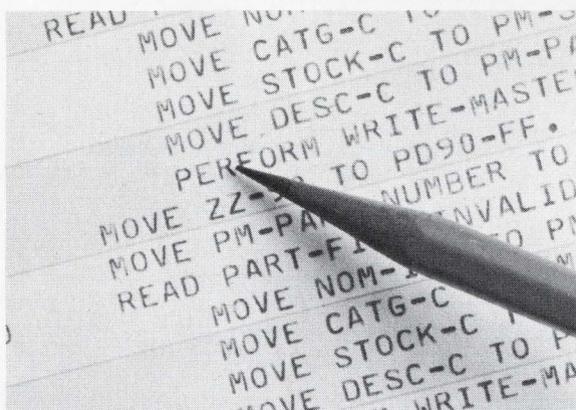
1. Identify the slow parts of the program. The H-P 1000 has an activity profile generator that creates a histogram online to show all CPU activity. With it, users can decide which areas of the program should be microprogrammed.
2. Determine the entry point (address) for the control memory module to be used.
3. Write the microprogram in symbolic code.
4. Load the microassembler into main memory. The microassembler translates the user's symbolic code into micro object code, generating the source program with a listing and object file.
5. Load the cross reference generator. This prepares tables, labels, and cross references for easier program debugging.
6. Load the object code from disk into writable control store using the Microdebug Editor or the WCS Load Utility.
7. Debug the program with the Microdebug Editor. Users can take advantage of the breakpoints in the debugger or they can enter their own online from a terminal. H-P's debugger is symbolic so users can examine and change control storage microcode in symbolic form (e.g., READ PASSA S1) rather than in octal form as with other debuggers.

Users needing permanent microcode can punch PROM "burn" tapes with the H-P 1000 PROM tape generator. Usually, the production "burn" tape will be transferred from disk to the 1000 minicartridge and then converted to paper tape at the local H-P field office. With the paper tape, a PROM burning vendor can create the PROM part.

the operating software and not interfere with other programs that are also running. As a result of all this, Palm says, "A user that has a little more knowledge than assembly language can microprogram. It no longer takes a computer designer engineer to microprogram." Adds Palm, "A user need only be familiar with the unit's 211 microinstructions, 12 general purpose scratchpad registers, and three levels of nested subroutines.

The E processor has still other nice points: a time base generator, two direct-to-memory ports that can handle any

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CIRCLE NO. 18 ON INQUIRY CARD

H-P 1000 BASIC SYSTEMS

Model	30	31	80	81
Cabinet	Desk	Upright	Desk	Upright
CPU	21MX-E	21MX-E	21MX-E	21MX-E
Memory	64KB <i>(320KB)</i>	64KB <i>(608KB)</i>	128KB <i>(320KB)</i>	128KB <i>(608KB)</i>
Disk	14.7MB <i>(117.9MB)</i>	4.9MB <i>(117.9MB)</i>	14.7MB <i>(117.9MB)</i>	14.7MB <i>(117.9MB)</i>
Console	2645A display	2645A display	2645A display	2645A display
Other Peripherals			200-lpm printer <i>(up to 1250 lpm)</i> 1600-bpi tape drive <i>(800 bpi)</i>	200-lpm printer <i>(up to 1250 lpm)</i> 1600-bpi tape drive <i>(800 bpi)</i>
Operating System	RTE II <i>(RTE III)</i>	RTE II <i>(RTE III)</i>	RTE III + Image/1000	RTE III + Image/1000
Price	\$37,500	\$33,500	\$62,600	\$63,600

Options in parenthesis

peripheral, memory protect, dynamic mapping, power fail recovery, and ROM loaders for CRT and disk.

As operating software on the System 1000, H-P borrowed the multiprogramming RTE II and RTE III from its M series line. Both allow online system generation and online program development using Fortran II or IV, Algol,

Assembly or multiuser Basic. RTE II has a foreground and a background mode; RTE III has dynamic mapping of up to 64 partitions of disk resident programs.

The 1000 also incorporates new peripheral hardware, including the 2645A CRT and 12962 disk cartridge subsystem that H-P recently introduced. The CRT, now standard on all systems, uses a dual mini cartridge tape. The cartridge subsystem uses a microprocessor-based control unit and incorporates a two-sided cartridge whose capacity ranges from 14.7 to 117.9 megabytes. The upright model 31 uses the 12960A cartridge drive as the standard, and it has 4.9 to 19.6 megabytes of storage.

INDUSTRY USES

At a cost between \$30,000 and \$40,000, models 30 and 31 will appeal to the automated test/measurement and process control market. With the optional H-P interface bus, users can add over 100 instruments, such as counters, digital multimeters, printers and scanners. Add another \$30,000 to get a model 80 or 81, and a user can move into data processing, especially data base management. The Image/1000 data base that has a 32K memory requirement is claimed to be more compact than any other, and the natural-language Query access language makes it easy for nonprogrammers to use the system. Programmers can set up the data base with the definition, utility and management subsystems, and an unsophisticated terminal user can access it or format reports interactively with English-like Query. (See "Mini's Impact on DBMS," page 26.)

H-P believes that the System 1000 will open new markets in minicomputer data base management and dedicated applications. H-P's 2000 systems, intended for multiterminal remote job entry, will also eventually incorporate the new processor. And the Cobol-oriented 3000 Series II system that contains its own new processor will remain in small business. To attract OEMs, H-P will offer 30 percent price reductions to give both DEC 11/34-based systems and Data General Nova 3/D systems a run for their money. ■

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THE EQUIPMENT LEASING MARKET

Leasing was a \$20 billion a year business in 1974/75 and the total U. S. inventory of leased equipment is now over \$75 billion. Leasing will continue to grow because of the shortage of capital, and by 1980 some \$150 billion in assets will be under lease.

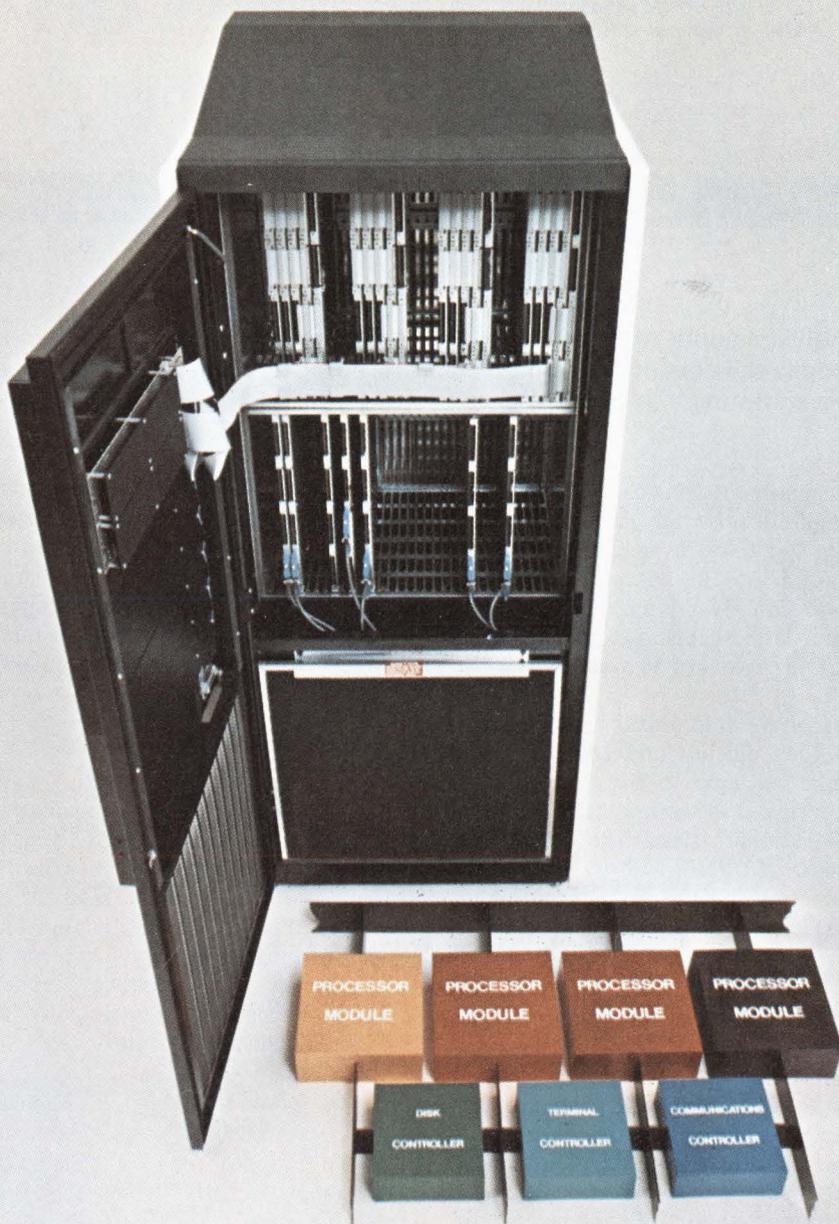
Frost & Sullivan has completed a 180-page report analyzing and forecasting through 1985 the market for leasing in 24 industry applications. The results of a mail survey of both users and suppliers are presented. A forecast is made of various markets and the expected penetration of leasing during the next ten years. The leading leasing companies in each market segment are identified and an overall assessment is made of the industry structure. Accounting changes which affect the market are considered. Possible new market opportunities are identified. Industrial markets analyzed include:

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TANDEM

CIRCLE NO. 9 ON INQUIRY CARD

the mini's impact on data base management systems

FRED M. GIBBONS / Hewlett-Packard Co.

DBMS, once applicable only to \$1 million mainframes, can now be employed on a minicomputer to reduce the cost of developing computer programs, manipulate a data file, and simplify the computer's use by non-data processing experts. Here is what DBMS is all about.

Even though data base management systems have been used on large mainframe computers since the late 1960s, most computer appliers do not yet fully recognize its inherent power to reduce the cost of developing computer programs, manipulate a data file, and simplify the use of a computer by managers and other non-data processing experts. Despite such advantages, less than five percent of all systems installed today employ a DBMS.

Computer professionals have traditionally shunned the technique because even they did not understand it. And they did not want to take the time to do so, since they viewed DBMS as a high overhead software that would overload an already busy computer system. They were also turned off by the high cost of DBMS, whose price started at \$30,000, and which was suitable for use only on big \$1 million computer mainframes.

NO LONGER VALID

Such limitations, however, no longer hold, and DBMS has become an industry buzz word that is as rich with meaning as those other hot expressions — “distributed processing” and “structured programming.” The advent of cheap, high density disks that can be married to cheap powerful minicomputers has dramatically cut the cost of a DBMS that, in essence, is a high level, compiler-like language used to describe the location, content, relationship, and security of data stored in a collection of files, thus allowing for the random manipulation of records. A computer applier can now buy a stand-alone, interactive system that includes both hardware and software for \$100,000. Moreover, discounts on purchases in OEM quantities can cut the cost another 30 percent as well.

At these prices a user can afford to dedicate a DBMS to a particular task, and thus any online data base search need not threaten the throughput for other jobs run on a mainframe CPU. A carefully planned DBMS can also produce unexpected side benefits. For one, a DBMS-oriented system



FRED M. GIBBONS, who holds an M.B.A. from Harvard University and an M.S. degree in computer science from the University of Michigan, is product manager for data base management and distributed systems in Hewlett-Packard's Minicomputer Division.

takes less time and effort to program than does a conventional file management system. Data conversion to a DBMS format is relatively straightforward. In addition, it takes comparatively little ongoing programming effort to maintain application software on an operational system. Finally, when a data base is altered, the query language can serve as a fine testing tool to verify quickly that the changes are correct.

CURRENT USES

Current users of a dedicated, minicomputer-based DBMS include manufacturing companies, research facilities, and service companies — typically, organizations employing between 20 and 200 employees, having several hundred customers, and with annual sales ranging between \$5 million and \$35 million. The motivation for wanting rapid random access to masses of data may result from a compelling need to improve customer service, reduce inventories, or make quick management decisions in a volatile marketplace. Typical applications follow.

Manufacturing	Financial and Administrative
Production Control	Accounts Receivable and Payable
Order Processing	Budgeting
Inventory Control	Sales Status
Shop Loading	Personnel (Employees)
Tooling and Routing	Customer Information Files
Vehicle Scheduling	Credit Verification
Medical	Automatic Testing
Medical Histories	Quality Control
Pharmacy Prescription Files	Test Measurements

As a result of the emerging interest, minicomputer manufacturers are beginning to make available DBMS software packages, either by developing their own or by acquiring packages supplied by an independent software house. The following chart lists such offerings:

DBMS Software	Manufacturer	Typical Host Computer
Total*	Digital Equipment Corp.	PDP-11/45
Total*	Harris	Model 100
Total*	Modcomp	Modcomp IV
Total*	Varian	V71
Reality	Microdata	Model 160
Image/1000	Hewlett-Packard	HP1000
Image/3000	Hewlett-Packard	HP3000

(*TOTAL is a DBMS package developed by Cincom Corp.)

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A data base management system is especially useful when a file is likely to be manipulated in ways that cannot be foreseen at the time when a data base is created. It enables a user to take a mass of data at a later date and to retrieve elements in an organized fashion and arranged in a structured format. A word of caution: A computer applier must take great care and spend lots of time on what should go into the data base, and how it should be organized to get such benefits.

BIG GAINS

The gains, though, can make this effort worthwhile. A San Francisco manufacturer, for example, is successfully marketing a turnkey materials planning system based on a minicomputer and DBMS. The company uses the data definition facility of the DBMS, called a "schema compiler," to customize a customer's data base and applications programs.

WHAT IS A DBMS?

A data base management system (DBMS) is a software package designed to operate interactively upon a collection of computer-stored files, or what is called a data base. Its primary operations are to count data base records that have in common whatever characteristics may be specified by a user and to retrieve those records for further processing and display. A typical DBMS includes a:

- *Schema* — a high level, compiler-like language that can be used to describe the location, contents, relationships, and security level of data that are stored in a data base.
- *Data Manipulation Subroutines* — callable from high level languages such as Cobol or Fortran, that are used to manipulate and extract data from the data base.
- *Query Language* — an English-like language, incorporated into some DBMS, that acts as an impromptu report generator.
- *Utility Programs* — off-line routines that are used to load the data base on to disk from other media and to duplicate the data base as a backup.

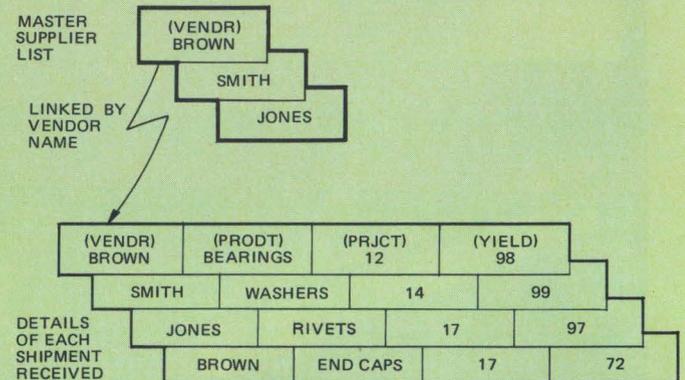
Because it can do this each time without extensive reprogramming, the company can sell the system at a competitive price and make a profit, too. The schema, indeed, is key to the DBMS technique. (Fig. 1.)

In another case, the Manpower Administration in Denver, CO, uses a minicomputer-based DBMS to retrieve employment information. The system proves especially useful on answering one-of-a-kind questions, such as: "How many females that are registered as unemployed with the agency are heads of households and have two dependents?" Such one-shot queries used to take days, or even weeks, to answer, but now administration personnel simply access the data base by means of simple English-like commands on a terminal, and the information is spewed out in seconds. (Fig. 2.)

Besides such efficiency gains, the Colorado state agency also achieves cost reductions — a nice fringe benefit to have in these times of tight municipal budgets. The agency, by switching to DBMS, cut its programming load by more than 50 percent. Under the previous computer system, special

FIG. 1
THE SCHEMA: KEY TO DEFINING DATA BASE STRUCTURE

The best way to show how a schema defines a data base structure is by a case example — a materials requirements planning system, in this case. Suppose a manufacturer wants to monitor the quality of parts received from suppliers. For each incoming shipment, a file is kept on the supplier (vendr), part description (prodt), applicable project (prjct), and the percent defects that eventually show up (yield). A master list of suppliers is also set up. The manufacturer can then query the data base on: What is the origin of a given part? Or, which vendors tend to supply high quality parts? low quality parts? And so on. The data base is organized as follows:



A schema that describes this data base is listed below, using the schema language of Hewlett-Packard's Image 1000 DBMS.

- | | | |
|-----|--|---|
| 001 | Begin Data Base MRP,
Security Code = 379951 | (names the data base and assigns a security code) |
| 002 | Levels: | (passwords that define the read/write access associated with data items stored in the data base) |
| 003 | Clerk | |
| 004 | Supervisor | |
| 005 | Data Items: | |
| 006 | VENDR, A10,
(Supervisor, Supervisor) | (This is a list of data items used in the data based followed by data type (A=ASCII, I=Integer), FIELD LENGTH, READ SECURITY PASSWORD, AND WRITE SECURITY PASSWORD) |
| 007 | PRODT, A10,
(Supervisor, Supervisor) | |
| 008 | PRJCT, I1, (Clerk or Supervisor, Supervisor) | |
| 009 | YIELD, I1, (Clerk or Supervisor, Supervisor) | |
| 010 | Data Sets: | (associates data items with specific lists) |
| 011 | NAME: Master Supplier List | (master list of suppliers) |
| 012 | ITEMS: VENDR | (vendr represents the supplier name) |
| 013 | CAPACITY: 100 | (maximum number of records in this list) |
| 014 | NAME: Shipment List | (detailed list of shipments received from each supplier) |
| 015 | ITEMS: VENDR | (items that make up a record in the shipment list) |
| 016 | PRODT | |
| 017 | PRJCT | |
| 018 | YIELD | |
| 019 | CAPACITY: 100 | (capacity of the list) |
| 020 | END | |

requests for information had to be specially programmed, and this entailed use of two programmers. Now, with DBMS, only one programmer need be on hand.

DBMS is valuable in other ways too. The technique requires fewer programming steps than does a traditional file management system, for example. With DBMS, it is not necessary to build file maintenance utilities or to write algorithms to search through the interrelated records. (Fig. 3.)

In this fashion, a Portland, OR, software firm achieved big savings on software development when building a mini-based DBMS to help an eyeglass manufacturer control financial losses caused by improperly filled prescriptions. The

**FIG. 2
AN IMPROMPTU QUERY SCENARIO**

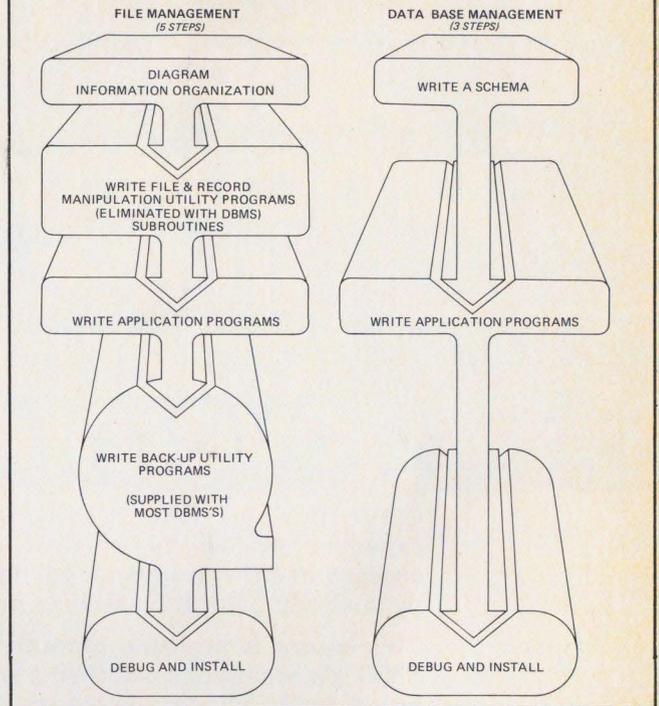
<u>RUN, QUERY</u> *	(initiates execution of the Inquiry language processor)
NEXT?	(Inquiry processor prompt)
<u>DATA-BASE = MANPOWER</u> *	(defines data base to inquiry)
<u>SECURITY CODE = 7xP309</u> *	(user defined password)
NEXT?	
<u>FIND SEX IS "F" AND STATUS</u> <u>*IS "HEAD OF HOUSEHOLD"</u> <u>AND DEPENDENTS IS "2" END;</u>	(actual inquiry request)
1 ENTRY QUALIFIED	(only one entry in the data base satisfies the inquiry conditions)
<u>REPORT ALL</u> *	(user requests a report of the one entry that satisfied the inquiry conditions)
NAME: Dale Fischer SEX: F STATUS: Head of Household DEPENDENTS: 2 ADDRESS: Poplar St., Denver, Colorado TELE. NO.: 303-963-1986	
NEXT?	(additional inquiries could be made at this point)

*Underlining indicates dialogue entered by the user

data base is on frame style and size, lens magnification power, distance between pupils, lens tints, and other inventory and order information. A Fortran application program issues DBMS subroutine calls to retrieve each order from the data base; the ordered items are then exploded into material lists. (Fig. 4.)

Next, the system searches the inventory data base, again using DBMS subroutine calls, to make certain that all required parts are in stock. It then uses the information to print a work order and reduce the inventory record. On those parts that are not available, the system prints a production order ticket and also issues a delay notice that is sent to the prescribing doctor.

**FIG. 3
TWO WAYS TO IMPLEMENT
A MANAGEMENT INFORMATION SYSTEM**



This particular application points up the power of a DBMS. If the software were not available, any attempt at a similar data manipulation would have to be run in batch mode and not in the interactive one that DBMS permits. Thus, DBMS may be viewed not only as a vehicle to retrieve random information in real-time, but also as a design and development tool that an astute user can employ to save significant amounts of programming effort and money.

**FIG. 4
TYPICAL DATA BASE MANAGEMENT
DATA MANIPULATION SUBROUTINES***

The DBMS subroutines are designed to access and manipulate data stored in a data base. The location of data is known through the structure of the data base (the schema). These subroutines which are callable from application programs written in Fortran, Basic, Cobol, or RPG, perform such functions as: Opening the data base for access; closing after usage; reading; writing; updating; adding; or deleting data. Several examples follow:

DBOPN (Data Base Open). Prepares a data base for subsequent accesses by the other DBMS subroutines. This consists of defining the subset of the data base a particular user can gain access to.

DBCLS (Data Base Close).

DBGET (Data Base Read). Accesses data from a data base in a sequential, direct (or random), chain, or keyed read fashion.

DBUPD (Data Base Update). Modifies existing data in a data base.

DBPUT (Data Base Put). Adds new data to a data base.

DBINF (Data Base Information). Returns information about the data-base structure. The information can be the type and length of data items, the relationships between data, etc.

DBLCK (Data Base Lock). Gives the user temporary exclusive use of the data base to add, delete or update entries.

DBUNL (Data Base Unlock). Relinquishes exclusive user control and restores the data base to full use by others.

DBFND (Data Base Find). Locates the head of a chain using a mathematical transformation (randomizing) on a key value. This is done in order to perform subsequent chained reads via DBGET.

*Taken from Hewlett-Packard's Image 1000 DBMS.

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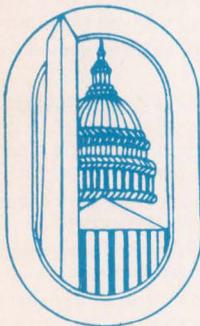
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getting the most out of a performance analysis

DR. BORIS BEIZER / Data Systems Analysts, Inc.

The trade-off between processing load vs. processing delay, though often ignored, is key to determining how many functions a microprocessor should handle. The article discusses when such a performance analysis should be applied. And a follow-up article in another issue will tell how to conduct one.

The microcomputer is emerging as just another machine component, albeit a complicated one that is unique in one critical way: It is programmable, and so a systems designer can conceivably load any number of operating functions onto it. In practice, however, the designer faces one of his most difficult tasks in determining just how many functions should be loaded onto a microprocessor and which specific ones. For example, should a given function, such as the polling of data logger sense points, be implemented as software? Or would it be more desirable to develop a special logic box? Or should an additional microprocessor be added to handle this and other functions? The key to such decision-making is to analyze the relationship between each additional function loaded onto the microcomputer and the incremental processing delay caused by the added burden.

FAILURE TO SPECIFY

Systems specifiers, however, frequently fail to note processing delay times as a performance criterion. A typical specification usually only requires that an item of equipment process "N-transactions a second." But this is only half a specification because a complete one would read "N-transactions a second with a delay not to exceed T-milliseconds." Ironically, the same engineer would never specify a resistance value without a corresponding value in watts or specify capacitance without a voltage.

In the design of a telephone PBX, for example, the systems engineers derived a big payoff through a constant analysis of processing load versus processing delay. The designers wanted to use an existing microprocessor in lieu of a logic box to synchronize the turning on and the shutting off of the bell relay. This would eliminate a relay, costing several dollars, on each of the 100 lines in the system to result in significant savings. The added function, however,

noticeably increased the load on the microprocessor. So a performance analysis was conducted to make certain that the computer would not become saturated leading to excessive processing delays, and ultimately, a relay or power supply failure. Such continuing monitoring of the CPU performance as additional functions were added enabled the designers to make effective hardware/software trade-offs.

WHAT IS AN ACCEPTABLE DELAY?

Just what constitutes an acceptable processing delay depends on the application. In keyboard terminals, for example, the need for human interaction becomes a limiting factor. An operator, keying in data, will not be aware of any delay of up to 50 milliseconds caused by the time that the electronics takes to respond to the key strokes. An operator finds the same terminal slow and non-responsive when this kind of delay exceeds 200 milliseconds. Some PBX functions require that the delay not exceed 5 milliseconds, as in the capture of dial digits. On the other hand, the same PBX can get by with a delay of up to 500 milliseconds when generating a dial tone.

The theory behind obtaining processing delay times is rather elementary; it is related to performance measures that are based on percent of utilization. If the capacity of a computer is M instructions per second, but it will be called upon to execute only N instructions per second, the percent utilization is N/M. This simplistic analysis suggests that a system design is adequate as long as the utilization factor is under 100 percent, though a designer will cut the capacity utilization to perhaps 80 percent as a safety factor.

The popularity of the approach is unfortunate because such an analysis is incomplete. It does not answer the question: What will happen when the system becomes 100 percent committed? In this case, the system breaks down. It does not work at all. In computer terms, the transactions to be processed suffer an infinite delay, and as a solution, the system requires an infinite amount of memory to store the transaction, or alternatively, it rejects the workload.

Such a breakdown becomes apparent in an equation that gives the relationship between processing delay (d), the utilization factor (r), and the time required to process a single transaction (t). The processing delay is then approximately given by: $d \approx t \div 1 - r$.

As shown in Fig. 1, the equation makes it apparent that at zero utilization, the delay is simply equal to the time re-



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quired to process one transaction. At 50 percent utilization, the delay doubles; at 80 percent the delay goes up five times. All systems behave according to this asymptotic expression, though a real operating system is actually more complex. Nonetheless, the asymptotic vertical line shows

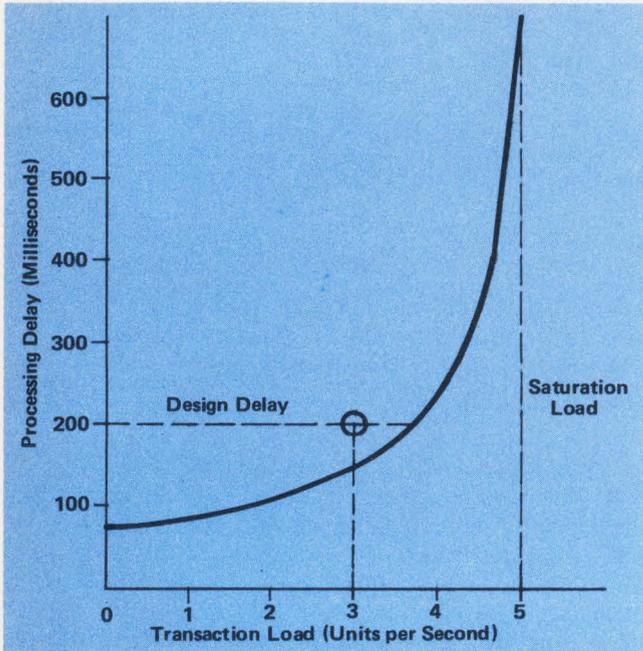


Fig. 1. Typical Processing Delay Vs. Transaction Load Curve

the load at which a system becomes saturated, and this should be the cornerstone in a performance analysis. Certain data must be collected and deduced to perform such an analysis. But the information is usually very difficult to obtain, and gathering it can dominate a design effort. This means that a systems designer must tackle a prerequisite question: Is such a performance analysis worthwhile in the first place? And the answer here is tied to the anticipated cost of the system and to the size of the production run. For low cost, one-of-a-kind systems, it rarely pays to agonize over the microprocessor selection to seek the lowest cost. Instead, an engineer should simply overbuy.

WHEN TO CONDUCT AN ANALYSIS

Systems that will have mass production runs and that will sell at a low price make up the opposite end of the spectrum. Here, an engineer would want to spend considerable effort on the performance analysis. Between the two extremes, it takes judgment on how to proceed. In any case, the principle on when to carry out a performance analysis is illustrated in the table below:

	Instrumentation Telephone	
	Package	PBX
	SYSTEM A	SYSTEM B
Software Development Cost	\$100,000	\$100,000
Analysis Cost	\$ 10,000	\$ 10,000
System (less software) Developments	\$200,000	\$200,000
TOTAL	\$310,000	\$310,000
Production Run	2	200
Amortized Analysis Cost	\$ 5,000	\$ 50
Computer X	\$ 3,000	\$ 3,000
Computer Y	\$ 6,000	\$ 6,000
Computer Z	\$ 3,100	\$ 3,100

The table, which is a composite of actual design experiences, compares two systems. System A (instrumentation package) has an expected production run of two units, and System B (telephone PBX) has an expected run of 200

units. The table clearly shows that on System A, a \$10,000 cost analysis is not warranted to conclude that computer X is the best buy. The cost of the analysis amortized over the two units, plus the cost of the cheaper computer, is still more expensive than a decision to go with the most expensive \$6000 computer in the first place. On the other hand, the table shows that the telephone PBX does merit a \$10,000 cost analysis. In this case, the cost amortized over 200 units comes out to \$50 a system, and this compares to a \$100 saving that an analysis would produce by showing that computer X at \$3000 will do the job in lieu of computer Z at \$3100 a piece.

WHAT IT COSTS

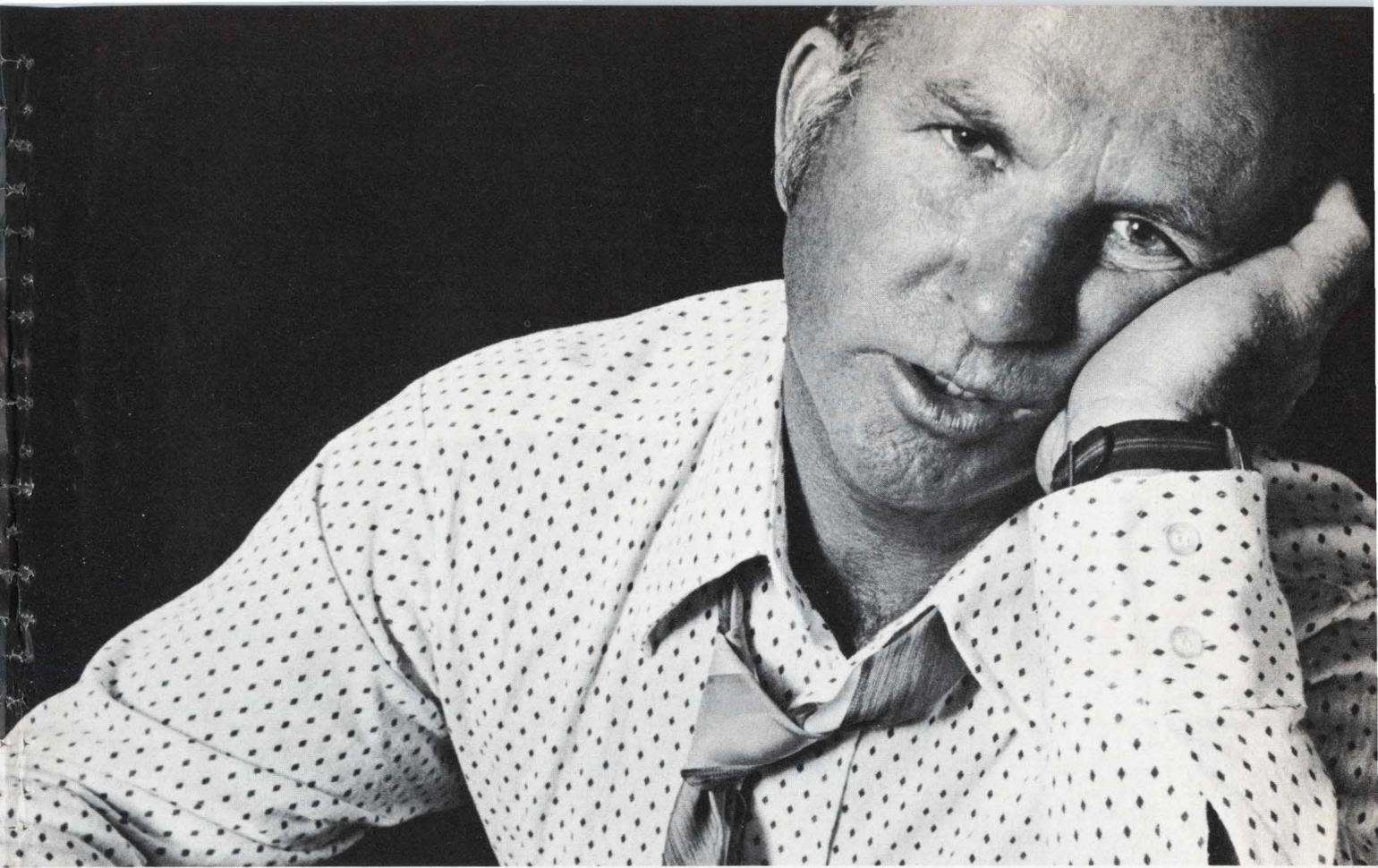
Indeed, the cost of an analysis becomes a factor when selecting a microcomputer precisely because the devices are inexpensive. The expense, in turn, is related to software development cost because the number of functions coded on a microprocessor largely determines the programming costs. As a rule of thumb, a performance analysis comes to 10 percent that of software development costs. And when more than two microprocessors need to be evaluated, each additional analysis adds another 2 or 3 percent to the cost.

Most of the cost in a performance analysis results from the need to gather extensive data on a proposed system. Details on alternative configurations must be examined, for example, including ROM, RAM and PROM memories, direct memory access channel, interrupt overhead time, and anything else that affects processing. Similarly, the designer must take into account the execution times on all instructions in the repertoire. And he also must estimate the arrival rate on each transaction. In sum, the designer must obtain values for any parameter that affects a decision to be made by the software. Furthermore, the parameters tend to be so interrelated and mixed that a probability factor must also be developed on each estimated value. All of this is extraordinarily difficult to do, and it may call for inspired guess work.

STILL OTHER CONSIDERATIONS

Nor does the job end here. The systems integrator must prepare a reasonably detailed preliminary sketch, as a final step. It should incorporate flow charts, trial codes, etc., on the software to be used in the transaction processing. This is the most important aspect of the analysis — and the most time consuming. It is just not possible to analyze a micro's performance in an application without first understanding the software to be used. This is not to say that every detail must be included. Many items can safely be left out, such as initialization and loading routines, error recovery routines (but only if errors are not likely to be frequent), and exception routines. Nevertheless, the process can amount to as much as 25 percent of the cost of a complete programming effort.

At this point, it is necessary to add that such a complex performance analysis on a product application is but one factor to be considered when selecting a specific microprocessor. A systems designer should also take into account the reputation of a vendor for product quality and on-time delivery; support software and development tools available on each microprocessor and depth and breadth of the supporting product lines. Such factors will differ according to the end-use application and other circumstances. Generalized rules cannot be formulated except for one: A well-executed performance analysis could render a competitive edge to a product in the marketplace. ■



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BARBARA A. REYNOLDS / Associate Editor

BATTLE OF THE GIANTS AT COMM CROSSING

New York stock analyst Harry Edelson of Drexel Burnham & Co. is still busy convincing the Computer Industry Association that IBM isn't so bad after all. In fact, as computer communications take an ever increasing hold on industry and society, IBM may be the only party that is strong enough to challenge the real monopolist, AT&T, he says. Furthermore, IBM is still a dwarf compared to Ma Bell, Edelson adds (see chart).

1975	AT&T	Western Electric	AT&T Total	IBM
Fixed Assets	\$80.1	\$5.0	\$85.1	\$15.5
Shareowners' Equity	33.8	3.2	37.0	11.4
Revenues	29.0	6.5	35.5	14.4
Net Income	3.1	.1	3.2	2.0
Employees	939,000	153,000	1,092,000	289,000

Inter- and intraoffice communication networks, electronic mail and EFTS will sooner or later become a reality, replacing most paper transactions. AT&T wants a monopoly over all communications, not just telephone communications.

In 1971, the FCC allowed specialized carriers to set up private lines and in some cases to interconnect to Bell lines. AT&T has taken several subtle measures such as offering high-low density rates and below cost Dataphone Digital Service (DDS) to kill this competition. DATRAN was its most recent victim. The most recent and most blatant anti-competition measure — the Consumer Communications Reform Act of 1976 — would endorse a unified monopoly-controlled communications network, thwarting all competition. Only Satellite Business Systems, of which IBM owns one-third, has enough financial resources or technical commitment to prevent

AT&T from monopolizing all communications, says Edelson who definitely would like to see IBM in the communications field.

The outcome of the impending collision between IBM and AT&T depends on whether the FCC approves the SBS application and whether Congress passes the Consumer Communications Reform Act. The FCC will eventually approve SBS, says Edelson, but not within the original timetable. SBS will be able to install earth stations at two IBM locations in its 4/6 GHz

satellite system. By 1980, SBS should be allowed to launch its 12/14 GHz satellite, says Edelson.

Although no one gave the Reform Act much chance when Representative Roncalio first introduced it in March, 165 representatives and 15 senators have endorsed some form of it so far. Money and power of the act's proponents make it almost inevitable that some version of the law will be passed eventually. Ford or Carter could change this, but neither has taken a firm stand so far.

WHAT IF?

If SBS is allowed to operate, AT&T will definitely lose some revenues. But if a strong version of the Reform Act is passed, SBS could be out of business. Meanwhile, AT&T is making its long distance rates insensitive to distance to compete with satellite rates and has even turned to Amdahl for two new computers.

MCI FIGHTS FOR EXECUNET LIFE

MCI Communications Corp. needs Execunet service in order to survive says company chairman William G. McGowen. Although MCI has other private line services, Execunet provides about 40 percent of the company's income according to McGowen. After the FCC ordered MCI to stop its Execunet service for a second time, MCI obtained a stay against the order from the Washington, DC Court of Appeals. The FCC and AT&T are now doing their best to get the court to lift the stay, which would close down the service that competes directly with AT&T's Message Toll Service and Wide Area Telecommunications Service (WATS).

MCI's Execunet uses Bell local loops, but routes the calls over its own long distance lines which connect 17 cities. About 7 percent of Execunet's volume is data transmission. The 1971 FCC decision allowing specialized common carriers limited the carriers to "private line" service says the FCC. Execunet is not actually a private line because it has dial in access rather than hard-wired lines. MCI maintains dial-in access to shared lines makes the service less expensive and is therefore more beneficial to customers. AT&T says Execunet competes with only the profitable part of the telephone service, leaving the unprofitable local service to AT&T.

After the DATRAN failure, the FCC is sensitive to failing specialized common carriers. MCI is using the threat of its own failure as a wedge to keep its Execunet service although its Service 12 would qualify as a hard-wired private line.

PORTABLE TROUBLESHOOTER

Communications test systems usually involve either a paper tape or CRT. But program debugging with paper tape often requires a memory dump to diagnose programs containing various nonprinting characters and CRTs don't give hard copy for analyses. The Execuport 380 hard copy keyboard terminal prints the full ASCII character set plus 32 special symbols for nonprint characters and it delivers a printout. The desktop troubleshooter prints at 10, 15 or 30 characters per second and weighs less than 23 pounds. It is compatible with most minicomputers and can be connected to most peripherals in an RS-232 interface. *Computer Transceiver Systems, Inc., Paramus, NJ.*

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DATASPEED 40 UPDATE

Although the FCC decided in March that AT&T was going beyond its communicating limits with the synchronous Dataspeed 40/4, at least 20 states have ok'd its use within state boundaries, according to the Center for Communications Management monthly newsletter. The Dataspeed 40/4 uses a processor in its controller for clustered terminals, which the FCC says performs data processing, something forbidden to AT&T since the 1956 Consent Decree.

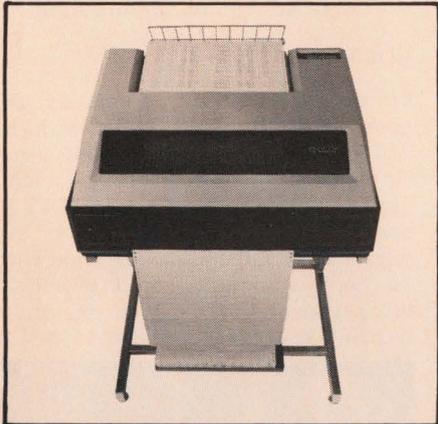
PAPERTAPE READER/PUNCH

Data Specialties, Inc., (Northbrook, IL) paper tape reader/punch attaches to any 300 baud terminal with an RS-232 or current loop interface. Standard features include full/half duplex and line/local operation, search/edit, back space and tape feed control. The SRP-300 punch mechanism cuts all paper, Mylar, rolled and folded tapes without readjustment or modification. Price is \$1995.

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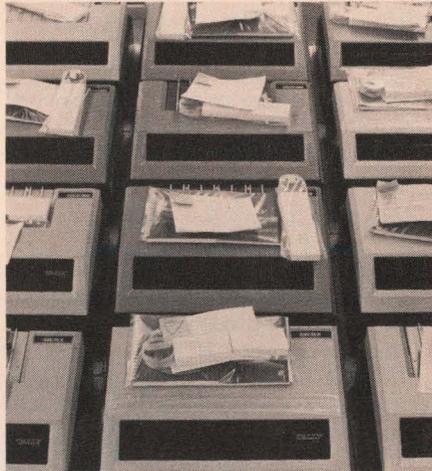
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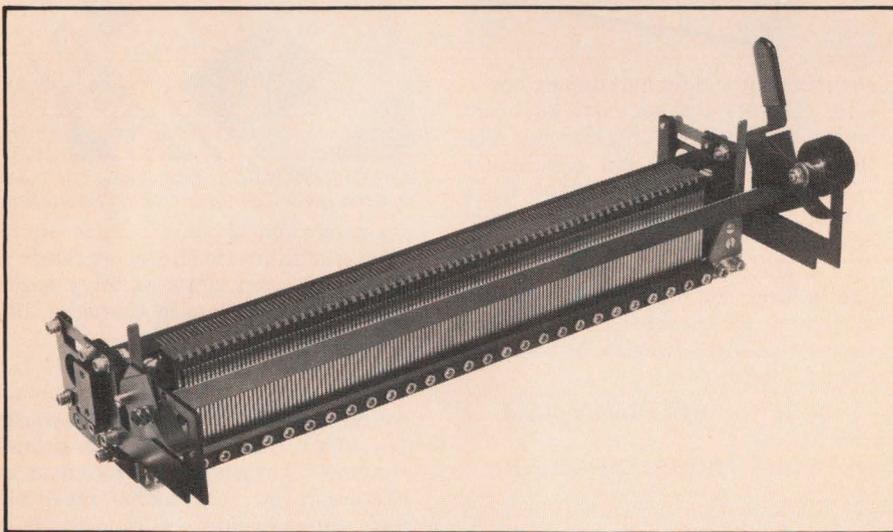
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EFTS VS. THE POSTAL SERVICE

If EFTS is allowed to cross state boundaries, the United States Postal Service could lose two-thirds of its first class financial mail reports a recent Arthur D. Little study. The Cambridge (MA)-based firm says digital inter- and intraoffice networks will further reduce mail volume. This could make a \$.35 letter a reality by 1980 says ADL unless the Post Office can enter the telecommunications business.

DATRAN'S MISTAKES

AT&T won, DATRAN lost. And AT&T's campaign to do away with specialized common carriers continues both in Congress and in the courts. The Wyly Corp. subsidiary, Data Transmission Co., couldn't compete with AT&T's Dataphone Digital Service rates, which the FCC declared anticompetitive, so the company filed for bankruptcy. The specialized common carrier industry is now understandably nervous. It not only has to fight AT&T, but has to convince the public that specialized common carriers can survive.

DATRAN did make several tactical errors, however, says a Cambridge

(MA)-based communications research group. The Yankee Group says DATRAN misread the telecommunications market, which is both voice and data. DATRAN offered only data transmission, which is only 5 percent of communications traffic. Even within the data transmission market, DATRAN's technologically new Data-dial service required heavy capital investment. And the data transmission market was slow to accept the new technology. These problems might have passed as growing pains, but AT&T's semi-digital service DDS with rates 40 percent below those of DATRAN stopped all prospects of DATRAN's growth.

HP'S LOWER-PRICED CRT

Hewlett-Packard's 2640B CRT carries a lower price tag and offers more features than its predecessor, the 2640A. The \$2600 price is 13 percent lower than the 2640A and firmware enhancements give users a choice of either main channel protocol or standard reverse



channel protocol for half-duplex operation. The CRT also has a new keyboard layout and includes absolute and relative cursor sensing and positioning.

Like the 2640A, the 2640B has a microprocessor and memory that stores 400 lines. The terminal supports up to four character sets, including optional line drawing and mathematical symbol sets. And for Scandinavians, there's also a Danish/Norwegian or Swedish/Finnish character set.

Circle No. 101 on Inquiry Card

NETWORK TROUBLESHOOTER

A CRT screen on the DLM II network troubleshooter displays data and control characters that flow on the transmission line so the engineer can see problems as they occur and identify the cause. The troubleshooting tool is designed for central site network control centers, workbench testing of hardware and software (in production and engineering environments) and as a portable tool for remote sites. The 21-

pound data line monitor has a 640 or 1280-character CRT with separate box for monitor electronics. A large variety of codes (EBCDIC, BAUDOT, USAS-CII, HEXIDECIMAL), protocols (Sync, Bisync, Teletype, Async), and data rates (up to 9600 bps) can be accommodated by DLM II. Price of a single unit without CRT is \$2495. *Digi-Log Systems, Inc., Horsham, PA.*

Circle No. 105 on Inquiry Card

CDC's μP-BASED CRT

Control Data Corp. is joining the micro-based terminal ranks with its 751-10 CRT. The 8080-based asynchronous terminal with 1920-character display supports RS-232 or CCITTV24 communication interfaces. Users can select half or full duplex operation with 10 transmission rates from 110 to 9600 bits per second. The 128-character detachable keyboard contains 95 ASCII



A NEAT PACKAGE. CDC's new CRT with desktop nonimpact printer and cassette unit.

characters and 33 control codes. Microprocessor firmware allows operators to select odd, even, mark or space parity and to transmit data in character, line or block modes.

The microprocessor also controls a desktop nonimpact printer, an impact printer and a single or dual tape cassette unit. The 753-10 nonimpact printer prints 30 characters per second in an 80-column line. The higher speed impact printer handles multiple forms at 173 or 180 cps, depending on the power source. The single cassette drive holds 288,000 characters, the dual drive twice that. Price of the CRT is \$3150. The nonimpact printer is \$2540; the impact \$4370. The single drive cassette goes for \$2200 and the dual drive costs an additional \$320.

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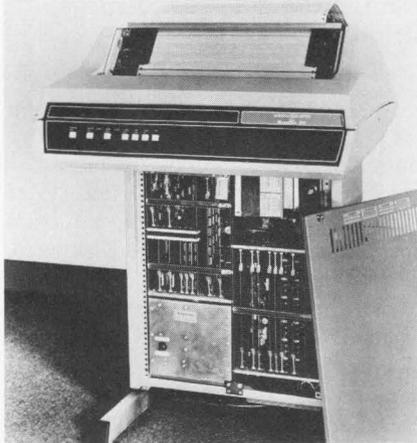
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μP-BASED COMM CONTROLLER

The TermiNet 9600 Communication Controller gives GE's TermiNet 120, 310, 320, 330, and 340 terminals greater interface flexibility. The controller is a factory programmed device



with a microprocessor, memory (EPROMs, RAMs or jumper PROMs) power supply and input/output interfaces. It can handle data transmission up to 9600 baud synchronous or asynchronous and is compatible with different communication protocols through emulation packages. Emulation packages include IBM 2780 or 3780, DCT-1000, and those for GE's Mark III time sharing service. *General Electric Communication Systems, Waynesboro, VA.*

Circle No. 106 on Inquiry Card

PALM MONITOR

Goodwood Data Systems (Ogdensburg, NY) handheld monitor permits direct access to individual signal lines and allows operation of the system terminal



in the echo mode. The unit continuously displays DRT, CD, DSR, CTS, RTS, RD, TD, and TEST INDICATOR on eight LEDs. Pin connections are available for oscilloscope monitoring. Power comes from the line, batteries or rechargeable batteries.

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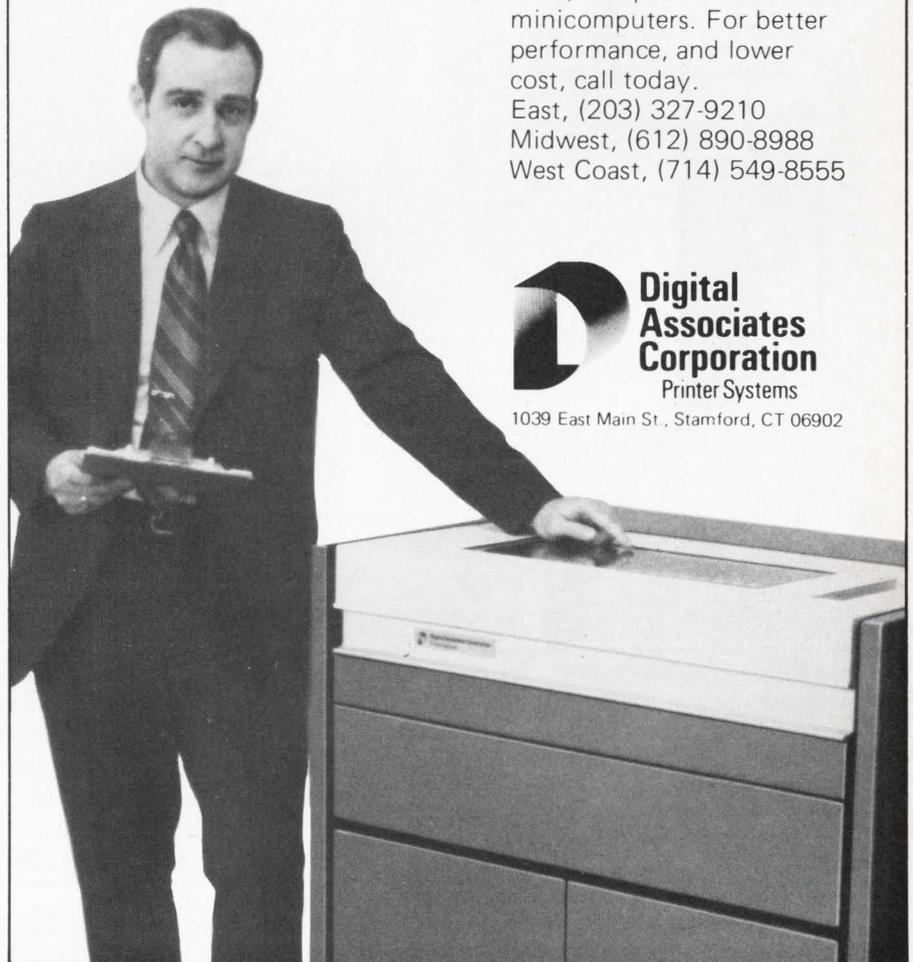
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CIRCLE NO. 24 ON INQUIRY CARD

THE VALUE OF INTERRUPTS

The proper use of interrupts in a microcomputer can eliminate hardware, protect against damage, and speed up transaction processing, among other gains. But pitfalls exist.

PERRY LYNNE / Microcomputer Applications Engineer, Intel Corp.

Both big computers and minicomputers typically use interrupts to stop a routine operation so that the computer can process a higher priority function instead. Such a technique can impart many benefits to a microcomputer system as well. Among the gains:

- A quick response to asynchronously occurring random events which change the flow of a program.
- The capability to use the processor's speed to service many slow peripheral devices.
- Elimination of hardware.

milliseconds, and shuts down the system in an orderly fashion. In this way, an interrupt can save important system parameters, such as the time of day. Power fail interrupts also can be used to protect motors, drills, and disk heads, where such mechanical devices are under microprocessor control. The devices must be disengaged or otherwise put in a state where they will not cause damage or be damaged.

The data that are generated by power fail interrupts are stored in a RAM memory that is backed-up by battery. Upon a loss of power, the microcomputer disables the control logic that writes to the RAM memory, and this serves

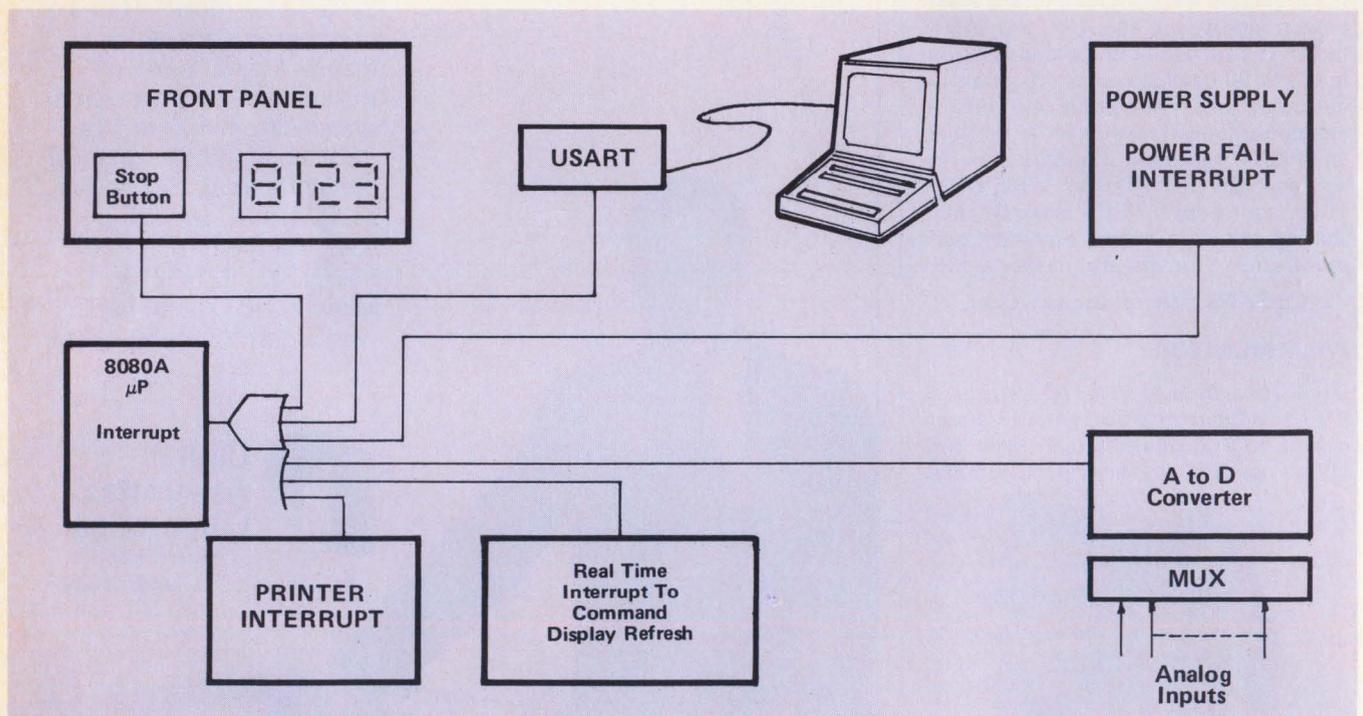


Fig. 1. How Interrupts Are Applied

The application of interrupts in a data acquisition system (Fig. 1) shows how the technique maximizes use of the processor. The system multiplexes many analog inputs to an analog-to-digital converter and all conversions to actual measurements, such as thermocouple readings into temperature, are done by a microcomputer. The computer then routes the results to an LED display, a printer, and, by means of a serial interface, to a remote CRT terminal.

POWER FAIL IS CRITICAL

The system uses many interrupts; power fail is one of the most critical. It warns that the system will lose power in

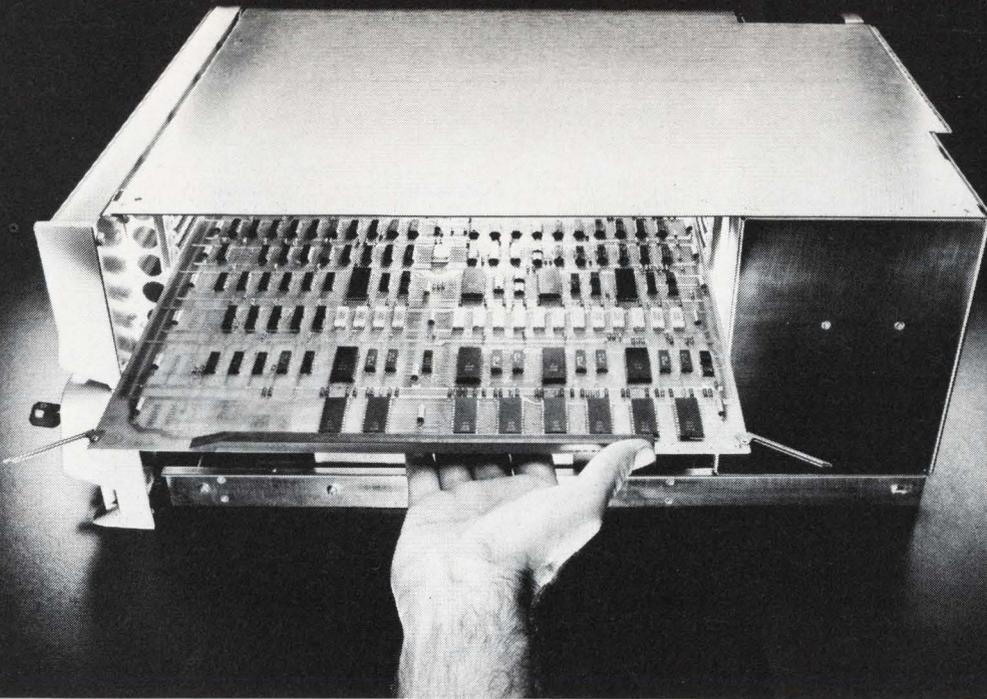
to prevent spurious write operations from destroying data in the memory. When power is restored, the processor instructs the logic to resume write operations.

Other interrupts include:

Emergency Stop, triggered by an operator at the front panel. It causes the system to shut down and gives the operator immediate control.

End Calculation, triggered by the A to D converter. It indicates that the process has completed a conversion and has new data.

Printer Ready, triggered by a local printer. It indicates that the processor is ready to receive another line of data.



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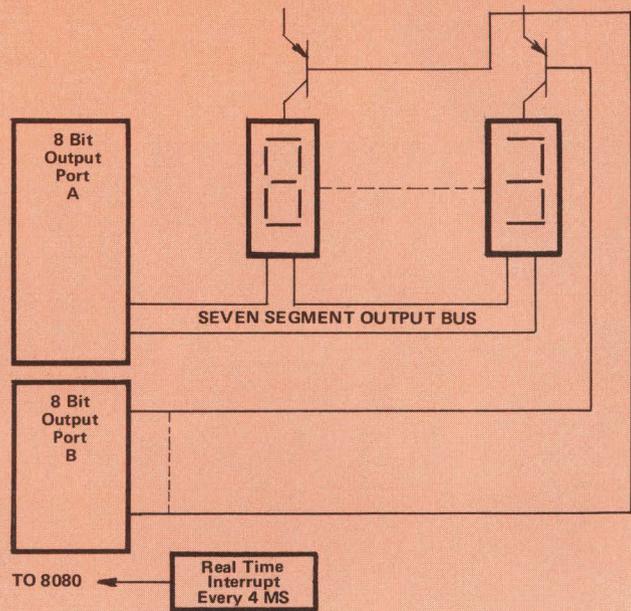
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CIRCLE NO. 25 ON INQUIRY CARD

An Interrupt in Detail

A real time interrupt, one received on a periodic basis, generates a clock for keeping track of hours, minutes, and seconds. Real time interrupts can eliminate switches, displays, and other hardware in human machine interfaces. For example, applying a real time interrupt to a multiplexer display can eliminate shift registers, BCD-to-7 segment decoders, and timing circuitry. To achieve this, the processor stores a copy of the display data in a scratch pad RAM memory. An interrupt tells the processor periodically to display a new LED and then transmits the next data character (Port A in diagram.) The table illustrates an operation code as applied to an 8080A microcomputer. Overhead time is approximately 2 percent of the processor's total time — given that an 8-character display is refreshed 30 times a second.



Example of using real time interrupt for multiplexing a display:

SUBROUTINE:

PUSH	A	; SAVE ACCUMULATOR
PUSH	H	; SAVE H & L REGISTERS
LDA	MUXNO	; GET MUX NUMBER
OUT	PORT B	; TURN ON NEXT DISPLAY
RLC		; ROTATE MUX NO
STA	MUXNO	; STORE MUX NO
LXI	H, START DIGIT	; IF MUX NO ROTATES INTO
JC	NEXT	; CARRY THEN START WITH 1ST DIGIT
LHLD	DIGITPTR	; GET POINTER FOR NEXT
		DIGIT INTO H & L
NEXT: MOV	A, M	; GET NEXT 7 SEG DIGIT
OUT	PORT A	; SEND OUT DIGIT
INX	H	; INCREMENT POINTER
SHLD	DIGITPTR	; RESTORE NEW POINTER
POP	H	; RESTORE REGISTERS
POP	A	
EI		
RET		

TIME = 80 μ S OR 2 % OF OVERALL TIME

Transmitter Ready, triggered by a universal synchronous-asynchronous receiver transmitter. It indicates that the processor is ready to send out another character to a remote terminal.

By putting all of these functions under interrupt control, many operations of a DA system can be carried out in parallel. These operations include display refresh; A to D conversion; engineering calculations; outputting to a printer and serial interface; and sensing of stop and power fail conditions. A big gain results. Overall system throughput increases significantly when these numerous asynchronous events are allowed to dynamically change the program flow.

Indeed, if interrupts were not used, additional hardware would be required to run the display. Furthermore, the system would not respond to a stop, or power fail, condition until the processor completed other normal operations.

Another inefficiency: Data to multiple printers, remote terminals, and other output devices would be transmitted sequentially rather than in parallel, and this would seriously slow system throughput.

Writing such so-called interrupt driven software into a DA system, or any other for that matter, has certain pitfalls. First, each interrupt should be properly cleared by the processor before another is permitted to enter the system. Otherwise interrupts will constantly re-interrupt the processor. Second, an interrupt source should not be so fast that it can re-interrupt the subroutine that is already servicing that interrupt. Otherwise, the data from the first interrupt will be lost. In some instances, however, interrupts are not a solution. If a source generates interrupts at a rate that is too fast for the processor to service sequentially, for example, then the interrupt technique cannot be used at all on the device, and it must be serviced in other ways. ■

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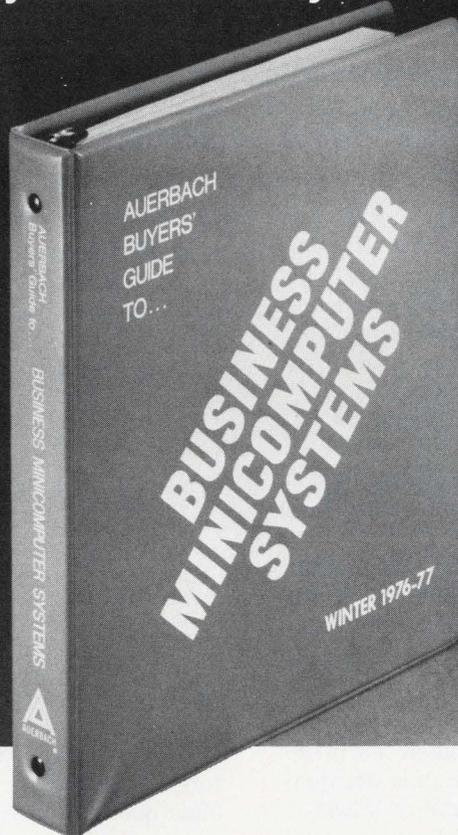
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How Maintainability Pays Off

GEORGE O. NIELSEN / Sorbus Inc.

Both designers and buyers of data processing components and systems frequently do not take into account how readily a product can be repaired. The oversight can be serious, and knowing how to size up the maintainability of hardware can avoid considerable woe after it is bought.

End users and OEM buyers of minicomputers, small business systems, and computer peripherals typically inquire into cost, equipment speed, software compatibility, and even vendor reputation when selecting among competing makes. Despite the desire to be thorough, however, buyers tend to overlook yet another important factor — maintainability, or the time that it takes to repair hardware.

The oversight has serious implications. All computer systems fail at one time or another. But the really big trouble ensues when the system remains out of order over too long a period of time. As a result, a manager may make faulty decisions because vital data are unavailable or late in being amassed; customer ill will may result; personnel overtime costs may become excessive. As for a production run in a manufacturing plant, any such extended downtime caused by a computer is unthinkable.

WHY MAINTAINABILITY IS IGNORED

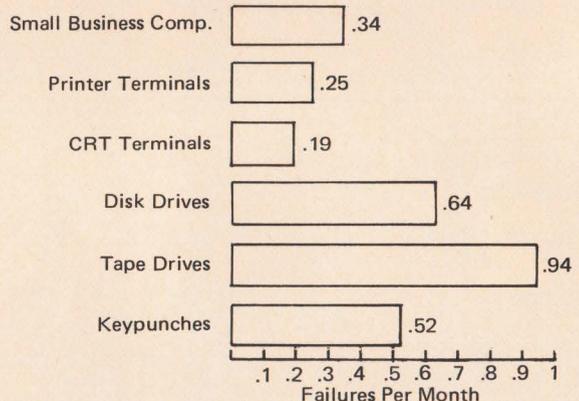
Nevertheless, computer equipment buyers ignore the maintainability of products, primarily because this decision-making factor is often confused with reliability. Chart A sets forth some representative figures on different types of equipment. It shows, for example, that a CRT typically fails slightly more than two times during a year. Thus, a wise buyer will check with other users to determine that his choice of unit is at least this reliable.

But this is only half the job. A product's viability can be judged only if its maintainability is also investigated. For example, a particular brand of CRT terminal may indeed fail only twice during a year, but if the vendor or a service representative cannot fix the unit quickly because either the unit is inadequately designed or the service rep lacks spare parts, is unqualified, or whatever then a buyer ought to seek out a more easily maintained unit. He should do this even if the unit tends to fail, shall we say, four times a year.



GEORGE O. NIELSEN is vice president for product management at Sorbus Inc., a subsidiary of Management Assistance Inc., located in King of Prussia, PA. The company specializes in the maintenance and repair of computers, computer peripherals, and computer-based systems.

CHART A Representative Mean Time Between Failures



The key point is that the equipment lend itself to repair and that a service rep will be on hand quickly to make that repair.

Determining the maintainability of equipment is straightforward, although a difficult task. A buyer must ask a few basic questions and study the hardware. Of course, some types of computer products are more vulnerable to failure than others; tape drives, for example, can be especially troublesome. But no matter what type of equipment a buyer is evaluating, he or she needs to take into account four basic considerations:

PHYSICAL. At any visit to a user site, be certain to ask for a demonstration on the equipment that you are expecting to buy. Ask to have a panel or two removed, and while this is being done, check that all enclosures can be readily removed and handled. Next, examine the unit to see whether principal elements are accessible, such as card feeds, capstan systems, and print heads. They should be easy to test, adjust, and replace should anything go wrong.

You should also be able to reach all printed circuit cards; and back planes should either simply unplug or be hinged into place. Power supplies and the rear of control panels should also be accessible. And wiring harnesses that are soldered, rather than fastened on by connectors, will take much more time to replace. The most easily maintained equipment is also modular in design. Printed circuit boards, frames and racks, control panels, and power wiring all should be attached to the main unit via connectors or terminal strips. The same holds for motors, switches, and other electromechanical elements.

1976 minicomputer— microprocessor market survey

The results of the fifth annual market survey among buyers of minicomputers, microprocessors and miniperipherals are now available in a special 80-page report.

The report features over 60 cross tabulations showing share-of-market statistics for all major vendors of minicomputers, microprocessors, microcomputers and miniperipherals.

The survey participants reported having 39,000 minis in place as of January 1, 1976 — accounting for nearly 30% of the total installed base of minicomputers in North America.

The survey respondents took delivery on more than 21,000 minicomputers in 1975 at a reported value of \$536 million. The respondents' purchase plans for 1976 include 28,000 minis at a total value of \$733 million.

microprocessors

Nearly one-half of the 5,700 sites represented among the survey replies reported having an active interest in microprocessors.

The respondents reported plans to buy 362,000 microprocessors in 1976 and another 576,000 (up 59%) in 1977. The microprocessor vendors being considered, the distribution by application and word length, and the factors considered most important by prospective buyers of micros when choosing a vendor are tabulated and analyzed in this year's survey report.

miniperipherals

The survey participants reported plans to buy an unprecedented quantity and assortment of peripherals in 1976 for interconnection with their minis and micros. Here is a partial list.

Type of Peripheral	Qty to be Purchased By Survey Participants
CRT Terminals	45,558
Mag Tape Transports	10,276
Floppy Disk Drives	9,909
Disk/Cartridge Drives	13,285
Line/Serial Printers	12,357
Teleprinters	18,466

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A user, if he does not check on all of these seemingly rudimentary points, can get stuck with a cumbersome product or system. One type of add-on core memory, for example, is bolted and wired into the frame, but fortunately that unit is now off the market.

FUNCTIONAL. Many designers add trouble-shooting aids, or self-diagnostic routines, and this is another good way to assess how easy it is to maintain an item of equipment. Such diagnostic aids can be special test lights that indicate a circuit malfunction, test points with which to attach scope and meter clips, and extension racks that hold additional printed circuit boards.

HARDWARE MAINTAINABILITY CHECK LIST

Physical

- _____ Easily removed and handled enclosures.
- _____ Accessibility to principal elements for testing, adjustment, and replacement.
- _____ Modularity of principal elements, e.g., no soldered connectors.

Functional

- _____ Test points for scopes and meters.
- _____ Software diagnostic aids.
- _____ Operator checks.

Documentation (service manual content)

- _____ Explanation of theory.
- _____ Schematics and logic diagrams.
- _____ Parts lists.
- _____ Part assembly drawing blow-outs.

Service Organization

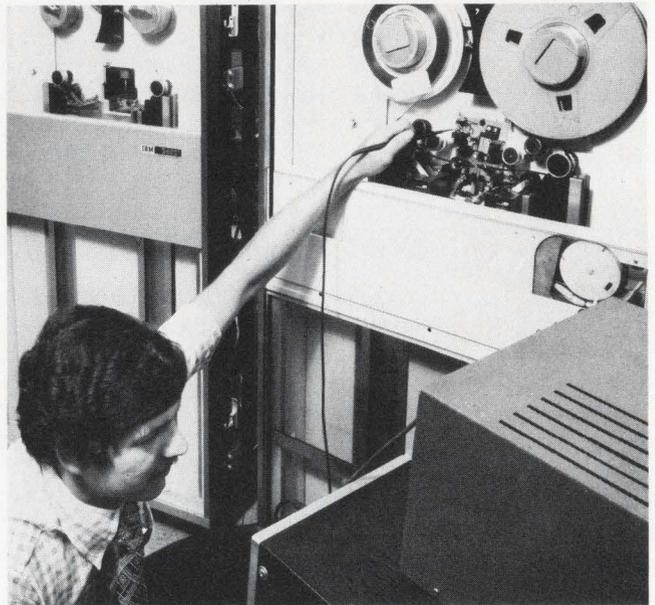
- _____ Local servicemen and hours of service availability.
- _____ Response time.
- _____ Regional repair centers or other support.
- _____ Spare parts availability.
- _____ Service and parts price schedule.
- _____ Quality of call and maintenance reports.

Simple operator checks should also be incorporated into equipment. Light indicators, for example, can alert a user to a blown fuse, paper jam, and other types of ills. A user then can correct these himself. On a more sophisticated level, computer-based systems may also come with packaged programs that automatically diagnose a faulty system and report out the results. Overall, such diagnostic helpers will be found in the most advanced systems now coming into the market. The small business computer made by Basic/Four Corp., for example, contains diagnostic aids to detect power failure, faulty disk performance, and transmission errors.

Some service dispatchers require a user to fill out a "problem determination form" before they will even authorize a service call. A user puts the equipment through a sequence of simple tests, whereupon lights and switches may indicate the nature of the problem. With such information in advance, a service rep can then come to the job already equipped with the necessary spare parts and any

unusual tools to fix the unit. The benefits: The repair man need not return, and he restores the equipment to operating order in a minimum of time.

DOCUMENTATION: The thoroughness and clarity of the equipment service manual is another way to check on a vendor's commitment to putting out equipment that can be easily maintained. The manual should explain the theory of operation to some degree; it should contain quality schematics and logic diagrams and other kinds of visual aids for making adjustments and replacing parts; parts should be listed with drawing blow-outs; and trouble-shooting procedures should be spelled out on common, predefined problems. Finally, the manual should clearly state the company's policy on parts swapping vs. onsite repair. Exemplary service manuals include those on the 1340 terminal by Diablo and the 99 computer system by GRI Corp.



Sorbus service rep checks out a malfunctioning tape drive.

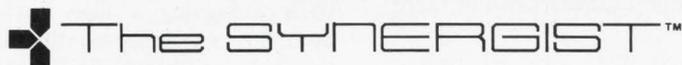
SERVICE ORGANIZATION. Of most importance, perhaps, do not forget to inquire of the service organization that will do the maintenance, especially if it will be a third party. Typically, service activities are organized in three tiers: (1) local serviceman; (2) regional repair and spare parts centers; and (3) headquarters. Make certain that you know where each of these activities is based in relationship to your own site. Know beforehand the schedule of parts and service costs and the availability of service — around-the-clock? 8 a.m. to 5 p.m.? weekends? Ask for a sample copy of a service call report.

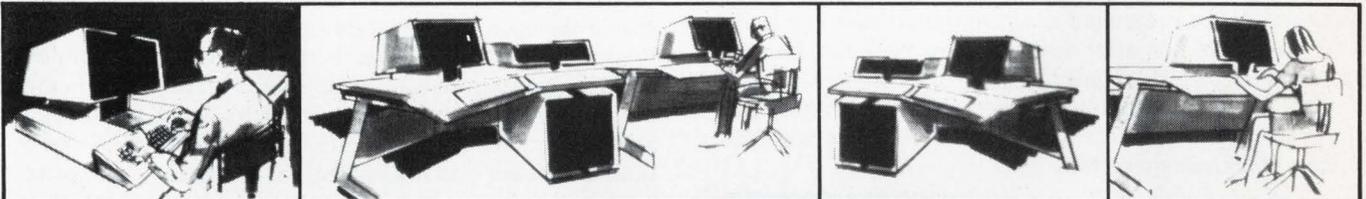
A vendor should be willing to make available all of this information. If not, you should find out why. Perhaps repair costs tend to be out-of-line, or service tends to be tardy. Perhaps the vendor does not stock spare parts locally. Perhaps the service manual is only three pages long, and the outfit does not even use formal call reports. Whatever the reason, be wary. Any such deficiencies could suggest trouble ahead. Indeed, the very same repair or maintenance problem that might later prompt you to sell the equipment will turn out to be why its resale price is disappointingly low. So, investigate before buying. Do not risk learning the hard way about maintainability — when a system is down and the vendor is cavalier about answering your call for help. ■

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CIRCLE NO. 26 ON INQUIRY CARD

WESCON abstracted

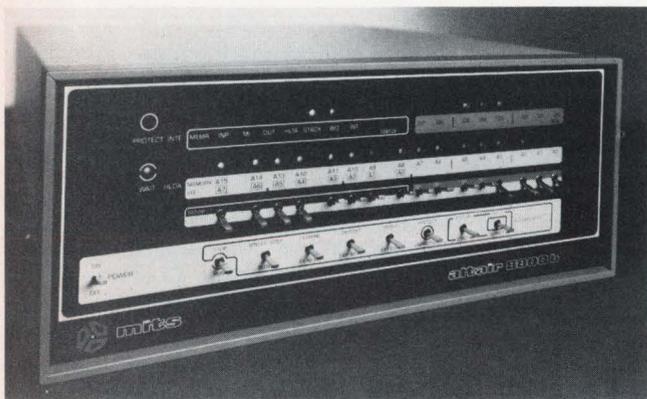
Presenting abstracts on some of the more systems-oriented papers given at this year's WESCON conference.

The IEEE WESCON show held in September in Los Angeles marked a 25th anniversary. Attendance at over 38,000 set a record, and such a crowd was lured into the L.A. convention center because the mini-computer and microcomputer received a top billing. Some of the more systems-oriented papers are abstracted below:

THE SHAPE OF THE PERSONAL COMPUTER USER

Robert Wickham of Vantage Research, Inc., in Los Altos, CA, estimated that between 8000 and 10,000 hobbyists now use a microcomputer or are in the process of constructing one. He forecasted that the number will increase by 10,000 to 15,000 annually over the next three years. At the end of this period, the hobby market will have lost some glamour, but a strong personal computer market will then exist.

The computer hobbyist, much like other electronic hobbyists who assemble Healthkits, attempts to save money, occupy spare time, and win satisfaction by completing the computer kit. A kit typically costs the hobbyist between \$200 and \$500. Assembled microcomputers start at \$1000. Most hobbyists stop after assembling the basic box because a computer that does tasks needs to be fitted with I/O equipment, which requires another \$2000 to \$4000, and more dedication. After a while, the kit builders will lose interest, Wickham predicted.



TODAY'S LOOK IN PERSONAL COMPUTERS. The Altair 8800B microcomputer kit from MITS is more sophisticated than its predecessors and sells for under \$900.

But all is not lost. As standard microcomputer boards are developed that have simpler interfacing and easy-to-use software, a second personal computing group will begin to emerge: the artist, model builder, or small businessman who can use a computer professionally, but does not want to assemble one. This group will set the stage for the so-called home computer, which will have little resemblance to today's computer. Such a personal machine will be portable, have a universal high level programming/problem solving

language, and come with canned programs, such as one for personal financial modeling. But, the appearance of such a machine is a long way off. First, an effective high level language needs to be developed, and partly because of this, a consumer computer will not appear until 1980.

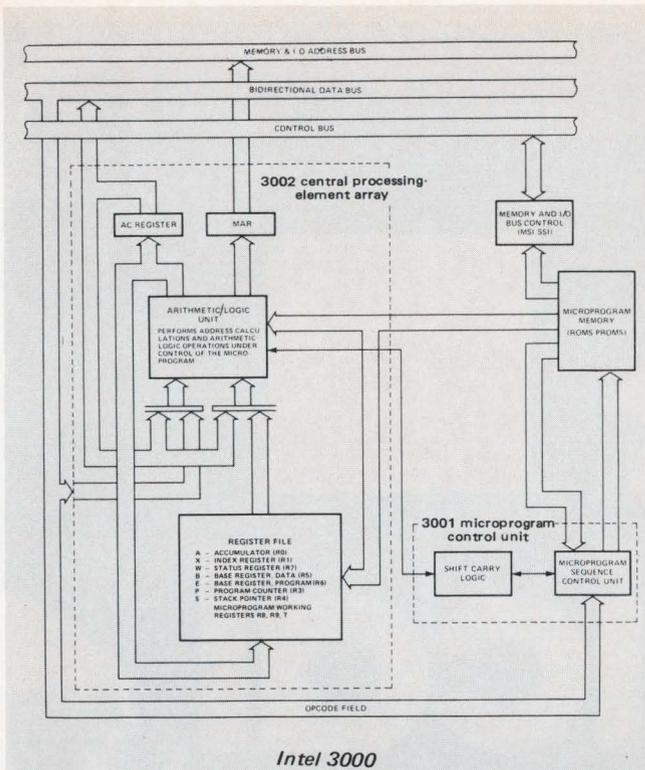
MICROPROGRAMMABLE BIT SLICES: AN OVERVIEW

When designing a high performance system, a microprocessor is not necessarily sufficient by itself to achieve the goal, and the traditional alternative, custom LSI design, can be prohibitively expensive. In such instances, bipolar bit slices that lie between the two extremes may be the way to go, said Peter Alfke of Fairchild Semiconductor. They enable the economies of scale typically inherent in a mass-produced product, and give better performance than does an MOS microprocessor. A bit slice, because of its microprogrammed architecture, has a flexible word length, variable instruction set, higher rate of microinstruction execution, and fewer parts than MSI/SSI technology. The hardware is also independent of software.

Intel introduced the two-bit slice in 1974. Since then, four other manufacturers have followed that approach but have gone one better by offering four-bit slices. It's difficult to choose a microprocessor, said Alfke, but even harder to choose a bit slice, which are variable by nature. Most bit slices, however, are designed with microinstruction rates between 5 and 10 MHz for high performance applications. All contain data path circuits, such as arithmetic logic units, accumulators and shifters that are expandable to any word length. Each bit slice also has a microprogram control or sequencer circuit that can address the microinstruction store in ROM or PROM, test flag bits, and execute conditional branches while allowing the nesting of subroutines.

Although most bit slices use Schottky TTL technology, Fairchild has a CMOS bit slice, and Motorola has an ECL LSI bit slice. Packaging and architecture also vary among the competitive offerings as follows:

- The Intel 3000 two-bit family contains a microprogram control unit in a 40-pin package, a central processing element in a 28-pin package, and five support circuits that perform look ahead carry generation, interrupt control, latched buffering and bidirectional bus driving.
- The Monolithic Memories four-bit processor slice in a 40-pin package has a 16-word two-port register and one-bit



Intel 3000

shifter. The microprogram control unit can address 512 words, and additional support circuits are coming.

- Similar to Monolithic Memories slice is another four-bit slice by Advanced Micro Devices, Inc. The slice also comes with a 16-word dual port register and one-bit shifter.

- The Fairchild family of Macrologic slices comes in two forms — as a Schottky TTL device to give fast execution or as a CMOS device to provide low power consumption. Macrologic parts are available in small 24-pin packages, but there are more of them: arithmetic register stack, data path switch, program stack, data access register, RAM, and more.

- The Motorola ECL-based 10800 family is the newest and fastest family of four-bit slices. The 48-pin unit is the only one available currently, and though it has more ALU functions than other circuits, it also has less storage capacity.

A UNIVERSAL MICROCOMPUTER DEVELOPMENT SYSTEM

Development system maker, Microkit, Inc., assumed that three or four microprocessors — the 8080, the 6800, and their variants — would eventually dominate the market when the company designed its “universal microcomputer development system,” according to Microkit’s Bruce Gladstone. Even so, the company had to decide on one of two basic micro design approaches to develop a universal system: single or dual processors.

Intel’s MDS system uses a dual processor. A host processor manages the peripherals, runs the software, and then routes the parameters to a second, so-called user microprocessor that executes the program in real-time. Each processor requires a minimum software set which can be generated by a cross assembler and a cross loader. The user processor executes object code only, so no speed penalty results and the development environment remains the same for all processors. However, the use of two processor boards is costly and this also renders memory mapping and partition-

ing more difficult. As a result, a new processor’s timing cycles will not necessarily be compatible with the time-shared bus requirements of the basic system.

Gladstone claimed that Microkit cuts down the hardware cost by using a single processor system. To make this system “universal,” the company had four options: rewrite all system software in the assembly language of the new processor, translate all system software automatically, interpret the instruction set of the original microprocessor on all new microprocessors, or write all code in high level language and write a compiler or cross assembler for each new microprocessor.

Rewriting software in assembly language for each microprocessor requires time, but it is a worthwhile expenditure if many microprocessors are to be used. Moreover, assembly language requires less core and executes faster than higher level languages. Using a translator for system software takes less time, but program execution slows down — by as much as one-third that of the normal rate in the case of converting 8080 software to 6800. In addition, the software consumes up to twice as much memory.

To interpret the machine’s original instruction set results in even slower execution (one-sixth) and requires an additional 2K of memory over assembly language programming. High level language programming requires even more time and memory.

Since Microkit’s design goal was to emulate two processor families, the company reprogrammed each microprocessor — a “great but not overwhelming” task, Gladstone said. The company wrote 6800 code on an 8080-based development system. About 15 percent more code was necessary, and execution time was slower than it would have been by using the 8080 code. “Overall,” said Gladstone, “the approach saved memory and processor time over the other single processor methods.”

MICROPROCESSOR VS. LSI COMPUTER SYSTEMS

Microprocessors have revolutionized industrial measurement and process control and other special purpose applications by reducing the component count and the engineering turnaround time to produce hardware designs. The processor-on-a-chip, however, has not led to any similar revolution in data processing, said John Stidd of Four-Phase Systems, Inc., in Cupertino, CA. A 16-bit CPU, for example, accounts for about 4 percent of a minicomputer’s \$15,000. No micro-

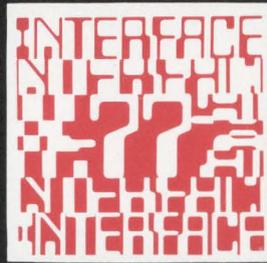
	16-bit LSI Processor (μsec)	8-bit Microprocessor (μsec)
Load 16 bits from memory	4	20.8
Store 16 bits to memory	2.7	20.8
Register-to-register copy ¹	3.3	6.5
Register add ¹	3.3	9.1
Shift register left one bit ¹	3.3	5.2
Conditional branch	2.7	13.0

¹ A 16-bit operation on 16-bit mini NP/80 is compared with an eight-bit operation on the microprocessor.

LSI FOR DATA PROCESSING. *Faster instruction times for the 16-bit LSI mini, compared with an eight-bit microprocessor, support Stidd’s contention that minis go better with LSI technology.*

processor or other LSI technology advances, for that matter, can have much of an effect on a system where more than 90 percent of the cost is in peripherals. Although a microprocessor can bring down the CPU cost, the eight-bit architecture limits a mini’s performance in most cases. LSI, on the other hand, will be able to increase a computer’s performance at no extra cost. For example, the \$2500 that

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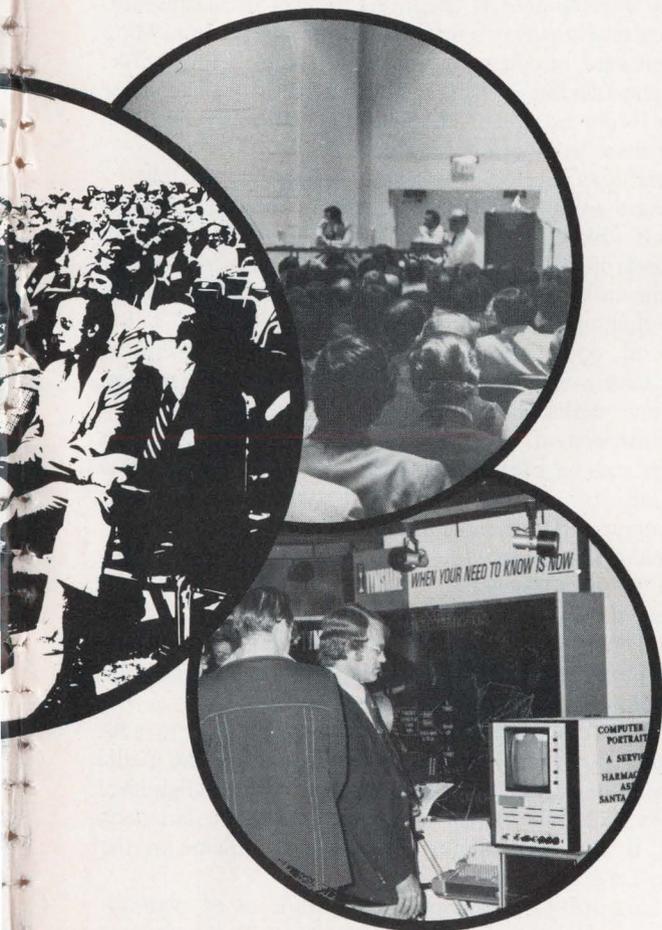
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buys a 16-bit LSI mini with 6K memory today will eventually buy a 32-bit LSI processor with decimal arithmetic, hardware multiply/divide and memory.

Data processing designers are better off to distribute functions rather than try to put everything on one chip. LSI circuits can be used to do this job, as in high speed sub-arithmetic logic units. Page map control chips can support virtual memory management. DMA chips can provide interface to I/O device controllers. When designers use LSI chips correctly, parallel operations and CPU pipelining can boost minicomputer performance significantly.

BATTERY BACKUP FOR MINIS

MOS memories have made battery backup an integral part of most minis. Choosing an AC backup is not just a matter of looking at cost and reliability said Hewlett-Packard's Kenneth Check. Users should consider other characteristics as well before deciding on the type of battery: How easy can that battery be interfaced to the AC supply? How must the battery be charged?

Check then discussed some different types of batteries and their features. Primary non-rechargeable batteries are inexpensive, but they have a short shelf life and are difficult to connect to a mini because they can't be "floated" online to the power supply — they must be switched in.

The nickel cadmium battery, a secondary type, works off a simple charger, and though many minis use this type, they have several drawbacks. Like the primary battery, the Ni-Cad battery must be switched into the system, because the battery draws current even after it is fully charged. This can result in overcharging and overheating. Ni-Cads, if not used, lose capacity to store energy, so they must be discharged every so often and then recharged.

Lead-acid, gel-type batteries do not have Ni-Cad's drawbacks. They cost less than one-third that of a Ni-Cad; they

can be "floated" online; and users can readily check the charge. However, gel-types have pitfalls too. They outgas and lose water because they can be sealed only to 4 psi. Outgassing can occur during normal charging and it accelerates during overcharging.

The ideal battery backup, according to Check, is the sealed lead-acid type. Such a unit is sealed in a steel can to about 60 psi. It can withstand moderate overcharge without outgassing. And it costs only a little more than the gel type. Sealed lead acid batteries are easily charged by means of a constant voltage source. But one drawback does exist: Because the charge that a lead-acid battery accepts depends on temperature, this type requires a temperature-compensated charger to prevent over- or undercharging.

MICRO SOFTWARE DEVELOPMENT TOOLS

Software development is becoming an ever increasing portion of an investment in a microcomputer application. Mini-based software, of course, has been around for a long while, said Duane Dickhut of Digital Equipment Corp., but micro software tools are still in their infancy. The user needs to evaluate these from scratch.

Preferably, a development system should be "flexible;" it should have an operating system, editor, assembler and debugger. If disk-based, it should have file management. In some cases, high level languages can help, too. All of this makes the software system easier to program and adaptable to more than one microcomputer.

A good operating system manages system resources without taking up a programmer's time. With an alternative, stand-alone development programs — a programmer must manage the system, and this can be very costly. A macro assembler can be useful also. With it, a user can assemble instruction sets on microprocessors by writing a set of macros, creating a source file in the target machine language, and passing the source file along with macro definitions through the macro assembler.

Buyers should watch the type of debugger. One breakpoint in a debugger is necessary and additional breakpoints help the programmer. Symbolic debuggers are also easier on the programmer, but they do take up memory.

A good file manager should not only be able to add, delete and copy files, but handle bad sectors on the media by mapping them unavailable to other software. High level languages such as Fortran or Basic give users a fall back strategy if the programmers encounter problems in the assembly language program.

The ideal software system can require a lot of memory. So users must weigh the software attributes with the amount of memory they require. If the resident software takes 4K, three or four times that can be required to assemble a program.

After users examine the software inventory, it helps to step through a simple program (edit, assemble, link, debug) to get the feel of the software tools. Is the command language simple and logical? Is it consistent throughout all programs? Are error messages understandable or do they require cross referencing?

Microcomputer software development prices range from \$3000 to \$10,000. An inexpensive system can cost more in the end if it takes a lot of programmer time due to poor design. If designers are developing software for more than one type of microprocessor, one good system can be less expensive than three separate systems. And a user saves money in the end if he buys a little bit more rather than a little bit less.

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MINI/MICRO MEMORIES

DEC 11/70-Compatible Core: I. ARM-1170 memory, available in 128-kilobyte increments, can be used to expand PDP-11/70 computer memory to its 4 megabyte capacity. With four-way interleaving, the effective cycle time is 350 nsec, compared with 800 nsec for the basic ARM-1170 memory or 1000 nsec for the DEC memory. One megabyte of ARM-1170 memory occupying 22.75 inches of rack space within the PDP-11/70 cabinet, sells for \$48,500 in single quantity. *Ampex Corp., El Segundo, CA.*

Circle No. 190 on Inquiry Card

DEC 11/70 Compatible Core: II. The ECOM 70 chassis may house up to 16 memory modules and one control card. Capacity varies from 64kilobytes up to 512KB in 64KB increments. Full read/write cycle time is 800 nsec. The companion remote programming box (RPB) contains reconfiguration controls for address range selection, a downgrade switch to disconnect non-DEC memory from the CPU, AC power controls, and cooling fans. The ECOM 70 including the remote programming box, is priced at \$7100 in single quantity. The basic 64KB expansion kit costs \$4400. *Standard Memories, Newport Beach, CA.*

Circle No. 191 on Inquiry Card

LSI-11 Core. Designed to plug directly into the DEC LSI-11 micro-computer, the MM-1103 8Kx16-bit core memory system has a 400-nsec access time and 1.2- μ sec cycle time. The MM-1103 can be installed in

any location in the DEC LSI-11 chassis. Each module contains timing control, decode, drive circuits, address registers and data registers. Price is \$795 in OEM quantities. *Micro Memory, Inc., Chatsworth, CA.*

Circle No. 192 on Inquiry Card

320-kilobit RAM Card. The Model NS3000-1 is a 320-kilobit RAM system, organized into 16K 20-bit words on a single pc card. Standard configurations are 16Kx16, 18, or 20 bits, but individual 8-bit, 9-bit, or 10-bit byte structures are available as options. Other options include parity generation, parity checking, and "data available reset," used to release the data bus in a shared system. Access time is 280 nsec, and the read or write cycle time is 430 nsec. The price per card is \$1050 in quantity. *National Semiconductor Corp., Santa Clara, CA.*

Circle No. 194 on Inquiry Card

64-Bit Bipolar RAM. The 64-bit bipolar memories are organized into 16 four-bit words. Available with either open collector output (DM74LS289) or tri-state output (DM74LS189), these RAMs are intended for scratch-pad applications in computers and minicomputers. The 35-nsec memories requires 25 mA maximum input power. Commercial versions cost \$3.75 each and militarized versions cost \$8.00 each in lots of 100. *National Semiconductor Corp., Santa Clara, CA.*

Circle No. 195 on Inquiry Card

TI'S μ P ADD-ONS

Three new pre-assembled add-on learning modules, including a controller, memory and input/output, along with a previously announced microprogram-module, complete the TI's user-paced system for understanding microprocessors. Each module has its own instruction manual, battery, charger and interconnecting cables. Module prices range from \$109.95 to \$189.95. *Texas Instruments, Inc., Dallas, TX.*

Circle No. 177 on Inquiry Card

DISK PACK SUBSYSTEM

The Tri-Star Nova-compatible desk subsystem includes a controller, drives, power supply, interface, and all the necessary cables and mounting hardware. Each controller handles from one to four drives for a capacity range of 40 to 300 MB. Price for an 80-MB system is \$17,000. *Tri-Star Computer Systems, Inc., Moorestown, NJ.*

Circle No. 153 on Inquiry Card

I/O BUS CONVERTER

Computer Products complete family of analog and digital I/O measurement and control equipment can be interfaced to DEC's LSI-11 or 11/03 with the RTP7410/65 I/O bus converter. Price of the converter, including one bus cable termination card, is \$300. *Computer Products, Inc., Ft. Lauderdale, FL.*

Circle No. 181 on Inquiry Card

PROM PROGRAMMER

The Series 92 Prom Programmer uses plug-in personality modules to adapt to various MOS or bipolar PROMs. It can program, list, duplicate and verify PROMs. Via 20 mA current loop interface, it can operate with a teleprinter, development systems or terminals. Users buy a master control module for \$995 and add personality modules ranging from \$350 to \$550. *Pro-Log Corp., Monterey, CA.*

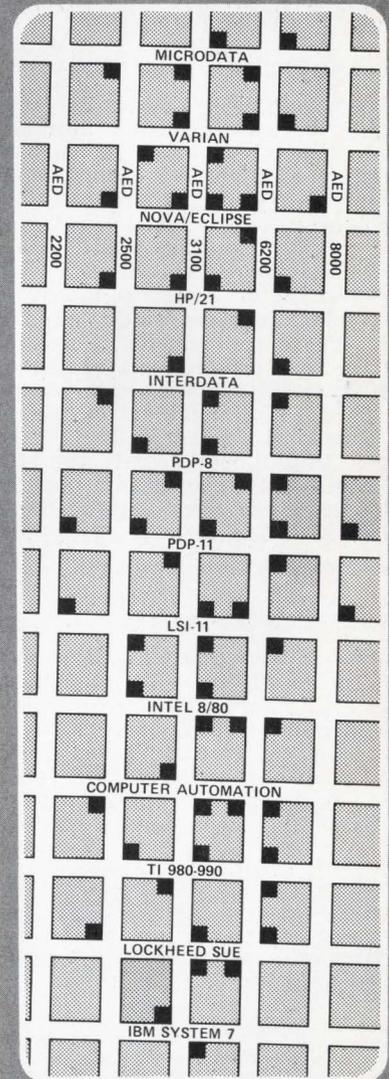
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Deep in California lies Disk City, a rapidly-growing metropolis offering the world's most complete selection of rigid and floppy disk systems. The streets are computers and the avenues plug-compatible disk controllers.

Cost-effective disk systems appear at no less than sixty-six locations. These systems range in size from the tiny hard-sectored AED 2500 floppy to the AED 8000 skyscraper, which fully emulates RP11-C/RP03 or 4231/4231A. Middle range units include the soft-sectored floppies: IBM-compatible 3100's and double-density 6200's, and the RK-11/RK-05 compatible 2200 Cartridge Disk System.

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CIRCLE NO. 27 ON INQUIRY CARD

FLOPPY FOR PDP-11

The FD11 floppy disk system which is hardware, software, and media compatible with Digital Equipment Corp.'s RX11, contains Write protect switches, Unit select switches, a 6-msec track-to-track access, single PDP-11 Unibus load for up to four drives, PROM self-diagnostic, and a bootstrap loader.



One single quad card holds the interface, formatter, PROM and other interface logic. Single quantity price is \$2500. *Charles River Data Systems, Inc., Waltham, MA.*

Circle No. 182 on Inquiry Card

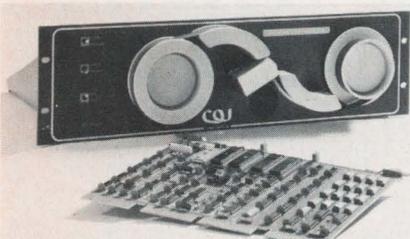
DATAPoint LINE PRINTERS

Using the rotating belt technique, Datapoint's impact 132-column printers print upper- and lowercase text at speeds up to 240 lines per minute. The model 9212 prints 120 to 240 lines per minute and the model 9214 prints 230 to 240 lines per minute. Either printer may be ordered with an option that restricts the printer to uppercase text only, raising the printing speed to 340 lines per minute. Standard sprocket-fed one-to-six-part paper as narrow as 1-3/4 inches can be accommodated. The printers interface directly to Datapoint's Cassette 1100, Diskette 1100, 2200 or 5500 models. The 120-240-lpm model costs \$8640; the 230-240-lpm model costs \$11,800. *Datapoint Corp., San Antonio, TX.*

Circle No. 158 on Inquiry Card

LINC TAPE FOR 11/03

Computer Operations Linc Tape system for the 11/03 is DECTape compatible. A Linc Tape driver for DEC's RT-11 operating system supports Macro, Edit, Linker, Fortran IV and Basic. The controller supports four 148K-word drives and occupies a quad slot in the 11/03. An optional dual capa-



city mode increases drive capacity to 296K words. Price of drive and controllers is \$1995. Additional drives are \$1395. *Computer Operations, Inc., Lanham, MD.*

Circle No. 164 on Inquiry Card

LAB AUTOMATION SYSTEM

The PEAK-11 laboratory automation system acquires and analyzes data simultaneously from as many as 16 different analytical instruments that produce data outputs with peaks. Typical applications include gas and liquid chromatographs, AutoAnalyzers, atomic absorption, ultraviolet-visible, and infrared instruments. Both a cartridge system and a floppy system are based on DEC's 11/34 and contain 32K words of memory. PEAK-11 runs under DEC's RT-11 real-time operating system, and uses Basic. Prices start at \$33,905. *Digital Equipment Corp., Maynard, MA.*

Circle No. 138 on Inquiry Card

MICROPROCESSORS

16-bit Bipolar. The RDS 605 is a 16-bit general purpose microprogrammed microprocessor consisting of four bipolar LSI four-bit microprocessor units, the associated bipolar LSI PROMs and standard TTL support devices. N-channel LSI memory modules with 800-nsec cycle times are produced in 32K to 64K byte increments. *Randal Data Systems, Torrance, CA.*

Circle No. 136 on Inquiry Card

250-nsec 8-bit. The Model 8X300 has a simplified double operand instruction set along with eight 8-bit working registers, separate instruction address, instruction and I/O data busses, an on-chip oscillator, TTL-compatible input and output, a tri-state I/O data bus, and a dedicated program counter. These features, combined with the partitioning of the address/data bus into right and left banks, make it possible for 8-bit parallel data to be rotated or masked, to undergo arithmetic or logical operations, and then to be shifted and merged into any set of from one to eight contiguous bits at the destination — all in one 250-nsec cycle. Price is \$86.75 in quantities of 100. *Signetics, Sunnyvale, CA.*

Circle No. 137 on Inquiry Card

LSI-11 DISK SYSTEM

The Xylogics Phoenix 145 is an LSI-11 disk-based system packaged in a rack-mountable chassis with an operator's control panel and a nine-slot backplane. It can be configured to support up to 20 megabytes of disk, four terminals, a line printer and a 28K-word LSI-11 processor. It has a larger disk capacity than DEC's 11V03 because the disk controller interfaces directly to the LSI-11 without the Unibus adapter. Price of a 5-megabyte system is \$12,650. *Xylogics, Inc., Burlington, MA.*

Circle No. 144 on Inquiry Card

A/N DISPLAY FOR μ P

The DE/200 Random Access Micro-Display which has an interface, drive and refresh electronics and is compatible with bus-oriented systems. The 20-character display tube uses fluorescent technology with a starburst character design. Displayed characters are uniformly bright, claimed readable from 20 feet away under high ambient light conditions. Price of the DE/200 Display with all interface and refresh electronics is \$250 in sample quantities. *Digital Electronics Corp., Oakland, CA.*

Circle No. 155 on Inquiry Card

DESKTOP μ C

The MKII microcomputer is actually a typewriter terminal with 600,000-character dual floppy disk. There are two RS-232 serial I/O ports. The software operating system provides file



management and utilities for data transmission/reception. A \$350 assembler and \$500 Basic are optional. Price with 8K-memory is \$4295. *Data Terminals and Communications, Campbell, CA.*

Circle No. 178 on Inquiry Card

THREE CAROUSEL PRINTERS

Carousel printers feature a number of paper handling devices and a power front-forms insertion mechanism, which automatically feeds ledger cards, single sheets and bottom-glued multipart forms into the platen. The Carousel 350 with a split platen can accommodate two paper-handling devices simultaneously. For example, a user can combine a journal tape spool and a front forms-insertion device to handle ledger cards. Either the ledger card or the tape can be printed and advanced independently of one another — either under computer or operator control. The Carousel 310 provides a single platen, enables 4800 points/inch² plotting capability, and can accept any forms-handling device in the line — from a pin-driven tractor accessory for standard perforated computer paper, to a front insertion feeder for multicarbon business forms. The Carousel 320 computer console is a complete computer input-output printing terminal, which includes a 120-character per second papertape reader and plotter. Single-quantity prices are \$2995 for Model 310; under \$3495 for Model 320; and \$3995 for Model 350. *Perkin-Elmer Data Systems, Randolph, NJ.*

Circle No. 196 on Inquiry Card

BOARDS AND BOXES

Z-80-based μ C. Quay 80AI uses Zilog's Z-80 microprocessor. The Z-80 is compatible with Intel's 8080, but has a larger instruction set and faster throughput. The board has a ROM with monitor for utilities and an 8K RAM for user programming. RS-232, Teletype and parallel interfaces are standard. Price of kit is \$450; assembled, it's \$600. *Quay Corp., Freehold, NJ.*

Circle No. 125 on Inquiry Card

Portable 6800 μ C. The DE68 stand-alone microcomputer comes in an attache case. Besides the processor board with 1K RAM, there's a 96-character keyboard, 100K-byte cassette unit and a 20-column alphanumeric display. A hard copy printer is optional. Memory is expandable to 32K. The Debug operating system in 5.5K bytes of PROM has a mnemonic translator which allows users to write and debug software in 6800 assembly language mnemonics. Price of DE68 with optional printer is \$3500. *Digital Electronics Corp., Oakland, CA.*

Circle No. 126 on Inquiry Card

SC/MP Evaluation Kit. Preamsembled SC/MP eight-bit microcomputer boards carry all the firmware and components to evaluate National Semi's microprocessor. Each 4x5-inch board has an SC/MP microprocessor, 4K-bit ROM preprogrammed with the Kitbug program, two 1K RAMs for application programs, a voltage regulator, an eight-bit data buffer, a 1 MHz timing crystal and a 20 mA current loop interface. Price of the SC-8 board in quantities of 10 is \$125. *National Semiconductor Corp., Santa Clara, California.*

Circle No. 127 on Inquiry Card

6800-Based μ C: I. The completely assembled Micro-68 uses a Motorola/AMI/Hitachi 6800 microprocessor. For \$430, it contains a power supply, 16-button keyboard, six-digit

LED display and 128 words of RAM. With the Mon-1 Bug PROM, users can load programs, edit and insert break points. Memory is expandable to 64K with edge connectors. *Electronic Product Associates, Inc., San Diego, CA.*

Circle No. 128 on Inquiry Card

6800-Based μ C: II. This 10x10-inch board has a 6800 processor, 4K-byte RAM, 1K-byte EPROM, four peripheral interface adapters and address/data drivers for \$595, without a power supply. With other boards such as power, PROM, PROM programmer and general purpose interface, users can assemble a full hardware/software development system. *Revenue Control Sciences, El Segundo, CA.*

Circle No. 129 on Inquiry Card

Eight-bit-Bipolar μ C. The single-board microprogrammable M-82 lets a user emulate an existing eight-bit instruction set or define his own instruction set. Via the System 8 programmer's console, the user can also microcode standard console functions for the system or tailor the interface to his needs. The M-82 has a micro-assembler program written in Fortran available on the Dialcom time sharing network or on tape or cards for an extra charge. Price of the 4.5x4.5-inch microcomputer card with microprogramming manual is \$285. *Warner & Swasey Co., Edina, MN.*

Circle No. 130 on Inquiry Card

Bipolar Evaluation Kit. This AM 2900-based kit helps users learn microprogramming. Designers can write and execute 32-bit microinstructions to control Advanced Micro Devices' four-bit slice. The kit has 40 ICs, LEDs, switches, decoupling capacitors, PC board and manual for \$289. *Advanced Micro Devices, Inc., Sunnyvale, CA.*

Circle No. 131 on Inquiry Card

FLOATING POINT FOR 8080

This hardware floating point unit for 8080-based microcomputers plugs directly into the Altair and Imsai card holders. Besides the usual add, subtract, multiply/divide, the processing unit can be expanded with additional ROMs to perform sine, cosine, tangent, decimal and natural logs and antilogs, arctangent, square-root, and constants. Additional ROMs allow 256-digit decimal calculations. Price of a kit in single quantity is \$350. *Linker/Wolf, Beverly Hills, CA.*

Circle No. 156 on Inquiry Card

FLOPPY FOR INTEL SBC

A new interface card for iCOM's Frugal Floppy plugs into a slot in the Intel single-board computer card cage. It contains a software driver PROM and iCOM's FDOS-II software with macro assembler and string oriented text editor. Software features include named variable length files, auto file create, open and close, multiple merge and delete, and auto disk repacking. The Floppy Disk System with floppy, controller and interface card is priced at \$1495. *iCOM, Inc., Canoga Park, CA.*

Circle No. 171 on Inquiry Card

SYSTEM/32 PRINTERS

System/32 can print faster and in two directions with two new printer offerings. A 285-line per minute printer or 120-character per second bidirectional are now among System/32 options. For bankers, the IBM MICR reader can be added, which reads up to 750 documents per minute. *IBM Corp., Atlanta, Georgia.*

Circle No. 145 on Inquiry Card

EPROM ERASER

The S-52T ultraviolet lamp, featuring timer assembly and holding tray, erases up to 16 EPROM chips in about 7 minutes. Another lamp, the UVS-54T, also with timer assembly and holding tray, can erase up to eight chips in 14 minutes. *Ultra-Violet Products, Inc., San Gabriel, CA.*

Circle No. 179 on Inquiry Card

PERIPHERAL INTERFACE SAMPLER

The Sampler contains 13 LSI circuits and technical information to help engineers with peripheral interface design. It's packaged in a looseleaf binder containing complete technical data for each circuit. Price is \$99. *SMC Microsystems Corp., Hauppauge, NY.*

Circle No. 180 on Inquiry Card



PDP-11 USERS

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A TCU-100 will tell you what month and day it is. It will tell you the time of day. It doesn't have to be initialized every time you turn the computer on; you don't have to service interrupts every 60th/second, nor update counters. The TCU-100 is shipped to you already working, pre-set to your local time. Just plug it into a peripheral slot, address it, and the date (month and day), time (hours and minutes), and seconds are available. While your computer is off the TCU-100 will continue to operate on its own rechargeable battery power. If this isn't enough, the TCU-100 can also be set by the user to interrupt at a particular date or time or at intervals which are integral multiples of 1/2048 seconds. Once you have it, you'll wonder how you ever managed without it. There's nothing comparable on the market at this price.

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The Human Resources System with the Nomad data base helps companies compare their hiring practices to local census information in order to keep up with Equal Employment Opportunity Commission Affirmative Action requirements. The online system is said to be unique since it can match customer data with both the 1970 census data and the 1975 EEOC compliance data, broken down by location, industry, and job type. *National CSS, Inc., Norwalk, CT.*

Circle No. 216 on Inquiry Card

APL FOR HP 3000

APL/3000, featuring virtual workspaces, allows users to define functions in APLGOL, an extension to the APL language. APL/3000 is implemented as an incremental compiler, not a simple interpreter; compiled code is preserved and used repeatedly without recompiling as long as tests for appropriateness are met. The full text editor/function editor uses English-like commands. *Hewlett-Packard Co., Palo Alto, CA.*

Circle No. 203 on Inquiry Card

DISK ALLOCATION

ALLOC I, imported from Germany by C-S, automatically allocates disk space for permanent and temporary files eliminating the problems of manually mapping and maintaining disk files in a multi-partition environment. The disk manager can save 10 to 40 percent of disk space, according to the company. ALLOC I consists of three programs, which set up dates to protect disk space, free disk space without a service request being issued and give the amount of available space on a disk pack. Price of ALLOC I is \$3800. *C-S Computer Systems, Inc., New York, NY.*

Circle No. 211 on Inquiry Card

DATAPoint COMMUNICATIONS

MULTILINK allows Datapoint 1150 intelligent terminals along a multidrop line to perform all necessary local processing tasks, including intelligent data entry and report generation, and to post inquiries to a host computer whenever data is not available from the local data base. Inquiries to the host computer need only be made when necessary. If the requested data is not available from the host computer, the host can request the information from the other terminals on the line. This data transfer can occur totally transparent to the user. MULTILINK is an enhancement of Datapoint's DATABUS business programming language. *Datapoint Corp., San Antonio, Texas.*

Circle No. 214 on Inquiry Card

8080 DOS AND BASIC

A floppy-based disk operating system and compiled Basic are available for the Intel 8080. The software packages require less than 16K bytes of memory and one floppy disk. Up to eight disk drives can be accommodated and as many as four open files can be manipulated. File data can be accessed sequentially or randomly. *Intelligent Computer Systems, Mountain View, CA.*

Circle No. 210 on Inquiry Card

8080 INTEL-LIGENTSIA

Development Software I. Tychon's Editor (TED), Assembler (TAS) and debug programs can be run in microcomputers with at least 4K of read/write memory. Programs are available on paper tape or in 1702A or 2708 type PROMs. Each software package includes complete documentation on its use and information about changes for different I/O formats. Listings for each program are also available. Prices are: Editor/Assembler—\$25 (Tape), \$40 (Listing); D-BUG—\$10 (Tape), \$40 (Listing); Documentation package—\$5. *Tychon, Inc., Blacksburg, VA.*

Circle No. 204 on Inquiry Card

Development Software II. RDP2 includes an editor, assembler, and monitor preprogrammed on four 2708 PROMs that plug directly into the Intel SBC 80/10 microcomputer board. The package price of \$995 includes the four PROMs, complete documentation, periodic software updates, and a warranty. *Extensys Corp., Sunnyvale, CA.*

Circle No. 205 on Inquiry Card

Real Time Executive. Automation's Real Time Executive System schedules and distributes system resources on a priority basis to as many as 64 concurrently executing tasks. RTX-80 features interrupt driver device handlers, real time clock control, multi-task scheduling, task stack management, and power-up initialization. Services available to a task include scheduling, suspension, time delay, termination, saving and restoration of the environment, device I/O control and calendar maintenance. *Automation, Inc., Houston, TX.*

Circle No. 206 on Inquiry Card

Fortran. FORT//80, a resident Fortran compiler designed for the Intel 8080 microprocessor, allows the microcomputer user to compile Fortran programs directly on his inhouse development system. FORT//80 occupies less than 12K of memory and is priced at \$750. *Unified Technologies, Inc., Islington, Ontario.*

Circle No. 207 on Inquiry Card

MULTILEVEL μ P LANGUAGE

The standard microFORTH package, which sells for \$1000, includes a disk operating system, macroassembler, the FORTH compiler and interpreters, a text editor and interactive debugging aids for the Intel MDS 800 and RCA CDP 1800 development systems. Documentation includes a self-teaching primer and technical manual. Extended math, BCD I/O and other optional functions are available. microFORTH runs with a minimum of 6K bytes memory, diskette and terminal. *FORTH, Inc., Manhattan Beach, CA.*

Circle No. 201 on Inquiry Card

CONTROLLER BASIC

Executed under Computer Automation's Real-Time Executive, the Controller Basic programming language permits transfer of data, commands and status information to and from input/output devices not commonly associated with the use of Basic (standard Basic normally supports only a command I/O device). The user can develop programmed routines to accept and service randomly-timed interrupts. Controller Basic requires 8K words of memory for execution. It provides arithmetic and trigonometric functions, multidimensional arrays, matrices, string and relational operations. Price is \$400, including documentation. *Computer Automation, Irvine, CA.*

Circle No. 202 on Inquiry Card

MANUFACTURING MANAGEMENT

MANMAN consists of six interacting modules that run on Hewlett-Packard minicomputers for inventory control, bills of materials processing, material requirements planning, purchasing, work-in-process, and product costing. The modules are integrated via a common data base which uses IMAGE, Hewlett-Packard's data base management software. Total package cost is \$35,000. Lease plans are available. *ASK Computer Services, Inc., Los Altos, CA.*

Circle No. 209 on Inquiry Card

SYSTEM/32 APPLICATIONS

IBM's new System/32 application packages include one for distributors, one for lumber dealers and one for food distributors. Each consists of billing, inventory control, accounts receivable, and sales analysis modules that can be installed separately or in any combination to assist distributors. The management packages operate with the recently announced modular financial applications for distributors—accounts payable, general ledger, and payroll (Distribution Financial Accounting System). *IBM Corp., Atlanta, GA.*

Circle No. 208 on Inquiry Card

MATERIALS HANDLING SYSTEM

The Interlake microcomputer, described in this brochure, performs alone or with slave computers mounted on fully automated Courier cranes to handle crane and transfer car control, conveyor control, inventory control, diagnosis of system malfunctions and various memory transactions. *Interlake, Inc., Chicago, IL.*

Circle No. 252 on Inquiry Card

MINI-MASTER STATION

Westinghouse's four-page brochure on its Mini-Master Station for electric transmission and distribution systems discusses the advantages, operation and use of the station, which offers two-state control capability, incremental control, system supervision and telemetering. *Westinghouse Electric Corp., Pittsburgh, PA.*

Circle No. 284 on Inquiry Card

VARIAN TRAINING

Varian's training courses, held at Costa Mesa, CA, and Brussels, Belgium, are the subject of this 32-page brochure. Software courses provide training in assembly and higher level languages; hardware courses cover all Varian computers and many of the standard peripherals. *Varian Data Machines, Irvine, CA.*

Circle No. 274 on Inquiry Card

PAPER TAPE READERS

Described in this four-page brochure are three series of Summit-Infranor paper tape readers, each available in reader panel, reader fan fold and reader/spooler models. All models have capstan drive, use photoelectric sensing and handle five, seven or eight-level tape. *Summit Engineering Corp., Bozeman, MT.*

Circle No. 279 on Inquiry Card

STORAGE TECHNOLOGY NEWSLETTER

Record Times, an Emerson Electric publication, focuses on new system approaches for storage devices. Featured in the first edition of the quarterly newsletter is a column by L.C. Hobbs on low-cost storage devices. *Emerson Electric Co., Santa Ana, CA.*

Circle No. 287 on Inquiry Card

MINICOMPUTER COMPONENTS

HP's 21MX-K Series of miniprocessor components are the subject of two brochures. One four-page catalog describes 21MX components which make life easier for the OEM. An eight-page color brochure summarizes 21MX applications. *Hewlett-Packard Co., Palo Alto, CA.*

Circle No. 262 on Inquiry Card

CONFERENCE PROCEEDINGS

1976 NCC. Over 130 papers from the AFIPS-sponsored National Computer Conference are included in this hardbound 1082-page volume. Copies are \$50 and can be ordered from *AFIPS Press, 210 Summit Ave., Montvale, NJ 07645.* Members of AFIPS Constituent Societies receive 50 percent discount if order is prepaid.

COMPCON '76. the 392-page digest of papers from this fall's IEEE computer society conference goes for \$15 for IEEE members, \$20 for nonmembers. Focus of this year's conference was microcomputers and microprocessors. For copies, write *IEEE Computer Society, 5855 Naples Plaza, Suite 301, Long Beach, CA 90803.*

LSI-11 APPLICATIONS

New application notes explain how LSI-11 microcomputer assemblies are being used in a variety of applications. Three notes involve case histories in such diverse fields as voice-input data terminals, ultrasonic biomedical scanners, and visual displays, while the fourth explains the manufacturing testing procedures of LSI-11 units. *Digital Equipment Corp., Marlboro, MA.*

Circle No. 251 on Inquiry Card

POWER SOURCE SELECTION

Choosing a power source is easier with this four-page short form selection guide, which describes nearly 150 off-the-shelf line operated power supplies and DC/DC converters. Two charts — one for line operated supplies and one for converters — give basic specifications, salient features, extended prices and package/pinout index. *Semiconductor Circuits, Inc., Haverhill, MA.*

Circle No. 259 on Inquiry Card

OEM CALCULATOR

A four-color illustrated brochure describes how to use the Model 31 programmable calculator as an OEM component for analytical systems in such areas as industrial, laboratory and medical applications. The brochure explains the 31's functional characteristics and interface capability. *Tektronix, Inc., Beaverton, OR.*

Circle No. 264 on Inquiry Card

MARKET RESEARCH SOFTWARE

General advantages and features of the Marketab III software package for marketing research are discussed in this eight-page brochure. Price for the package starts at \$375 per month. *Mnemonics Inc., Norwalk, CT.*

Circle No. 256 on Inquiry Card

PROCESS CONTROL TRAINING

Foxboro's nine portable instrumentation schools that provide onsite training in all phases of process control instrumentation are detailed in this eight-page brochure. *The Foxboro Co., Foxboro, MA.*

Circle No. 276 on Inquiry Card

MAG HEAD MAINTENANCE

A four-panel poster describes the care and handling required for magnetic recording heads used in digital disk drives, including Infomag's family of 4040, 6060 and 8080-bpi recording heads and 5636-bpi Winchester heads and carriages. Twelve photos illustrate "do's" and "don'ts"; other photos show proper packaging for shipping when the heads or head-carriages are sent for service or replacement. *Information Magnetics Corp., Goleta, CA.*

Circle No. 265 on Inquiry Card

DATA COMM TEST

Test and interface equipment for network evaluation or data communications testing is described in this catalog. Featured are the company's Intershake series including the Interview CRT display, Data-Tech 9600 test equipment, and the Data-Patch series. *Atlantic Research Corp., Alexandria, VA.*

Circle No. 271 on Inquiry Card

WORD PROCESSING

The Powertype Word Processing System, which is based on a daisy wheel printer, that types at 450 words per minute and that has only 12 moving parts, is described in this brochure. System features are font wheels for 22 different type faces, cartridge ribbon loading, variable 10 or 12 pitch, and single or dual cassette units. The Powertype Word Processing System's terminal has full communications capability and an envelope mode of operation where continuous form envelopes are automatically aligned. *Bedford Computer Systems, Inc., Bedford, MA.*

Circle No. 288 on Inquiry Card

SUPPLY CATALOG

Computer supplies from computer tapes and floppy disks to CRT disks are described in this 64-page catalog. *Edward Ochman Systems, Fairfield, Connecticut.*

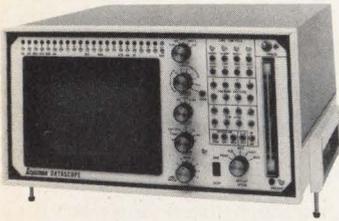
Circle No. 268 on Inquiry Card

DA CATALOG

Data Translation's complete line of data acquisition modules and analog I/O systems for mini/microcomputers is described in this 16-page catalog. Included are block diagrams, pricing and ordering information. *Data Translation, Inc., Natick MA.*

Circle No. 258 on Inquiry Card

DATASCOPE
a new diagnostic tool for
data communications systems



Operates on-line to:
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PINPOINT SYSTEM
FAILURES
DEBUG SOFTWARE

- Provides CRT display of every data link character, sent or received
- Simultaneous full duplex data stream tape recording
- Accepts all codes, line disciplines and speeds up to 9600 bps
- Switch selectable alphanumeric or hexadecimal display
- Monitors full and half duplex circuits
- Printed record available on standard teletype printer
- Designed for operating personnel, programmers and engineers
- Compatible with EIA Interface RS-232
- Lamp display of all EIA Interface signals
- Complete electrical isolation from monitored channel
- Lightweight portability . . . single compact unit
- Simple, straight forward connection



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