SEPTEMBER 1976

mini-micro systems

DATA ACQUISITION a Technology Profile

Beginning two new series...

MASTERING THE MICRO

A MINI-MICRO STAR

...and a news feature department:

Old Minis Never Die

Hands-On Experience ... at $24 an hour

We started working on disc packs 75 years before they invented the computer. But then we've always been slightly ahead of our time.

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.

Our extensive experience and expertise also allows Nashua to provide the full range of products within a particular drive's configuration requirements (as, for example, our fast turnaround on the family of disc packs for the latest CDC series drives). And our capabilities keep us on top of the market supplying a complete selection of dependable magnetic media for all current configurations specified by drive manufacturers.

But Nashua even goes beyond that. We offer a planned program specifically designed to service the needs of both O.E.M.'s and systems houses. That means Nashua is geared to working with you during the design stage of any new memory modules to fit your own special requirements.

You'll find that Nashua computer products meet or exceed all specifications in all instances. They come to you complete, with all factory-recorded servo information.

By going way back, we stay way ahead.

NASHUA
CORPORATION
Nashua, New Hampshire 03060
O.E.M. Sales Offices:
Nashua, NH—(603) 880-2769
Oakland, CA—(415) 655-9361

These Nashua Disc Packs are compatible with CDC Storage Modules 9876 (40 MB), 9877 (80 MB), 9883-91 (150 MB), 9883-91 (300 MB) and Ampex Storage Modules DM-940 (40 MB), DM-980 (80 MB), DM-9100 (100 MB), DM-9200 (200 MB), DM-9300 (300 MB).

CIRCLE NO. 1 ON INQUIRY CARD

Just how long is the model 40 designed to last?

The Teletype® model 40 system will last for a very long time for a very good reason. Its modular design permits it to grow as your needs grow

Because of this modularity, you can select from a variety of configurations to suit your present application. Then, as your requirements increase, a full complement of capabilities and options can be added to permit maximum expansion at minimum costs.

Advanced solid-state circuitry and high-quality parts and components also add to the model 40's long, trouble-free life. And just as we've increased longevity and reliability, we've decreased service and maintenance requirements.

No matter how you look at your data needs, the model 40 system offers outstanding reliability, versatility and economy. For a very long time. And delivery is sooner than you might expect. No wonder you can't beat the model 40 on a price/performance basis. Now. Or later.

For complete information, please contact our Sales Headquarters at: 5555 Touhy Ave., Skokie, Ill. 60076. Or call Terminal Central at: (312) 982-2000.

TELETYPE

The Teletype model 40 system.
Nothing even comes close.

Timbuktu needs terminals, too.

Timbuktu, Tallahassee and Topeka all need intelligent terminals that make data entry a breeze. ADDS System 70 is the answer.

Easy does it. Two pre-programmed microprocessors make System 70 easy to use, easy to customize, easy to print from, easy to communicate with and easy to maintain.

For instance, English language commands (*e.g.*, "SEARCH," "VERIFY") mean branch office personnel can learn to use these sophisticated terminals in less than an hour. And you can program System 70 for automatic arithmetic and logical functions right on the screen.

ADDS System 70 is IBM 3780 or teletypewriter compatible and has one or two IBM 3740 compatible diskette drives, plus a whole line of optional printers.

Last (and least) is the price: System 70 workstations cost under $7000 in moderate quantities. So there's just no reason why Timbuktu can't have intelligent terminals, too.

ADDS System 70. The intelligent terminal that makes branch offices seem like home.

ADDS

Applied Digital Data Systems Inc., 100 Marcus Blvd., Hauppauge, N.Y. 11787 (516) 231-5400

CIRCLE NO. 3 ON INQUIRY CARD

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BPA

SEPTEMBER 1976 • VOLUME 9 • NUMBER 9

mini-micro systems

COVER CREDIT:

Beauty in a box: Datel Systems Inc. uses low-power CMOS technology, instead of TTL logic, to put 256 analog channels on a rack-mounted data acquisition system, compared to 64 channels for other rack-mounted systems. MOS and IC technology will enable engineers to design increasingly more sophisticated and yet smaller systems.

DEPARTMENTS

letters

To the Editor:

Two specs on our Intershake II programmable datacomm monitor and interactive tester were incorrectly cited in the June issue. Intershake handles various codes and line disciplines at speeds up to 64K bits per second, not 6400 bps. With an internal clock, the speed goes up to 256K bps, not 2560 bps.

Jean S. Wilkins, Manager
Atlantic Research Corporation
Alexandria, VA

To the Editor:

The prices on our VM8E NMOS memory for the PDP-8 quoted in the June issue needs to be updated. The 4K unit now sells for $400, not $475 and the 8K unit for $650, not $750. Your readers are important enough that I hope you will note the changes.

Richard D. Eandi, General Manager
WE Computer Extension Systems
Houston, TX

To the Editor:

In "Minicomputers and Microcomputers" (June) Michael Teener says when using cross-assemblers on time-sharing systems that "the kicker is the high running cost." But this is not necessarily the case.

The Boston Systems Office, Inc. has produced a family of cross-assemblers that is now available on national time-sharing nets. Numerous benchmarks have proven that the cost to the user is between 1 percent and 5 percent that of the cost of using the Fortran cross-assemblers supplied by hardware manufacturers. Sounds too good to be true? Contact us. We'll show you copies of the benchmarks and even run one for you.

The efficiency results primarily from two factors: One is that all the assemblers are written in assembly language as opposed to higher level languages. Second, they are designed and produced by software professionals, not hardware manufacturers. To date, we have produced cross-assemblers for thirteen microprocessors with still more on the way.

In our opinion, the use of an efficient cross-assembler, either via commercial time-sharing or in-house computers, is a very viable, economical way of producing software for microprocessors when you take into consideration both material costs and people time. It is also the quickest and easiest way to go about the jobs.

Michael Rooney, President
The Boston Systems Office, Inc.
Waltham, MA

To the Editor:

With the magazine's change in name, I note that you have also dropped the "Corporate Profile" feature. I find the profiles useful; I was unaware of some companies, until you had written them up.

I have a collection of the profiles, which are the one "sure" part of each magazine that I save. I hope they will return.

G.Y. Gilbert, Space Division
General Electric Co.
Philadelphia, PA

(ED. NOTE: See new feature, Mini-Micro Star on page 20. Many readers tell us that they like the corporate profiles, and the feature is being restored in this issue in a new journalistic format that should make them more telling, while yet giving a concise picture.)

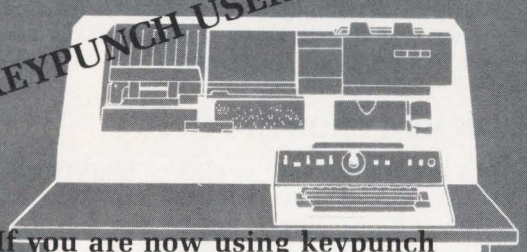
To the Editor:

I want to clarify a "News and Comment" item in the February issue that says at IBM "a worker with 25 years service can retire on half salary for four years, or until he becomes 65." We have offered such special opportunities just three times during the last five years. These were not a part of our retirement plan. Employees did not have to be eligible for retirement to take advantage of the special opportunities. They were temporary offers which were part of our effort to reduce and rebalance personnel resources in order to maintain full employment.

P.F. Judice
Manager, Corporate Information
IBM Corp., Armonk, NY

oUTGROWN Your Present Data Entry Equipment...

KEYPUNCH USERS



If you are now using keypunch equipment for data entry, ENTREX can help you achieve:

- 30–45% overall cost reduction;
- 20–30% increase in productivity;
- Approximately 95–98% reduction in errors reaching your mainframe;
- 20–40% reduction in mainframe processing time.

KEY-TO-DISC USERS

If you are now using key-to-disc or key-to-tape equipment, ENTREX can help you achieve:

- 10–25% overall cost reduction;
- 10–15% increase in productivity;
- 40–60% reduction in errors reaching your mainframe;
- 10–20% reduction in mainframe processing time.

If these numbers sound good to you, give us a call, and join the Users of over 2000 ENTREX systems who have discovered that changing to ENTREX is simple and profitable.

Once you change to ENTREX, you'll never make another system conversion — all ENTREX key-to-disk systems are compatible, to make upgrading a simple matter of reading your programs and data into the new system. And since ENTREX systems cover the gamut from simple keypunch replacement to ultrasophisticated remote processing systems, you'll never outgrow the ENTREX system family.

Try ENTREX On For Size

ENTREX

168 Middlesex Turnpike, Burlington, Massachusetts 01803 (617)273-0480

CIRCLE NO. 5 ON INQUIRY CARD

AD OUT FOR CAMBRIDGE MEMORIES

The game is almost over for add-on memory maker Cambridge Memories. Most of the employees are gone and the banks want their money, but company president Joseph Kruy is still giving refinancing one last volley. Eight months ago, the Bedford (MA)-based firm brought in Los Angeles management consultant Jerry Goldress as president to turn things around after a year of losses. Then five months ago Cambridge refinanced its outstanding loans. But then IBM cut its MOS memory prices and the competitive edge for Cambridge was gone. Goldress, who left the company in June, says he wanted to discontinue the Poughkeepsie MOS manufacturing plant since it was draining the company's assets, but Kruy didn't agree. Cambridge still has one point to play says Goldress if refinancing is granted, and if Cambridge buys its MOS memory for add-on modules instead of manufacturing it.

PERKIN-ELMER INTERGRATES

Perkin-Elmer, whose computer interests started when it bought Interdata in 1974, has expanded its data processing environment with the purchase of disk and tape drive manufacturer Wangco. And now it's joined both subsidiaries to form the Perkin-Elmer Data Systems Group, headquartered in Ocean Port, NJ. That means, Interdata minis, Terminal Products Carousel printers and Wangco drives are all on the same block now. Former Interdata President Daniel Sinnott will head the new group. Ben Wang will stay on as Wangco's president and a former Interdata vice president, James Bruno, will take over that company's presidency. Same block, but the marketing houses will be separate.

VIRGIN TERRITORIES FOR SMALL COMPUTERS

Small computers are about to make it big in two types of offices where automation previously meant typewriters and telephones. The independent insurance agents will install $7 billion in computer systems in the next decade, forecasts a Frost & Sullivan study. And doctors will start with micro-based small business systems for bookkeeping and later use them to automate the physical examination, predicts another F&S study. Both file-laden offices will at last be put online for automatic inquiry and maintenance of customer or patient records.

UNIVAC TOPS ITS LINE

Although it recently began emphasizing distributed processing with the introduction of the UTS 400 and UTS 700 terminal systems, Univac is far from finished with large systems. The new top of its line is the 90/80 virtual system. It's intended for users upgrading from Univac's 90/60, 90/70 systems, the Series 70 virtual system (RCA Spectra 70) or IBM's 370/145. The company expects the system, priced from $2 million to $4 million, to compete with the 370/158. When asked which direction it's taking – toward large centralized processing or distributed processing – Univac replied it depended on the customer.

NEC AND INTEL MAKE FRIENDS

NEC Microcomputers was one of the first to second-source the Intel 8080A microprocessor. To this chip, the company added its own 8080A-compatible memory and interface chips. Then the patent conflicts began: Intel vs. NEC and NEC vs. Intel. To settle the issue, NEC and Intel signed a 10-year royalty-free cross licensing agreement. Intel already has similar agreements with other 8080A second-source companies, but this is the first to include plans for technology transfers. Not even Intel can ignore the Japanese.

LOW BALLING PDP-8 MEMORIES

Two independent add-on memory manufacturers have recently reduced their prices for PDP-8 memories. Both *WE Computer Extension Systems (Houston, TX)* and *Monolithic Systems Corp. (Englewood, CO)* offer 4K and 8K MOS boards that plug in to the 8/A, E, F or M Omnibus chassis. A 4K board sells for about $400 from the independents; an 8K board sells for about $700. This compares to DEC prices of $1230 for a 4K MOS board and $1500 for 8K core. DEC maintains that what it lacks in price, it makes up for in reliability – the PDP-8's strong point.

UNEVEN MINI GROWTH

This year's mini market will grow at a 40 percent annual rate forecasts Modern Data Services *1976 Minicomputer-Microprocessor Market Survey*. But the growth so far is anything but evenly distributed if recent quarterly earnings are any reflection (see chart).

	1976	1975	Change
DEC	$46,586,000	$28,580,000	+64%
DG	4,621,000	2,915,000	+55%
HP	23,771,000	23,952,000	0%
CA	841,500	277,042	+300%
GA	(1,425,000)	(660,000)	-200%

"The strong pace of new business in most markets is progressing in the U.S. and abroad," says Digital Equipment Corp. The business upturn helped Data General, too. Hewlett-Packard attributes its static growth to increased development expenses along with increased revenues. Computer Automation's markets for low-cost minis and automated production testing systems are expanding and the company's new SyFa system has just begun to produce revenues. Manufacturing and organization changes and slippage of shipments caused its operating loss to almost double, says General Automation.

WHAT'S COMING

OCT.

19-21 Mini/Micro Computer Conference Exposition. Brooks Hall/Civic Auditorium, San Francisco, CA. Contact Robert D. Rankin, Mini/Micro Computer Conference and Exposition, 5544 E. LaPalma Ave., Anaheim, CA 92807.

19-21 Semicon/Europa '76. Zurich, Switzerland. Contact Semicon/Europa, c/o Golden Gate Enterprises, Inc., 1333 Lawrence Expressway, Santa Clara, CA 95051.

Nov. 8-11 Info '76. McCormick Place, Chicago, IL. Contact Clapp & Polick, Inc., 245 Park Ave., New York, NY 10017.

Your mother needs help.

At one time, people were willing to wait around for your big computer to get around to them.

No more.

Now they're demanding more work, faster than your mother can possibly do it.

Which has put you in a rather difficult position. You've either had to put them off, or put your mother through an upgrade so expensive it's unreal.

Neither of which you have to do any more. Because now you can get your mother a little help. A computer that can do the jobs she's too busy to do.

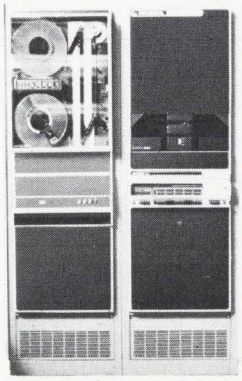
An ECLIPSE C/300.

The C/300 is smaller than the big computers you may be used to using. But it has the things big computers have. A comprehensive commercial instruction set that even has an EDIT function, for example. And large memory configurations.

The C/300 also has an incredibly sophisticated data management system with multilevel keyed access called INFOS. It supports the languages anyone could ever want: COBOL, RPG II, Real-time FORTRAN. And INFOS runs under RDOS, our real-time multitasking operating system.

And the C/300 has intercomputer communications ability that lets you interface to your mother. Directly via channel connect, or via communication lines so it can emulate 2780's or HASP. Or be itself. And, wherever you put an ECLIPSE C/300 you can hang terminals off it with synchronous or asynchronous lines.

The COBOL that comes with the C/300 is the highest level implementation of ANSI 74 COBOL standards. It's a complete language system that comes with features like an interactive debugger. And an integrated SORT/MERGE.



And you can get all your peripherals at Data General. Because Data General has all kinds of discs, tape drives and printers. In all sizes. Discs for example, come in anything from a floppy to 3330-type 90 megabyte drives.

Write for more information.

That way, you'll be able to spend more time with your mother. Because you'll be spending less time making up excuses.

ECLIPSE C/300: BECAUSE YOUR MOTHER NEEDS A LITTLE HELP.

Data General

Data General, Route 9, Southboro, Mass. 01772 (617) 485-9100. Data General (Canada) Ltd., Ontario.
Data General Europe, 15 Rue Le Sueur, Paris 75116, France. Data General Australia, Melbourne (03) 82-1361/Sydney (02) 908-1366.

When it comes to computer networks, MODCOMP offers you a big advantage.

Experience.

At MODCOMP, we were pioneers in making the concept of resource-sharing computer networks a practical reality. The tieing together of multiple computers in distributed processing systems whereby several computers work together, sharing the work load.

Putting the computing power out where the work is, yet allowing each computer in the network to do not only its own job, but also draw upon the resources of every other computer in the system.

We developed MAXNET as a standardized operating system exclusively for this purpose. And MODCOMP systems using our network software have been in operation for more than two years.

We now have over forty network systems in the field, with another fifteen or so being readied for early delivery. Which means that we have more experience—both in length of time and in numbers of systems installed—than all our competitors combined.

In addition to traditional "host-satellite" networks, we have systems in operation that include so-called "ring" networks, "star" networks, and many more. The important thing is that you can link your computers together in any format you want. Provide each computer with whatever peripherals are best suited to your purpose. And leave the rest to MAXNET.

We figure the best way to give you an idea of what MAXNET can do is to give you some examples showing how other people are now using it.

We invite you to study these case histories. More important, we invite you to get in touch with us so you can get a first-hand look at how well they work. Which is a lot more convincing than just listening to us brag about them.

Meanwhile, we have a couple of brochures you should send for.

Our MAXNET brochure deals with computer networking, and how MAXNET makes it all happen.

The other is a thirty-two page booklet that explains in detail exactly what we mean by MODCOMP "TSP." The Total Systems Performance that has made MODCOMP first choice of many of the world's toughest computer buyers.

If you're into computers at all, the TSP brochure is "must" reading. If you're into resource-sharing networks (and if you're not, you soon will be), the MAXNET brochure is equally compulsory.

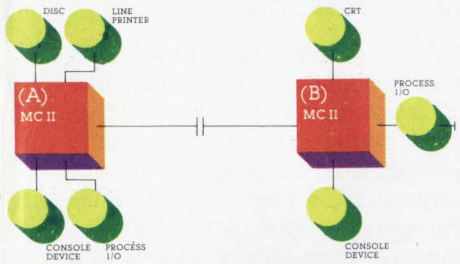
Write Modular Computer Systems, 1650 West McNab Road, Ft. Lauderdale, FL 33309. Phone (305) 974-1380.

European Headquarters:
Export House, Woking,
Surrey, England
Phone (04862) 71471

Case History No. 1
A giant aluminum company chose MODCOMP for this simple two-computer "network."
Computer A is at one of the Company's plants in Pennsylvania. Computer B at a research facility in Tennessee, several hundred miles away. The two computers communicate with each other over ordinary dial-up telephone lines. Using MAXNET, operators at either location have full access to all the resources of both computers. Data, programs, peripheral services can be freely exchanged.

For example, suppose a research engineer at Computer B needs to compile a new program. By a simple terminal request, he can call down language processors from Computer A, compile and edit his program on his own computer, and transmit his listing outputs back to Computer A for printing.

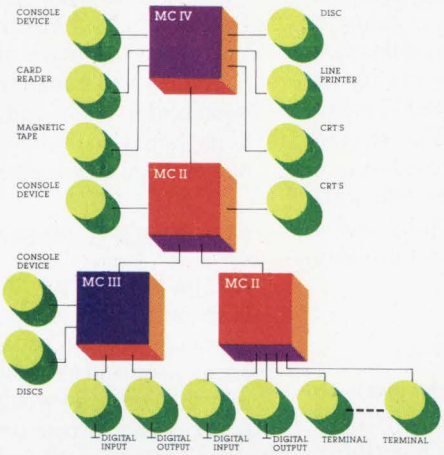
Alternatively, a programmer at Computer A can prepare a program and load it directly down to Computer B. Even though it's the break of day in Tennessee, and the computer is all alone in the office.



This relatively simple system illustrates the flexibility of MAXNET, whether the computers in your network are in adjoining rooms, or a thousand miles apart. It would work just as well if they were on different planets, but nobody's asked us to do that. Yet.

Case History No. 2
This MODCOMP Network is in operation at the central R&D facility of a major oil company. It's a good example of how MAXNET, coupled with across-the-board compatibility of MODCOMP hardware, allows you to start as small as you want to, and grow as big as you need to. Without a heavy initial investment. And without costly re-programming as your system expands.

It started, as part of a long-range plan, with the installation over two years ago of a MODCOMP III. Although this model has now been superseded in our line by later models of the MODCOMP II, it is indicative of the long-term compatibility of MODCOMP systems that the III remains today a vital part of this network.



As the system has since evolved, a 32-bit MODCOMP IV now acts as host computer. Replacing (at a fraction of the cost) the company's former stand alone IBM 1800, the MODCOMP IV is expected to provide 10 to 25 times the throughput of the big machine, which had long since reached its saturation point.

A MODCOMP II acts as communications controller between the host and satellite computers.

The satellites consist of 16-bit MODCOMP II's performing various data acquisition and control functions for a series of pilot plants. The MODCOMP III handles analytical instrumentation, providing simultaneous service to over 80 instruments of various types.

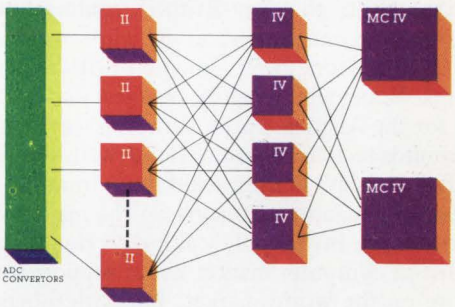
The advantages of this system are, firstly, it's computing power—many times that of the old stand-alone system. It's reliability (the MODCOMP system has had an overall availability of 99.3% of prime time over the past two years). It's expandability, which allows virtually unlimited future growth. And last, but far from least, it's economy and ease of operation.

Case History No. 3
A NASA prime contractor has installed this highly sophisticated MODCOMP hierarchical network to handle complex stress and fatigue test analyses.

Dual redundant 32-bit MODCOMP IV's at the "host" level communicate with an intermediate level of several smaller 32-bit MODCOMP IV's, screening data received from the satellite computers. A large number of 16-bit MODCOMP II satellites interface directly to the various processes. The entire system has built-in redundancy at each level.

Among minicomputer vendors, only MODCOMP has the capability to build a network of this size and complexity, using standard hardware and software products. At a small fraction of the cost for a single stand-alone computer large enough to perform the same multiple tasks. And with far greater efficiency.

It clearly illustrates the unlimited expandability of MAXNET in setting up any kind of network system you need to do your particular job.



For clarity, peripheral devices omitted from this diagram.

Note: The MAXNET systems shown here are all resource-sharing networks of the type commonly used in laboratory and industrial measurement and control systems. For dedicated telecommunications applications, MODCOMP offers a separate software system called MAXCOM. For more information, send for our Data Communications brochure.

MODCOMP TSP*

*TSP = Total Systems Performance.

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CIRCLE NO. 7 ON INQUIRY CARD

international news

PHILIPS STARTS NEW SILICON VALLEY – IN ENGLAND

Last year Philips bought semiconductor manufacturer Signetics of Sunnyvale, CA. This year, it's invested in Mullard of Southampton, England, to establish a European base for manufacture of its NMOS products. Philips is going to start with a $5.4 million investment in Mullard and increase it eventually to $12.6 million. The company says it had its eye on Mullard, which has been manufacturing NMOS memories for two years, before it bought Signetics. Rather than expand the Sunnyvale facility, Philips says it made more sense to start a European base so there would be two areas of technology development, two sources of supply and a base of strong engineering support close to the European market, a market that Philips expects to multiply.

BRITAIN NATIONALIZES ITS BUYING

"Buy British" was the recommendation recently given to Britain's National Economic Development Council (NEDC) on how to improve the British industrial sector's performance. Right now, that restriction applies to the ministries of the central government, but Britain is thinking of expanding the policy to local government and nationalized industries. The immediate benefactor in the computer sector will be ICL, in which the British government has a 10 percent interest. Although "Buy British" could eventually include equipment manufactured in Britain – whether it be ICL, DEC, IBM or Honeywell – the non-British companies are up in arms. Honeywell recently charged that a $2 million contract for the Anglian Water Authority was awarded on political grounds to ICL instead of Honeywell. The deciding group on "Buy British" has representatives from various industrial companies, including Honeywell. The majority of the group favors the pro-British policy although Honeywell argues that the British computer market needs support to make it competitive on the world market. But with things the way they are in England, who can blame the government for wanting to keep major capital expenditures in the country?

INTERNATIONAL MARKETS BEYOND THE BIG FOUR

Look beyond the data processing markets of Germany, France, Japan and the U.K. and what do you see? Probably nothing according to TRW Datacom International Vice President Melvin Wellerstein. Markets other than those are hard to figure out since conventional measurements, such as EDP base, GNP, inflation and unemployment don't work for developing countries. A country full of political turmoil can actually be a lucrative market if the economic intrastructure is stable. If a country has no measureable installed base, it can mean no competition instead of no market. One way for indepedents to find these hidden markets is to follow in the footsteps of larger marketing organizations, says Wellerstein.

CORE LIVES – IN SWEDEN

Swedish peripherals manufacturer Datasaab is going to buy $2 million of core memory from Ampex Corp. for its data systems. The people with long-lived cars like their memories long-lived, too.

LEGO MOVES FROM TOY TO COMPUTER NETWORKS

Danish toy manufacturer Lego is stepping up its marketing of toy construction kits through a computer network. NCR Century 8200 minis will be placed in 13 locations, including Denmark, U.S., Austria, Germany and Australia. At first the minis will perform online capture and invoicing. But later they will communicate with a Century 251 at Lego's data center in Billund, Denmark. With its wordly inputs, Lego hopes to better control inventories and production and evaluate new markets.

ICL SCOOPS UP SINGER REMNANTS

ICL isn't stopping with the Singer overseas data processing base, but is also buying Cogar, Singer's intelligent terminal subsidiary. Cogar Corp. is Singer's last remnant of data processing to be sold although Singer President Joseph Flavin had said the company would keep it since it was profitable. ICL is also going to take over U.S. manufacturing and development of System 10 and POS terminals. TRW agreed earlier to provide maintenance for this base. All ICL's manufacturing of Singer equipment will be at the Cogar facility in Utica, NY. Although former ICL U.S. President Peter Weill reportedly resigned over ICL's lack of commitment in the U.S. market, ICL's interest in the U.S. is more than passive.

THE CONSERVATIVE EUROPEAN

"The European computer user is more anxious to stay with well-proven supplies and harder to convince to accept new alternatives than his U.S. counterpart," International Data Corp's President John Pryer said recently. The European's main concern is that independents can provide the same maintenance and applications as the large supplier. While U.S. independents try to compete with IBM by offering advanced technology, European firms such as Nixdorf do it differently. Heinz Nixdorf says his computers may not have the latest technology, but the technology used is proven and reliable so Nixdorf can support its computers the same way IBM does.

FOOTHOLDS ABROAD

The Saudi Computer and Management Consultants will be selling Prime computers in the Arab countries of Saudi Arabia, Kuwait, the Gulf States, Syria, Sudan, Iraq and Yemen.

Our statement on high density head-per-track disc technology:

For quite some time now, there's been a real need for a low profile, high capacity head-per-track disc.

To reduce system space requirements. To reduce system complexity. To reduce system costs.

And while the need was there, the technology wasn't.

Until now.

Introducing the AMCOMP 8500 Series Disc Memory Unit. It has a capacity of 38.4 million bits. It's only 8.75" tall, including power supply, and fits a standard 19" rack. It has a phenomenally low cost of 0.019 of a cent/bit in typical OEM quantities.

And it's available – right now.

There's even more:

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mini·micro systems bookstore

book review

AND TOMORROW . . . THE WORLD? Inside IBM *by Rex Malik. Millington, Ltd., London. 490 pages plus index. Computer Industry Association, Rosslyn, VA, U.S. distributor, $15.*

The *magnum opus* of Europe's inveterate IBM-watcher, Rex Malik, is a lot more than the antimonopoly polemic it promises (threatens?) to be at first glance. In fact, it's a readable history of computing, a carefully researched recounting of IBM's court battles, a very interesting history of IBM's corporate strategy and, most importantly, an intelligent assessment of the company's current and near-future position in the industry worldwide. For good measure, the book also offers a hearty serving of corporate gossip, strategically placed dead-center in the book, just where reader interest wanes. Malik had to devote as many pages as he does (about 200) to historical and legal detail because his thesis is a very serious charge: IBM is a feudal empire that recognizes no democracy internally, and that externally is concerned soley with its own profit, not with the law, the economy, or the real needs of its customers and potential customers. Furthermore, in what is probably the most important part of the book, the author asserts that those who could possibly curtail IBM's monopoly power have not done their jobs – primarily the officials of the U.S. Dept. of Justice.

Malik draws together a lot of convincing evidence, some new, some made familiar by recent lawsuits (especially *Telex vs. IBM*) to show that IBM's antitrust law strategy was to bend the law to the limit, and even to break it when profit outweighed the consequences. Indeed, Malik believes that most Americans particularly Justice Department officials, are too trusting of IBM's intentions although no less a personage than IBM President Thomas Vincent ("Attila the Hun") Learson has said "We want 100 percent (of the data processing market)."

The reader who looks for weaknesses in the author's approach and arguments will find them. For example, Malik is very careful to explain his collection and use of unattributable statements from IBM employees and former employees. He claims a high degree of corroboration on most issues, and says "where there was doubt, I cut it out." However, he stops short of assuring us that he refused to use any uncorroborated claims, a rule sacred to most investigative reporters (for example, Woodward and Bernstein of Watergate fame). However, much of the strength of Malik's arguments comes from *public* documents.

What Malik does in this book – and does well – is to collect the familiar and blend it with his own discoveries into a fascinating and disturbing narrative. The book is not perfect, but those who defend IBM's size, prominence and strategies must reckon with it. *And Tomorrow . . . The World?* is a must for every IBM-watcher, and for everyone who wants to understand the agonizing legal, economic and technological questions IBM's power poses for the next decade or more. – Ernst Barlach

(Ernst Barlach, a computer marketing specialist, is a frequent contributor to MINI-MICRO SYSTEMS.)

path processing from a programmer's viewpoint. Includes hand computation and computer techniques, plus many solved problems you can adapt for your own use. *428 pp., 171 illus., 6x9, $15.95*

7. APL PROGRAMMING AND COMPUTER TECHNIQUES

By Harry Katzan, Jr. A Programming Language (APL) uses a concise notation based on ordinary mathematics that's easy to learn and apply. It works hand in hand with time sharing to solve a wide variety of DP problems. And this job-oriented sourcebook shows you how. *330 pp., illus., $12.95*

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By Harry Katzan, Jr. Introduces a new systems modeling technique, HIPO (Hierarchy, plus Input, Process, Output). Utilized to describe what a system does rather than how it does it, HIPO is extremely useful in system design, development, analysis and documentation. *158 pp., illus., $12.95*

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By Hans R. Camenzind. Containing building blocks for both linear and digital systems, this book details the performance, limitations and optimization of all integrated components. It shows how to breadboard an IC for checkout, and guides you through the layout stage (geometrical and graphical). *480 pp., 324 illus., $17.95*

PROFESSIONAL IMPROVEMENT

17. THE EXECUTIVE DESKBOOK Second Edition

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18. BUZZWORDS A Guide to the Language of Leadership

By Robert K. Mueller. Describes and explains new words ("buzzwords") which are used to convey fresh concepts in business, science and government. Provides a diverse collection of buzzwords and phrases from various fields of industry. *192 pp., 6x9, $7.95*

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By Richard C. Belew. Shows how to prepare presentations that vastly increase a company's chances of obtaining sizable loans. Includes explanations and examples for developing forecasts of operations, related cash flow, and the resulting pro-forma balance sheets and estimated borrowing requirements. *192 pp., 8½ x 11, $6.95 paper*

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CONSERVATIVE BUYING DOESN'T ALWAYS PAY

Every Federal agency goes through pains when it comes to buying computer equipment. Yet, despite the pairs of multiple bids, presentations and benchmarks, most Federal agency equipment is technologically far behind that of the commercial sector, according to Peter McCloskey, president of Cbema. In fact, only 68 percent of the equipment listed in GSA's computer inventory is no longer being manufactured compared with 26 percent in the commercial sector. Unfortunately, obsolescence in the computer industry doesn't just mean out-of-date cabinetry, but can also mean longer task times and subpar performance, which then leads to excessive personnel costs. "Forty-seven percent of all Federal dollars spent for data processing represents personnel costs," says McCloskey. "The comparable figure in the private sector is only 33 percent," he adds.

To eliminate this Federal waste, Cbema has a five-point program.

1. Establish a new office within the Office of Management and Budget for EDP management and policy. Instead of centralizing procurement under GSA, Cbema wants a policy office to perform long-range planning.
2. Adopt an investment capital approach instead of budget ceiling approach to procurement.
3. Set up different procurement methods for different types of acquisitions (e.g., new, extension, technical improvement).
4. Give the power of procurement back to the user agencies instead of trying to centralize procurement under GSA.
5. Replace older systems requiring extensive personnel support.

There was an attempt ten years ago to establish a comprehensive data processing procurement plan, to provide for long-range planning by individual agencies, and to bring in new vendors. The Brooks Act did bring in more bidding vendors, – however, there are still no long range data processing plans. But then, long range planning for anything is foreign to the U.S. Govt.

GOVT. OK'S DG COBOL

The Federal Cobol Compiler Testing Service (FCCTS) of the Navy has validated Data General's recently introduced Cobol for its Eclipse C/300 business system. That means DG's Cobol compiler conforms to the FIPS and ANS standard, giving it a certain amount of interchangeability among data processing installations. DG claims its Cobol implements the frequently used ANSI-74 modules to the *highest* level. But validation tests were only available for the *intermediate* level. Still it was a first for testing even the intermediate levels of Cobol 74 on a small computer, according to the federal testing service. The validation test consists of 180 audit routines, their related data and an executive routine.

1984 CLOSES IN

Not George Orwell's 1984, but House Bill 1984, which deals with protection of privacy by the private sector, is getting closer to reality. Companies, needless to say, are trying to stop privacy legislation restricting the commercial sector, saying it will cost the consumer too much money. To prevent the disorganization and subsequent cost, should privacy requirements for the commercial sector become a reality, PRC Information Services Co. (McLean, VA) has the System 1984 Management Package.

When you buy a Series 400 disk drive in 26.6, 40 or 53.3 megabyte capacity, you get two drives in one compact package! The first has a removable 13.3 Mbyte cartridge; and the second has 13.3, 26.6 or 40 Mbytes of fixed capacity. It's only possible with our exclusive inertial actuator that gives our Series 400 drives two independent head positioners. That means you can be reading or writing with the upper unit, seeking with the lower unit. And, of course, all the inherent Series 400 features are there: power interrupt protection, data track servo following, common dimensions for all models, 100% common spares, interface compatibility in all models and proven Diablo disk drive performance dependability and reliability. For a complete presentation of the new Diablo Series 400 disk drive family, call or write Diablo Systems, Inc., 24500 Industrial Blvd., Hayward, CA 94545 or Diablo Systems, S.A., Avenue de Fre, 263, 1180 Brussels, Belgium.

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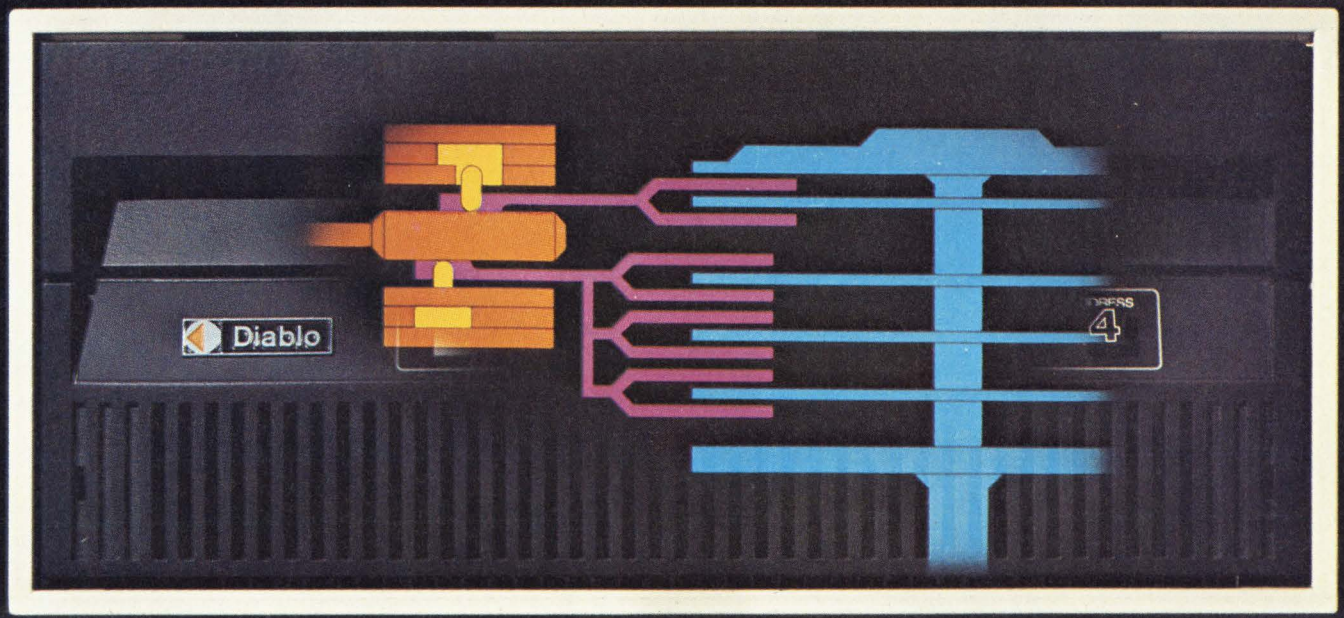



GENERAL ELECTRIC
TermiNet 340

GE puts it on the line with a new family of TermiNet® line printers

Four value-packed true line printers with real 90-340 lines per minute throughput at practical, low prices

Small size. Compact design. Modern styling. Quiet operation. Low prices.

At the same time this new space-saving family of GE TermiNet line printers is big on performance. They're big on throughput. Gives you a range of speeds from 90 lpm to 340 lpm, depending on the number of printable characters per line and the size (64 or 96) of the ASCII subset. And that's *real* throughput (see graph).

They're big on reliability backed by years of proven electronics and rotating belt technology. (Over 75,000 GE belt printers installed worldwide.) Big on versatility. 67% of the parts are common to TermiNet 300, 1200 and 120 printers. For resellers this means a minimal spare parts investment. For users it means improved service and less downtime due to a lack of spare parts. You can modify or upgrade quickly and at modest cost. They're big on interfaces. Serial and parallel, buffered and unbuffered.

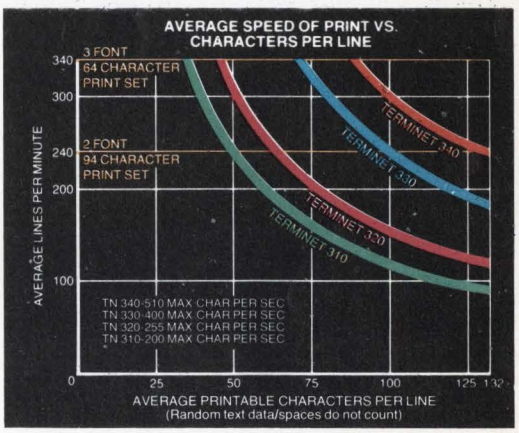
Big on quietness. They're a welcomed addition to any office or computer room. Big on value-packed features. Both front (recommended for multi-part forms) and rear loading. 132 columns. Original and 5 copies. A unique ribbon cartridge. With a life span of 50 million print characters. Operators can replace in less than a minute. Easily. Cleanly.

And, they're big on troubleshooting. 14 light emitting diodes (LED's) located on the outside of five printed circuit boards quickly indicate malfunctions. A test button on the control panel provides rapid checkout of printer action. Staggered or "ripple" test patterns print continuously as long as TEST is activated.

This big new family of TermiNet line printers are *true* line printers.

In fact, the only thing you'll find small about this new family of line printers is their size and price. In these days of spiraling costs, GE is putting it on the line with practical, low prices. From $3900 for the TermiNet 310 printer to $5130 for the TermiNet 340 printer (user quantity 1). That could well be the best cost/performance in line printers available today.

Let us prove it. Write General Electric Company, TermiNet 794-17, Waynesboro, VA 22980.



The print rate for TermiNet line printers varies with the number of printable characters per line and the size of the ASCII subset used. Analysis of the typical rate curve shows that TermiNet 340 throughput for the 64 character ASCII subset is an average of 340 lines per minute when there are 90 or fewer characters printed on a line. This includes one line feed per line. Minimum throughput is 231.8 lines per minute when printing characters in all 132 columns, faster if there are spaces in the print line.

For your special kind of needs-A special kind of printer

GENERAL ELECTRIC

CIRCLE NO. 45 ON INQUIRY CARD

LEASED CALCULATORS

First there was the purchase-only IBM 5100 and HP 98XX. Then there was the semi-leased 5100. And now there's the full-service lease HP 98XX programmable calculator. The leases run 6, 12 or 18 months at rates ranging from 4.75 to 8 percent of the purchase price each month. Hewlett-Packard provides full weekday service. To qualify, a customer must include at least $2500 worth of hardware. At the end of the lease, the customer can either cancel the lease, continue it on a month-to-month basis, sign up for another lease or purchase the equipment with up to 70 percent of the lease payments applied to the purchase price.

NATIONAL DATA ON COMSHARE NETWORK

National Data Corp. (Atlanta, GA) has entered into an agreement with Comshare, Inc., (Ann Arbor, MI) whereby National Data will offer its customers time sharing services through the Comshare network. National Data is said to be the nation's largest third-party supplier of cash management information. The company presently provides 100 of the nation's largest banks and 1,000 corporations in the U.S. and overseas with such services as daily accounting for deposits, disbursements or balances, and other management data such as sales and inventory.

PERTEC OEMS TO SPERRY UNIVAC

A major OEM agreement covering future acquisition of Pertec disk drives by Sperry Univac specifies that Univac may purchase multiple quantities of D3000 series disk drives during the next five years, which could possibly result in purchases in excess of $15,000,000.

ON THE MOVE

Tesdata Systems Corp. announced the move of its manufacturing and production engineering operation in Sunnyvale, CA, to a 15,540 square foot facility in the 400 acre Sunnyvale Oakmead Village Industrial Park.

IMS Associates, Inc. of San Leandro, CA, recently moved into new facilities which more than quadruple the company's manufacturing space. The company's new address in San Leandro is 14860 Wicks Blvd., 94577; the phone number remains the same, (415) 483-2093. The rapid growth of IMSAI has been atributed to the demand for the new IMSAI 8080 Microcomputer which was introduced earlier this year.

EARNINGS (LOSSES)

Tally Corp. reported revenues of $6,112,000 for the quarter ending March 28, 1976 compared with $4,432,000 revenues for similar 1975 period. Net income for the quarter was $658,000 compared to $28,000 in 1975.

Earnings of **NCR** in the second quarter of 1976 were $18,503,000, a substantial improvement over the $13,224,000 reported for the first quarter and slightly ahead of the $18,472,000 reported for the second quarter of 1975. Second-quarter revenues totaled $556,252,000, compared with $471,111,000 in the first quarter and $516,520,000 in the second quarter of 1975. This brought revenues for the first six months of the year to $1,027,363,000 which was the first time they exceeded a billion dollars for that period. In 1975 six-month revenues were $995,407,000. Net income of $31,727,000 for the first six months of the year, however, fell short of last year's $39,320,000 for the comparable period.

Microdata reported revenues of $8,508,214 for the third quarter ended May 31, 1976, with net income of $882,354 or $.40 per share. In the prior year's third quarter ended May 31, 1975, revenues were $3,820,338, with net income of $318,391 or $.20 per share. For the nine months ended May 31, 1976, revenues were $19,665,311, and net income of $1,883,642 or $1.01 per share. In the prior year, nine-month revenues were $10,679,575, with net income of $364,350 or $.23 per share.

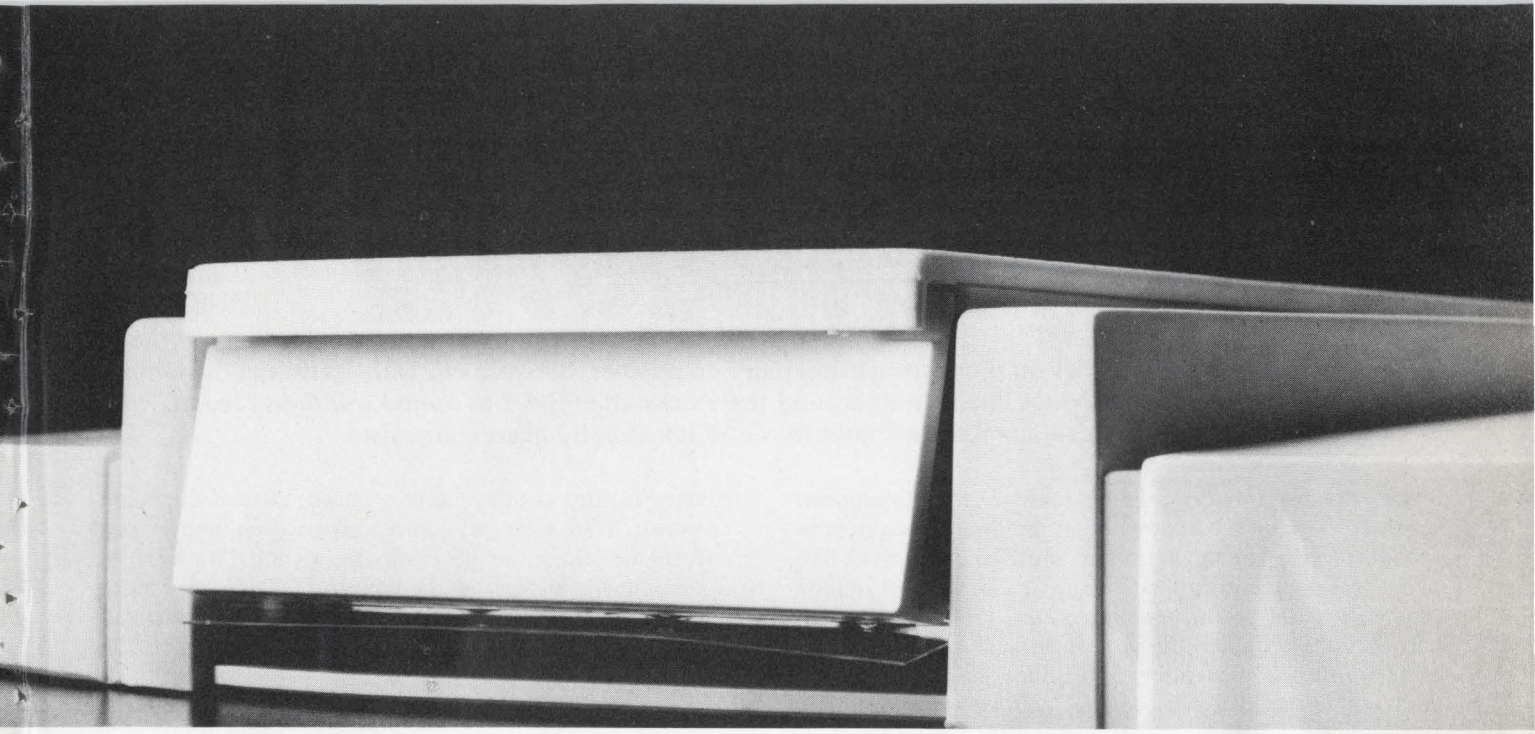
Honeywell reported substantial improvement in its second-quarter earnings compared with the second quarter of 1975. Worldwide sales, rental and service revenues in the second quarter of 1976 were $702.4 million, compared with $680.1 million in the second quarter a year ago. Net income for the quarter including extraordinary income was $19.4 million, compared with $12.7 million. All last year's net income figures have been restated to comply with the new accounting standard. Primary earnings per share for the second quarter of 1976 were $.95, compared with $.65 in 1975. Extraordinary income from tax-loss carryforwards for the second quarter of 1976 was $2.2 million or $.11 per share, compared with extraordinary income from the same source of $1.2 million or $.06 per share in last year's second quarter.

Fabri-Tek reported operating revenues for the fiscal year ended April 2, 1976 were $28,859,948 as compared to $35,258,176 for fiscal 1975. The next loss for the period was $1,542,052 against a loss last year of $1,678,899. On a per share basis the loss was $.42 and $.46 respectively for fiscal 1976 and 1975.

National Data Corp. reported record unaudited fourth quarter earnings of $579,000 or $.12 a share for the period ended May 31, 1976. This compares with $394,000 or $.08 a share for the corresponding period last year for an increase of more than 50 percent on a per share basis. The company also reported year-end unaudited earnings of $1,923,000 or $.38 a share, compared with $1,890,000 or $.36 a share for the fiscal year ended May 31, 1975. Revenues for the fourth quarter were $8,245,000, compared with $8,086,000 for the 1975 period, and revenues for the year were $32,946,000, compared with $31,277,000 for the previous year.

Mini-Computer Systems, Inc. (Elmsford, NY) reported unaudited revenues for the period ended April 30 of $3,553,000, compared with $2,012,000 for the same period a year earlier. Net income for the 1976 first half was $337,000, or $.51 per share, compared with $177,000, or $.29 per share in the prior period before an extraordinary credit of $.15.

Ampex announced an increase of 89 percent over the prior year in pre-tax earnings from continuing operations exclusive of non-recurring items. For the fiscal year ending May 1, 1976, such earnings rose from $5.0 million in fiscal 1975 to $9.4 million in fiscal 1976. Net earnings for fiscal year 1976 were $8.0 million, or 74 cents per share after giving effect to an extraordinary charge of $2.25 million for the proposed settlement of the class action suits brought over four years ago by purchasers of the company's securities during the period May, 1970 to August, 1972. Net earnings for the prior fiscal year ending May 3, 1975 were $10.3 million or $.95 per share and included a non-recurring pre-tax gain of $13 million as the result of a settlement with IBM.



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*Patent Pending

MEMOREXCLUSIVE

CIRCLE NO. 9 ON INQUIRY CARD

DATA TERMINAL SYSTEMS, INC.

STANLEY KLEIN / Editor-in-Chief

a mini-micro star

Beginning a series of profiles on pioneering mini-micro companies. Six-year old Data Terminal Systems, whose cash register product line is built around the Rockwell PPS-4, has scored a winning record in a fiercely competitive field that is dominated by giant companies.

Sears, Roebuck & Co. commissioned Digital Equipment Corp. to develop a computer-based point-of-sale system in the late 1960s. The retailer offered both to pay for one-half of its development cost and then to place a $10 million order on initial production units. DEC President Kenneth Olson, however, nixed the project because he did not want DEC, whose sales were about $30 million, to become dependent on the retail giant. Sears, of course, went elsewhere, and Robert S. Collings, who headed DEC's POS investigations, became manager of product displays. When Collings then tried to convince Olson to move DEC into the point-of-sales terminal business on its own, Olson again turned the idea thumbs down.

All of this is how Collings recalls his break away from DEC in 1969 to form Data Terminal Systems, Inc., which the 37-year old founder took public last month. The company, located in Maynard, MA, a short jog away from DEC headquarters, epitomizes how the advent of the microprocessor promises to spawn upstart companies that can unsettle existing markets and give birth to new ones. Data Terminal produces microprocessor-based cash registers, and by use of the technology, DTS has captured a 10 percent share of a market that is crowded with 20 competitors, including the dominant NCR Corp. Moreover, Collings, a graduate of Harvard University Business School, aims to boost that market share to 25 percent by 1981. Says Collings: "Our rate of new product introductions would be drastically slowed without the microprocessor.

DTS differs from its rivals in one key respect. At the moment, the company spurns the sophisticated point-of-sales systems intended for the chain department stores that can cost $50,000 and up. Collings points to the pile up of failures in this part of the market – Pitney Bowes-Alpex, Singer, General Electric, and others. Instead, DTS concentrates on stand-alone registers having "advanced cash and inventory control features, but which work without any need for expensive backroom computers or computer hookups," Collings explains. "Even a ma and pa store can afford to convert from a mechanical cash register to one of our microprocessor units," he says.

Collings: The microprocessor speeds up our rate of new product introductions.

The company's sales picture tells the story. Stand-alone units make up 99 percent of all shipments, with grocery stores accounting for 50 percent of the total; fast food restaurants 25 percent; drug stores 10 percent; and convenience stores 10 percent. But the company is not content to stop at this juncture. Through use of the microprocessor, DTS engineers can readily program and expand units to tie into an on-line computer set up. "We were the first company to destroy the concept that a cash register must be either a stand-alone or a terminal-based system," Collings says. "Most of our products can be used either way."

OFFICERS

Robert F. Collings. Age 37. Co-founder and president since inception. Previously a product manager with Digital Equipment Corp.

Ronald D. Bufton. Age 35. Vice president-manufacturing. Previously, from 1969 to 1972, manufacturing task manager with GTE Sylvania Electronic Systems, Inc.

William J. Hallahan. Age 46. Vice president-sales and marketing. Previously, from 1968 to 1971, national sales manager for Sweda Div. of Litton Industries Inc.

Louis G. Orsatti. Age 45. Vice president-engineering. Previously, from 1968 to 1975, director of engineering at Mohawk Data Sciences Corp.

Marvin W. Schenk. Age 45. Vice president-finance. Previously, from 1965 to 1972, controller of Commodore Foods, Inc.

Edward H. Sonn. Age 36. Vice president-new product development. Previously, from 1968 to 1972, manager of computer applications at Spiras Systems, Inc. sub. of USM Corp.

That Data Terminal Systems is a rising micro-star shines through in the company's financial results. Sales have risen nearly eight-fold in three years to $11 million in 1976 while earnings over that same timeframe have doubled to $1 million, or $.76 a share. Obviously, profit margins declined over that period, but the squeeze occurred largely because the young company tripled its selling expenses and quadrupled engineering, research, and development costs.

Results for the first quarter ended April 30 in FY'77 show profit margins starting to rebound. Earnings more than doubled on a 50 percent sales growth. In addition, Data Terminals has built up a juicy order backlog – $4 million on April 30 compared to less than $1 million in the previous year. Of the current backlog, 76 percent are for products introduced since April 1975, and all are to be shipped by the end of September.

All of this appears to be reflected in the stock price. The shares, which went public on July 13 at $14.75 each, scooted up about $2 shortly thereafter, though the stock action has since settled back to $15 a share at the beginning of August.

TRACK RECORD

	1972	1973	1974	1975	1976	3 Mos. Ended 1975	3 Mos. Ended 1976
Revenues ($ millions)	$0.05	$1.5	$4.0	$7.4	$11.1	$3.0	$4.2
Net Income ($ millions)	(0.02)	0.3	1.0	1.3	1.9	0.5	0.9
Earnings per share	(0.24)	0.14	0.38	0.48	0.76	0.18	0.38

BALANCE SHEET as of April 30, 1976

Current Assets	$6,587,723	Receivables	$3,545,190	Stockholder equity	3,154,147
Current Liabilities	2,105,520	Inventories	2,702,681	Deferrals	138,000
Cash Items	285,242	Long-Term Debt	1,601,784	Shares Outstanding	1,323,216

The microprocessor, as it now is sold, does not account for all of Collings success. Indeed, the microprocessor did not even exist when Collings went into business in 1969. So Collings' first electronic cash registers, the so-called DaPac series, used discrete logic technology that DTS engineers jury-rigged into a microprocessor of sorts. But when standard devices did start to come available in the early 1970s, Collings was quick to recognize the advantages of off-the-shelf units, and he moved quickly to incorporate the technology into new cash register designs.

PRODUCT LINE

The DTS product line is made up of four cash register series for the most part:

- **SERIES 100** *which is the simplest model, does automatic sales tax computation, multiple price extension, weight and error correction, automatic change computation, and four different kinds of sales analysis totals. DTS has sold more than 3000 units since introducing the product in October 1975.*
- **SERIES 300** *performs the same functions as Series 100 and, in addition, handles up to twelve sales analysis totals, including food stamp calculations; also, the register can be interfaced into an online computer system. DTS has sold more than 10,000 units since introducing the unit in October 1974.*
- **SERIES 400,** *besides having all the above capability, also does price look-up (on as many as 4000 items), clerk and cashier control, item movement analysis, stock number capture, price modification, and summary management reports. DTS has sold more than 1000 units since the company began to ship units in January.*

DTS also sells printing systems, interfaces that link the registers to electronic scales, beverage dispensing systems and change dispensers, and other options.

But the devices turned out to have some big drawbacks. Only the Intel MCS-4004 and Rockwell PPS4 were then on the market, and both were imperfect for the applications Collings had in mind. The Rockwell device, for example, did not have an interrupt scheme. But it did have other advantages, such as a peripheral controller to handle the keyboard and display and another controller to run the printer. The PPS4 was also cheaper, and that was the decisive factor in its favor.

Microprocessor selection, however, was only the beginning of headaches. Discrete technology gives engineers access to data buses, registers, and strobes to facilitate design changes, but the microprocessor eliminates such conveniences because of its integrated design. Still another hurdle: The microprocessor instruction sets were too general and therefore inefficient. DTS engineers paid a price in toil, time, and head scratching for being early in the microprocessor game since the vendors have since alleviated some of the problems.

The gains, however, have come to outweigh the initial cost. For one, DTS engineers cram all of the necessary electronics on about 60 percent less real estate when compared to the discrete circuitry PC boards used in the DaCap series. This provided more design flexibility. In addition, the microprocessor-based design cuts power consumption, so DTS engineers place one battery inside of the cash register cabinet in the new models compared to three batteries located on the outside in the DaCap series where they serve as a back-up power source in case of a line failure.

But the ultimate success of a company depends on more factors than its products. Data Terminals, at an $11 million sales level, is still a pipsqueak when compared to IBM, Data General, General Instruments, TRW, Litton Industries and other giant contenders. Unlike arch rival NCR Corp., which uses a direct sales force, for example, DTS markets electronic cash registers primarily through 164 dealers in the U.S., accounting for 70 percent of total sales, and 19 distributors in 17 foreign countries. The dealers perform all warranty and service work. The company's accounts receivables reflect the marketing structure. Some 30 percent were outstanding for three months or longer on April 30 – 16 percent for six months or longer. But Collings insists that the allowance for doubtful accounts at $370,000 "is adequate," though hard times in the economy could upset that confidence.

The embryonic company is also approaching a dangerous cross-over point – where it is no longer entrepreneurial in size. Continued growth depends on big expansion, a business phase that always entails high risk. The company plans to double office and manufacturing space at its headquarters site in Maynard to a total of 90,000 square feet. In addition, the company plans to set up an assembly plant in Puerto Rico to gain tax advantages.

But Collings believes that DTS is simply undergoing teething problems. He is adamant that DTS is on the right track by sticking to simple microprocessr-based cash registers as replacements for the mechanical types. "Such a changeover can be cost justified," he says. He envisions the market becoming a billion dollar one in a few years, with DTS growing in stride. The company expects to have a 50 percent annual growth rate through 1980, Collings says. "By then, our sales should be $75 million." ■

TERMINALS

8080-Based CRT. The 8030 Display Terminal from *Omron Corp. (Sunnyvale, CA)* is a firmware-programmed CRT with a two-page refresh memory. Unlike most firmware programmed CRTs, the 8030 lets the user program communications speed, parity, bits per word

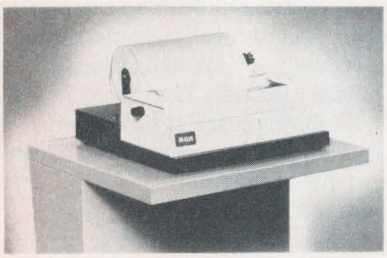
and stop/start bits. The 1920-character display uses a 7x9 dot matrix with half-dot shift for an effective 14x9 dot matrix. The unit is RS-232 or TTY compatible and communicates at speeds up to 9600 baud. Price is $2750.

Circle No. 60 on Inquiry Card

15/30-cps Hard Copy. Two new 4000 Series teleprinters from *Trendata (Sunnyvale, CA)* have operator-programmable function keys; operator-selectable modes of ASCII, correspondence, EBCD or APL; and optional tape cassettes. Both the 15-cps Model 4000A and 30-cps Model 471 are compatible with IBM protocols.

Circle No. 61 on Inquiry Card

RO Teleprinter Without Ribbon. Extel Corp. (Camden, NJ) has a new receive only teleprinter with five-level Baudot coding. It has switch-selectable speeds of 75 or



100 wpm. An optional eight-level ASCII version has speeds of 100 or 150 wpm. The teleprinter uses pressure sensitive paper instead of ribbon. A one-year lease is $55 per month.

Circle No. 62 on Inquiry Card

BELL BILLS DRAW SUPPORT AND FIRE

AT&T says support of its Consumer Communications Reform Act of 1976 is growing. A total of 138 Representatives and 13 Senators want to review the Communications Act of 1934. The Reform Act has several versions: the House bill filed by Wyoming Congressman Teno Roncalio and the Sentate bill filed by Indiana Senator Vance Hartke. Both versions would prohibit competition in the Bell system, especially in the interconnection portion, and take much of the regulatory power away from the FCC. Support, however, is not unanimous.

"The bills will increase consumer costs by subjecting users as well as manufacturers to a wide variety of conflicting and diffuse state regulatory standards and requirements," says Cbema in a letter to all Senators and Represenatives. "The substance of the legislation will not benefit the consumer despite its attractive label," it adds. The Computer and Business Equipment Manufacturers Association recently joined the other anti-AT&T forces, which include the FCC, Independent Data Communications Manufacturers Association, Datran, MCI, Southern Pacific Communications, Graphnet and United States Transmission Systems.

Another opponent, Drexel Burnham's computer analyst, Harry Edelson, told the Computer Industry Association that it's AT&T, not IBM, we have to worry about. "IBM is a dwarf compared to AT&T," he says. IBM's Satellite Business Systems may be the Consumer's only way to cheaper communications. For if AT&T gets its way with the Communications Reform Act, as he believes it will, consumer rates are bound to rise. Satellite communications, on the other hand, will make toll charges about the same for all calls, regardless of distance.

"AT&T is already competing with satellites," says Edelson, "by reducing the rates for long distance calls and increasing the rates for short distance calls."

ACOUSTIC COUPLER FOR TI733

Installing the Model 1733 acoustic coupler kit in the Texas Instrument 733 terminal requires only about 10 minutes. All parts, including modem card muff assembly and hardware, are included in the kit. Pricing starts at $289.82 with substantial discounts for OEM quantities. *Omnitec Corp., Phoenix, AZ.*

Circle No. 52 on Inquiry Card

MODEMS AND MUXES

General Datacomm Industries, Inc. (Wilton, CT) has an LSI data set with switch-selectable bit rates of 4800, 7200 or 9600 bits per second. The 9601 offers optimum protection against a total range of impairments instead of maximum protection against one or two types. It's designed for full-duplex operation with point-to-point applications using four-wire circuits. Price is $7250.

Circle No. 53 on Inquiry Card

Also from *GDC* is the 2400-bps 201-7 synchronous modem. The

LSI modem is designed to operate over unconditioned four-wire private lines. Price is $875.

Circle No. 54 on Inquiry Card

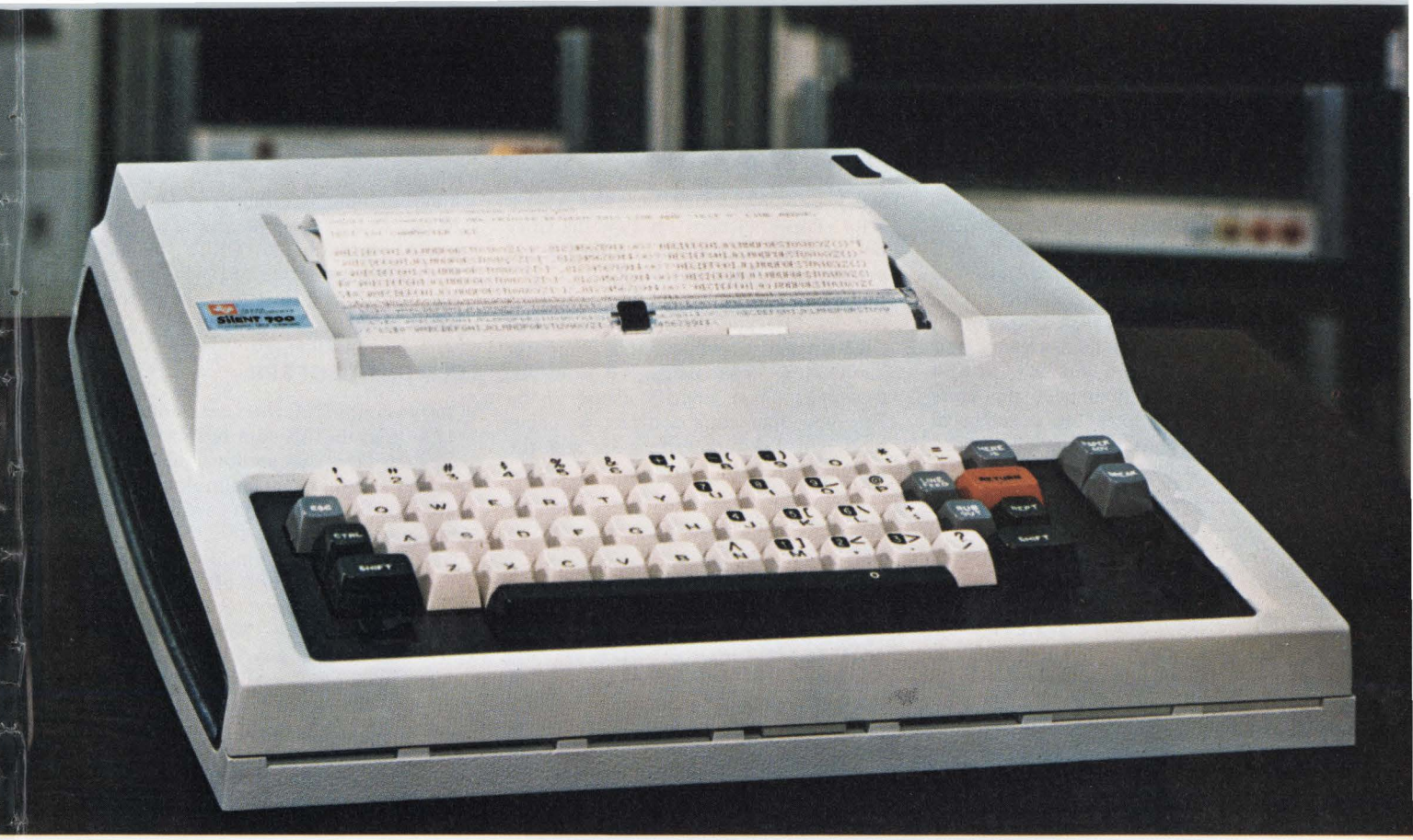
A limited distance modem for unloaded private cables or local exchange loops from the *Tele-Dynamics Division of Ambac Industries, Inc. (Fort Washington, PA)* provides full or half-duplex operation at data rates from 1800 to 19,200 bps. The 7300 features a

special phase-delay system of data encoding, which generates a narrower transmitted spectrum than other two-level techniques. This results in lower transmission frequencies and allows higher transmission levels. Price is $695.

Circle No. 55 on Inquiry Card

The first of the McModem series from *Data-Control Systems, Inc. (Danbury, CT)* is a private line data set for local lines operating at speeds from 1200 to 19,200 bps. The 4800 operates both synchronously and asynchronously in point-to-point or multipoint applications. Price is $995.

Circle No. 56 on Inquiry Card



743 KSR terminal...$1,395. Uncompromising *Silent 700* quality... at an unprecedented price.

The new *Silent 700*® Model 743 KSR data terminal is the lowest priced 30-cps printer terminal available today. And, true to its heritage, it combines all the popular *Silent 700* performance features . . . speed, reliability and quietness.

In fact, its speed and reliability are enhanced. Now there's true 30-cps throughput, because incoming data is buffered. Reliability is improved because its microprocessor logic means fewer circuit boards and components. This application of the latest design technology not only adds up to enhanced reliability but reduces size and weight as well.

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At $1395* quantity one, the 743 KSR is another TI price/performance value leader. . . whatever your application: console I/O for software development, keyboard terminal for inquiry response, data entry, interactive remote computing, or a message network terminal.

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For more information on the 743 KSR and other *Silent 700* terminals, contact the nearest TI office listed below or contact Texas Instruments Incorporated, Digital Systems Division, P.O. Box 1444, Houston, Texas 77001. Or, phone Terminal Marketing at (713) 494-5115, extension 2126.

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CIRCLE NO. 39 ON INQUIRY CARD

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CRTS KEEP NEWS HOT

The AP and UPI wire services are constantly racing against time and each other since newspapers pick up the story that comes over the wires first, not second. It's not just a matter of how fast a reporter gets a story and how fast he writes it, but how fast he can transmit it. Previously, reporters typed the story, corrected it and gave it to the Teletype operator, who punched it in paper tape and transmitted it. But CRTs are making the process a lot simpler. Reporters type the story on the CRT, edit it on the screen and press the transmit button.

UPI has phased in CRTs and phased out its Teletype operators. Each UPI CRT transmits to the central computer in the New York office. AP, however, is caught by a security clause in the Teletype operator's contract. So paper tape and Teletypewriters are still the main method of transmission. Things may be changing though for AP is going to buy Delta Data Systems' Model 4000 microprogrammable CRTs to input stories to each office's PDP-8/I for storage and to transmit the stories to the other offices.

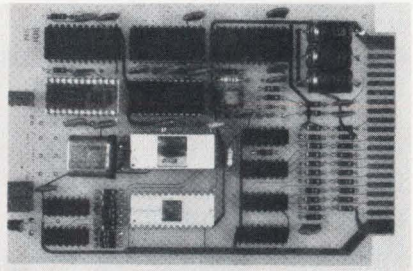
CCD DATA BUFFER

Charge-coupled-device semiconductor technology in this data buffer provides more storage and greater speeds than other semiconductor technology. Applicable for both common carrier and private data networks, the Model 1355 data buffer accommodates 32,000 characters (5, 6, 7 or 8-bit). Additional modules can expand capacity to 256,000 characters. With it, users can interface almost any two digital networks, can temporarily store data for editing, and retransmit data already output. Operation is full or half-duplex, synchronous or asynchronous. Message switching functions include full message accumulation, automatic forwarding of data in response to polling signals, automatic message counting, and retransmission of previously handled data. *Plantronics, Inc., Santa Clara, CA.*

Circle No. 63 on Inquiry Card

DIGITAL TOUCH TONE DECODER

The digital DTMF tone decoder meets or exceeds the critical telephone company requirements for dynamic range, twist, detection time and talk-off sensitivity. The single card module can be interfaced either by direct connection to the telephone line or through any of the telephone company approved interface devices. It appears as a high impedance, AC coupled and electrically balanced load to the telephone line.



The input tones are split into upper and lower bands and filtered before being digitally detected. The module detects all 16 Touch Tone codes and provides for data storage and buffering. Optional buffering for up to 40 digits provides complete handshaking for direct connection to minicomputer or microprocessor data bus lines. Price is $175 in quantities of 500. *BDI Electronics, Mountain View, CA.*

Circle No. 59 on Inquiry Card

U.S.-MEXICO PACKET-SWITCHED SERVICE

Telenet Communications Corp. and Teleinformatica de Mexico S.A. have agreed to provide the first public packet-switched computer communications service between the United States and Mexico. Service will commence during the third quarter of this year.

AUERBACH'S DATACOMM 80

A new informational concept covering the entire field of data communication information needs was introduced by Auerbach Publishers. The new concept, AUERBACH DATACOMM 80, is a continually updated data base of information on data communications that can be accessed through five separate information services. 1. Auerbach DataComm Advisor, a monthly report which serves an an introduction to data communications; 2. Auerbach Data Communications Management, a regularly updated information service that covers planning, evaluating,. and managing a data comm system; 3. Auerbach Data Communications Notebook, providing technical coverage, specifications and prices on over 1200 currently available devices and systems, updated monthly; 4. The expanded Auerbach Data Communications Reports, a five-volume set of detailed reports on computer terminals, minicomputers, data entry/collection equipment and data comm products and systems; 5. Auerbach Distributed Systems, an 11-volume set on designing, implementing and selecting products and services for a cost-effective distributed processing system. Contact Auerbach Publishers, Inc., 6560 North Park Drive, Pennsauken, New Jersey 08109.

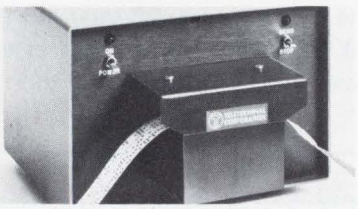
μP-BASED MULTIPLEXER FOR HARRIS

Harris is using an eight-bit microprocessor in a DMA multiport communications multiplexer. The microprocessor concurrently controls the character-level protocol, error checking and buffer maintenance of each of eight ports at aggregate data rates up to 76,800 baud. Each asynchronous line interface or port is configured in pairs and has its own parameter stack, vectored priority interrupt, word assembly/disassembly buffers to operate independently of the other. The Series 8400 DMA multiplexer is standard on all Harris S100 and S200 systems. With Slash computers, it's $3900. *Harris Corp., Computer Systems Div., Fort Lauderdale, FL.*

Circle No. 51 on Inquiry Card

PAPER TAPE TO TRANSMIT

The Fly Reader 232 from *Teleterminal Corp. (Burlington, MA)* reads at 300 characters per second and transmits over RS-232, current loop or TTL interface. The reader has back panel programming switches to select one of 16 baud



rates, to control the character length and parity number of stop bits and to inhibit or enable RS-232 control signals. Price is $695.

Circle No. 57 on Inquiry Card

The Model 1200 Paper Tape Transmitter from *BAI (Cherry Hill, NJ)* has an integral power supply and RS-232 interface with dual outputs: modem and terminal. Five transmission rates from 110 to 1200 baud are switch-selectable. Price is $895.

Circle No. 58 on Inquiry Card

A NEW VAN

ITT wants to join the other value-added networks, such as Telenet. Its new subsidiary, ITT Corporate Communication Services, Inc., is applying to the FCC for a Switched Private Network Service to begin in 1978. If the application is approved, the company plans to lease channels from AT&T, MCI and others for transmission between switching centers in six cities – New York, Dallas, Cleveland, Chicago, Los Angeles and Atlanta. Later the service will expand to 10 other cities. Unlike Telenet's VAN service, which is economical with high volumes over long distances, this service is designed for low to medium volumes over distances of less than 500 miles.

AT&T'S SHORT TRANSACTION SERVICE

Bell's Western Electric is developing a communication service for large volumes of short data messages and inquiry-response financial transactions. Transaction Network Service will interface with Touch-Tone telephones, Transaction I and II telephones, non-telephone co. terminals and a new Transaction III terminal.

Richard B. Shapiro

MASTERING THE MICRO

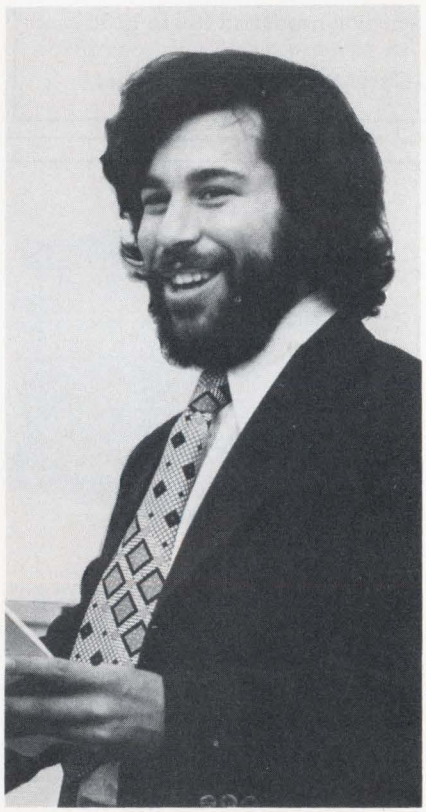
Beginning a series of first-hand accounts on what it takes in sweat, patience, and knowhow – and even tears – to master the micro. Here, 25-year-old Richard Shapiro, who founded Charles River Data Systems, Inc. in 1972, tells of his adventures to build a floppy disk controller system with the Rockwell PPS-8, at first, and then the Intel 8080.

I recently turned to microprocessors to expand the product line of my three-year old company, Charles River Data Systems, Inc. The company's principal products are add-on memory systems for two Digital Equipment Corp. computer models. The market has become increasingly less attractive because of the competiton and price erosion among core and MOS memory vendors. The floppy disk market, which is booming, looks more promising and I resolved to enter the market. My familarity with the DEC product line put me on to the need among users for an improved PDP-11 floppy disk system as an initial product. And in January I began the design work.

Any product of this kind entails hundreds of detailed decisions along the way, but one big problem popped up immediately. Which type of electronic logic should I use? Small-scale integration logic (SSI), like the 7400 series TTL? A microprocessor system? Or a specially designed, floppy disk controller chip? The choice is critical. It determines the size and cost of the ultimate production unit, how adaptable the product will be to a variety of applications, and how the equipment is to be serviced at customer locations. The best choice is not necessarily obvious.

Indeed, I approached the use of microprocessors with trepidation. Microprocessor software was new ground for me, although I had learned to program a computer in high school, and afterwards, when a student at both Johns Hopkins Univ. and Brandeis Univ., I worked as a programmer in the physics department. Some of this work was on programming minis, but the majority of my experience entailed the use of Fortran as applied to large computers. Even that experience, needless to say, was a big help. Otherwise, I would probably have had to team up with a programming expert. In any case, I was willing to tackle mastering the micro when my initial analysis pointed unequivocally to its use. Among the gains:

Have you used a micro and want to share that experience? Tell us briefly about what you went through, and MINI-MICRO SYSTEMS will provide all the back-up editorial support necessary to chronicle the micro application in an accurate and telling style on those descriptions chosen. The experience can even be an unfortunate one, just as long as you learned lessons helpful to others who are attempting to master the micro.



Richard B. Shapiro

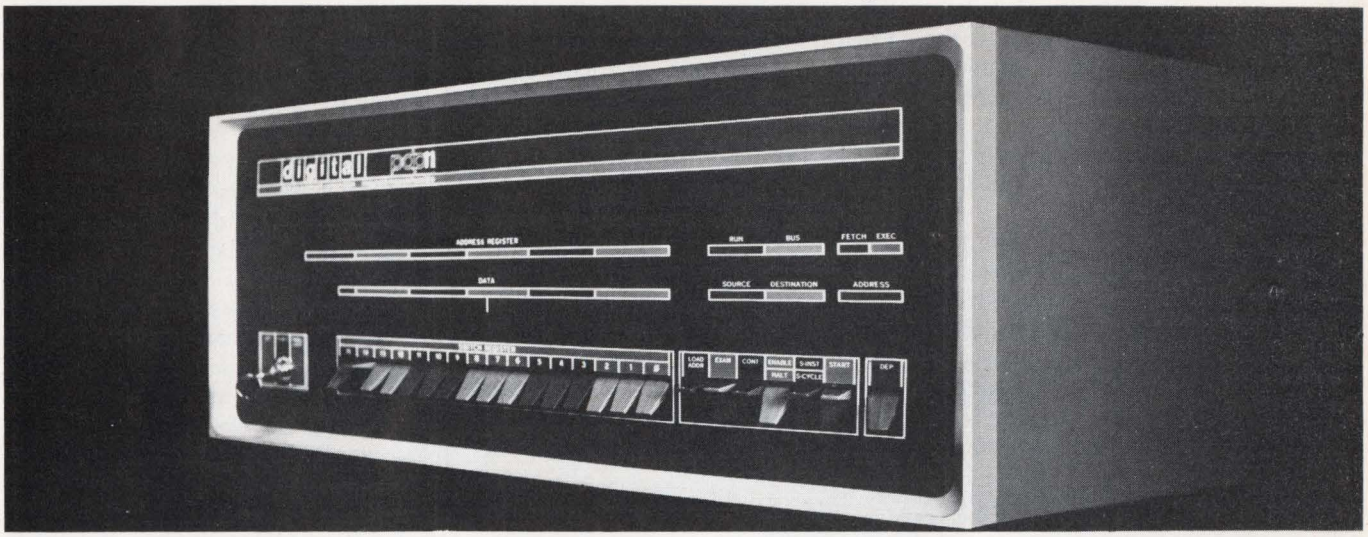
PARTS REDUCTION: I examined the innards of controllers to estimate a parts count based on a 7400 series TTL logic. The controller I had in mind would be compatible with IBM's format and when looking at such devices I saw that they contain at least 100 7400 dual-in-line packages. My controller would also require another 30 DIPs to handle the interface logic because I wanted it to be software compatible with Digital Equipment Corp.'s PDP-11 floppy disk unit.

A microprocessor-based design, on the other hand, would require about ten large chips, I calculated, including those for the CPU, clock, read-only memory, random access memory, input/output registers, and perhaps interrupt handling or special input/output chips. I also had to add about 20 chips, because a microprocessor, with its comparatively slow two microsecond cycle time, can not generate and check the cyclic redundency code, detect the missing clock pulse pattern used to mark the beginning of a sector, transmit data to and from the processor without an intermediary buffer and control logic, and do other high speed functions. The lesson here is that a designer needs to know the limitations, as well as the capabilities, of a microprocessor when considering its use.

Besides the special chips, I also needed another 30 chips to make up my PDP-11 interface just as I required in the discrete logic design. In sum, the microprocessor-based design had a clear advantage in parts count – approximately 65 chips compared to 130.

COST SAVINGS: Typically, a big reduction in parts count serves to reduce cost in a big way, too, and my disk controller was no exception. For one, the reduction in the size of the printed circuit board enabled us to put the entire controller on one quad-height board whose 8 in.x10 in. dimension fits readily into a small peripheral slot within the processor itself. This yielded considerable cost savings. Mechanical packaging came down by $15, printed

Need DEC Memory?



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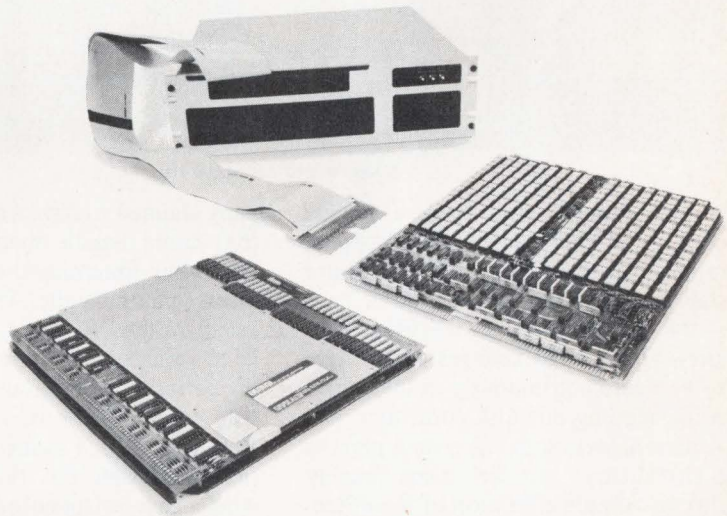

EMM Model	Increment and Type	Used With	Advantages	Price Qty One
7405	16K/32K Core in Add-on Chassis	PDP-11 UNIBUS	Up to 128K in 5¼" Chassis. Interleave and Parity Options	$8500 (64K words)
7805	16K NMOS in Add-on Chassis	PDP-11 FASTBUS	Up to 128K on the FASTBUS (64K in 5¼" Chassis) Includes Parity	$19,000 (64K words)
7711	8K/12K/16K NMOS Add-In	LSI-11	High density, High Performance	$1590 (16K x 16)

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CIRCLE NO. 15 ON INQUIRY CARD

circuit board costs by $15, assembly costs by $25, and testing components by $20. In addition, we saved another $25 on cabling because in my design the interface board includes the controller and only one cable is required which runs directly to the disk drives. In Digital Equipment Corp.'s RX-11 disk system, an additional cable is required between the interface and the controller boards.

The real world, however, did not permit us to realize all of the theoretical cost savings that came to $100. Half of the gain was offset by the higher pricing on the microprocessor itself and the associated chips when compared to TTL prices based on 100 unit quantities. Microprocessor technology though does have a pricing edge . . . product costs are dropping rapidly while prices on TTL gates have stablized, and may even rise.

Shapiro and his apparatus

APPLICATIONS FLEXIBILITY: I knew that design changes would have to be made continuously in the course of developing our disk controller, and a microprocessor-based system permits such changes to be made readily through simple alteration of the microprogram that is coded in the central read-only memory. Reprogramming is simpler and easier than changing circuitry and wires, and this flexibility was as important in my decision to use a microprocessor as was the reduction in parts and cost savings. Indeed, the capability to reprogram paid off only two months into our developmental effort. I had selected a floppy disk drive made by Diablo for the Charles River system, but I dropped the brand when the company announced that it would no longer market and support the product. I switched to a drive made by General Systems International, and because I had chosen a controller design based on microprocesors, I was able to simply alter the read-only memory to accommodate differences in the stepping and settling delay times, input/output lines, and elsewhere.

After having chosen to go the microprocessor route, I was faced with the next step: the choice of a microprocessor type. In retrospect, this turned out to be the most difficult decision of the entire project. Indeed my first microprocessor choice bombed out, and it hurt. About four weeks into my design effort, I had opted to use Rockwell International's PPS-8, because the company claimed to have a specialized chip that could handle many floppy disk controller functions that a microprocessor cannot handle. This chip was to calculate the CRC code, perform parallel to serial data conversion, check clock bit patterns for address marks, and do still other functions, and it and the Rockwell CPU, I thought, would significantly lessen the time and cost I would have to spend on my product's development.

The decision, though rational, turned out to be an unfortunate one. Everything in my design – the software, support circuitry, mechanics, and so on – is dependent on the microprocessor, so my work ground to a halt after two months when the floppy disk controller chip that had been scheduled for release in April continued to be unavailable. I remained in the awkward position of having to choose between waiting for the chips or to start afresh. Meanwhile, Rockwell had claimed that National Semiconductor, through a mask-exchange contract, was a second-source for the chip, and this taught me another vital lesson about microprocessor selection. The existence of a second-source contract does not necessarily mean that the other company will make the part or can even do so. I was under the illusion that transferring a mask was like sending a color negative to a processing lab – a dead wrong impression. Now, I discount claims that a product is being second sourced unless I have chips bearing the company's logo in hand. In fact, I am as skeptical about the claims by a primary source that it has a new product on the market unless that device, too, is in my hand.

In any case, I was now two months behind schedule, because Rockwell could not deliver the controller chip, so I decided to switch microprocessors. Actually, the change was made easier when a friend permitted me, for a nominal fee, to copy part of his floppy disk controller design. Essentially, I used that part of his logic and programming that pertained to the transfer of data in the IBM format. I saved about two-and-a-half months of development effort because these tasks account for about 50 percent of the total effort in making a PDP-11 compatible disk system. This also led me to choose the Intel 8080 since my friend's design was based on it. Technically, the 8080 has some big drawbacks. Its instruction set is limited and its two microsecond cycle time is slower than some of the bipolar devices now becoming available, but it proved adequate for my purposes. On the other hand, Intel has other things going for it. The company does deliver, the product is second-sourced by several vendors, and it also has a two-year history of field applications.

Now, at long last, I was ready to tackle the software development, undoubtedly the most troublesome chore in micro-applications, though I had not anticipated just how arduous it would be. At first I estimated my control program would be a mere 300 instructions long, and such a length I thought I could code directly into machine language. That was a mistake, but fortunately, it became apparent quickly. What appears to be a short program for a 16-bit minicomputer having a good instruction set turns out to be a much longer program when it is written for an 8-bit microprocessor that has a

limited instruction set. Coding the small program turned out to be a much larger job than I expected because so much cross-referencing of addresses is required. The solution was to use assembly language to cross-reference storage locations, subroutine entries, and branch points. Because such references are designated by assigned mneumonics, this otherwise tedious task is now simple to manage and the cross-references are automatically calculated by the assembler. Also, because of the mneumonics, writing a program in assembly language automatically provides some degree of documentation, and this is not at all true for machine language. A big gain results: I could now document the software well enough by simply adding a few comments to the program so that someone else could understand the program's algorithm.

At this juncture, I wanted to buy a complete microprocessor development system, but I could not afford to lay out the $15,000 cost. So, to assemble the programs and to code the PROMs, I used a development system located at the Cramer Electronics Inc. design center in Newton, MA. (See story on page 56.) The center was a big help when it came to assembling programs and programming a PROM. But it was not practicable to use the center to debug the hardware and to make the hundreds of changes and patches that came up in the course of the program development, even though the Cramer center has an Intel ICE-80 emulator. This is a nice tool to have when debugging, but I could not bring my tools, parts, power supplies, PDP-11, and controller prototype to the development center and work on the premises for three months.

As an alternative, I had to jury-rig debugging hardware and spent one month alone just to do that. The debugging scheme entailed interfacing a core memory to the microprocessor, which is one way to correct errors in programming and also to make temporary modifications that permit a program segment to be tested under particular conditions. The big advantage of the technique, known as simulating ROM with RAM, is the ease with which changes may be made in the microcode. It is a far better alternative than trying to continually reprogram an erasable Intel 2708 PROM. That job requires ten minutes to erase under unltraviolet light, three minutes to reprogram, plus set-up time. Since I had to make hundreds of changes, the cumulative time consumed would have been excessive. With my jury-rigged core memory, I can make program changes in less than one minute each – the time required to toggle in the address and new data on our memory tester.

I had to improvise on yet another hardware item. It turned out that I needed more than an oscilloscope to monitor the microprocessor system in debugging sessions. I needed to trace the activity of the microprocessor and other support chips in more detail – as they execute each step in the program. The Intel ICE-80 emulator is ideal for the task. Since I didn't have access to one, however, I installed a single step switch on the microprocessor, along with address and data line indicators, and used this assembly to display a program address and the contents of the PROM while stepping through the program. My indicators, however, did not show information internal to the microprocessor, such as the contents of the various registers, but I learned to live without this information.

Altogether my floppy disk controller took six months and hundreds of manhours of my personal efforts to develop. Now I can happily report my product is on the market. ■

BARBARA A. REYNOLDS / Associate Editor

DATA ACQUISITION

EDITOR'S NOTE:

Engineers are using microprocessors and IC technology in the move toward smaller and smarter data acquisition systems. Part 1 of this two-part series chronicles this trend as it overviews the market and product types. In next month's issue, Part 2 will explain some of the problems of microprocessor design and will give a list of data acquisition suppliers and products.

Data Acquisition ... a market in flux

Users of data acquisition systems no longer buy rack mounted types for large mainframes and minicomputers. A user, who designs his own DA system, seldom buys individual components any longer, either. A new trend is in full force. A user will now buy a palm-sized data acquisition module, containing all the discrete components, or they buy a data acquisition card with I/O that is interfaced to a microcomputer card. "IC technology has completely changed the data acquisition market," says Lewis Solomon, president of Venture Development Corp., a Wellesley (MA)-based marketing research firm.

Modular DA systems and PC board systems, which Solomon groups together, have 36.9 percent of the present market. But by 1980, those systems will have 53.8 percent of the market, he predicts. Intelligent and communications-oriented systems that incorporate a microprocessor have about 12 percent of the market now. By 1980, they'll have over 19 percent of the data acquisition market, Solomon says. While IC data acquisition systems bound ahead, the "standard" or rack-mounted unit will lose 70 percent of its market by 1980.

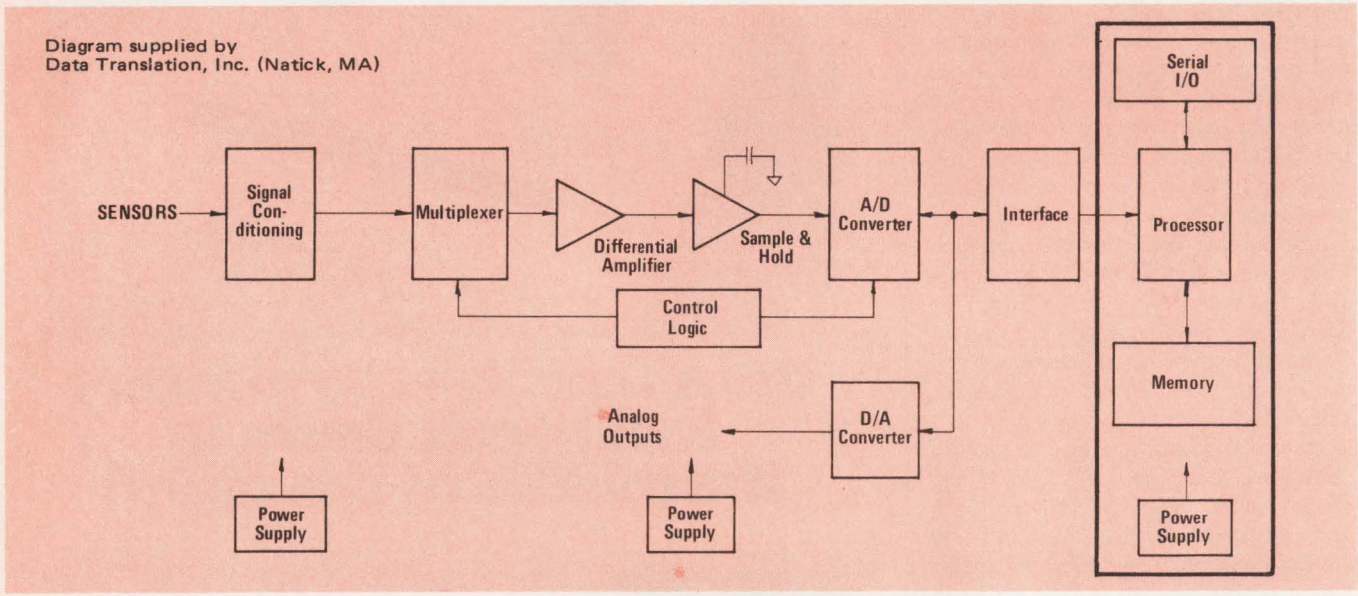

Fig. 1. Basic Data Acquisition System

Regardless of how users buy data acquisition systems, the basic data acquisition unit has these components: sensors and signal conditioners to obtain the analog data, multiplexers to time sequence more than one signal, amplifiers, sample and hold circuits to keep the input to the A/D converter constant, A/D converters and in some cases D/A converters and interfaces to the microcomputer or minicomputer (see Fig. 1).

The discrete components become smaller and less expensive as IC technology takes over. Add to this the already tiny, cheap microprocessor and you have an intelligent data

Venture Development Corp. (Wellesley, MA) has a three-volume study on the market for data acquisition components, subsystems and systems. The first volume, *Data Acquisition Components, 1975-1980,* was published last year. *Data Acquisition Subsystems, 1975-1980,* was the source of statistics for this article. The final volume, *Data Acquisition Systems, 1975-1980,* will be completed later this year.

Hughes' low-cost C-9 display terminal makes a minicomputer work like a giant.

Here's an interactive graphic terminal that does with hardware what most terminals need software to do. It needs only a minicomputer or telecommunications coupler and a 110-volt outlet to give you a ready-to-work system. And it costs less than $10,000.

More for your money

The new C-9 terminal offers high resolution, selective erase, serial interface (standard), and several other features otherwise offered only by units costing almost twice as much—like 17-inch diagonal, 1029-line-scan, cathode-ray-tube video monitor with high light output screen for easy daylight viewing....computer independent zoom and pan....a joystick for graphics and alpha-numerics interaction....a hardware graphic processor for scaling and rotating graphics and alpha-numerics.

The architecture of the terminal embodies a micro-processor driven by micro-programs contained in read-only memories. A serial interface connecting the detached keyboard to the CRT display eliminates restrictions imposed by parallel interfaces used in other models.

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You can extend the C-9's capability even further with options like enhanced graphic hardware package with rotations, reflections, and line-texturing features or programmable gray levels for graphics (16 levels) and digital raster continuous tone images (256 levels). We also offer parallel interfaces for a variety of minicomputers and interfaces to popular digitizers for local data input and control of the interactive CRT cursor.

The new C-9 offers a continuous writing mode and a new capability which guarantees that writing occurs only during vertical retrace time.

Smoother curves and lower costs

The patented Conographic™ generator, using conic curves to plot curvilinear information, produces smoother curves from much less data, thus requiring less computer memory, simpler software, less computer or telecommunications time. Result: The lowest *total cost of ownership* of any graphic terminal available today.

Many FORTRAN IV software programs are available, including a new set of Tektronix-compatible subroutines. The basic software package, called CONO-PAC, is available at no extra cost.

To find out how your minicomputer can work like a giant for much less cost, contact your local representative, or Hughes Image and Display Products, 6155 El Camino Real, Carlsbad, California 92008. Or call (714) 438-9191.

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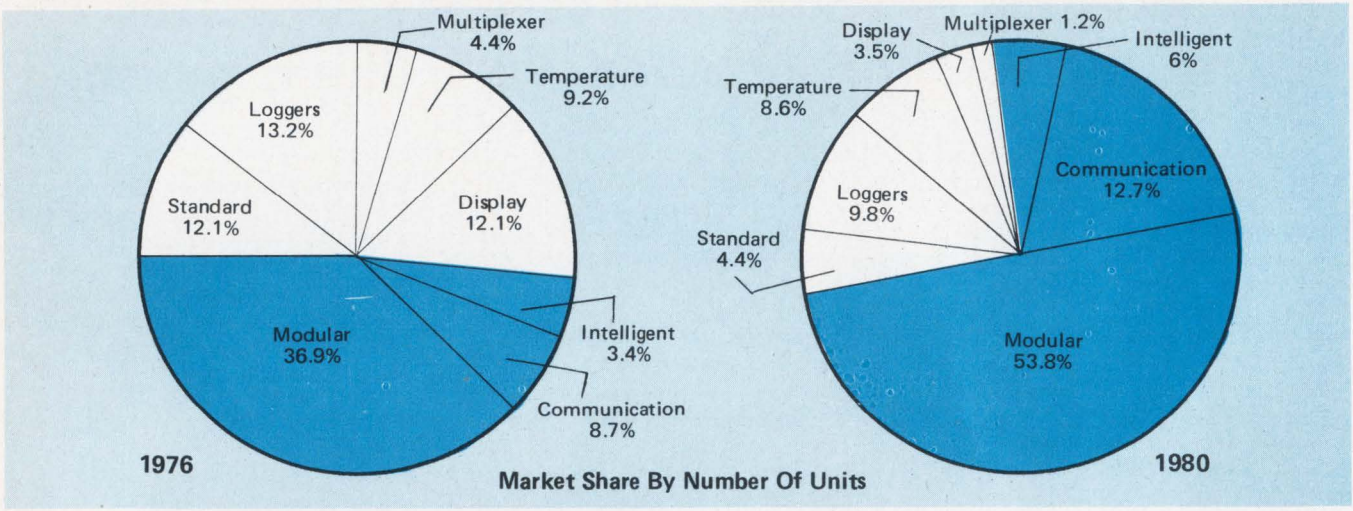
acquisition system that's small and inexpensive enough to distribute throughout a laboratory or factory. "Prices for modular data acquisition systems will drop by half between now and 1980," says Solomon. "Intelligent and communications systems will cost between 30 and 50 percent less by 1980," he adds. But he expects the "standard" system to cost about the same in 1980. Price drops like these not only change the way of buying data acquisition systems, they *extend* the data acquisition function. Whereas before it took a mini to make a system intelligent, now microprocessors can expand the intelligence to small groups of sensors.

Solomon warns, however, that the micro road is not without problems, especially with software and interfacing. Whereas minis have software already developed, micros do not. So it's left up to the hardware-oriented data acquisition house to go into the software development business. Interfacing to a mini is relatively easy, providing it uses an RS-232 or other standard interface. But each microcomputer has a different size board and different interface requirement.



CHANGING TECHNOLOGY'S EFFECT ON DATA ACQUISITION. *Venture Development breaks the data acquisition market into eight system types: modular (PC board), communication, intelligent, standard (rack-mounted), loggers, display, multiplexer/scanner and temperature sensing. Three of these systems – modular, communication and intelligent – will eventually, if not already, incorporate microprocessors.*

Most of the problems are merely the result of the microprocessor industry's early stage of development, Solomon says. In time, the micro makers will follow the lead of the mini makers and move toward providing standard interfaces, longer word lengths and larger instruction sets. The mini makers are already on the way to micro standardization by extending their mini lines downward into the micro area.

As microprocessors move more and more into data acquisition, the next step will be the data acquisition computer, Solomon forecasts. One LSI or hybrid IC package will contain everything – data acquisition circuitry, processor and memory. ■

Yesterday, Today, and Tomorrow

The Evolution of Data Acquisition

FRED MOLINARI / President and **AARON FISHMAN** / Vice President of Engineering
Data Translation, Inc., Natick, MA

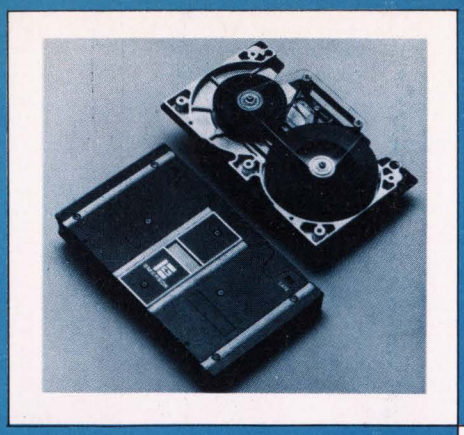
The design of data acquisition systems has changed drastically over the last 10 years. Each design advance also meant smaller size, less cost and better performance. Data acquisition has come a long way, but it's only just begun.

HOW IT ALL BEGAN

Data acquisition didn't start with sensors and A/D converters. It began with man reading a measurement and acting on that data. That system, however, had limitations. Man made errors. And it was a slow way to collect and reduce data. Then the era of sensors and A/D converters brought the data acquisition front-end that tied into a large central computer (Fig. 1). The front-end acquired analog information to be signal-conditioned and converted into digital information. After A/D conversion, the data went to the central processor and its peripherals to be stored or reduced. But data acquisition was only one of many tasks the large central computer performed. There was also payroll, inventory and manufacturing control. The cost of cabling was extremely high. Analog signals had to be sent over long distances where they were susceptible to noise. And when the computer went down, so did everything else.

Minicomputers brought data acquisition out of the computer room into the laboratory or manufacturing floor – a first step in decentralized data collection and control. Two or three minis offloaded the data acquisition function from the central processor. Minis worked well in distributing the Previously, system builders had to integrate various data acquisition components, including a multichannel multiplexer,

Fred Molinari and **Aaron Fishman** founded Data Translation, Inc., in 1973 with the intent "to combine the analog and digital worlds." Since the company's first product, a data acquisition module, sales have tripled each year. As the use of microcomputers spread, customers started demanding DA interfaces for Intel's SBC 80/10, National Semi's Imp and Pace and Computer Automation's Alpha 16 or LSI minicomputers. The next product will be the data acquisition computer, says Molinari.



Tape Pac® ½-inch computer compatible tape in a cartridge

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Standard features include a bi-directional read/write speed of 25 ips and a search/rewind speed of 240 ips. Available densities of 200, 556, 800, 1600 or 3400 bpi. 7 or 9 track NRZI, 9 track PE recording or a special recording format that's serial PE recording at 3400 bpi.

600 feet of ½-inch magnetic tape (1000 feet is optional) in a standard Tape Pac®...results in 12 or 20 megabytes of data storage. The basic transfer rate is 40K bytes per second.

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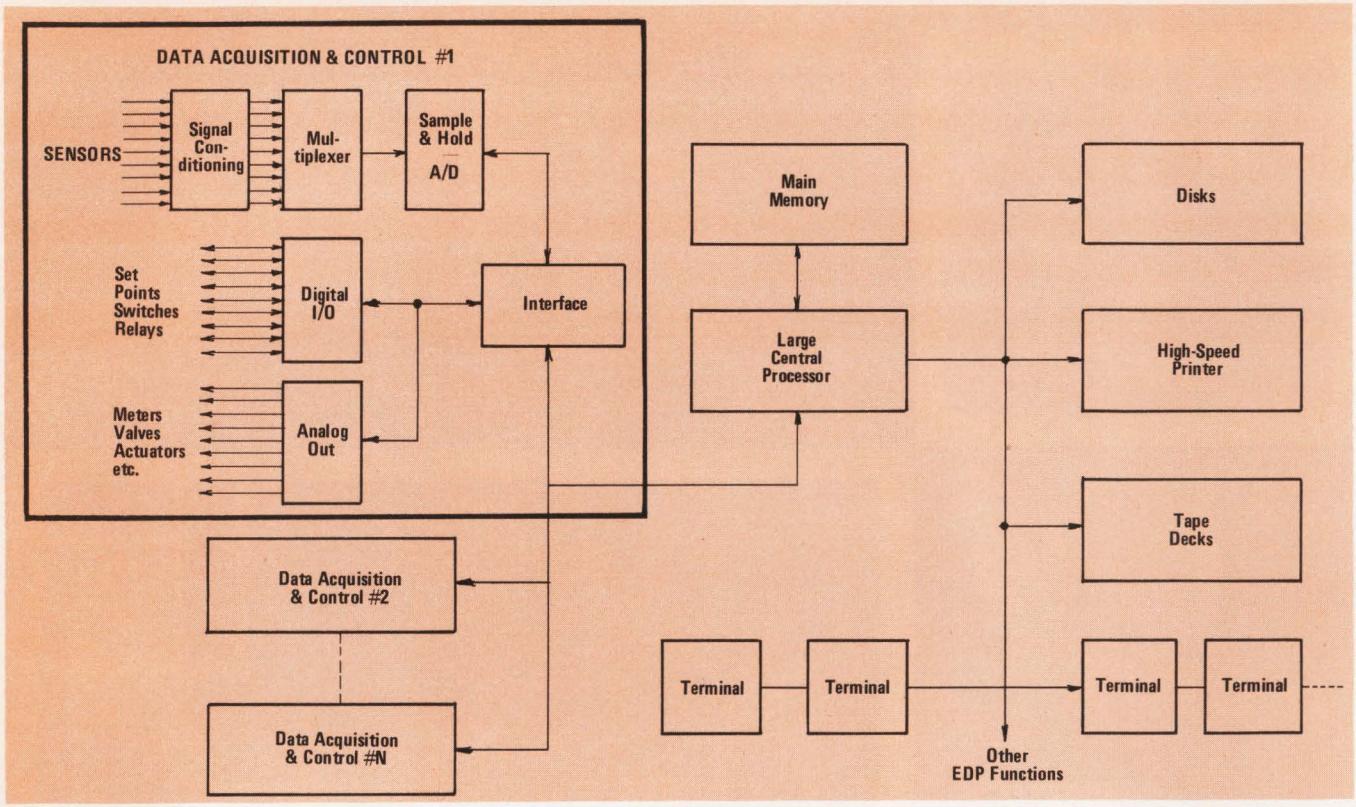

Fig. 1. Central Computer System With Data Acquisition & Control

load – so well that the engineers found the closer the processor got to the sensors, the more they could measure. And the overloaded mini became as effective as the overloaded central processor.

Minis, however, were to expensive too distribute on a smaller scale. And they required high-speed DA systems, large memories and mass storage. What the mini couldn't do, the microcomputer could. That is, distribute low cost processing power to a small number of sensors. That way data acquisition, collection, storage and some data reduction could be done at the measurement source. The microcomputer stations or remote process loops could then report through a serial communications link to a management computer, which oversaw the total process system (Fig. 2).

The next step was bring the cost and sizes of the data acquisition function in line with the microcomputer system.

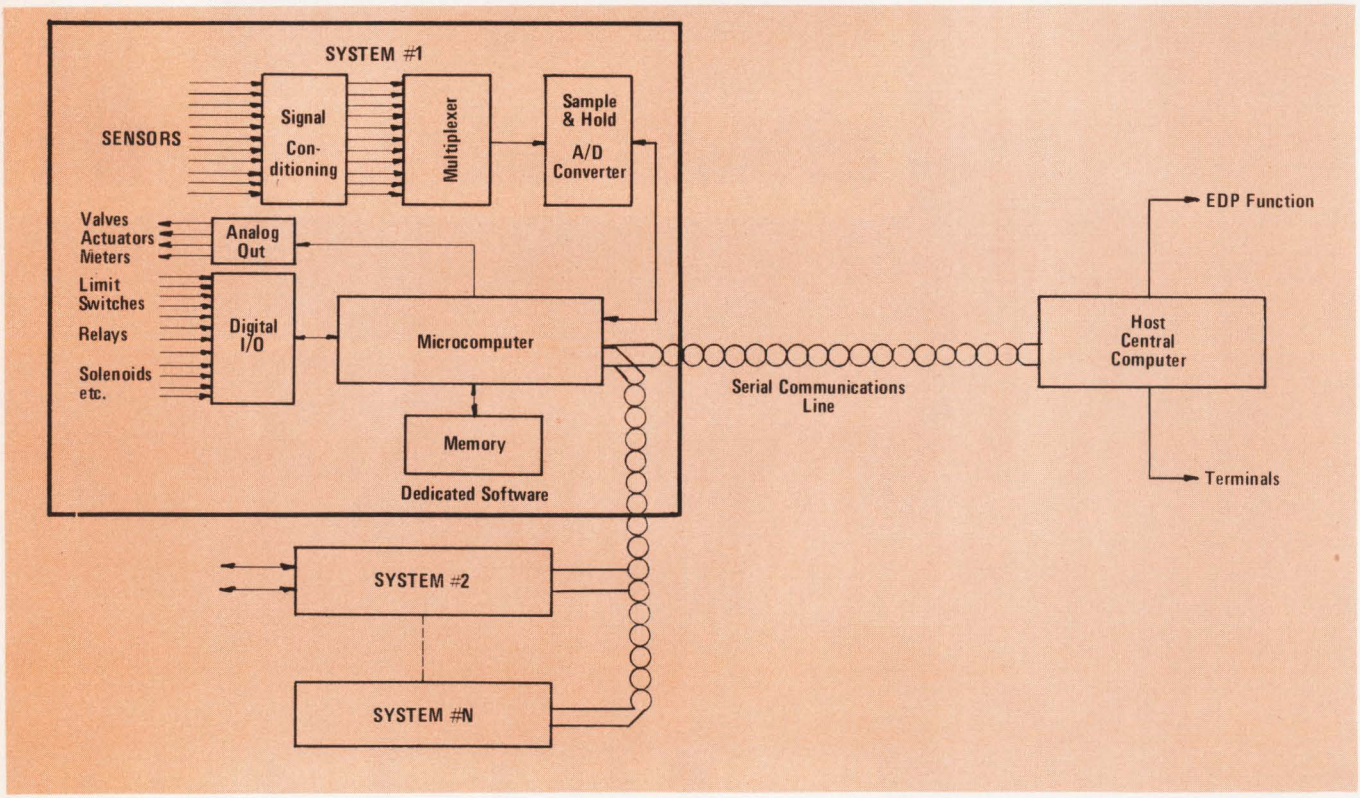

Fig. 2. Distributed Data Acquisition System With Microcomputer

When it comes to add-on memories, we've stacked the DEC.

Fabri-Tek is the only independent memory manufacturer to offer a complete line of add-on memories for DEC PDP 11, 8 and 12 Series minicomputers. With unbeatable prices, proven reliability and quick delivery—you can't lose.

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We've just topped off the PDP 11 Series with the Model 7011 add-on for the PDP 11/70. Expand up to a full 1024K words in 32K word increments. The first independent memory supplier to offer this capability with successful installations to prove it!

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Get up to 128K words of memory expansion. Add the Model 4511 Cache Buffer, which has given users an average throughput increase of 35%. Memory plus Cache equals price/performance effectiveness.

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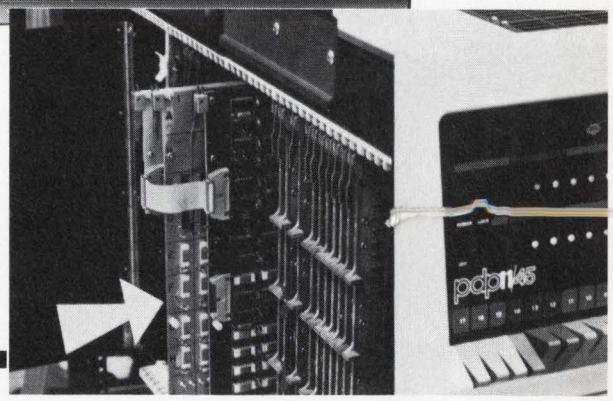

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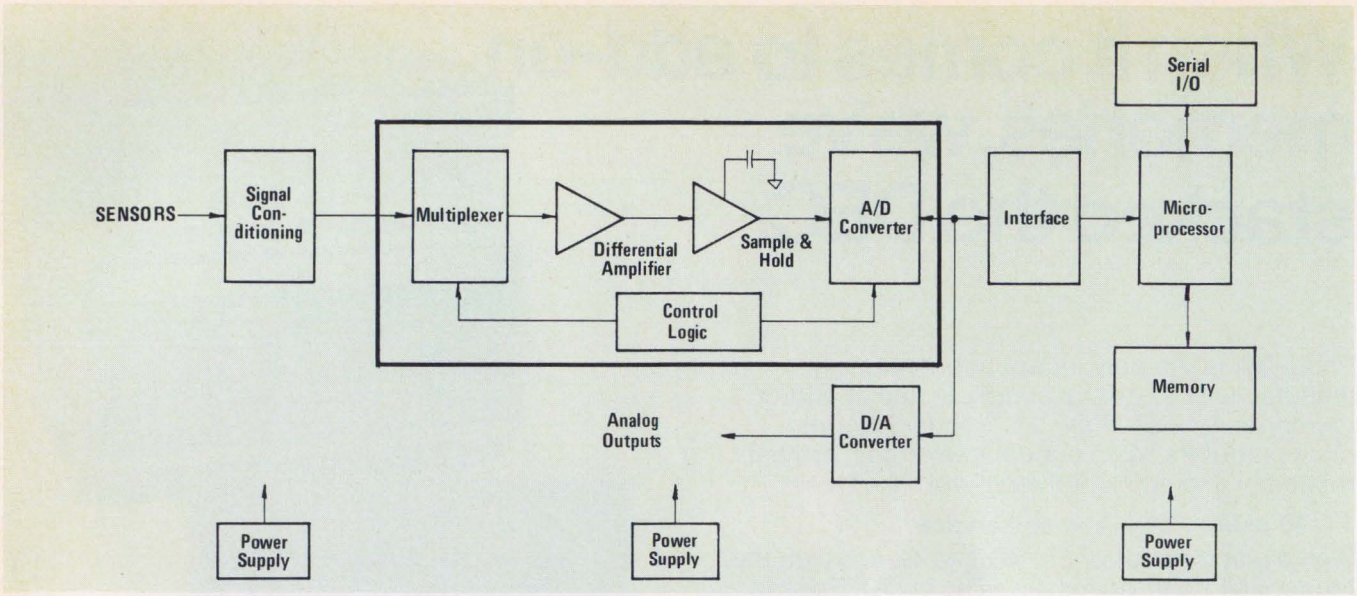


Fig. 3. Data Acquisition Module

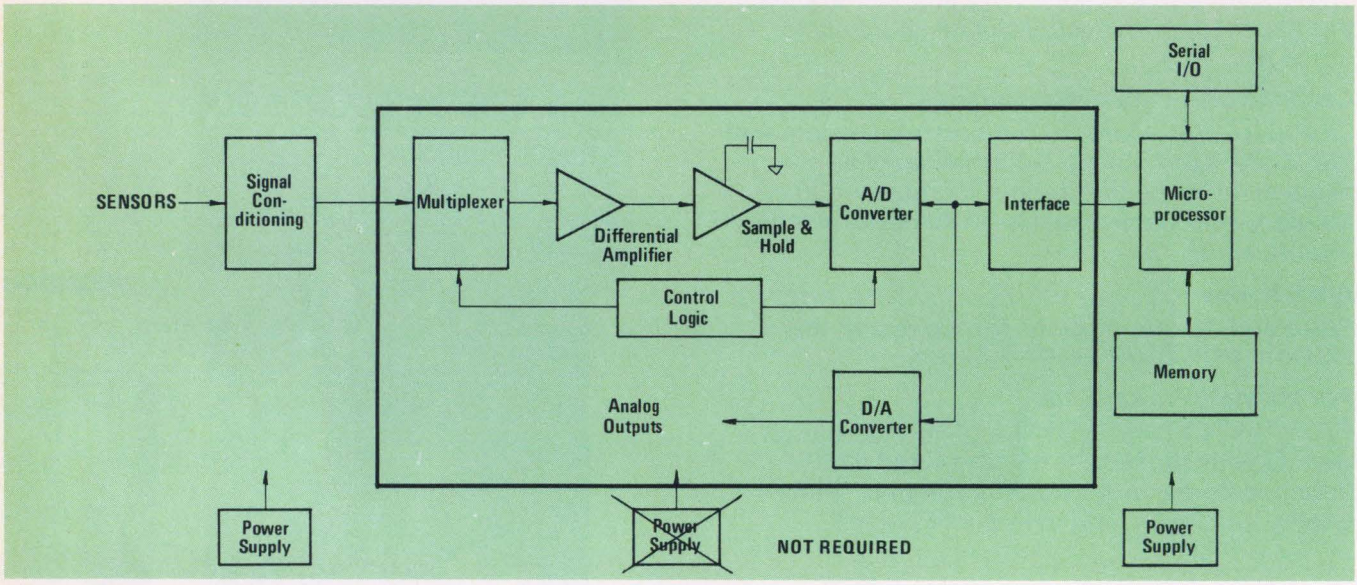


Fig. 4. Analog I/O Board For Microprocessors

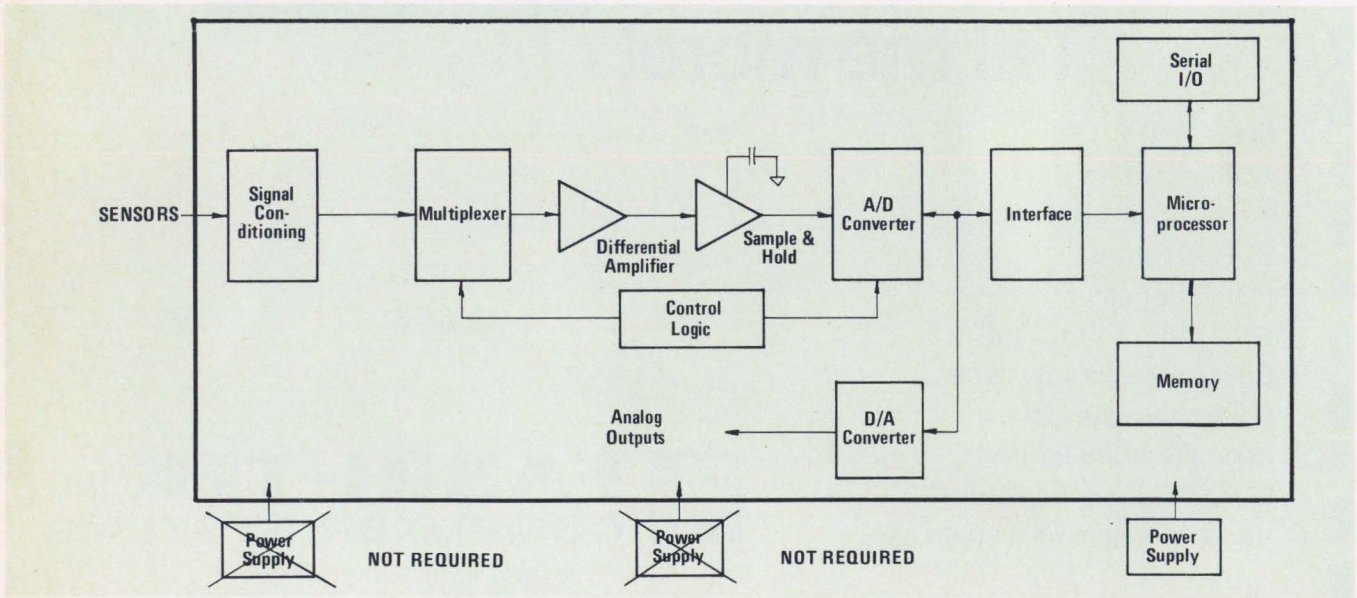
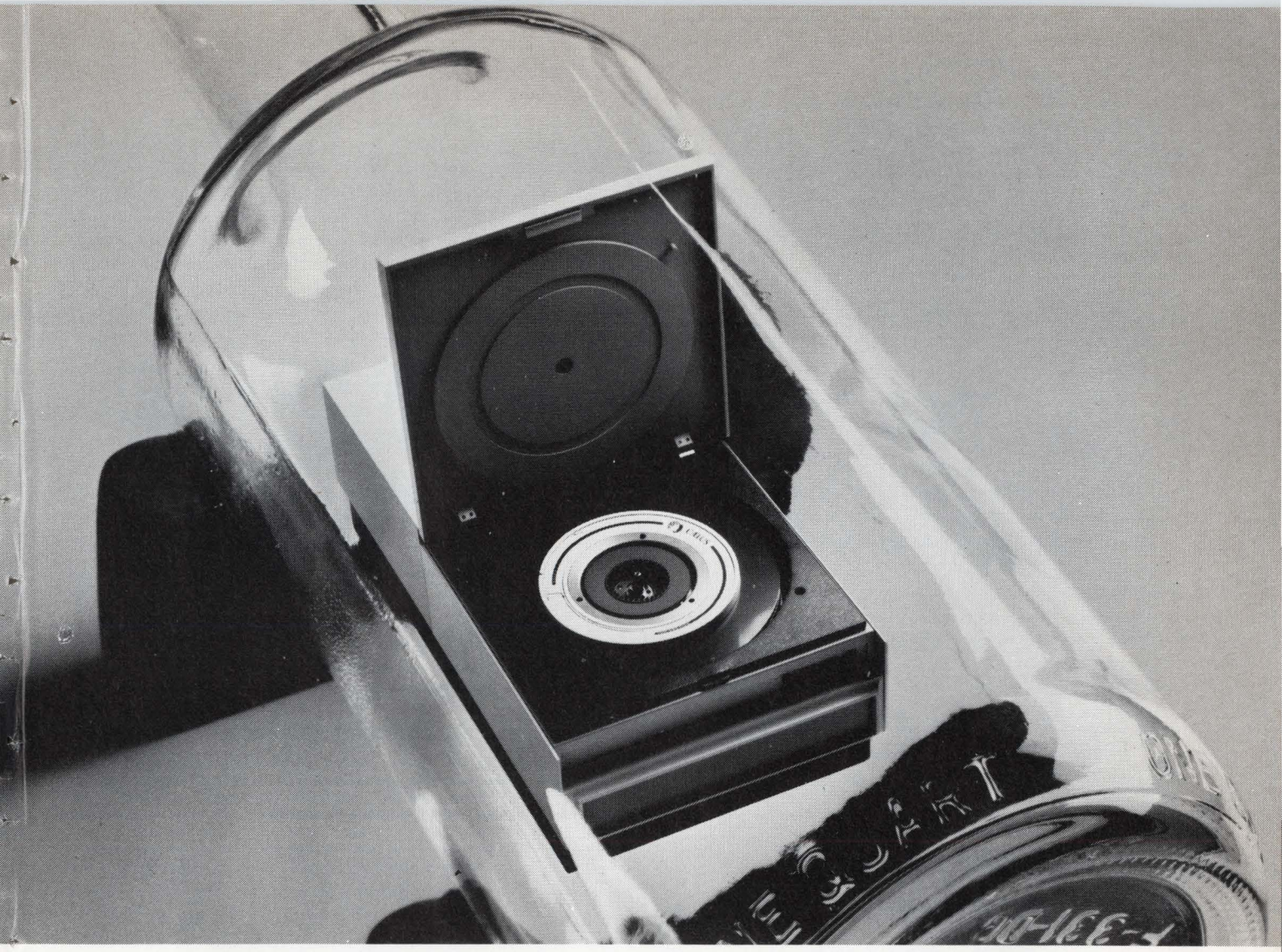


Fig. 5. Data Acquisition Computer



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The Trident Series has one of the lowest cost-per-byte ratios in the industry.

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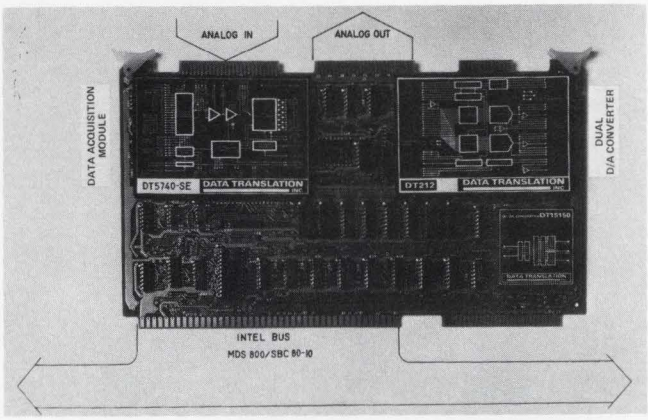
buffer, amplifier, sample and hold amplifier, and high-speed A/D converter. Each component had to perform very different functions, which caused long design cycles and ground and noise loops. A lot of design expertise was needed, in many cases more than the process engineer or laboratory user had. The data acquisition module not only brought down the size and cost of the data acquisition function, but it relieved the process engineer of much of the design effort. He could concern himself with the ins and outs of only one component – the module – instead of many (Fig.3).



DA MODULES AND MICROCOMPUTER INTERFACES. The 12-bit, 16-input data acquisition system from Data Translation, Inc., carries a price from $175 to $750, depending on the throughput rate. Enclosed in the 3x4.6-inch module is the multiplexer, simplifier, sample and hold, A/D converter and programming logic. The complete analog I/O system comes on a standard Intel-size board (6-3/4x12 inches) and includes a dual D/A converter to output information to a CRT in addition to the microcomputer interface. Price of the I/O system is $1195 in single quantity.

But building a system with a module was a lot like building a system with a microprocessor. Just a microprocessor was not complete without I/O and memory, the module was not complete without an interface to the microcomputer. Software was also necessary to make the microcomputer loops effective. So Data Translation developed a data acquisition system with analog I/O on a board that interfaced directly to a microcomputer with the same size board (Fig. 4). This way both could fit in the same backplane. And the stable configuration made software development easier.

BEYOND THE BOARD

But this, too, is only an interim step. Soon both the data acquisition and computing functions will be on the same board (Fig. 5). And within five years, all functions should be on the same chip. Whether in chip or board form, the data acquisition computer will be dedicated to a small number of sensors with similar signal characteristics. The data acquisition computer will accept analog signals, store data, reduce data and report to a host computer. Tasks previously impossible because of throughput limitations of the central computer will be performed. This will allow much tighter control of all processes. A physician who today takes an electrocardiogram and manually analyzes the waveforms will be able to use a microprocessor-based cardiograph that analyzes the data instantly after it is taken. With a patient's previous history stored in memory, he can compare the present reading immediately with past conditions. In industry, engineers will have online control of a process as they change parameters instead of having to reduce and analyze data offline.

The microprocessor has changed and is continuing to change the data acquisitions system. But more importantly, it's spreading it to areas where it's never been. ■

ROBERT CALKINS / Manager of Circuit Development, Micro Networks, Worcester, MA

the shrinking data acquisition module

Large, bulky rack-mounted data acquisition systems, consisting of large numbers of discrete components, went out of style along with yesterday's big cabinet-size computer. Today the microcomputer-on-a-board requires a small data acquisition system to match, a hand-sized DA module that, together with interfacing, can fit on a small PC board. Within the year, the microcomputer-on-a-chip will make an even smaller DA system necessary. And here, Micro Networks already has a start.

Whether a user needs a card, hand or finger-sized DA system, modules are the best way to go on most applications. The multiplexer, sample and hold, and A/D converters are matched within the module, and the user only needs to worry about acquiring the analog "ins" and interfacing the digital "outs." Engineering time is kept to a minimum, and little design expertise is required compared to that necessary when designing with discrete components.

Today's hand-size modules can be separated into two groups: discrete components packaged in a metal shell or integrated circuits mounted on a PC board. Metal shell modules protect the discrete components from physical damage and shield them from radio frequency interference.

Integrated circuits, on the other hand, are more reliable than discrete components. So we use hybrid integrated circuits in our 16-channel MN 7000 and MN 7002 modules. The hermetically sealed circuits have their own layer of environmental protection. And a metal shield can be added to the PC board when extra protection is needed.

Integrated circuits offer another advantage. A user, wanting to use his own board layout, can buy just the circuits. Still, he's not buying discrete components, but a fully optimized DA system.

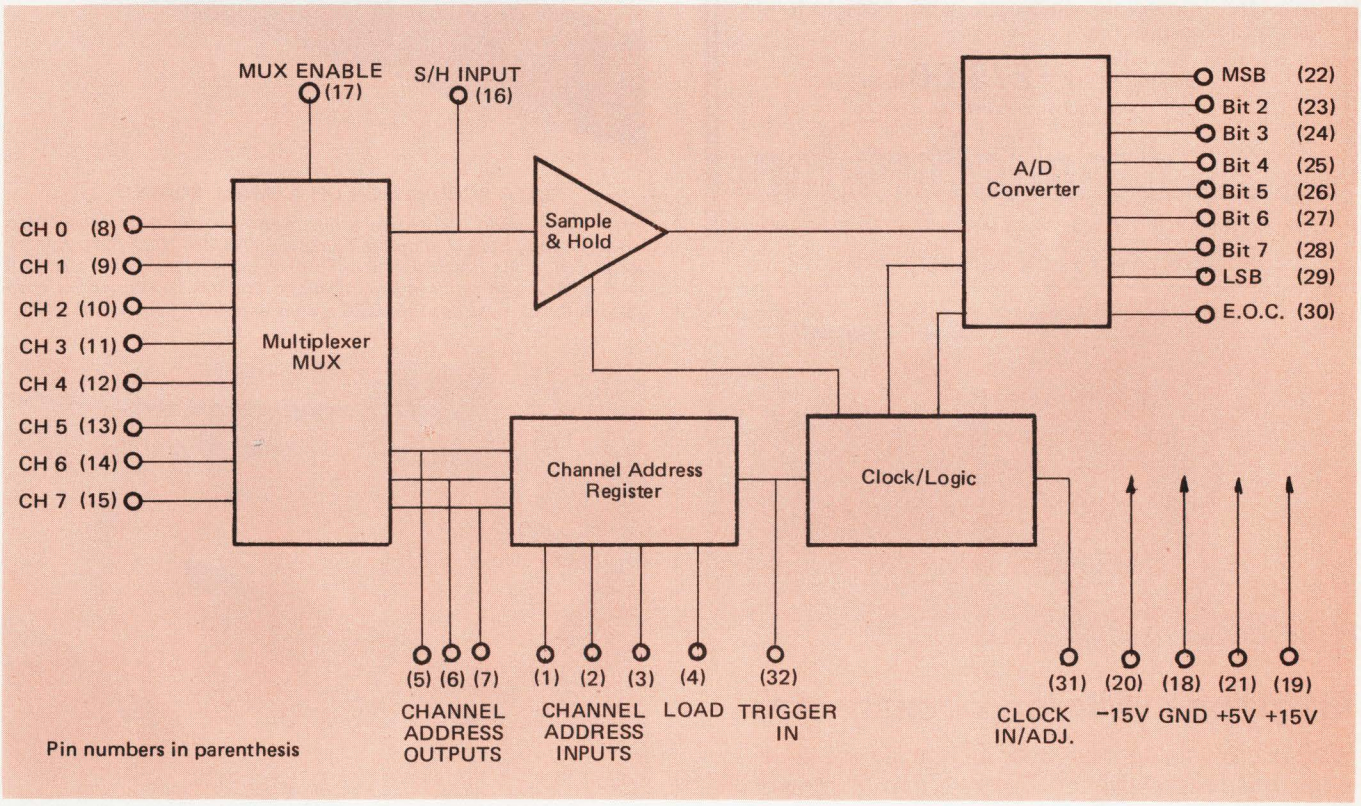
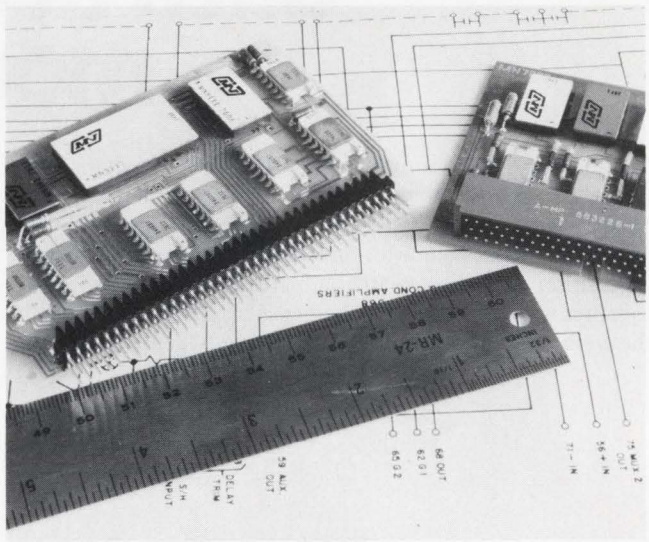


Fig. 1. DATA ACQUISITION IN 32 PINS. By using thin film hybrid technology, Micro Networks gets the major data acquisition function in one small package.

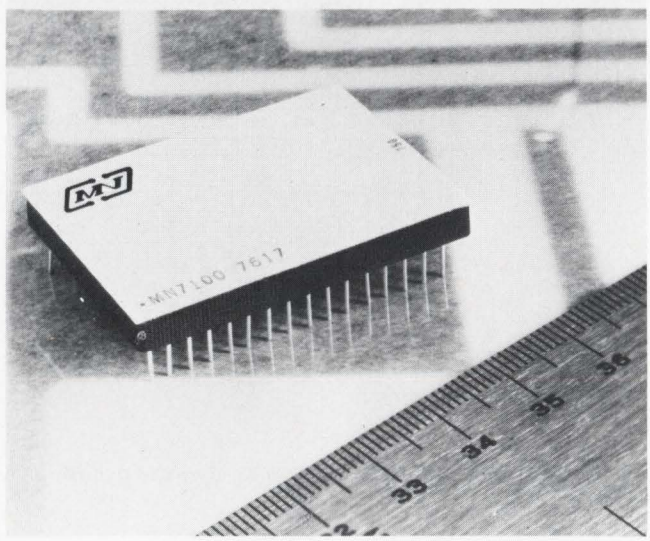
Robert Calkins has been developing circuits for Micro Networks for over four years. Micro Networks started in 1969 with military hybrid circuits and gradually moved into D/A converters. Its present product line is almost exclusively data conversion products.

Micro Networks has recently taken hybrid circuits one step further. And in so doing, it has reduced the size of the data acquisition module to the size of a microprocessor, which makes it the smallest DA system on the market. The MN 7100, shown in Fig. 1, has all the standard DA components – multiplexer, sample and hold, A/D converter and control logic – in a single 32-pin dual inline package (DIP). Monolithic components would have made the design too complex so we stayed with hybrid circuits. Thin film technology (thin film of gold evaporated onto ceramic substrates) simplified the manufacturing process.



DATA ACQUISITION ON A SMALL SCALE . . .

Both 16-channel, 12-bit data acquisition modules from Micro Networks contain hybrid integrated circuits. The MN 7002 (left) has tri-state outputs for interfacing to microprocessors. It's small in size (2.9 x4.5 inches) and small in price ($495). The MN 7000, without tri-state outputs, measures 2.8x3.25 inches and carries a price of $475.



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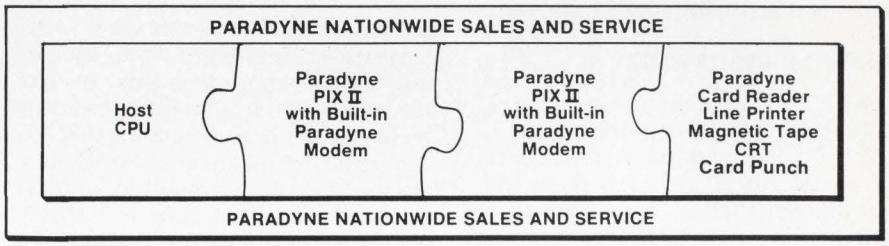

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CIRCLE NO. 37 ON INQUIRY CARD

MALCOLM L. STIEFEL / Contributing Editor

MINI HIGH-LEVEL LANGUAGE TRANSLATORS

Contributing Editor Malcolm Stiefel has logged 17 years in the computer field working as a systems analyst, systems engineer, programmer and writer. If you have input for the column, write:
Mini-Micro Software Editor, Mini-Micro Systems, 5 Kane Industrial Drive, Hudson, MA 01749

Most minicomputer users buy a CPU on the basis of price, CPU speed, internal memory capacity, and input/output capability. Through lack of awareness, they give short shrift to the software that can make or break the system development cycle — the programming language translator, be it compiler or interpreter.

True, a buyer may look at the operating system, utilities and application programs, but he won't evaluate the language translation program beyond choosing the language itself — Cobol, Fortran, Algol or Basic. He automatically assumes the translator will do the job. If it doesn't, he either lives with the problem, switches to a new machine with a more powerful translator, or tries to enhance the existing software.

If he chooses enhancements, he must then depend on the manufacturer to supply these. It's the rare user who has the inhouse expertise to play with his own translator. So unless the initial choice is made with some care, the user can find himself in a box that's hard — and expensive — to escape from.

WHICH TRANSLATOR?

If the user decides on a high-level language, selecting the appropriate one is easy — Fortran and Algol for science and engineering, Cobol for business and easy-to-learn Basic for education. Although assembly languages have the advantage of economical use of CPU time and fast execution time, these savings are often depleted by the number of manhours needed to program in assembly language.

And anyway, the typical disk-oriented mini sold today has enough core (32K bytes or more) and enough secondary storage (1 megabyte or more) to accommodate a fast, richly appointed language translator — one able to handle random, sequential, indexed, and other file organizations, usable in conversational or batch mode, married to debugging tools that make testing a joy and abetted by a global optimizer that minimizes core usage and running time.

If that's true, what's the problem? The problem is no one makes such a translator, although some come close. In fact, we don't know of any translator that has been built with debugging considerations cranked into the design. Even in the maxicomputer world, where thousands of manhours have been expended in translator development, testing tools are still grossly inadequate.

Everyone supplies translate-time diagnostics to isolate syntax errors, mistakes in punctuation, sequence errors, etc. But very few translators allow the programmer to see the source statement number being executed when a program exception occurs, or give aim a backward trace from the procedure being executed, or a dynamic history of the offending bit of data when the job aborts. For example, it would be nice, in case of an addressing exception due to an incorrectly-set subscript, to find out how that subscript was initialized and how it was altered (to what value and by what statements) during program operation before the exception occurred. That sort of sophistication simply isn't available.

What's a problem in the maxiworld is even worse in the miniworld where language subsets are built to squeeze into small memory segments. Some of the power of the language is inevitably sacrificed. And the translate-time diagnostics will sometimes suffer too, leaving the programmer to uncover errors in program testing that should have been trapped earlier. Arrays might have fewer allowable dimensions. Data names may be shorter, reducing program legibility. Nesting of IF statements or of procedures may be restricted. Ironically, these constraints further penalize the subset user, who has to write more code and use more of his limited memory to make up for translator deficiencies.

Another problem with subsets and also with language extensions such as Business Basic is they aren't entirely portable. So, if a user contemplates switching machines, he could face a bit of reprogramming to allow his old Fortran programs to run on the new system. Alternatively, he or the manufacturer may be able to build a conversion program that will rewrite the offending sections of code automatically.

One alternative to a weak translator is a batch or time sharing service bureau. With it, the user can write his programs for a cross-compiler and then transfer the object code to his machine by communication line, paper tape or cards for testing.

COMPILER OR INTERPRETER?

After which one, it's which type — compiler or interpreter. A compiler translates the source code into a machine language object module, which can be stored in a library for later execution or run immediately. An interpreter saves the source code itself or an abbreviated version of the source code instead of the object code. Thus, each time the program is run, the interpreter translates every source statement into machine language and executes the machine instruction immediately.

Generally, if a program is to be executed a number of times, a compiler is better since it is more efficient. It isn't unusual to see a given program run in 5 minutes when it is compiled and 20 minutes under an interpreter. Interpreters can't optimize the object code globally since they deal with each statement separately. But compilers like Data General's Fortran 5 provide extensive object code optimization.

However, if programs are to be developed interactively, an interpreter should be considered — at least for the program development stage. The one-statement-at-a-time translation capability of the interpreter makes it ideal for an online environment. If the programmer makes a syntactical error, the interpreter can stop him at once. He doesn't have to wait for his listing to come back tomorrow to find out what he did wrong today. Moreover, some interpreters allow the programmer to compile once the testing is complete so that production runs don't suffer the interpretation overhead.

The key interpretive language is Basic, developed for instruction of computer science students. For such applications, instant feedback is far more important than efficient execution since most programs will seldom be used. Basic also has its limitations, especially in file handling. But extensions like Basic Plus, Basic II and Extended Basic have overcome this drawback. ■

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CIRCLE NO. 13 ON INQUIRY CARD

DAN M. BOWERS / Technical Editor

mini/micro computers in the automotive industry

the microprocessor controlled automobile

EDITOR'S NOTE:

Part 4 of this Applications Profile continues to explore the "on-board" automobile computer. The article which describes microprocessor technology as it may be applied to the automobiles in the future, makes extensive use of information provided by General Motors Corp. and is based on an evaluation of a proposed microprocessor-based "Alpha IV" vehicle system.

Most automotive functions are analog in nature. Although some, such as ignition firing, are discrete on-off or digital in their outputs, the actual time to fire the digital discrete ignition pulse has always been derived from analog sensors and an analog computation has been accomplished by mechanically positioning the contact points or pulse sensor with respect to engine position.

Three main interrelated areas need to be considered when deriving algorithms in a digital format: resolution, time response and error analysis. An additional area of concern when applying microprocessors to automobiles in a cost effective manner, is the tradeoff between hardware and software.

RESOLUTION RESTRICTIONS

In a standard ignition system, the vehicle distributor contains the sensor, computational unit and actuator. In the Alpha IV automotive system, the standard 8 pulse per revolution of the camshaft sensor was used. This creates a problem of resolution in determining the engine angle for firing a spark plug since at least a degree or better accuracy is required, which was overcome by substituting a high frequency timing signal to divide the 90° engine rotation into fine enough increments to allow accurate spark plug firing. This time division is more complex than would appear since there are two orders of magnitude variation in the full operating range of an internal combustion engine. This can result in data which would require double, triple or even greater precision arithmetic in a 4-bit processor. A range selection computation was used to scale the problem for various speed ranges, thus trading an extra calculation for reduced precision in the arithmetic. This type of tradeoff, while not desirous, is ncessary in applying the microprocessor to the automobile. In automobile applications, the speed of a microprocessor is never fully utilized even when several functions are being time shared, many hardware vs. software decisions must be based upon the situation rather than standard computer engineering principles.

This hardware vs. software decision is demonstrated by selection of a vehicle speed measurement system for the functions of wheel-lock control, cruise control, traction measurement are required for these systems. Wheel-lock control requires rate of change of speed at moderately high data rate, while cruise control requires an averaging of the speed measurement free of the small perturbations caused by wheel hop, rough roads, etc. Due to the cost of sensors, it becomes apparent that the different qualities of vehicle speed data required for the above systems should be generated by the computer software rather than by addition or complication of the vehicle speed pickups. Thus a sensor with high enough resolution to perform the high frequency requirement of wheel-lock is used, and the CPU provides the time averaging and smoothing required of the cruise control and speedometer. The opposite approach is to use a low resolution sensor for cruise control and speedometer, with time division and the CPU providing the high resolution for wheel-lock control.

High resolution and powerful computational units usually entails added cost. The challenge of applying digital electronics to the automobile lies in the simplification of control algorithms to take advantage of the lowest cost hardware. Resolution restrictions within the computation,

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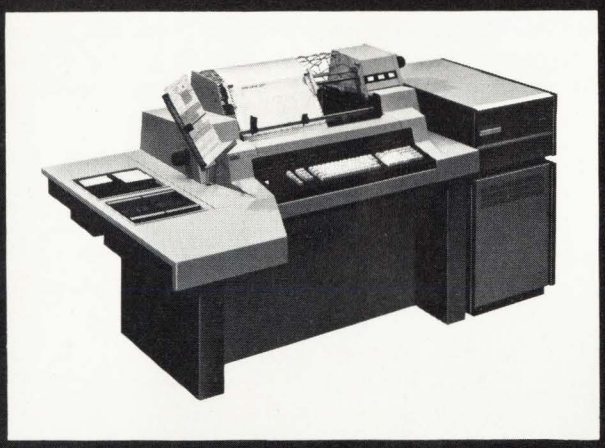

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input and output data resolution, and the entire subsystem must be considered, since while it may be desirable to calculate vehicle wheel acceleration to high resolution, it may not be required to control wheel slip within limits dictated by the mechanical laws of the vehicle itself. Expertise in the mathematical calculations must be closely coupled with a firm knowledge of actual vehicle requirements in order to reach a cost effective solution to the problem.

TIME SCALING

Time scaling is closely related to resolution: if time is of no consequence, resolution is no problem. In general, time scaling will be dictated by the frequency response requirements of a functional algorithm. However, strict adherence to frequency response may not always be the most cost effective solution, since other means, either hardware or software-wise, are available to compensate for compromises in time response.

Various time scaling can be generated in the CPU software as the case mentioned above with wheel-lock control with its high data rate requirement and a cruise control with a smoothed average data rate. The software can accomplish this by simple addition of many input data words to obtain the smooth data.

Another consideration is scaling of data to a binary format, when possible, since the computing machine is of this format. The algebraic calculations should be set up to be manipulated in a binary format whenever possible to relieve the microprocessor's computational burden.

It must always be kept in mind when designing an automotive system that engineering time spent in optimizing hardware, since this is a majority of the cost of a high volume system, is time well spent. When it may seem expeditious to use standard computer techniques for hardware and software, this can result in additional cost in a production design.

ERROR ANALYSIS

Errors must be considered in a digital system much the same as in an analog computer. It is merely that the sources of error are not in the more familiar format of an analog system. Truncation errors can occur and be significant even though a sensor may be highly accurate. Also, errors created in computations must be considered such as dropping lower bits, etc. Amplification of these errors can also occur depending upon algebraic manipulations to which the data is subject from input to output.

Of course, the effects of errors must be considered in terms of system performance, since errors always exist. The systems engineer will only minimize the errors when necessary to obtain the desired system performance. For example, in the instance of the wheel-lock control, some rather large errors are tolerable in the calculation since input data rates are fairly high and thus random errors due to truncation of data are cancelled out by the next calculation which contains a complementary error.

This effect can also occur where a smoothing of data such as a cruise control is the desired calculation. Since the calculation itself is designed to delete small perturbations in speed it also tends to negate the effects of errors.

SIMULATIONS

Computers have become accepted tools in both the design and evaluation of automotive systems and components. They are definitely a useful tool in the generation and evaluation of control algorithms for an automotive computer control system. Most vehicle simulations are already available in some form and the designer need only find the available ones and perhaps tailor them to fit his needs. The algorithm for control of a vehicle function still must be conceived, however once conceived it is a minor task to program it into the computer simulation. Care must be exercised to limit the simulator computer's computational capability. The calculations for control of the vehicle simulation must be kept within the bounds dictated by the processor which will ultimately be used in the vehicle. Various parameters however can be read out in any format which will best aid in evaluating the control algorithm being studied.

Limitations are usually encountered in most vehicle simulations. The engineer must recognize these and realize that the value of the simulation has reached its limit of usefulness and that further evaluation must by necessity be done with a vehicle.

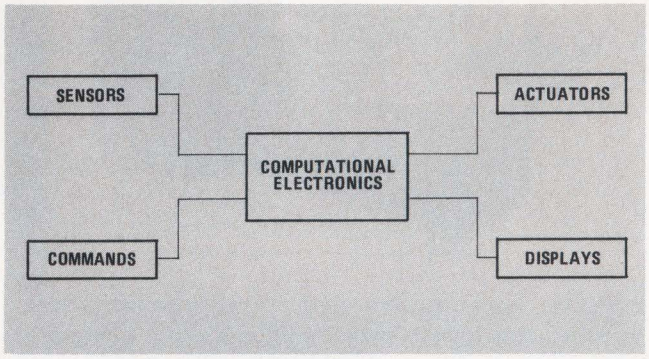

Fig. 1. Automotive Electronic System

The amount of vehicle testing is a function of the system being considered. If it is a complex function which is affected by many vehicle operating conditions, such as wheel-lock control, then many test runs must be made. If the system is simple and affected by only a few operating conditions, far less testing is required.

Of course, after the complete time shared multiple-function system is completed, final testing in the vehicle is necessary to determine that no interaction exists which creates problems not revealed in the subsystem analysis.

HARDWARE CONFIGURATION

Any automotive electronic system can be generally shown to consist of the configuration shown in Fig. 1. The speed sensors and their interactions with the subsystems of the computer system are depicted in Fig. 2. The electronic cir-

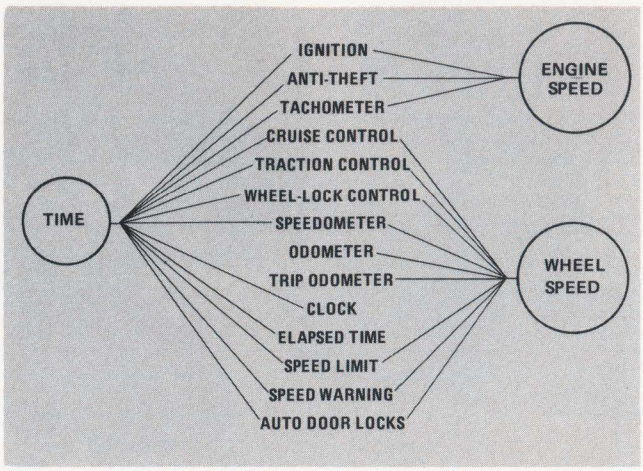

Fig. 2. Computer Subsystem Chart

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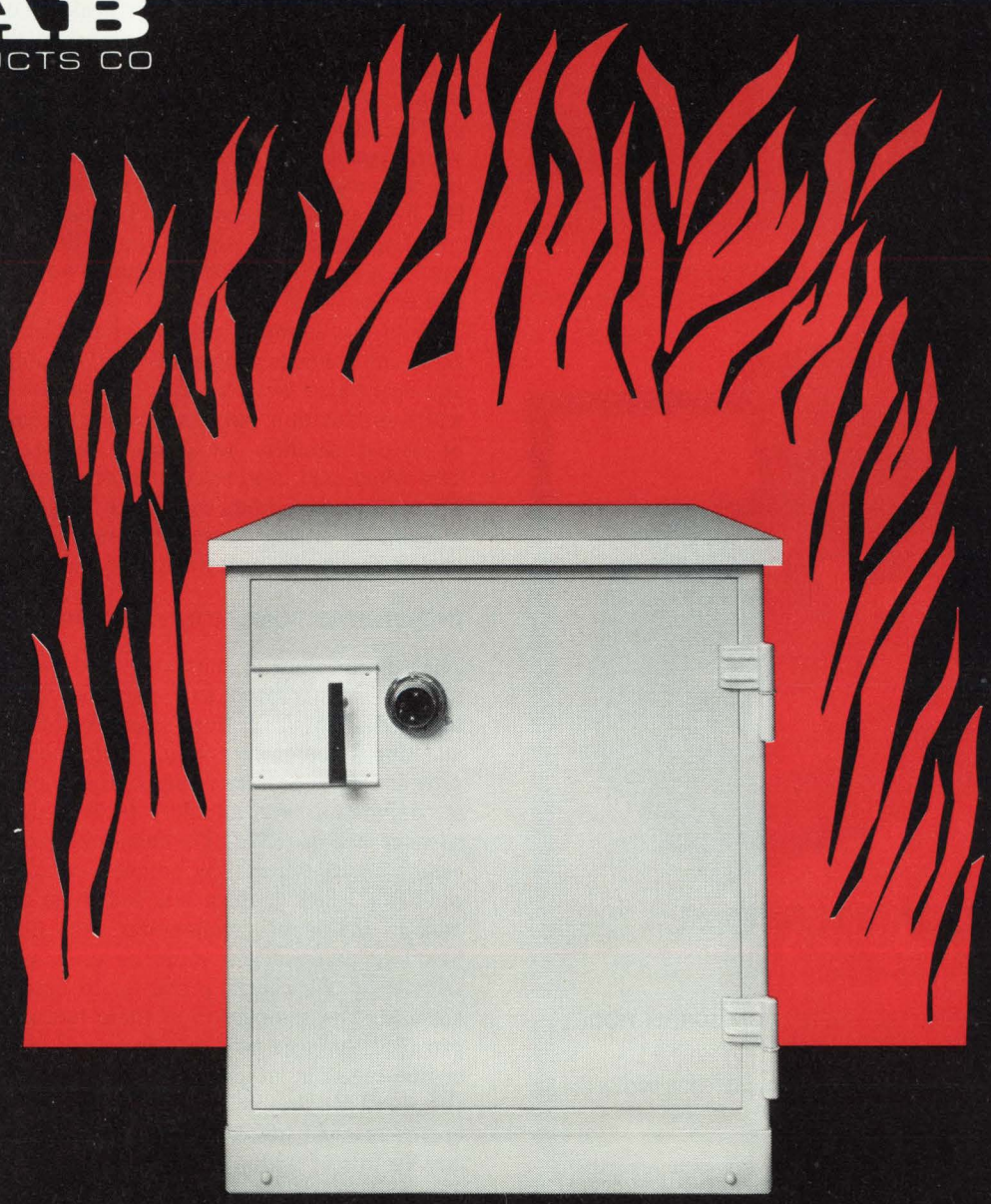

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cuitry can be divided into two main areas: one, the central processor unit and its associated hardware, such as the memory and timing circuits along with the data and address bus structure and the necessary input and output ports; and the second is the interface circuitry necessary to transform input (and ouput) signals to (and from) the computer.

The microprocessor portion of the electronic unit in Alpha IV is a commercially available four-bit parallel processor which utilizes MOS technology to achieve the complex functions on small chips. The commercially available hardware also includes, in addition to the CPU, other devices such as memory and input/output chips. The memory consists of random access memory (RAM) and programmable read only memory (PROM). The RAM memory is required to store temporary data used in the course of the computations. The PROM memory is used to store the actual program steps. PROMs are used because of their ability to be erased and reprogrammed which is a valuable asset in an engineering developmental system; a production system would likely use mask programmed ROMs for lower cost, smaller size and lower power requirements.

The input counting circuitry in the Alpha IV system consisted of digital counters gated with fixed period signals, providing a means of counting wheel speed pulses in a given interval of time. The binary number in the counter at the end of the prescribed period would then represent the vehicle speed.

The output circuitry consisted of counters and latches which could provide a similar asynchronous operation as the input counting circuitry. A number would be calculated by the central processor and transferred to the output counting device. The device would then count to zero and output a carry bit pulse. This pulse would then drive a control device.

With this counting capability, a number of output functions are available. Some of these capabilities are energize and deenergize the spark coil for ignition control and pulse width modulation outputs to drive actuators. Other forms of output circuitry are discrete latches that would store data which had been calculated or determined in the CPU. These discrete outputs could also be used to interface with a digital to analog converter which in turn could drive an analog display, an analog actuator, or servomechanism.

INDIVIDUAL FUNCTION IMPLEMENTATION

The ignition control subsystem had two main input parameters: engine speed and manifold vacuum. The engine speed was obtained from a crank shaft magnetic pickup and input counting circuit described previously. This provided the necessary input for the central processor in conjunction with a lookup table to determine the spark advance due to RPM. The manifold vacuum signal was an analog signal which was coupled to a voltage controlled oscillator which in turn was fed to an input counter. The data in the input counter was then proportional to the manifold pressure and could be used with a table lookup scheme by the central processor to determine the vacuum advance. The summation of these two advance parameters provided the necessary data for spark plug firing time. The engine speed input parameter was also used to determine the dwell or the coil energizing time. As the automobile engine reached higher RPMs, the dwell was reduced sufficiently to stay within the 90° rotational time of the engine. The parameters involved in spark firing time were transferred to output counter circuits as described above. One counter provided the time at which the coil begins to

energize. The other output counter controlled the spark firing time. These counters operated asynchronously from the CPU and therefore the computer did not have to cycle and output data to the output counters for each spark firing. This approach assumed that the input parameters did not change significantly between successive computer loops. This proved to be a valid assumption. A basic flow chart for the program used in this subsystem is shown in Fig. 3.

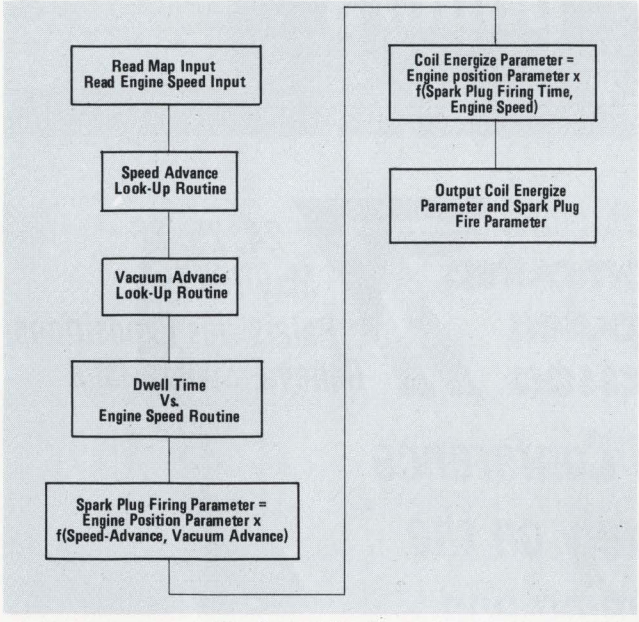

Fig. 3. Ignition Control

The cruise control subsystem utilized one input wheel speed signal. This signal was accumulated in an input counter which was gated at a fixed interval of time. Thus, the CPU could input the data from the counter and this data would be proportional to the wheel speed of the vehicle. The data was averaged over a number of samples. When the cruise control was activated, the present wheel speed data in the CPU was stored in the reference wheel speed RAM location. This reference data would provide an output parameter proportional to deviations between the reference speed and the present vehicle speed. This output parameter was proportional to the difference between the present speed and the reference speed plus some proportional function of the reference speed. The output parameter was also modified at higher throttle angle to provide system gain corrections in the high throttle area where the vehicle gain is generally lower. A hysteresis subroutine was

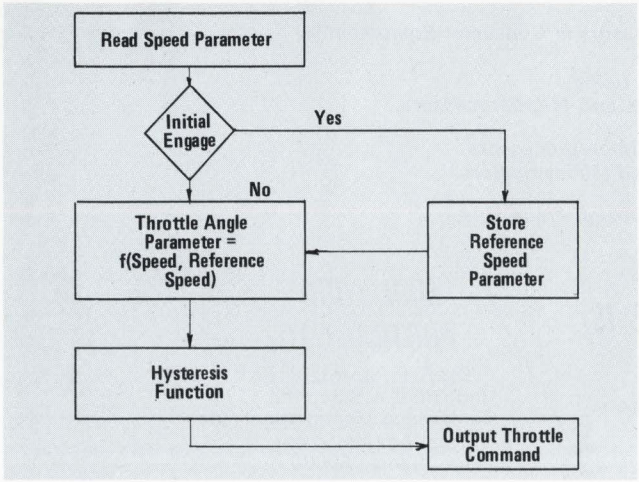

Fig. 4. Cruise Control

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included in the algorithm to filter out any small ripples in the data. The output parameter was then transferred to discrete output circuitry which performed a digital-to-analog conversion and controlled the analog throttle servomechanism. This servomechanism controlled the throttle angle of the carburetor. Again the output control was asynchronous to the CPU allowing the CPU to provide the calculation and logic functions for the other subsystems. A basic flow chart of the cruise control program is shown in Fig. 4.

Traction control has two input parameters, the front wheel speed which is the same as the cruise control discussed above, and the rear speed or driven wheel speed signal which is counted in an input counting circuit. These two parameters are then compared in the processor and a throttle angle calculated based on the relationship between these two input parameters. The output throttle angle parameter is then subtracted from the cruise control parameter to determine the net throttle angle position. Because of the commonality between the output parameters of the traction control and the cruise control, the output from this function is analogous to output of the cruise control subsystem.

The wheel-lock control system has two or four wheel speed inputs, depending upon whether a two or four wheel lock control system is utilized. The brakes are released if the wheel speed data indicates an excessive deceleration which implies that particular wheel is approaching zero wheel speed (or lock up). The brakes are reapplied if the wheel speed starts to approach synchronous vehicle speed at a high acceleration rate, if the wheel speed exceeds a pre-calculated speed which is a function of the speed at the time the brakes were first released, or if the brakes had not been reapplied within a certain time period after the occurence of a brake release command. The brake control outputs from the computer are two discrete signals, one discrete for the front modulators and the second discrete for the rear modulators.

The speed warning and speed limiting functions are derived from the speedometer subroutine; when the vehicle exceeds 85 miles per hour, a warning is given to the driver by a discrete output which energizes the hazard flasher and the horn. Above 95 miles per hour, the output is transmitted to the throttle control angle output such that the throttle angle cannot be advanced and the speed is limited to 95 miles per hour. The automatic door lock function also receives its inputs from the speedometer; when the vehicle exceeds five miles and hour, the door locks are locked with a discrete output from the processor if they had not been previously locked by the driver. Likewise, when stopping and placing the car in park, the door locks automatically unlock if the driver has not locked the doors himself. The anti-theft subsystem receives its input from the door lock. If a key had been used to open the door, no effect would be noticed. If the car had been entered without a key being used, the ignition control system was overridden and spark ignition was deterred, thus preventing the engine from being started.

SUMMARY AND CONCLUSION

The result of the Alpha IV program is an operating vehicle system utilizing the economics of a MOS LSI microprocessor on a time shared basis to perform the multiple functions described above. It has been shown that by effective system engineering the 4-bit arithmetic format and limited memory of these microprocessors need not be a deterrent to applying this technology to automobiles. ■

BARBARA A. REYNOLDS / Associate Editor

Old Minis Never Die

The catalog on minicomputers and miniperipherals reads as if a fire sale is on:

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- An 8K expansion memory for the PDP-8/I or PDP-12, originally $10,000, goes for $2500.

No, Digital Equipment Corp. is not going down the tubes. The computer "buys" are listed in the spring edition of the Newman Computer Exchange catalog, and the prices apply to used computers. Furthermore, the Ann Arbor (MI)-based company offers cut prices on used DEC and Data General minicomputers, various miniperipherals and mini accessories, though the listings on DEC hardware exceed all other vendors combined.

The 31-page catalog indicates a burgeoning market for used minicomputers and miniperipherals that became a $20 million business last year, according to Al Newman, president of the Newman Computer Exchange. That's still a paltry sum when compared to the $450 million market that exists for used IBM 360s and 370s. But the market for used mini hardware is growing at a rate close to 100 percent annually, adds Sonny (Adolf F.) Monosson, head of the Boston-based American Used Computer Corp.

Engineers in industry buy most of the used mini hardware offered for sale. Andy Collins, computer buyer at Los Alamos Scientific Laboratories, for example, buys used terminals for low volume areas of processing. He figures he saves between 10 and 50 percent, depending on the age of the equipment. Some like Collins buy used equipment because of price, but that's not the only factor. Buyers turn to the used marketplace when a vendor quotes an excessive delivery schedule on new production units. Ironically, they may wind up paying a premium. Broker Kathy Burke of MiniComputer Exchange (Sunnyvale, CA) says a used PDP-11/70, when available, sells at a price that is 10 percent higher than the list price, but delivery is one to five days, compared to the three-to-six month delay when the unit is purchased directly from DEC.

To induce buyers, most dealers refurbish second-hand equipment to improve its appearance, and some will even bring the hardware up to its latest engineering spec. In addition, dealers offer a warranty period. The Newman Computer Exchange offers four different kinds (box), depending on the age and condition of the equipment. Some daring engineers also buy used equipment on an "as is" basis, without any guarantee, but generally they have computer experts and technicians on hand to make repairs and to maintain the second-hand products. Collins at Los Alamos, on the other hand, will buy only used hardware that is still eligible for vendor maintenance.

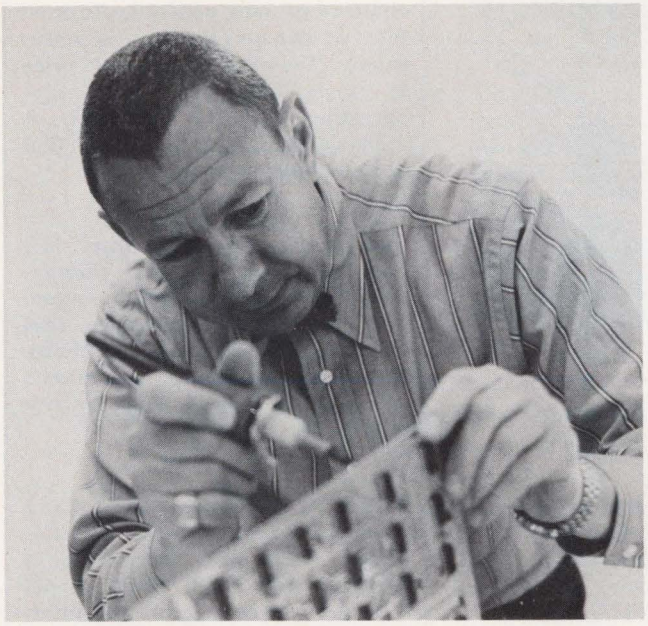
The used mini prices usually depend on the state-of-the-art of the technology. Prices change fast because technology changes are frequent. When the PDP-8/A was introduced in 1974, used PDP-8/M prices plummeted because the 8/A contained a faster processor and it also cost 40 percent less than a new 8/M. Prices are also sensitive to the state of the economy. In slack times, buyers turn to used equipment to save money, and, ironically, prices rise, Monosson says. "On the other hand, users prefer new equipment when times are good," Monosson adds.

USED MINI PEDDLERS

Company	Type	Products
American Used Computer PO Box 68, Kenmore Station Boston, MA 02215	Dealer	Everything – 370s, minis, peripherals
JM Associates 80 Emerald Ave. Westmont, NJ 08108	Dealer	DG, peripherals
MiniComputer Exchange 154 San Lazaro Sunnyvale, CA 94086	Broker	DEC, DG, HP, peripherals
Newman Computer Exchange 3960 Varsity Drive Ann Arbor, MI 48104	Dealer	DEC, DG, Westinghouse, peripherals

Prices can *really* go through the floor when a manufacturer no longer markets a specific model. The PDP-8/I, which cost $12,800 when it was first introduced in 1968, now sells for $1500. Indeed, such obsolescence accounts for the drastic price reductions on the DEC equipment in Newman's catalog.

Besides purchasing obsolete equipment, Newman and Monosson have many other supply sources for used hardware that is yet state-of-the-art, including companies that



Used Computer King Monosson and his refurbishing operation.

go bankrupt. Dealers purchase the equipment either at an auction or in a direct bid, strip away any special interfaces, and then offer the units for resale. OEM buyers and systems builders who change configurations will often sell their outdated inventory to used euqipment specialists. End users who want to upgrade their equipment will also sell to them. "We perform a valuable service," boasts Monosson.

HIGH PROFITS AND HIGH RISKS

For dealers though, the used marketplace does have pitfalls. Although dealers sell used equipment for about 75 percent more than for what they bought it, they have to, in most cases, be able to sell it quickly – before the "demand" or "supply" market changes. Dealers are caught in the crossfire of the two markets. What's available isn't always what users want and even that can change overnight. Right now, users would like to buy PDP-11s and Data General Eclipses and Nova 3s, but used versions are scarce. So users have to settle for the present "supply" market – PDP-8/Es, 8/Ms, and 11/05s or Data General 1200s and 2s. But a new product announcement can suddenly change this supply market, which happened last year when Data General announced the Nova 3. Suddenly, used Nova 1200s, previously unavailable, were everywhere. The used peripheral market also fluctuates with technology changes and even fads. "The demand for tape cartridges dropped as floppies came on the scene," says Burke of Mini-Computer Exchange. Diablo disk drives and Centronics printers are very big now, she adds. JM Associates reduces its risks by specializing in Data General equipment. But the largest dealer, American Used Computer, stocks everything from modules to customized equipment, because it can allow as long as two years to sell it.

About 10 dealers and brokers do most of the used mini business throughout the country. Dealers sell to customers out of their own inventory, and brokers merely arrange transactions between buyers and sellers. Brokers seem to come and go with turnover about 20 percent a year. Mini-Computer Exchange, which started business in 1972, is one of the longest-lived broker survivors. The largest and oldest dealer, American Used Computer Corp., was founded by Monosson in 1968 unexpectedly when his consulting firm received a PDP-10 as a partial payment from a bankrupt company. Monosson initially thought he was stuck with the machine, but then found that it sold easily, and he has been in the business of buying and selling used computers ever since.

Another big used mini dealer organization, Newman Computer Exchange was launched five years ago. And dealer John Melin started Westmon, (NJ)-based JM Associates in 1974. Mainframe vendors can also be an outlet for used mini equipment, though they don't actively market the second-hand products.

WARRANTIES TAKE THE RISK OUT OF BEING USED

A. NEWMAN COMPUTER EXCHANGE GOLDEN WARRANTY

Equipment is guaranteed to qualify for a original manufacturers maintenance agreement at the time of installation. In addition, all broken or defective parts not caused by misuse or accident are to be replaced, without charge to purchaser, for a period of 90 days after receipt of equipment.

B. NEWMAN COMPUTER EXCHANGE STANDARD WARRANTY

Newman Computer Exchange warrants that the unit will perform to all original specifications at the time of installation. All broken or defective parts not caused by misuse or accident are to be replaced without charge to purchaser for a period of 30 days after receipt of equipment.

C. NEWMAN COMPUTER EXCHANGE WORKING WARRANTY

Newman Computer Exchange warrants that the unit will perform to all original specifications upon proper installation. All broken or defective parts will be repalced upon arrival without charge to purchaser of equipment.

D. NEWMAN COMPUTER EXCHANGE "AS IS" WARRANTY

No guarantees are made.

Besides going to the main used equipment suppliers or looking at ads in *Computerworld* or *Electronic News,* users wanting second-hand equipment can subscribe to the used computer industry organ – *Computer Hotline,* a Fort Dodge (IO)-based weekly tabloid.

A DEMANDING SUPPLY

As the mini market grows, the supply of used minis will certainly increase. But what about demand? The high-end mini is secure. But on the low end, there's a new competitor – the micro. Used PDP-8s go for under $2000, but so do new microcomputers. Just what will happen in this low-end market is anyone's guess, including the dealers themselves. Monosson and Newman have both opened retail computer shops selling micros. "The CPU is a means to an end," says Monosson. "If it can be replaced by a chip, it will," he adds. "Peripherals, especially intelligent ones, will be the new and used markets of the future," he says. The market for used minis won't die – but it may change. ■

BARBARA A. REYNOLDS / Associate Editor

FLOPPY DISKS . . . OR WHATEVER HAPPENED TO THE TAPE CASSETTE

Contrary to popular belief, the tape cassette did not die with the advent of the floppy. It's still less expensive than the floppy and where access time is not important, it may fit the bill. Word processor manufacturer Lexitron Corp. (Chatsworth, CA) was happy enough with the cassette idea to develop a new cassette for its word processing systems. Advantages of the Tape II cassette, according to Lexitron, are lower cost, longer life and faster transfer rates. Although *random* access times are admittedly slower than those for the floppy, Lexitron says word processing systems don't need random access. Instead they use page-to-page access, which is more efficient with a cassette since operators don't need to worry about track addresses, etc. Tape II has the same dimensions as a standard cassette (300 feetx0.15-inch tape), but the 1-megabyte capacity is four times that of the average cassette, or the floppy for that matter. And the transfer rate of 580K bits per second is twice that of the floppy and over 70 times that of other cassettes. But how? The Tape II drive's read/write velocity is 120 inches per second; its search speed is 150 inches per second. Bit density is 2400 bits per inch. This high-speed, high density drive is available now only on Lexitron word processing systems, but Lexitron Vice Chairman Stephen Kurtin says, "it will soon be offered to the mini-micro community."

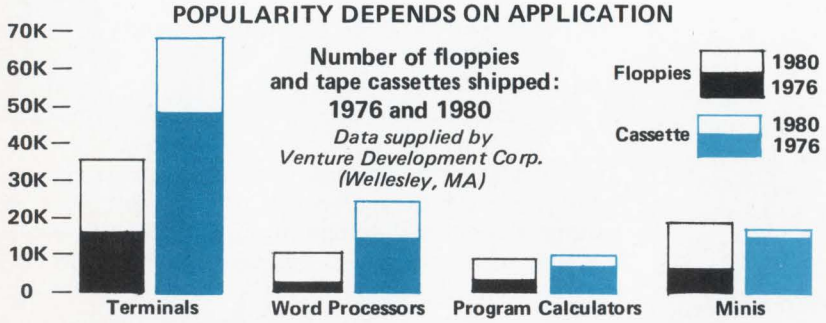
As a word processor manufacturer turns toward the cassette, a programmable calculator manufacturer begins manufacturing its own floppy. Hewlett-Packard's calculator division is manufacturing the first floppy disks to be offered by HP. The new master and slave drives are designed for the 9825 calculator, which already has a cassette. "Its for applications with large files of information that need to be sorted, merged and updated," says HP product engineer Herb Zimmerman. The double density drives store 468K bytes per disk. The $3900 master unit can control three $2500 slave units, simultaneously.

Although floppies have taken much of the tape cassette's market, the cassette will still be an important low-cost storage device in 1980, forecasts Wellesley (MA)-based Venture Development Corp. Cassettes will give way to the floppy in programmable calculator, minicomputer and word processing applications, but will be the main storage medium for terminals.

FLOPPY AND CASSETTE COMPARISON. Where price is more important than access time or transfer rate, the tape cassette still reigns.

Criterion	Floppy	Cassette
Drive Price	$700	$450
Media Price	$8	$8
Media Capacity	250K bytes	250K bytes
Transfer Rate	250K bps	8K bps
Access Time	350 msec	18.8 sec avg.
Per Bit Cost: Media	.25 mcents/bit	.148 mcents/bit
Per Bit Cost: Drive	21.8 mcents/bit	8.3 mcents/bit

POPULARITY DEPENDS ON APPLICATION



FLOPPIES AND CASSETTES

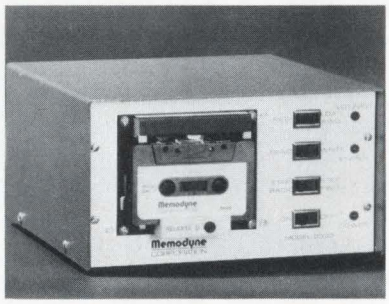
Hobby Floppy. iCom, Inc. (Canoga Park, CA) calls it the Frugal Floppy because it has the basic drive, connectors, and controller/formatter, but has no cabinetry or power supply. The result is an $1195 price in single quantity. iCom's disk operating systems, FDOS-II, is available as an option for any 8080 or 6800-based system.

Circle No. 65 on Inquiry Card

Dual Floppy for MicroNova. Ball Computer Products, Inc. (Sunnyvale, CA) has a dual floppy system with singleboard controller that plugs into the Data General Micro-Nova or Monolithic Memory's Micro-Nova. Price in single quantity is $4700.

Circle No. 66 on Inquiry Card

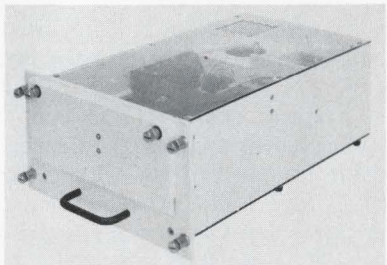
Cassette Drive. The Model 2333 from *Memodyne Corp. (Newton Upper Falls, MA)* comes in a portable case with front panel controls, I/O connectors and internal power supply. Designed for



microprocessor-based applications, the recorder writes seven-bit ASCII or eight-bit parallel data using a standard Philips cassette. Price is $775 in quantity.

Circle No. 67 on Inquiry Card

Rugged Floppy. Miltope Corp. (Melville, NY) offers a MIL-E-16400-compatible floppy that is



media-compatible with IBM's 3740. MTBF for the DD-400 is 5000 hours.

Circle No. 68 on Inquiry Card

DG REPLACES TELETYPE

Moving one step further in its vertical integration campaign, Data General is making its own teleprinter. It's a TTY 33/35 replacement that looks a lot like the Decwriter II, but has differences. Like the Decwriter, it has true 30-character per second printing. But unlike DEC, it offers 60-cps printing, too. All of the control logic, interface and encoder logic are on one board. Reliability and maintainability were the design criteria, says Data General. So the five modules for printhead/carriage drive, paper feed, ribbon drive and keyboard array can be easily accessed. Its carriage is driven by a lead screw instead of a belt and there are independent motor drives for paper, ribbon and the printhead, which eliminates linkages and clutches. The 132-column device prints up to six copies,

using a 96-character, upper and lowercase character set. Each character is formed by a 5x7 dot matrix. This version has as yet no provisions for paper tape or diskette for preparing data offline. Initially Data General is going after its own customers and expects each processor system shippped will include a printer. (DG processor shipments averaged 5000 last year.)

Users can already do most of their shopping at DG, which manufactures its own microprocessor and memory chips, core memories, paper tape readers, floppies, mag tape drives, cassettes and CRTs. Although the 30-cps KSR 6042 carries a higher price than the Decwriter II – $2400 vs. $1950, DG discounts up to 40 percent in quantities of 50. The read-only version goes for $2200. KSR and RO 60-cps versions carry prices of $2650 and $2450, respectively.

THE DUALITY OF NOVA 3

They've been busy in Southboro designing a new member to Data General's Nova 3 line. The Nova 3/D (D for dual) borrowed a feature from Eclipse: the Memory Mapping and Protection Unit that allows a batch program to be run in background concurrently with an online multiterminal program in foreground. Another feature – new to the entire DG line – is a 32K-word MOS memory module. Other minis still use 16K-word modules. The memory is made from DG 4K RAM chips or those from Texas Instruments. The 12-slot Nova 3/D joins the market of DEC's 11/34 or HP's 21MX. It has the same 16-bit architecture used in the Nova 3/4 and 3/12, along with hardware stack and frame pointer, high-speed DMA channel and 16-level priority interrupt structure. For $14,400, the Nova 3/D comes equipped with 32K words of MOS memory with parity, memory mapping, automatic program load, power fail/auto-restart and battery backup.

STANLEY KLEIN / Editor-in-Chief

Hands-On Experience ... at $24 an hour

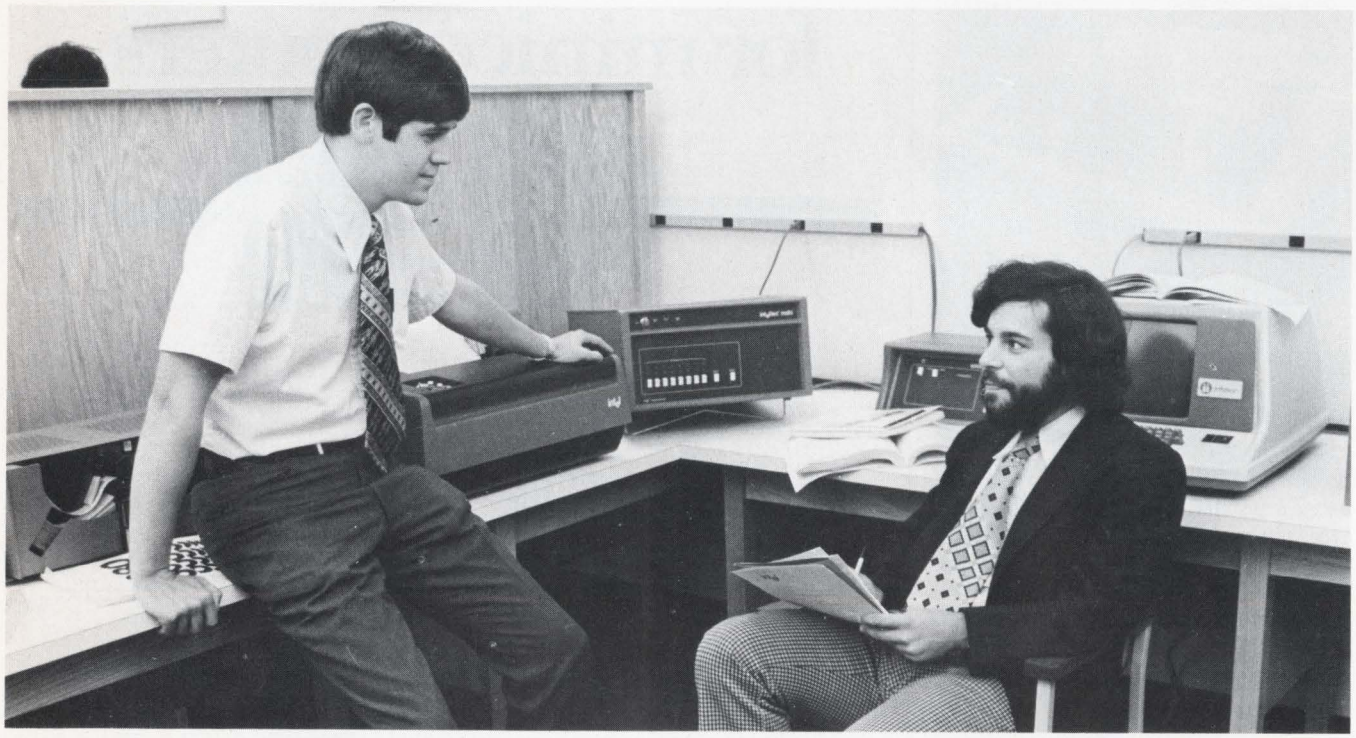
"One electronics distributor is interchangeable with another," says Richard B. Shapiro, president of Charles River Data Systems Inc. "They all charge the same prices," he explains.

Nevertheless, the 25-year old president of the Waltham (MA)-based peripheral manufacturer had good reason to give a recent $20,000 order for electronic components to Cramer Electronics Inc. in Newton, MA. Shapiro, who needs the Intel 8080 microprocessors, memories, and other support chips for a new PDP-11 floppy disk system that Charles River manufactures, did much of the product development at Cramer's microcomputer design center in Newton. "It was very useful," Shapiro exclaims.

Shapiro's comments are music to Nils Attemann, Cramer's corporate product manager. Attemann's strategy is to woo components business by giving newcomers a helping hand into the micro world. Cramer, of course, was one of the first companies to put out a microprocessor instructional kit. To follow up, the company recently opened a network of twelve microcomputer design centers throughout the country, besides the one in Massachusetts.

Attemann, who spent some $250,000 on microcomputer hardware alone to equip the centers says, "Our goal is to build customer loyalty." "Then, when these customers need PROMs, ROMs, CPUs, and other microcomputer components," he explains, "they will order from us."

At a design center, an engineer, or a programmer, or anyone else can get hands-on experience in the use of microcomputers at a cost of $24 an hour. This includes some hand-holding by an applications engineer who is on duty to help out. "The design center offers everything a customer needs to select, test, and apply his own microcomputer system," adds Cramer president Timothy X. Cronin. Shapiro, himself, spent 30 hours at the design center to write an assembly language program and to "blast" the program into a PROM, among other tasks.



A Cramer applications engineer gives Richard Shapiro a few pointers at the Newton design center.

Cramer has opened two types of design centers and they are equipped differently. So-called group A centers contain the Intel 800, Motorola Exercisor, and RCA Cosmac-CDS developmental systems, a Texas Instruments TI 990 prototyping system, microcomputer "Cramer kits," and microprocessors that include the American Micro Devices 9080A-1,

Mostek F-8 and the Intel 8080A. So-called group B centers are equipped only with the Intel MDS-800 developmental system, eraseable programmable read-only memory programming kit and the Cramer kits. "If the demand warrants, we will add equipment," Attemann points out.

Attemann: The design centers are intended to woo components' business.

No one claims, however, that a design center is a panacea. A designer can choose alternative approaches. Shapiro says he could have used a time sharing service to develop his programs and he also could have rented a PROM programmer. "But these alternatives would not have been convenient," he adds.

Nor did Shapiro debug his programs at the Cramer design center, even though it had an Intel ICE-80 in-circuit simulator that was "perfect for my needs," he says. "I would have had to spend one month solid there just to do the debugging," he explains. "Besides, I did not want to keep lugging my hardware to the center."

CRAMER MICROCOMPUTER DESIGN CENTERS

Group A Centers

Newton, MA
Gaithersburg, MD
Chicago, IL
Sunnyvale, CA
Irvine, CA
Long Island, NY

Group B Centers

Rochester, NY
Syracuse, NY
Northhaven, CT
Dallas, TX
Denver, CO
Orlando, FL
Minneapolis, MN

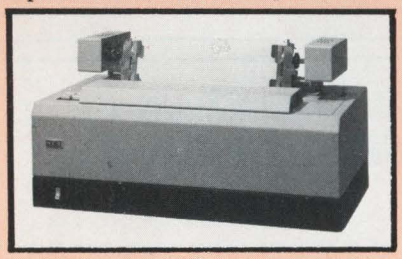
Because of the drawbacks, Shapiro recommends the purchase of a complete development system to anybody who plans to work extensively with microprocessors. Such a suggestion might seem to work against Cramer's design centers, but Shapiro also recommends that any prospective buyer first get hands-on experience with some of the different types on the market. And, that recommendation is again music to Attemann's ears. Says he: "The design center can provide that exposure." ■

PRINTERS

Plane Ticket Printers. Three new printers for the Raytheon PTS-100 programmable terminal should speed up the ticketing process at airline counters. The Model 3430 boarding pass printer, Model 3440 high-speed undercounter ticket printer, and Model 3445 hand-fed ticket printer are designed to complement the automatic fare calculation and passenger reservation software currently used by many airlines. The ticket printers can issue standard airline tickets, with up to eight parts, in less than 6 seconds. And since the printed tickets are much more legible than handwritten tickets, airlines can reduce the cost of ticket sales audits. Raytheon has eliminated all internal cutting mechanisms with the printers, which were major causes of previous maintenance problems. *Raytheon Data Systems, Norwood, Massachusetts.*

Circle No. 137 on Inquiry Card

Modular Matrix. The 6440 remote matrix line printer offers a variety of interface kits and options. It can print an original plus one to four copies at 173 characters per second



and is designed for communicating with NCR Century mainframes and 8200 minicomputers. Price is $2575. *NCR Corp., Dayton, OH.*

Circle No. 139 on Inquiry Card

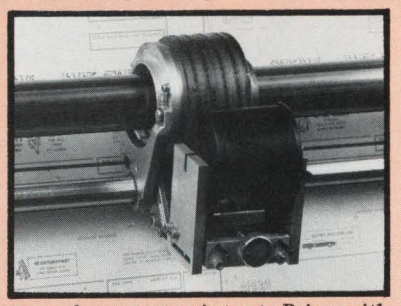
Printer Kit. The PR-40 alphanumeric printer kit uses a 5x7 dot matrix and prints up to 75 lines per minute with a 40-character line. Price of the kit including print mechanism, chassis, circuit boards, components, power supply, one ribbon and paper roll is $750. *Southwest Technical Products Corp., San Antonio, TX.*

Circle No. 145 on Inquiry Card

Bidirectional Matrix. The 120-cps 1202 uses a microprocessor to compute the shortest distance to the next print position. By searching for the shortest route to the next line of print, the 1202 gives the user a faster machine without increasing printing speed and causing additional wear. Prices start at $2830. *Tally Corp., San Francisco, CA.*

Circle No. 142 on Inquiry Card

Financial Serial Printer. The Printec 100M doubles as a MICR encoder and alphanumeric serial impact printer without requiring a type change. It prints up to 35 cps and up



to a three-part printout. Price with interface electronics is $8995. *Printer Technology, Inc., Woburn, Massachusetts.*

Circle No. 144 on Inquiry Card

500-LPM Printer. With the LP 6351 line printer, printing is accomplished with only two different moving parts: hammers and the platen. There are 22 hammers plus the spiralling platen with all hammers set in a single accessible bank for minimum maintenance. Microprocessor logic provides character generation and print control. The 132-column OEM and end-user printer has a standard 64-character font generated in a 9x7 matrix. The flexibility of microprocessor logic facilitates special character set generation by EPROM programming. *Potter Instrument Co., Plainview, New York.*

Circle No. 167 on Inquiry Card

32-Col Matrix. The Star 110 prints upper- and lowercase ASCII characters at 110 cps. RS-232C, 20 ma current loop, or TTL interface is standard with switch selectable parity and baud rate. *American Star Corp., Van Nuys, CA.*

Circle No. 168 on Inquiry Card

Low Speed Impact. The 2610 line printer for OEMs prints 150 lines per minute in an 80-column format and a 64-character set. Size of the printer is 6.2x17x15.5 inches. Price is $900 in OEM quantities. *Epson America, Inc., Torrance, CA.*

Circle No. 169 on Inquiry Card

Low-Speed Thermal. The TP-3120 printer uses a 5x5 matrix and operates at 29.4 cps. It's small and inexpensive and designed for micros. Brought to you from the calculator people. *Bowmar Instrument Corp., Fort Wayne, IN.*

Circle No. 170 on Inquiry Card

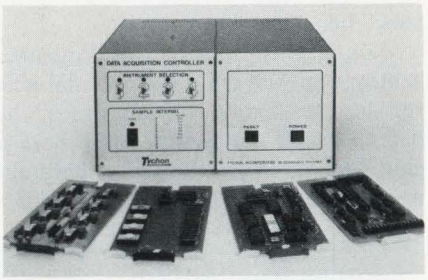
μP-BASED KEYPUNCH

The 501C data Entry Microprocessor is a keypunch, online terminal and preprocessor rolled into one. All 501C capabilities are stored in PROM so it can change with the user's requirements at minimal cost. Existing 501 installations may be field-upgraded to 501C's with the addition of communication and computation features supplied on PROMs. Communication is via an RS-232C interface, available in either binary synchronous or asynchronous mode. The computation feature allows fields to be multiplied and the result compared with or punched in another field. Price for the 501C with communications and computation option is $8600. *Tab Products Co., Palo Alto, California.*

Circle No. 158 on Inquiry Card

DATA ACQUISITION CONTROLLER

This modular microcomputer-based data collection and control system has both analog and digital inputs and outputs. The system is assembled at the company from a variety of hardware



and software modules. Functions are defined in software so future changes can be made in the controller's PROM, not in hardware. Prices start at $2500. *Tychon, Inc., Blacksbury, VA.*

Circle No. 160 on Inquiry Card

SIGNAL PROCESSING SYSTEM

The COMPASS signal processing systems uses a new computer architecture, resulting in higher signal processing speeds, while simplifying programming and reducing processing costs. The architecture is memory-centered. The memory contains logic, which coordinates accesses by different processors, computes memory addresses and converts number formats. This allows different processors' programs to access the same data using higher-level symbolic references without explicit concern about storage location or format. Initial Compass systems will consist of the Compass memory together with processors from the established SPS-41 and SPS-81 line, and will handle applications with signal bandwidths from a few kilohertz up to as much as one megahertz. *Signal Processing Systems, Inc., Waltham, MA.*

Circle No. 132 on Inquiry Card

WORD STATIONS

Wang is using its work station concept to distribute word processing. Basic elements for the new word processing systems – 10, 20 and 30 – are a 1920 character CRT single or dual diskette and a daisy wheel bidirectional printer. The bottom of the line Word Processor 10 has a single diskette and a price of $12,000. Next step is the 20, with dual diskette, price of $18,000 and allowances for up to two additional 4800 work stations. The top of the line 30 at $30,000 has a 10M-character disk and single diskette card and allows up to 12 additional work or printer stations. *Wang Laboratories, Inc., Tewksbury, MA.*

Circle No. 155 on Inquiry Card

RAMS AND ROMS

NEC Microcomputers, Inc. (Lexington, MA) has three new memory products. The μPD410 4Kx1 static RAM has a 100-nanosecond access time and comes in a 22-pin Cerdip package. The 4Kx1 dynamic RAM (μPD414) comes in 16-pin Cerdip and plastic packages. The TTL-compatible 1Kx1 bipolar memory (μPB2205) has a 50-nsec access time and also comes in a 16-pin Cerdip package.

Circle No. 134 on Inquiry Card

American Microsystems, Inc. (Santa Clara, CA) claims to have the highest speed and lowest power 16K MOS ROM available. The S6831 (Series A, B, C) is a 2Kx8 silicon gate depletion load ROM with a 450-nsec access time and 150-milliwatt power consumption. Available in plastic or ceramic, the S6834 is priced at $14 in quantities of 1000.

Circle No. 135 on Inquiry Card

Electronic Memories and Magnetics, Corp. (Hawthorne, CA) has a new 1Kx4 static RAM. The Semi 4104A has a 200-nsec access time and 350-nsec cycle time. Price in quantities of 100 is $18.75.

Circle No. 136 on Inquiry Card

EROM PROGRAMMER

Wince claims it has an alternative to $3000 EROM programmers. Its EROM programmer module for $195 is a single-card programmer for the 2704 (512x8) and the 2708 (1028x8) ultraviolet erasable read only memories. The programmer is mounted on a standard 4-1/2x6-1/2-inch card with standard 44-pin, 22-position read outs and is fully compatible with the Wince control, RAM and data acquisition modules. *Wintek Corp., Lafayette, IN.*

Circle No. 176 on Inquiry Card

D/A OUTPUT CARDS FOR INTEL

Datel Systems' eight-D/A output channel stand-alone peripheral card is pin-compatible to the Intel SBC-80/10 and MDS CPU bus. As a companion to A/D input, the D/A output supplies is analog feedback voltage to an actuator, servo, solenoid or other power handling device. The eight-channel card requires ±15-vdc power and is priced at $695. A four-channel version is $595. *Datel Systems, Inc., Canton, MA.*

Circle No. 154 on Inquiry Card

DISK CONTROLLERS

The Phoenix cartridge-type disk controllers for PDP-11 and Nova users include features for automatic CRC data verification, multiple sector transfers, parallel seeks, and automatic detection and bypass of defective sectors. The Phoenix 35 and 40 occupy a single I/O slot in a Nova processor; the Phoenix 45 is packaged in a standard system unit, so it can be installed in a PDP-11 or expansion box. Price for the Phoenix 35/40 is $3150; price for the Phoenix 45 is $3575. *Xylogics OEM Components Group, Inc., Burlington, MA.*

Circle No. 141 on Inquiry Card

FAST FOURIER TRANSFORM

The Plessey FFT modules are based on the company's 16-bit Miproc microcomputer. Data input for the SPM-01 and 02 modules may be in either analog or digital format at inputs up to 50 kHz. The modules perform either forward or inverse FFT and output the transformed data in analog or digital form as either real, imaginary, alternate real and imaginary or as a computed power spectrum. Price for the SPM-01 with a transform characteristic of 1024 complex points in 600 msec is $5000. The 250-msec SPM-02 has a price of $6000. *Plessey Microsystems, Irvine, California.*

Circle No. 156 on Inquiry Card

μP-BASED DATA ENTRY

The 7218 numeric-only data entry device stores formats and data on 320,000-character cassettes. Its 16-character keyboard buffer permits continuous data entry to be time-shared with recording and printing. It can accept up to 10 characters per second and it has a two-key rollover feature that permits the operator to press a second digit key before the first has been completely released. In addition to supporting such products as the NCR 399, 499 and the Century 8200 minicomputer, the 7218 is also replacement for the NCR 152 NOF (National Optical Font) adding machine and adding machine paper punch equipment. Price is $2275. *NCR Corp., Dayton, OH.*

Circle No. 173 on Inquiry Card

new products

μP LOGIC ANALYZER

With the 1625A logic analyzer, the microprocessor user can see total insystem performance and the operation of peripherals at any software address. It displays 16 channels of input data when triggered by an address data. Standard features include an integral 12-inch CRT, switch register/comparator, trigger delay generator and verifier. Price is $4600. *Vector Associates, Inc., Bellport, NY.*

Circle No. 178 on Inquiry Card

ELECTROSTATIC PRINTER/PLOTTER

The Gould 5005 prints 1600 lines per minute (132 characters per line) with a 64-character set and plots graphics at a maximum speed of 3.25 inches per second. Resolution is 100 dots per inch overlapped, horizontal and vertical. It uses 11-inch wide specially coated paper. The writing system includes a staggered-stylii writing head, a matrix printing approach and a special paper. Direct memory access interfaces are available for IBM 360/370, PDP-11, HP 2100, and Nova/Supernova computers. Price of plotter with print option is $7560; plotter only, $7060. *Gould, Inc., Cleveland, OH.*

Circle No. 177 on Inquiry Card

LINC TAPE IN A SUITCASE

The portable Linc Tape is specially suited for program development using either LTOS/SOS on the DG's Nova or RT-11 on DEC's PDP-11. Everything you need – tape drive and single-slot controller card – is in an aluminum

carrying case. The PDP-11 model includes a built-in ROM bootstrap, while the Nova model has an auto program feature. Total weight of the system is 21 lbs. *Computer Operations, Inc., Lanham, MD.*

Circle No. 165 on Inquiry Card

HPT for PDP-8

Capacities for the ADC-8 head-per-track disk memory systems range from 212K to 2M words. Average access time is 8.4 milliseconds. The ADC-8 is compatible with PDP-8 and is priced at $6800 in quantity. *Alpha Data, Inc., Chatsworth, CA.*

Circle No. 157 on Inquiry Card

I/O EXPANDER FOR HP 9825

The 9878A I/O expander adds six I/O channels to the HP programmable calculator's original three. It has seven I/O slots on one I/O card that plugs into one of the three calculator I/O slots. Price is $1200. *Hewlett-Packard Co., Palo Alto, CA.*

Circle No. 164 on Inquiry Card

SYSTEM/32 WORD PROCESSING

Following in Digital's footsteps (Datasystem 310W), IBM is combining data and word processing. New features include an ink jet printer and a word processing application package. IBM's 46/40 ink jet printer produces correspondence quality printing at speeds up to 92 characters per second and features automatic paper handling, magnetic card input, formatting capability and optional electronic communications. The word processing application package provides text manipulation, revision and formatting capability, production statistics, word processing sort functions, automatic letter writing and access to data processing files. *International Business Machines Corp., Office Products Div., Franklin Lakes, New Jersey.*

Circle No. 162 on Inquiry Card

announcing
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

to order

To purchase a copy of the 1976 survey report, fill in the coupon and clip it to your letterhead or company purchase order. No telephone orders accepted.

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Please enter my order for one copy of the *1976 Minicomputer-Microprocessor Market Survey* at **$295** per copy including U.S. postage.

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new software & services

NETWORK CONTROL SYSTEM

The Network Control System (NCS) enables Sycor Model 350 users to have program control of network communications without a host processor and its associated front-end. The NCS autodial software allows a central Model 350 acting as a master station to control data transmission to and reception from remote 350s without the need for an operator to dial the dataset. Once started, the automatic dialing software, operating unattended, is capable of dialing remote, unattended terminals and accomplishing device selection and address checking. *Sycor, Inc., Ann Arbor, MI.*

Circle No. 206 on Inquiry Card

TOTAL COURSE

The TOTAL Seven Video Training Course consists of 12 modules designed to teach the application programmer the functions and use of Cincom's TOTAL Data Base Management System. The course covers TOTAL Releases 4, 5, 6 and 7. Each of the modules is directed toward specific audiences such as data processing management, systems analysts and programmers. Actual COBOL application programs are used in explaining the functions and usages of TOTAL. The course licenses at a fee of $1500. *Eastern Airlines, Miami, FL.*

Circle No. 208 on Inquiry Card

MAP GENERATION

Qwik-Screen generates maps either online through the 3270 data entry console or through card input. There are two output options: basic mapping support macros or a hard-coded assembly language map. The programmer draws the desired screen on either the 3270 or the layout form, enters the field characteristics using a Qwik-Screen attribute character and Qwik-Screen does the rest. Qwik-Screen is available in object deck form on a license basis for a fee of $1495. *GMA Software, Chicago, IL.*

Circle No. 204 on Inquiry Card

JOB SCHEDULING FOR DATASYSTEM

For DEC Datasystem OEMs, there's the Critical Path Management system. It's designed for builders, contractors, job-shops, and anyone who needs close control over job scheduling. A major portion of a typical mainframe package is supported in 8K words and two floppies on a Datasystem 310. The package will accommodate 999 activities and calculates earliest start and end, latest start and end, and total and free floats. *Computer Applications Corp., Ames, IA.*

Circle No. 216 on Inquiry Card

CENTRONICS DEPOT SERVICE

Centronics Depot Service in Hudson, NH, provides maintenance for all the company's products, whether warranted or non-warranted. The staff is trained in all facets of support, including overhauls and refurbishments. *Centronics Data Computer Corp., Hudson, NH.*

Circle No. 210 on Inquiry Card

SYSTEM/32 MEDICINE AND DISTRIBUTION FINANCE

System/32's Medical Group Management System handles patient billing, accounts receivable, insurance claims and statistical data for practice analysis. Initial charge for the programs is $1250 and monthly license fee is $64. For distributors, there's the Distribution Financial Accounting System, consisting of four modules: general ledger accounts payable and payroll. General ledger and accounts payable have a $1405 initial charge and a $18 monthly license fee; payroll has $515 intial charge and $23 monthly license fee. *International Business Machines Corp., General Systems Div., Atlanta, GA.*

Circle No. 201 on Inquiry Card

DEC MAINTENANCE DOCUMENTATION

Offered as an annual subscription service, the Maintenance Documentation Microfiche Library contains hardware maintenance manuals, illustrated parts breakdowns, diagnostic listings, wire lists, field change orders, diagnostic change orders and circuit schematics. Each library's microfiche documents can be viewed on a 42X viewer. Price for each library starts at $2500. *Digital Equipment Corp., Maynard, MA.*

Circle No. 203 on Inquiry Card

DOS FOR NAKED MINIS/MILLIS

OPSYS1 is designed for both program development and batch on Computer Automation's minis/millis. Features include named file system, dynamic buffer allocation and device independency. It requires less than 3.5K of memory and costs $700 for a five-year lease. *Systems Pro Tem, Belmont, CA.*

Circle No. 205 on Inquiry Card

NETWORK SOFTWARE

Depending on network configuration, Dataflow may be used in remote online asynchronous communications or binary synchronous batch communications. Dataflow is an optional extension to Codon's OS800 operating system for its intelligent terminal network. *Codon Corp., Bedford, MA.*

Circle No. 213 on Inquiry Card

DISK MANAGEMENT

The VSERV utility helps the user identify wasted disk space and allocate space more efficiently. VTOC manipulation commands allow the user to graphically Display a pack map, Create, Delete, Update, or Rename a Format-1 label for a file, as well as Truncate one or more files to the last used track. VSERV requires 15K and has a one-time charge of $400. *Occidental Computer Systems, Inc., No. Hollywood, CA.*

Circle No. 207 on Inquiry Card

ECONOMETRICS RESEARCH

The Time Series Processor statistical program, originally developed at MIT and Harvard, is available on Computer Sciences' Infonet at standard time-sharing rates. Preprogrammed functions cover all of the computational steps that normally occur in econometrics research, including regression and simulation procedures, matrix operations and series generators. *Computer Sciences Corp., El Segundo, CA.*

Circle No. 212 on Inquiry Card

MILLI ASSEMBLER

The Omega 3/OS assembler/editor requires only 4K words of Computer Automation's LSI-3/05 Milli. The assembler reads free-form input, translates it and generates an object program. The editor performs interactive add, delete and control. Price of Omega 3/05 for Milli users is $140 with documentation. *Computer Automation, Inc., Irvine, CA.*

Circle No. 202 on Inquiry Card

GRAPHIC DATA MANAGEMENT

Regis, developed by General Motors, combines data management, graphics and statistics into one package. Questions no longer need to be translated into formal computer languages such as PL/1 and Fortran. Users can prepare data with the relational data management features, analyze the data with statistical operators and plot the results graphically. *General Motors Corp., Detroit, MI.*

Circle No. 214 on Inquiry Card

RPG II COURSE

RPG II Techniques of Programming is a general introduction to RPG II for both experienced programmers and those just beginning to program. The package consists of four one-hour audiocassette tapes; a workbook with self administered reviews, and test data for student problems. Average time required to complete the course is about 16 hours. *Informatics, Inc., Woodland Hills, CA.*

Circle No. 215 on Inquiry Card

new literature

TELENET NETWORK

"Telenet: The Intelligent Network . . . The Intelligent Choice" points out the economies and flexibility of a nationwide public network versus dedicated facilities. In operation since August, 1975, Telenet is the first U.S. carrier to provide computer/terminal communications on a packet-switched basis. *Telenet Communications Corp., Washington, DC.*

Circle No. 272 on Inquiry Card

IEEE PUBLICATIONS CATALOG

The 1976 edition of the IEEE Computer Society Publications Catalog includes listings from over 125 conference, workshop, and symposium publications. Among the topics listed in the catalog are: applications and systems, communications and signal processing, computer architecture, design automation, fault-tolerant computing, pattern recognition, optical computing, programming and software, and switching and automata theory. *IEEE Computer Society, Long Beach, CA.*

Circle No. 281 on Inquiry Card

MICROCOMPUTER KITS

Cramer Electronics' growing line of microcomputer kits is described in this brochure. Cramer kits are based on Intel, Texas Instruments, Motorola, AMD, RCA and Mostek microprocessors. Components available from Cramer, such as custom Augat Boards, UV EPROM eraser, EPROM Programmer, and Elexon and Lambda custom power supplies, are also included. *Cramer Electronics, Newton, MA.*

Circle No. 278 on Inquiry Card

COMMUNICATIONS MANAGEMENT

"A New Concept in Communications Network Optimization and Management" is geared to help the data communications manager in designing networks which minimize costs given such performance criteria as message response time, transmission error rates, traffic sensitivity, and blocking time. Discussed in detail is the Codex's 6000 Series Intelligent Network family. *Codex Corp., Newton, MA.*

Circle No. 280 on Inquiry Card

COMPUTER EVALUATION

As discussed in this six-page folder, Johnson's Performance Evaluation Division provides performance measurement and evaluation, real-time system optimization, application program optimization and operating system conversion assistance. Johnson's OS/DOS Job Accounting Report System is already installed in over 600 leading DP organizations. *Johnson Systems, Inc., McLean, VA*

Circle No. 264 on Inquiry Card

NOT FREE, BUT AFFORDABLE

Control Logic Catalog. The company's full line of microcomputer development systems, peripheral devices, software and microcomputer components is presented in this catalog. Extensive product descriptions and an ordering guide are supplied. Price is $2.50. Write *Control Logic, Inc., Nine Tech Circle, Natick, MA 01760.*

Selecting a Data Base. This 276-page report by Codasyl Systems Committee tells what to consider when buying a data base. Prerequisite conditions necessary to install a data base, the spectrum of data base capabilities and the relation of data base to other software systems are included. Price is $12. Write *ACM Order Dept., PO Box 12105, Church St. Station, New York, NY 10249.*

Microcomputer Catalog. Imsai's 8080 Microcomputer System is the focus of this 12-page catalog. Besides listing specifications, it explains how to select memory and interface boards. Price to cover handling is $1. Write *IMS Associates, Inc., 14860 Wicks Blvd., San Leandro, CA 94577.*

Data Base Digest. This 32-page report contains 54 digests of data base articles from periodicals and books since 1974. A bibliography lists articles published since 1965. Price is $20. Write *Data Processing Digest, Inc., 6820 La Tijera Blvd., Los Angeles, CA 90045.*

Auerbach Mini Guide. Every major mini system on the market is described in this 360-page guide. Configurations, performance characteristics, competitive positions and user interviews are included. Price is $34.95. Write *Auerbach Publishers, Inc., 6560 North Park Drive, Pennsauken, NJ 08109.*

ACOUSTIC COUPLER CATALOG

This four-page catalog can help even the most unsophisticated user in tying acoustic couplers and display or hard copy terminals together in time sharing and message communications environments. *Omnitec Corp., Phoenix, AZ.*

Circle No. 283 on Inquiry Card

DISPLAY SLIDE RULE

This slide rule helps in designing CRT displays. There is a sine wave MTF calculator on one side and a contrast ratio calculator on the other. Measuring 9-1/4x4 inches, the rule has four scales for contrast ratio calculations and one for raster scan displays. *Conrac Corp., New York, NY.*

Circle No. 282 on Inquiry Card

FACSIMILE APPLICATIONS

Applications of Alden's 800 telefacsimile system are illustrated in this applications sheet. The Alden 800 is a low-cost system for send only and receive only applications. *Alden Electronic & Impulse Recording Equipment Co., Inc., Westboro, MA.*

Circle No. 266 on Inquiry Card

MICRONOVA BROCHURE

Included in the 16-page microNova brochure is information on the 16-bit CPU and chip sets, board computers, fully packaged minicomputers and flexible-disk based development systems, as well as software, support and applications. *Data General Corp., Southboro, MA.*

Circle No. 279 on Inquiry Card

BUSINESS ACCOUNTING

Five general accounting application packages for Basic/Four business systems are described in this four-color, six-page brochure. Applications include order processing, accounts receivable, accounts payable, general ledger and payroll. *Basic/Four Corp., Irvine, CA.*

Circle No. 258 on Inquiry Card

LASER OCR SYSTEM

Documents unreadable by normal OCR systems are scannable with the Laser OCR-One OCR system, according to the company's six-page brochure. The OCR-One handles a wide variety of paper and reads over dirt, smudges and other extraneous matter. *Optical Business Machines, Inc., Melbourne, FL.*

Circle No. 260 on Inquiry Card

MEMORY LIT

A complete new literature package covers both the end-user and OEM product lines of Standard Memories. The OEM section contains separate bulletins for the Pincomm A, I, and N Series of replacement and add-on memories for most minis and the Buscomm H-11 Memory System for the DEC's PDP-11. End users have information on System/3 and 360 add-ons. *Standard Memories, Newport Beach, CA.*

Circle No. 268 on Inquiry Card

POWER SUPPLY CATALOG

This 34-page catalog provides complete electrical, mechanical and pricing information on 28 families of line operated power supplies and DC/DC converters. A comprehensive applications section presents power supply definitions, test methods and recommended usage practices. Also included is a detailed discussion of the cause and elimination of ground loops, electrical noise and thermal abuses. *Semiconductor Circuits, Inc., Haverhill, MA.*

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