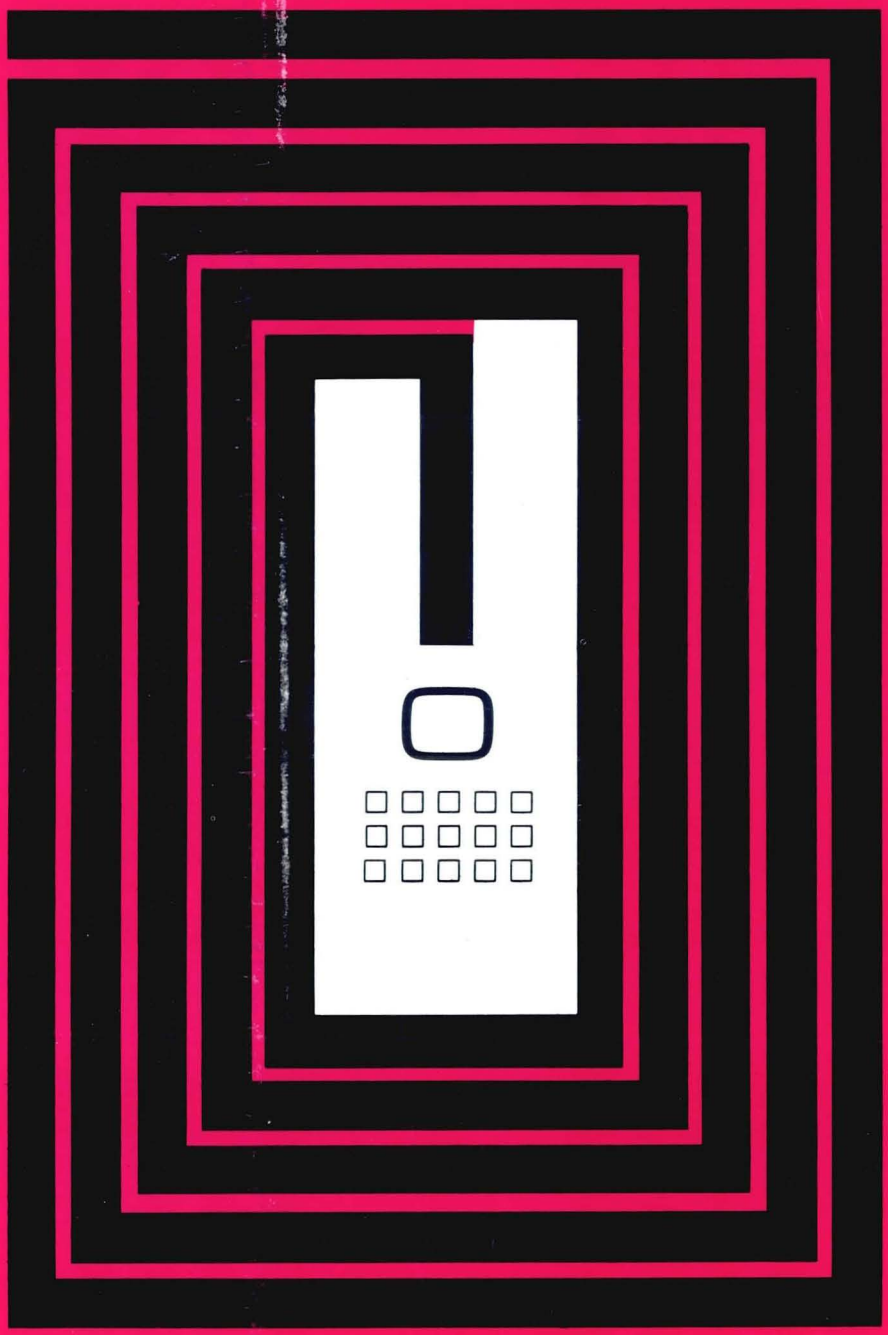
MODERN DATA

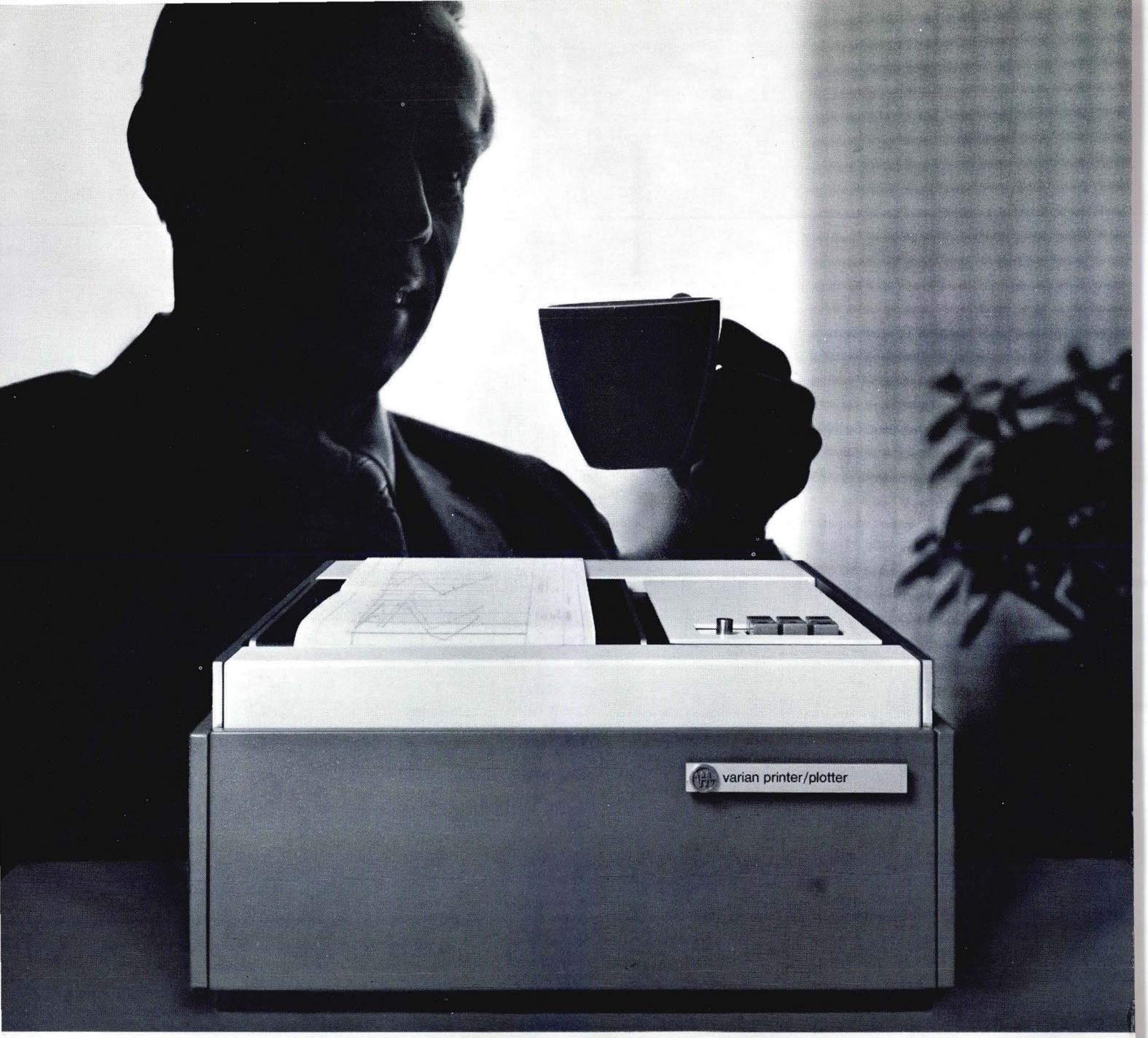
JUNE 1971

PRODUCT PROFILE:

CRT TERMINALS & SYSTEMS PART 1

MINICOMPUTERS





Statos 21 will print 300 pages of charts, graphs, and text while the boss has his coffee.

(But he'll have to drink fast!)

This new printer/plotter, latest in a line of electrostatic devices pioneered by Varian, can deliver hundreds of pages of computer-generated text and graphics while you take a 5-minute coffee break. That's four times the speed, at half the price, of most impact printers. And it does it in a 2-foot square without a whisper.

Statos 21 page-a-second printing is a full 8½ x 11, 80 column by 88 lines page. And its turn-around time in data processing applications is phenomenal! Just imagine: Core and tape dumps in seconds. Top management summaries generated in minutes, while bulk printing continues. Graphs printed simultaneously with alphanumeric characters, much faster than with separate printers and plotters. Card-image records and teletype-compatible listings handled with ease.

A problem solving computer peripheral—Statos 21 is plug-to-plug compatible with IBM/360, Varian 620/f and other computers both large and mini. The fact is, nearly every data processing and management information system can benefit from Statos 21. So for more on the story of Statos 21, contact us at 611 Hansen Way, Palo Alto, Calif. 94303. Call (415) 326-4000.

varian
data machines
graphics & data systems division

CIRCLE NO. 1 ON INQUIRY CARD

Double Your 360 RJE Throughput.

You say your line printer is running at half its rated speed? And you've been told the problem is your "2400 bps line." The problem, sir—plain and simple—instead lies with the ordinary dial-up modem you're using.

The cure? The Paradyne BISYNC-48 modem. A unique 4800 bps dial-up modem that, through unprecedented high speed modem technology, provides an effective throughput on the dial-up net of two to four times what you're now getting from your 201.

With the BISYNC-48 your line costs will be drastically reduced . . . you'll realize substantial savings in the front-end controller . . . you'll have improved data integrity and reduced communications cost in your CPU . . . and your high speed terminals can operate at full capacity on the dial-up network.

Such innovative features as a 5112 bps bit rate, automatic adaptive equalization, and powerful error control* enable the Paradyne BISYNC-48 to achieve a *4800 bps effective throughput* on dial-up lines. All for no more than ordinary modems which merely modulate and demodulate.

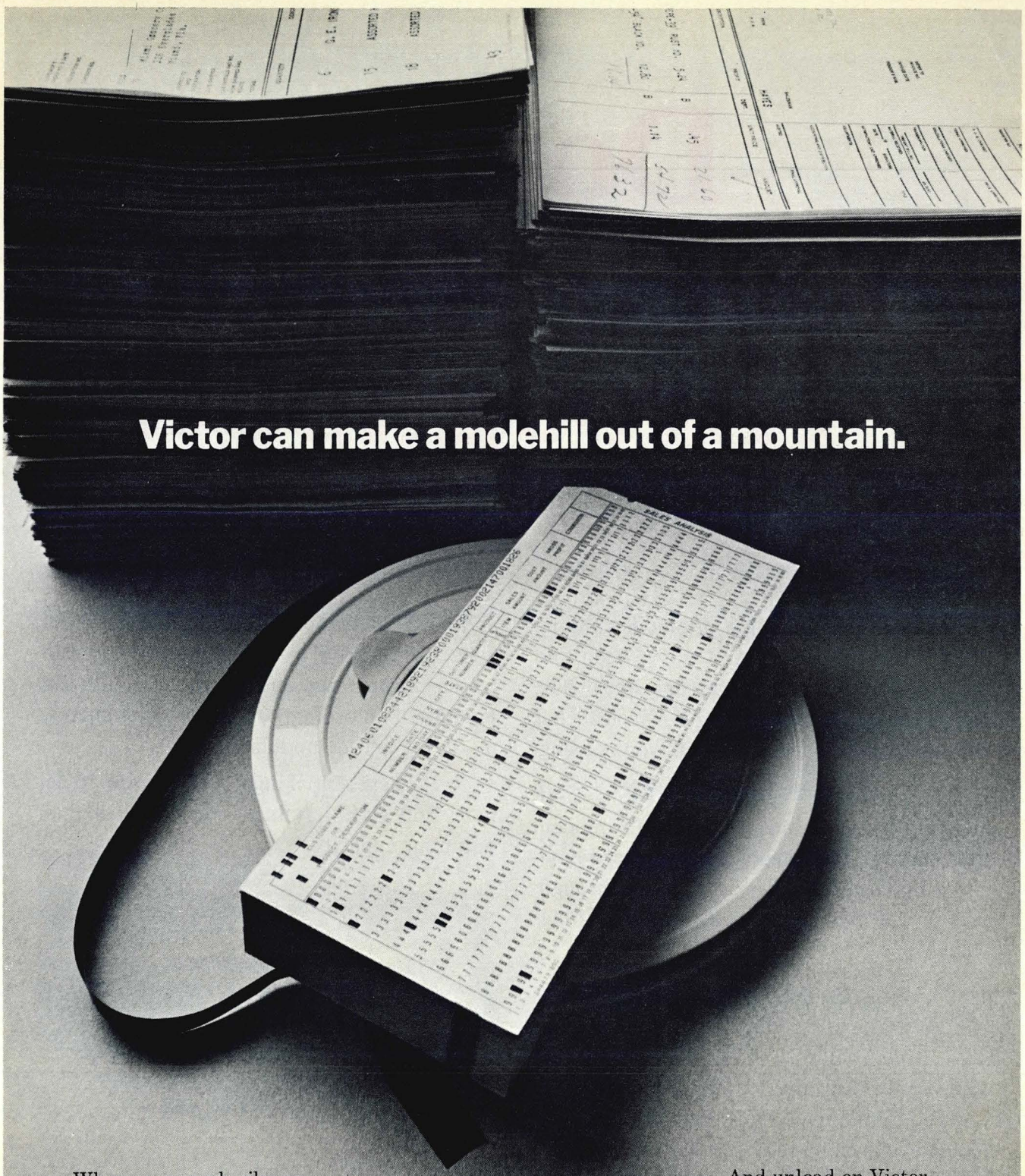
There's no longer any reason to let your 360 RJE terminals work at less than optimum capacity.

*continuous transmission ARQ using a simultaneous ACK/NAK "reverse channel" which eliminates line turnaround.

paradyne

Paradyne Corporation • P.O. Box 5144 • 2040 Calumet Street • Clearwater, Florida 33518 • 813/442-5126

CIRCLE NO. 2 ON INQUIRY CARD



Victor can make a molehill out of a mountain.

When paperwork piles up, Victor's data centers can get you out of a peak-load data preparation bind without interrupting your normal office routine.

Our data input preparation services—key punching, key to magnetic tape and OCR typing services—can solve your paperwork problems quickly and efficiently. And far more economically than you could do it yourself.

(And if that isn't enough, we'll be happy to tabulate, batch, code and edit your source documents.)

Look at it this way. If you're not equipped to handle peak-load data preparation, stop struggling.

And unload on Victor.

At any of 71 Victor data centers throughout the country.

For more information, look us up in the white pages, or write Victor Comptometer Corporation, Business Services Division, 3900 North Rockwell St., Chicago, Illinois 60618.

VICTOR DATA CENTERS

MODERN DATA

JUNE 1971 ■ VOLUME 4 ■ NO. 6

TDM or FDM?

An impartial viewpoint from a company that makes both.

Frequency Division Multiplexers carry a smaller price tag than Time Division Multiplexers. But that isn't what counts.

Because what you're really buying is *channels*.

For instance, it might cost you about $5000 for the first channel of a TDM, including the cost of a data set. Thereafter, the cost per channel steadily drops. In contrast, you can figure on about $600 per channel for FDMs no matter how many channels you need.

In other words, FDMs cost less where you need fewer channels, and TDMs cost less where you need more. The crossover price is at around 16 channels.

Let's get one worry out of your mind.

It's possible to have both FDMs and TDMs in the same system. So you can start with a few channels and work up to a larger system that includes one or more TDMs.

In general, you use TDMs if you have high concentrations of terminals in one remote location. You use FDMs where you have widely distributed communications, such as a small number of terminals in each of many cities.

And now—the biased viewpoint...

No other company selling both TDMs and FDMs can offer you a nationwide service organization. (We're based in 56 major cities.)

Is this important? Well, just consider—the breakdown of a TDM could kill 52 channels of data transmission. In practical terms, it could tie up the whole ticket operation of an airline.

We have 250 service representatives all over the country. They keep Ultronic's stock quotation system running from border to border. And they'll get to you fast if you should ever need them.

So, you can get excellent service from us.

You can get excellent equipment from us, too.

We can ship FDMs and data sets off-the-shelf. In 30 days or less, we can install an FDM system that will handle up to 23 channels on voice-grade line and 25 channels on a conditioned line.

We can give you a 20-channel or a 52-channel TDM. These have a single plug-in board that interfaces with all data terminals, so you don't need any intermediary equipment.

You can buy or rent TDMs or FDMs from us at a very reasonable cost. (One of our customers replaced his old FDM system with ours at a saving of $3000 per month.)

We have everything you need in data communications systems, including data sets and video and hard-copy terminals.

Get to know our equipment and services.

Then make your own impartial decision.

For details, write or call: Lee Shrout, Ultronic Systems Corp., Box 315, Moorestown, N.J. 08057. Telephone: 609-235-7300.

Ultronic Multiplexers

GTE INFORMATION SYSTEMS

MODERN DATA

EDITOR AND PUBLISHER . . . . . S. HENRY SACKS
ASSOC. PUBLISHER . . . . . WILLIAM A. GANNON
ASSOC. EDITOR . . . . . ALAN R. KAPLAN
ASSOC. EDITOR . . . . . JOHN A. MURPHY
CHIEF EDITORIAL CONSULTANT . . . . . DAN M. BOWERS

WASHINGTON EDITOR: Harold V. Semling, Jr. **FINANCIAL NEWS EDITOR:** James I. Leabman. **EUROPEAN EDITOR:** Richard Pettersen.

CONSULTING AND CONTRIBUTING EDITORS: Ralph G. Berglund; J. Reese Brown, Jr.; Richard T. Bueschel; Thomas DeMarco; Maurits P. deRegt; Ken Falor; Lawrence A. Feidelman; Ivan Flores; Michael B. French; Fay Herman; Walter A. Levy; Thurber J. Moffett; Joseph Popolo; John E. Taft; Jerome B. Weiner.

Editorial Prod.: Ruth Martin, Manager; Judith DeWitt, Diane Burkin, Sally Haskins, Assts.
Circulation Dept: Carol Grace, Manager; Stephen E. Hughes, Asst.
Ass't. to Publisher: Donna L. Maiocca

Cover Artist: William Kwiatkowski

ADVERTISING PROD. MANAGER . . . . . BERNARD GREENSIDE

All correspondence regarding circulation, advertising, and editorial should be addressed to the publication offices at:

MODERN DATA
3 LOCKLAND AVENUE
FRAMINGHAM, MASS. 01701
(617) 872-4824

SUBSCRIPTIONS: Circulated without charge by name and title to U.S.-based corporate and technical management, systems engineers, systems analysts, EDP managers, software specialists, and other personnel who qualify under our qualification procedures. Available to others at the rate of $18.00 per year; single issues $1.75. Subscription rate for all foreign subscriptions is $25.00 per year (12 issues). POSTMASTER: **Send Form 3579 to:** Circulation Dept., Modern Data, 3 Lockland Avenue, Framingham, Mass. 01701. Controlled circulation postage paid at Concord, N.H.

BPA

SALES OFFICES

SALES MANAGER . . . . . ROBERT J. BANDINI

NEW ENGLAND
Wm. A. Gannon, 3 Lockland Avenue, Framingham, Mass. 01701 (617) 872-4824

NEW YORK
Robert J. Bandini, 400 Madison Ave., Suite 401, N.Y., N.Y. 10017 (212) 753-0375, (203) 226-3544

PHILADELPHIA
Don McCann, 116 Haddon Ave., Suite C, Haddonfield, N.J. 08033 (609) 428-2522

MIDWEST
Gerald E. Wolfe, The Pattis Group, 4761 Touhy Ave., Lincolnwood, Ill. 60646 (312) 679-1100

WEST COAST & SOUTHWEST
Neil Canavin, 711 East Walnut St., Lands Bldg., Pasadena, Cal. 91101 (213) 681-1133

THIS ISSUE OVER 90,000 COPIES

Three new program packages developed by Cullinane Corporation.

EDP-AUDITOR: The most powerful tool yet developed for use by auditors to audit computer-based systems.

Too often the auditor has been the forgotten man: charged with the responsibility to analyze and prove the integrity of computer-based systems, yet without the tools to do it effectively.

This new generalized audit system changes all that. It can be used by any auditor, regardless of EDP experience. He can use it on any type of file, perform unlimited computational work with unlimited test and selection criteria.

Very efficient in its use of computer time, EDP-AUDITOR can produce any type of output for test purposes and can produce many and varied reports in one pass of a file. It will also generate random numbers.

With very fast turnaround time, EDP-AUDITOR can run on any IBM or RCA computer, DOS, OS or TDOS, DOS.

Auditors have never had a tool like this before. *Don't pass it up without investigating!*

CALL: Thomas M. Lescalleet

Formerly a Controller of a leading computer consulting operation. Tom has wide experience in business and accounting systems. When you talk directly to Tom about EDP-AUDITOR you can talk in accounting or software terms.

IMS-CULPRIT: The highly successful CULPRIT Output Processor system now has a special version designed especially for IMS users.

IMS-CULPRIT solves the chief problem of getting multiple production or one-time reports from your IMS data base on a batched, one-run basis. With IMS-CULPRIT's predefined "SEG" parameters to define the desired part of the data base for the various reports, the segments for all the required (sensitive) levels of the hierarchy are brought together in a buffer. When all corresponding segments are present, the buffer contents are delivered to CULPRIT as each succeeding lowest-level segment is changed, with higher level segments automatically changed when required. Different hierarchial structures are automatically handled. As each such record is obtained, IMS-CULPRIT tests and selects all the data it needs for many reports and/or subfiles before it goes to the next one.

CULPRIT processes at speeds equivalent to well-written BAL programs. Outputs are specified by parameters contained on two simple forms. Development time for your IMS application programs is much reduced, and one time reports can be generated on an overnight basis.

CULPRIT is widely recognized as a landmark among packaged programs. The new IMS version makes it even more versatile. *Send for a detailed technical brochure!*

CALL: James J. Baker

An M.I.T. graduate (math major and honor society member) who has completed requirements for a PhD at Harvard, Jim spent 5 years in advanced software systems design at IBM. He'll welcome your most searching questions about IMS-CULPRIT.

PLUS - D/A: The "PLUS" software security and control system, in use worldwide, is now available in a new Direct Access form.

PLUS - D/A, the most comprehensive source program library system on the market, is also exceedingly simple to use. It requires only half an hour for the average programmer to learn (and remember) because of its clear and concise one-card control feature.

PLUS-D/A re-uses old program areas and has character as well as blank compression with full restoration of the record, including all original sequencing and other ID.

There are many other secondary features. We've had a great variety of experience with program library systems and have designed features that add much convenience and efficiency to the system. For example: variable number of records per track, use of less or more than one disk pack, reorganization capability, "on-disk" backup, several operations performed with same access, ID features, etc.

You know you need it. Find out details!

CALL: Jean P. Lapointe

Jean was responsible for the development of the highly successful PLUS system which is now in use throughout the U.S., Canada, South America, and Europe. Jean will be glad to talk to you about the advantages inherent in the new Direct Access version.

MAIL: for details on EDP-AUDITOR

Name . . . . . .
Title . . . . . .
Company . . . . . .
Address . . . . . .
City . . . . . State . . . . . Zip . . . . .

MAIL: for details on IMS-CULPRIT

Name . . . . . .
Title . . . . . .
Company . . . . . .
Address . . . . . .
City . . . . . State . . . . . Zip . . . . .

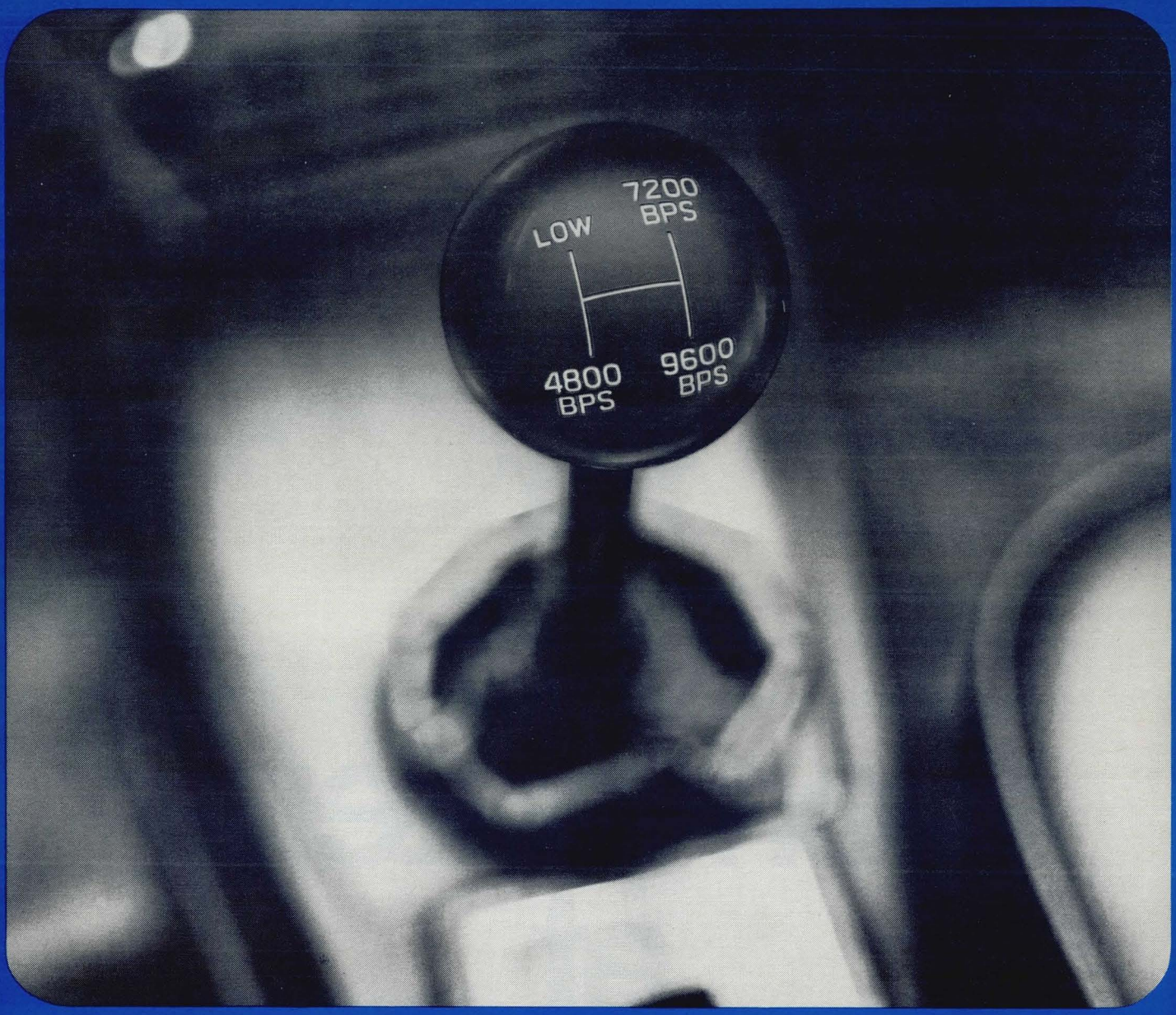
MAIL: for details on PLUS - D/A

Name . . . . . .
Title . . . . . .
Company . . . . . .
Address . . . . . .
City . . . . . State . . . . . Zip . . . . .

Cullinane Corporation

One Boston Place, Boston, Massachusetts 02108. Telephone (617) 742-8656.

Codex now gives you three high speed modems.



Are you ready to shift into high speed? With the addition of the new Codex 7200 you can select the best price-performance answer to your high speed modem requirements. Now you can trade-up with Codex through the entire high speed modem spectrum. We have all the options with three modem models and four different multiplexers. And we can put the right combination together for your own custom systems application. Write for complete specifications. Codex Corporation, 15 Riverdale Avenue, Newton, Mass. 02195. Telephone: (617) 969-0600. TELEX: 92-2443.

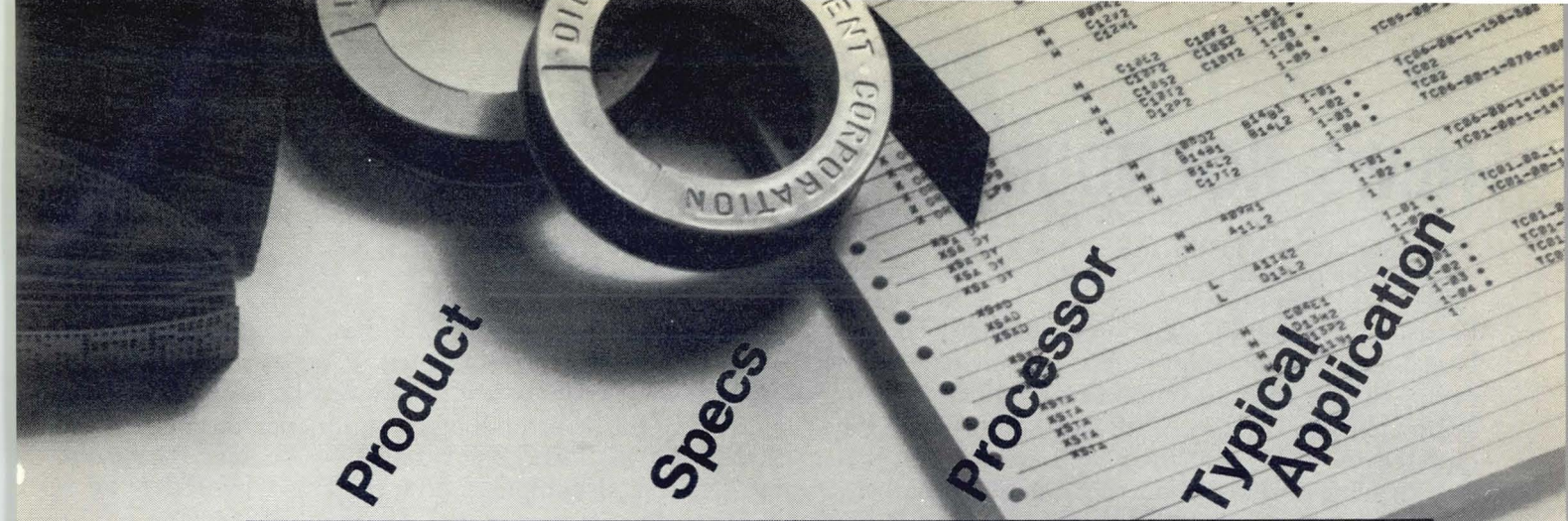
CIRCLE NO. 7 ON INQUIRY CARD

codex

We'll get you through.

Mini-Peripherals for Mini-Computers at Mini-Prices.

When DIGITAL starts a family,
DIGITAL takes care of its family.
PDP-8 and PDP-11 computers have been
amply provided for with the largest and best
selection of peripherals in the industry.
These are only the newest.
If we had tried to put them all in one ad,
the fold-outs would have begun to look
like a program print-out.



Product	Specs	Processor	Typical Application
DECwriter LA 30	An impact printer that is faster, quieter, and more reliable than teleprinters. 30 cps printing speed. 64 character set, ASCII 1968. 96 or 128 character keyboard.	All PDPs	Any application where conventional teleprinters are used: local and remote data entry, interactive computation, data logging, etc.
DECterminal VT 06	A low-cost CRT and keyboard for direct computer input/output, telephone line transmit/receive. All interfaces built in. Full ASCII keyboard, 1800 character image area.	All PDPs	Interactive terminal applications where hard copy output is not needed: graphic display from mass storage files, text editing, on-line debugging.
DECpack RK 02, 03	A disk file with moving head under electronic control. Reliable and quiet operation. Capacity 10 million bits, with 80 ms average access. Compact and low cost. Interchangeable disk cartridge.	PDP-11, 8, 12	Convenient storage of programs and data files in installations where several people use same computer.
DECprinter LP 08, 11, 12, 15	A low-cost, high-speed line printer with 80 or 132 columns and 64 or 96 character sets. Basic speed of 356 lpm can be increased to 1100 lpm for a 20-column line. Up to six-part forms for multiple copies.	PDP-11, 8, 12, 15	High quality alphanumeric printout for business and scientific reports.
DECmagtape TU 10	This magnetic tape system is IBM-compatible at 45 ips speed, densities: 200, 556 and 800 BPI, and 7 or 9 channels. Vacuum columns and a simple mechanism make it extra reliable.	All PDPs	Low cost file and program storage, preparation of data for processing on other systems, backup for disk files.
DECdisk RS 64	A low-cost, fixed-head disk with nominal capacity of 64K 16-bit words, expandable to 256K words. Average access time 16 ms. Real-time look ahead capability and cyclic redundancy error check.	PDP-11	Monitor program residence. Data file storage.
DECtape TU 56	A simple, compact, highly reliable magnetic tape system of proprietary design. Pocket-sized reels contain 2×10^6 bits. Read, write, search, or update in forward or reverse direction at high speeds.	All PDPs	Reliable, high speed alternative to paper tape. Used for program & data file storage.
DECscope VR 14	A versatile, low-cost CRT display. Combines high speed and high resolution for graphic and alphanumeric display. Features easy-to-read 63 square inch screen.	All PDPs	Manuscript editing, source data entry, interactive computation, file scanning and updating.

More than 10,000 mini-computers delivered.

digital

Digital Equipment Corporation
Maynard, Mass. 01754 (617) 897-5111

CIRCLE NO. 8 ON INQUIRY CARD

NEWS ROUNDUP

PANASONIC ENTERS U.S. COMPUTER MARKET

Panasonic, a Japanese electronics firm best known here for its consumer products, has introduced a complete line of minicomputers, peripherals, and components to the U.S. Initial sales efforts will be targeted to OEMs, but this may be only until the firm develops a handle on the American market; most of Panasonic's computer sales in Japan have been to end-users.

The minicomputer products are the Mc-7S and Mc-7F – the latter a 16-bitter with 4 to 16K of 600 nsec, plated-wire memory – and a billing computer station called the "Transactor" which consists of the slower (4 usec) Mc-7S with paper tape I/O, an optical mark reader for cards, and an IBM Selectric typewriter.

Also introduced were: a series of small disk memories; a photo tape reader; a general-purpose mark reader; a CRT terminal ("MACC-Scope"); a programmable desk calculator ("Computator"); and a number of smaller components.

NEW 1900 SERIES FROM ICL

International Computers Ltd. has announced a new series of processors that complements its present 1900 systems first introduced in 1964. The new "S" (for semiconductor) series includes the 1902S, 1903S, 1904S, and 1906S – the last the most powerful computer now marketed by ICL. Comparable in size to the IBM S/370-165, the 1906S uses plated wire for internal storage and is said to offer approximately 50 percent more power and more than twice as much throughput (11 megachars/sec) as the older 1906A, an I-C model introduced in 1968. Also announced were a disk-based version of the existing 1902A; remote job facilities for the 1901A; a communications processor (the 7903); an extensive package of systems-level software; a small, 30 chars/sec chain-printer for remote terminal applications (the 7081 "Termiprinter"); and a disk storage system (the EDS(60)) for clustering seven or nine eleven-high disk transports, each of 59.2 megachars capacity.

HELP TOP HELP

Computer firms and individuals in the Washington, D.C. area wishing to do something besides complain about welfare roles should contact "Training for Opportunities in Programming, Inc." (TOP), a voluntary, non-profit organization that educates and finds jobs for capable, but financially depressed, junior programmers. A few TOP graduates have already found jobs, but an urgent need exists to place other successful graduates. Additional forms of help needed by TOP include loans of equipment and teaching materials, technically qualified instructors, and financial contributions. Contact **TOP, Inc., P.O. Box 848, Adelphi, Md. 20783** for additional information.

D C DATASCAN

Harold V. Semling, Jr., Washington Editor

PROTECTING PROGRAMS – The National Council of Patent Law Associations is making a study of the patenting of computer programs, which, as yet, usually don't qualify for patents. No quick action is seen as it is unlikely Congress will be able to approve any plan before 1973. The lawyers hope to come up with something which is more than a copyright, but less than a full patent. One possibility is that they will develop a form of protection comparable to the "processright" proposed by Larry L. Constantine in the June, 1969 issue of **MODERN DATA.**

NEW BANKING CONCEPTS – William W. Sherrill, a member of the Board of Governors of the Federal Reserve System, has called for reorienting the concept of banking. Banking of the future, he said must be "more broadly conceived," and aware that "its function no longer is predominately lending." He foresees a time when financial information provided to the customer may be more important in the customers' eyes than the funds made available to him.

EDP FORMS – The U.S. Department of Commerce's annual industrial outlook for over 200 industries predicts greatly increased use of business forms due to computers. The outlook for OCR forms is favorable, but there will be heavy competition in the next decade from film recording systems and visual display systems.

IN BRIEF

The U. S. Naval Academy is said to have quadrupled its computer resources by installing a Honeywell 635 and linking it to Dartmouth College's time-sharing system.

The Dept. of Transportation has awarded a $346,900 grant to Kent State Univ. to complete the development of a computerized management aid (TRANSMAN) for bus transit systems.

IBM, Gaithersburg, Md., has received a $4,768,861 addition to an existing contract by the Federal Aviation Agency to develop a National Flight Data Processing Program.

We've made a great computer a lot better.

Varian's new 620/L has a dramatic price/performance ratio that gives more computer in less space at lower cost. The 620/L is an advanced design of the reliable, field-proven (over 1300 installed worldwide), systems-oriented 620/i computer.

Priced at only $7700, the 620/L has an 8K, 16-bit, high-performance memory that can be expanded to 32K inexpensively. Each 4K memory increment is $2300. What's more, if you don't need 8K, you'll find the basic 4K, 16-bit 620/L very attractive at $5400!

The 620/L is small, so small that when fully expanded—a 32,768-word system with all main frame options and up to eight peripheral controllers—fits into just 21 inches of rack height.

The 620/L is 100% I/O-and software-compatible with the 620/i, and new peripherals and software have been added. All peripherals, software, and application packages (developed for earlier 620 models), as well as the 620/L itself, are off-the-shelf.

You know us. You know that when we say we have something better, we can prove it. Talk to the big company in small computers.

varian data machines
The Big Company in Small Computers

U.S. Sales Offices: Downey (213-927-1371), San Diego (714-298-9292), San Francisco (415-968-9996), Calif./Washington (301-773-6770), D.C./Chicago (312-692-7184), Ill./Waltham (617-899-6072), Mass./Detroit (313-645-9950), Mich./Minneapolis (612-926-6571), Minn./Albuquerque (505-298-5570), N. Mex./New Rochelle (914-636-8118), Rochester (716-586-3273), N.Y./Fort Washington (215-643-2355), Pa./Dallas (214-231-5145), Houston (713-781-0105), Tex. Other offices worldwide/Varian Data Machines, a Varian subsidiary, 2722 Michelson Drive, Irvine, California 92664. Telephone 714/833-2400.

DATA GENERAL MAKES OUTRAGEOUS CLAIMS.

OUTRAGEOUS CLAIM #3.
Big Configurations: We promised we could put main frames, peripherals, and software together at prices as low as our main frames, and we're delivering.

OUTRAGEOUS CLAIM #2.
Nova 1200, Nova 800, Supernova SC: we promised three fast new mini computers, and we're already delivering ahead of schedule.

OUTRAGEOUS CLAIM #1.
Nova and Supernova: we promised the best small computers in the world, and we've delivered on that promise more than 1,000 times.

OUTRAGEOUS CLAIM #4.
Software: We promised the biggest single package of mini computer software ever, and we delivered FORTRAN IV, ALGOL 60, Time Sharing BASIC, Disk Operating System, and lots more.

True.

It's always been this way.

Ever since we said that our first 16-bit multi-accumulator mini computer, the Nova, was the best small computer in the world.

That we'd back everything up with software, peripherals, and world-wide sales and service. That we'd become a high volume manufacturer in a hurry.

Well, we've delivered on all counts.

With one very interesting result: We still make outrageous claims. But with our delivery record, people simply refuse to be surprised by anything we say.

For instance, we introduced three new members of the Nova line, featuring LSI, MSI and all-monolithic memory, at the 1970 Fall Joint, and the only people to get nervous were the competition.

We told everybody that the Nova 1200, the first mini computer to take advantage of large- and medium-scale integration to achieve maximum speed and reliability, was the least expensive multi-accumulator 16-bit computer on the market.

Did we shake anybody up?

No, we just wrote orders.

And then, to cap it off, we delivered the Nova 800 a month ahead of schedule, and the Nova 1200 two months ahead of schedule (which is really outrageous in this business).

At the same time, we introduced the Supernova SC.

Here we are, the cocky young kid on the block, introducing the first all monolithic memory in a mini computer and people didn't just accept it. They expected it.

Now we're telling people that it's not enough to love us for our low main-frame prices. They should love us for the way we can put main frames, software and peripherals together in configurations that meet real-world computing requirements at the lowest prices possible.

Reaction? Disk Operating Systems, Real-Time Operating Systems, Time Sharing BASIC Systems, all kinds of systems, are installed and running. Right now.

Sure we make outrageous claims.

But with more than 1000 computers, and all kinds of software, peripherals, and systems installed all over the world, it's getting harder.

Because people are simply buying everything we say.

DATA GENERAL

Southboro, Mass. *(617) 485-9100* / Hamden, Conn. *(203) 624-7010* / Commack, L.I., New York *(516) 368-3304* / Rochester, New York *(716) 235-5959* / Saddlebrook, N. J. *(201) 843-0676* / Bryn Mawr, Pa. *(215) 527-1630* / Washington, D.C. *(202) 296-0380* / Atlanta, Georgia *(404) 458-0118* / Orlando, Fla. *(305) 425-5505* / Chicago, Ill. *(312) 539-4838* / Cleveland, Ohio *(216) 486-5852* / Houston, Texas *(713) 622-2820* / Dallas, Texas *(214) 233-4496* / Denver, Colorado *(303) 758-5080* / Manhattan Beach, Cal. *(213) 376-7917*/ Palo Alto, Calif. *(415) 321-9397* / London, England *01 499 7735* / Munich, W. Ger. *0811 29 55 13* / DATAGEN OF CANADA LTD.: Hull, Quebec *(819) 770 2030* / Montreal, Quebec *(514) 341 4571* / Toronto, Ontario *(416) 447 8000* / Vancouver, British Columbia *(604) 731 2711.*

Data base: before you invest, investigate.

The most exciting concept in computer usage today is the data base information system.

The most *talked-about* data base management system is IMS-2.

But the most widely and successfully *used* DBMS is Cincom Systems' TOTAL.

With all of its power, TOTAL is applicable on 64K systems and up, and in any environment.

That says a lot for TOTAL. And it tells you something of great importance if you're thinking data base.

Because the most critical decision for the ultimate success of information system implementation is your *choice* of data base management systems.

It will serve you well to investigate TOTAL. (More than 80 blue-chip customers are achieving their information system goals using TOTAL.)

Even if you've already started to implement, TOTAL's design approach will allow you to accelerate your current progress and enhance the effectiveness of your investments in time and energy for future success.

In fact, it will pay you to consider TOTAL no matter what your status: if you're thinking data base; are in the decision-making stage; implementing; or just curious.

Write today for full information about TOTAL, the most powerful system in existence. Currently available for use with IBM DOS or OS, Honeywell and RCA. Cincom Systems, Inc./2181 Victory Parkway/Cincinnati, Ohio 45206.

Cincom Systems, Inc: We create efficiency.

Cincom offices also located in Palo Alto, California and Toronto, Ontario, Canada.

"Why pay more than $65 a month for a time-sharing terminal?"

Z. V. Zakarian, president, Western Union Data Services Company.

For $65 a month you can lease a Model 33 ASR exchange data terminal with acoustic coupler from Western Union Data Services Company for use with any telephone anywhere in your company. And chances are $65 is a lot less than you are presently paying.

The exchange data terminal 33 works with virtually all time sharing services. So even if you're not currently using this terminal, there's a good chance the 33 is compatible. (To make sure, just ask your time sharing service.)

If your requirements call for Model 33's Data-Phone,* or Data Access Arrangements, we can supply them too at equally attractive rates. We even have terminals with wheels so you can move them to any office location.

Regardless of which data terminal configuration you select, you can depend on Western Union Data Services Company for nationwide servicing, applications engineering, training and support.

Interested in the most economical and efficient data terminal for your needs?

Contact me at Western Union Data Services Company, 16 McKee Drive, Mahwah, New Jersey 07430. Phone: 201-529-4600. Outside N.J. call toll-free 800-631-7050. Telex: 12-5077.

western union

*Registered trademark of AT&T.

western union data services company

INTERNATIONAL NEWS

NO U.K. SOFTWARE CRISIS — Tony Hardcastle, chairman of the Software Houses' Association, made it clear that there is no crisis in the computer software industry in the UK in spite of suggestions to that effect by people outside of the industry. According to the **London Times,** he explained at the Association's first annual meeting that a number of software concerns, "the majority of them not even eligible for membership in the association," had expanded beyond their managerial, marketing, and possibly technological abilities and were now "feeling the draft." Firms offering highly specialized services should continue to thrive, he said.

FOREIGN TRADE UP — U.S. foreign trade in electronic computers, peripheral equipment, and parts accounted for 67% or $1.1 billion of exports of business machines in 1970, reports the U.S. Commerce Dept. Of the total, digital computers comprised $428 million, parts $281 million, and input/output peripheral devices $224 million. Major customers included West Germany, United Kingdom, France, Canada, and Japan. EDP equipment totaled $43 million or 8% of imports in 1970, increasing 91% from 1969.

RESTRICTIONS IMPOSED — Horst Jonas and Bruno K. Witter, West German traders in electronic equipment with strategic uses in computers, have been denied U.S. export privileges for failing to account for their dealings in transactions involving almost $200,000 worth of U.S.-origin equipment. The two men were part owners and co-managers of Codi Computer GmbH, Dusseldorf, which is now being liquidated.

QUICKLY AROUND THE WORLD

Honeywell Information Systems, Ltd., has signed an agreement valued up to $2.4 million to supply Linotype Paul Ltd., in London, with Honeywell 316 computers for use in phototypesetters. Included in the agreement is the firm's U.S. company, Mergenthaler Linotype.

CRC Information Systems Ltd. has ordered a Xerox Sigma 9 computer for its service bureau in London. The value of the order exceeds $15 million.

ORDERS AND INSTALLATIONS

Orders for more than 25 large-scale Series 6000 computer systems valued in excess of $41 million were reported by Honeywell Inc.

Graham Magnetics Inc. has announced receipt of a government contract for magnetic computer tape that could total nearly $3 million.

Geocom, a Houston-based company specializing in offshore and land geophysical data processing, has installed a Sperry Rand Univac 1106 computer valued at approximately $1.9 million.

Di/An Controls, Inc. of Boston, Mass., has received an order from Raytheon Co. for ticket printers to produce airline boarding passes. The order is valued at approximately $100,000.

After more than a year of in-store testing, Target Stores, the Minneapolis-based mass merchandising chain, has placed a $200,000 order for two computerized cash register systems from The Singer Company's Friden Division.

Tracor, Inc. of Austin, Texas announced receipt of a $1,058,594 contract from GTE Sylvania, Electronics Systems Eastern Division, for the development of a keyboard/printer device to be used in the Minuteman Weapon System.

Interdata announced the receipt of a contract for four of its Model 5 computers from the Ford Motor Company's Rawsonville Plant in Michigan. The three systems included in the $230,000 contract include Model 64KB mass memories, and a real-time operating system.

The University of Pittsburgh has ordered two large PDP-10 computers for its computer center from Digital Equipment Corp. of Maynard, Mass. The two machines, which will replace two IBM 360/50 systems and an IBM 7090 batch processing system, make up the largest PDP-10 system installed in any university.

What may well be the largest single order ($2.5 million) in the history of the industry for mini-computer magnetic tape systems has been awarded to Tri-Data Corp. by the Data Products Div. of Lockheed Electronics Co. Tri-Data will furnish standard production models of its "CartriFile" tape systems for incorporation in Lockheed Electronics MAC 16 computers. The first two hundred units are scheduled for delivery before the end of 1971.

Boeing Computer Services, Inc. has been awarded an $80,075 contract to design, develop, and demonstrate a natural resources information system (NARIS) for the Bureau of Indian Affairs.

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY . . . . . 7735 OLD GEORGETOWN ROAD
BETHESDA, MARYLAND 20014, Phone (301) 654-9360

Information Services

World Leader
In Time-Sharing
Service

AN OPEN LETTER TO EDP MANAGERS:

Gentlemen:

It's here. Our flexible NEW MARK II. Time-sharing designed with you in mind. Extend the power of your in-house systems with our features. MARK II has more than time-sharing's ever had before.

Much more than a problem-solving tool, our NEW MARK II is designed to help you, to augment and complement your in-house system.

Look at these new features:

- Universal access to a true information processing network. 250 major cities on a grid to three interconnected SUPERCENTERS*. Call any or all of our services on one local telephone number. And there's a satellite link to London and Europe.

- New high reliability. Protected power supplies. Strong security features, at specially designed SUPERCENTERS. And soon, dual systems throughout on our NEW MARK II service.

- Subscription management. You control who uses the service and how, and even how much. Make our system your system.

- Great capabilities. Full FORTRAN IV and more. More core. More storage (multi-million characters). Remote job entry. Deferred execution. INTERPROCESSING* and FORTRAN IV bring real compatibility with your in-house system.

But that's just the tip of the iceberg. GE's NEW MARK II can do lots more for you. More to get the most from time-sharing and your own in-house capabilities.

If you manage an EDP operation, we'll come out and show you just how much more you can do with our NEW MARK II. Let's talk about it. Call me collect at (301) 654-9360, Ext. 700.

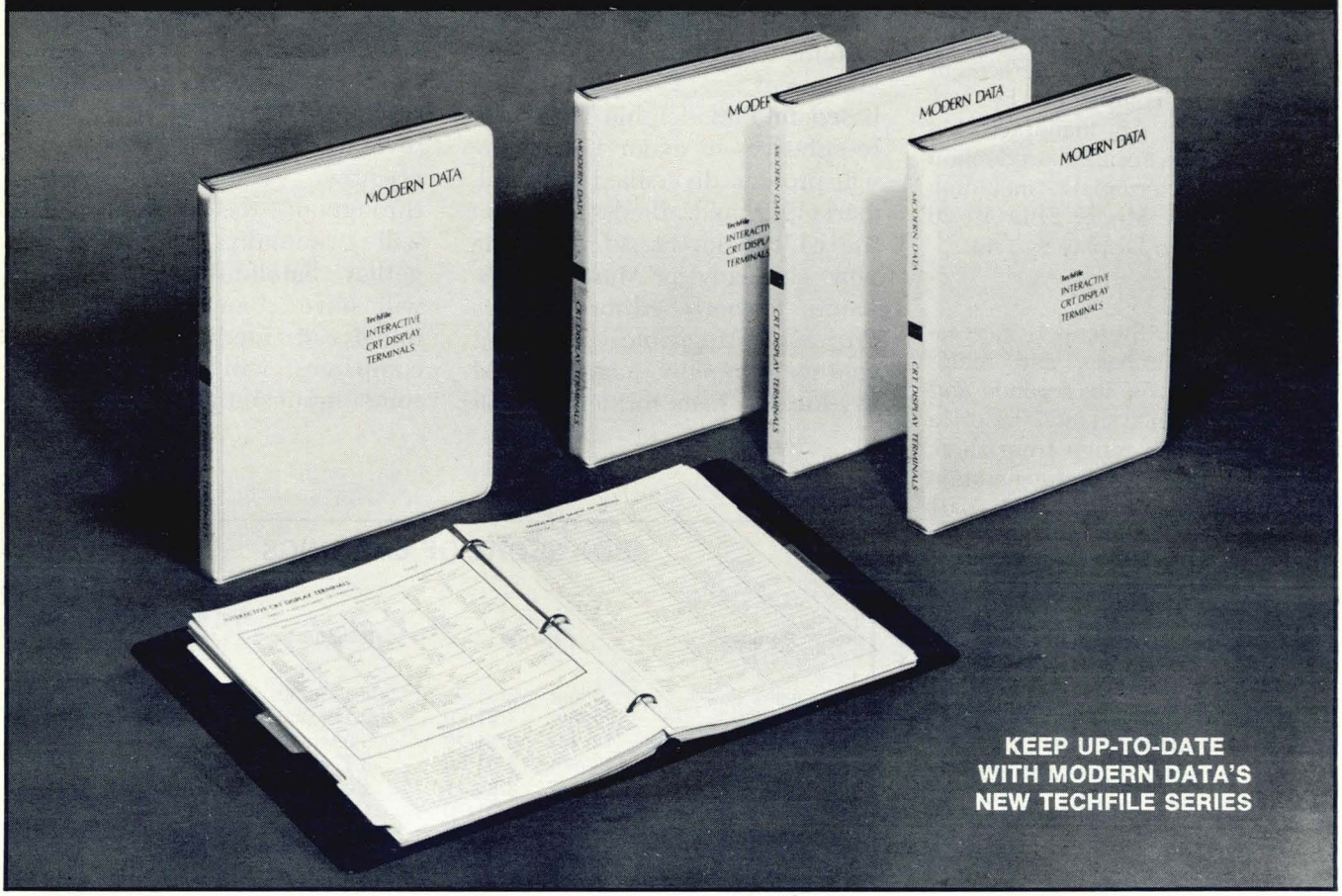
Sincerely,

Paul W. Sage

Paul W. Sage, General Manager
Information Services Marketing Department

*Service mark of General Electric Company

Buying computers, peripherals, EDP services? Enter that purchasing meeting armed with the facts!



TECHFILES are MODERN DATA'S new looseleaf reference service offering a choice of 12 subjects — each is updated quarterly:

- ☐ INTERACTIVE CRT DISPLAYS
- ☐ PRINTERS & TELEPRINTERS
- ☐ MINICOMPUTERS
- ☐ DISK/DRUM MEMORIES
- ☐ CASSETTE-CARTRIDGE TRANSPORTS
- ☐ OCR & MARK READERS
- ☐ DATA SETS & MULTIPLEXERS
- ☐ COM EQUIPMENT
- ☐ KEY-TO-TAPE/DISK
- ☐ MAGNETIC TAPE TRANSPORTS
- ☐ DIGITAL PLOTTERS
- ☐ TIME SHARING SERVICES

Each TECHFILE includes basic reviews, product comparison charts, market study, new developments, list of company reference literature, and a directory of suppliers' sales offices.

Avoid costly product research, make sound buying decisions, keep tabs on the competition, understand the market — with TECHFILES.

At the rate of just $5 per month per TECHFILE subject, you receive a full year's service representing the combined resources of MODERN DATA'S market research department and editorial staff. For full details, mail the coupon below.

MODERN DATA SERVICES, INC.
Information Products Division
3 Lockland Ave., Framingham, Mass. 01701

Please send complete details and order forms on TECHFILES.

Name_____
(please print)
Title_____
Company_____
Street_____
City_____
State_____ Zip_____

CIRCLE NO. 300 ON INQUIRY CARD

CORPORATE AND FINANCIAL NEWS

Incoterm Corp. of Marlborough, Mass. has signed an agreement with the TRANSAC Div of CIT-ALCATEL involving a minimum of $15 million in Common Market sales of Incoterm products over the next 48 months. The agreement calls for the completion by late 1971 of a French manufacturing facility for the licensed production of Incoterm terminals, including the company's Model SPD 10/20 Stored-Program Display System.

RCA Computer Systems is increasing rental, purchase, and maintenance prices on its second- and third-generation systems. The price increases, which range from three percent on second-generation Model 301, 501, 601, and 3301 computers, to five percent for third-generation Spectra series systems, will be effective Aug. 1. Although the company's recently introduced Model 2, 3, 6, and 7 computers will *not* be affected by the price increase, Spectra series peripherals ordered for use with RCA series central processing units *will* carry the Spectra price increase.

Raytheon Company announced tentative agreement on the sale of its memory and module product lines to Data Technology Corp. of Palo Alto. The product lines, manufactured at the Raytheon Data Systems facility at Santa Ana, include analog instruments, analog and digital logic modules, and "Biax" memories. The value of the proposed transaction was not disclosed.

Gould Inc. and Dictaphone Corp. jointly announced the termination of discussions relative to their previously-announced agreement in principle for Gould to acquire Dictaphone. The joint announcement stated that studies of markets and technologies did not reveal the fit which both companies had originally expected.

RECENT ENTRIES IN THE COMPUTER FIELD: Conversion Methods Corp. of N.Y.C. will assist EDP users converting their manual, first- or second-generation systems to a third-generation environment . . . **Computamation,** based in Philadelphia with representatives in major U.S. cities, will provide diversified editorial, marketing, and allied services in the EDP field. President of the new company is Martin Nussbaum, formerly editor of *Data Processing Magazine* . . . A joint venture company named **COM IV, Inc.** has been formed by Kalvar Corp. of New Orleans and Andersen Laboratories, Inc. of Bloomfield, Conn. to develop a fourth-generation COM system using dry-process film in microfiche format . . . **The Mentor Corp.** a Tulsa-based computer services firm, plans to develop several large communications-oriented computer centers throughout the nation which will eventually be linked together. Satellite centers, which will have communications terminals at medium and large companies, will service as customer input stations.

BOX SCORE OF EARNINGS

Company	Period		Revenues	Net Earnings (Loss)	Earning (Loss) Per Share
Burroughs	3 mos.	3/31/71	208,111,000	10,977,000	.60
	3 mos.	3/31/70	189,175,000	9,708,000	.56
Computer Dimensions	12 mos.	12/31/70	5,834,076	50,874	.04
	12 mos.	12/31/69	3,824,921	(1,339,427)	(1.31)
Computer Property	3 mos.	3/31/71	1,073,000	118,000	.18
	3 mos.	3/31/70	1,081,000	87,000	.13
Computest	9 mos.	2/28/71	7,540,908	394,248	.42
	9 mos.	2/28/70	8,229,314	580,278	.62
Computing & Software	3 mos.	1/31/71	19,053,000	1,625,000	.30
	3 mos.	1/31/70	18,445,000	1,472,000	.27
Control Data	3 mos.	3/31/71	141,007,000	12,644,000	.85
	3 mos.	3/31/70	125,539,000	457,000	—
Datascan	12 mos.	12/31/70	10,981,828	(155,620)	(.44)
	12 mos.	12/31/69	10,308,207	437,952	1.26
Elect. Data Sys.	9 mos.	3/31/71	55,018,312	7,415,371	.62
	9 mos.	3/31/70	31,787,755	4,931,671	.42
Honeywell	12 mos.	12/31/70	1,921,194,000	61,650,000	3.58
	12 mos.	12/31/69	1,837,634,000	62,238,000	3.76
Intn'l. Bus. Machines	3 mos.	3/31/71	1,870,133,046	250,807,781	2.19
	3 mos.	3/31/70	1,720,810,543	230,261,417	2.02
Itel	3 mos.	3/31/71	30,158,000	2,128,000	.30
	3 mos.	3/31/70	13,385,000	121,000	.02
Keane Assoc.	12 mos.	12/31/70	2,741,879	297,650	.40
	12 mos.	12/31/69	1,938,102	258,308	.37
Memorex	12 mos.	12/31/70	78,996,817	3,188,585	.83
	12 mos.	12/31/69	74,066,759	6,902,161	1.85
Nat. Cash Register	3 mos.	3/31/71	343,600,000	5,532,000	.25
	3 mos.	3/31/70	308,050,000	8,576,000	.39
National CSS	12 mos.	2/28/71	7,789,603	(1,737,121)	(1.67)
	12 mos.	2/28/70	2,587,089	(638,261)	(—)
Programming Methods	12 mos.	12/31/70	6,686,546	670,615	.80
	12 mos.	12/31/69	4,287,266	401,575	.48
Raytheon	3 mos.	4/4/71	316,069,000	8,874,000	.62
	3 mos.	3/29/70	307,146,000	8,806,000	.58
Scan-Data	12 mos.	12/31/70	2,193,264	(1,795,811)	(2.04)
	12 mos.	12/31/69	1,373,764	(1,418,129)	(1.84)
Standard Register	52 wks.	1/3/71	103,165,464	3,912,400	1.82
	52 wks.	1/4/70	103,622,182	4,401,968	2.05

MERGERS AND ACQUISITIONS: **Acme-Divac Industries Inc.,** Hawthorne, Cal., has acquired a complete line of CRT display terminals, including associated polling controllers and magnetic tape cassettes, from **American Data Systems,** Canoga Park, Cal. Details of the transaction were not disclosed . . . **Black Forest Development Co.,** a Colorado corporation, has purchased the majority of stock in **Systemation, Inc.,** the Colorado Springs-based systems education company . . . **Central Data Systems, Inc.** of Cleveland has agreed in principle to acquire the assets of **Pittsburgh Computer Co.** for an undisclosed number of CDS shares . . . **Computer Financial, Inc.** of Los Angeles has acquired the **Datatron Disc Div.** of **H.F.S. Manufacturing Co.,** subsidiary of **Datatron, Inc.,** Santa Ana, Cal. The new acquisition will operate as **CFI Memories, Inc.** . . . **Dashew Buisness Machines** of Santa Monica has agreed in principle to acquire **American Computer and Communications Co.,** Torrance, Cal. ACC produces magnetic encoding and reading devices used with credit cards . . . **Data Products Corp.** has completed its acquisition of 100 percent of **Core Memories, Inc.** Data Products previously owned approximately 78 percent of CMI's outstanding stock . . . **Harris-Intertype Corp.,** Cleveland, and **Datacraft Corp.,** Fort Lauderdale, Fla., have agreed in principal to a program which is expected to lead to Harris acquiring 60% ownership of Datacraft, a producer of digital computers and core memory systems. Part of the program calls for **Recognition Equipment, Inc.** of Dallas to exchange 640,000 shares of Datacraft for 142,000 shares of Recognition Equipment issued to Datacraft in 1969, and to cancel its outstanding Datacraft Warrants . . . **Image Information Inc.** of Danbury, Conn. has acquired the complete line of LGP-2000 Lasergraphic Plotter systems from **Dresser Systems, Inc.** . . .

CORPORATE PROFILE

Featured this month:

SCAN-OPTICS, INCORPORATED (Over-the-Counter)

East Hartford, Connecticut

DIRECTORS: **Anthony B. Coburn,** Chairman, Treasurer; **Richard J. Coburn,** President; **Ronald A. Haverl,** Vice President of Marketing; **Milton Stoller,** Vice President of Engineering; **Warren C. Heidel; Etalo G. Gnutti; E. Bulkeley Griswold.**

BACKGROUND: Scan-Optics, Inc. was incorporated in Delaware in September, 1968, to engage in the design, development, manufacture, and sale of optical character recognition (OCR) equipment and systems. In December of 1968, Scan-Optics acquired all of the assets and assumed all of the liabilities of Computer Technology Corp., a Connecticut corporation formed in May, 1968, in exchange for 48,654 shares of Scan-Optics stock. Prior to the acquisition, Computer Technology had no significant sales.

FACILITIES: Corporate headquarters are in East Hartford, where marketing, engineering, production, and administration are housed in a modern, one-story building. The company now occupies approximately 27,000 square feet and plans to expand to about 47,000 square feet by the end of this year. Sales, systems, and service capabilities are now being provided in major domestic computer markets such as New York, Washington, Philadelphia, Boston, Hartford, and Chicago. During the second half of 1971, the company plans to market its products in Cleveland and on the West Coast. In addition, Scan-Optics has initiated a foreign marketing program, and agreements are now being concluded with a large Japanese firm and a Dutch company to market Scan-Optics equipment in the Far East and in Western Europe.

PRODUCTS/SERVICES: Scan-Optics provides computer users with a full spectrum of OCR capabilities. The company's major product is its 20/20 OCR system, a high-speed combination page and document reader which features versatile, off-line operation. The basic 20/20 system includes a control computer, magnetic tape drive with controller, and an I/O console with on-line character insertion capabilities. Its modular design allows for the addition of a variety of options including additional fonts.

The company recently established a new function to market forms to OCR users and to offer forms design and development services.

CURRENT POSITION: Scan-Optics installed its first 20/20 system in late 1969, and is now starting deliveries of systems to insurance companies, banks, publishers, manufacturers, and the service industry. Based on the purchase value of equipment, backlog currently exceeds $4 million.

OUTLOOK: OCR equipment is finding ever-widening acceptance among computer users and shipments are predicted to grow from a current level of $150 million to between $400 and $500 million a year by 1975. There are between 1,500 and 2,000 scanners currently installed in the United States. The Scan-Optics 20/20 system is reported to be cost-justified by companies having between ten and twelve keypunch operators, and is competitive with key-to-tape and key-to-disk systems.

FINANCIAL SUMMARY: Scan-Optics made a successful public offering of 100,000 shares of common stock at $17.50 per share on December 16, 1969. At December 31, 1970, the company had outstanding a $1,104,000, 8½% bank note due February 1, 1971. This note was subsequently changed to a 7% demand loan guaranteed to the extent of $627,000 by a major stockholder. It is also secured by 200,000 shares of Scan-Optics common stock owned by four of the company's officers. Scan-Optics is now negotiating to obtain substantial long-term financing and to enter into equipment leasing arrangements.

Financial statements treat Scan-Optics as a development organization, therefore, the following summary presents receipts and disbursements for the periods indicated, rather than total revenues, net income, and primary E/S.

SCAN-OPTICS INCORPORATED

Fiscal Year Ending	7/31/70	7/31/69
Total Receipts*	$1,850,649	$756,754
Total Disbursements	$1,547,395	$721,433
Cash Balance	$ 338,575	$ 35,321
Shares Outstanding	475,154	371,754

*Includes $1,758,956 and $741,068 for the fiscal years ending July 31, 1970 and 1969, respectively, obtained from sale and issuance of common stock and warrants.

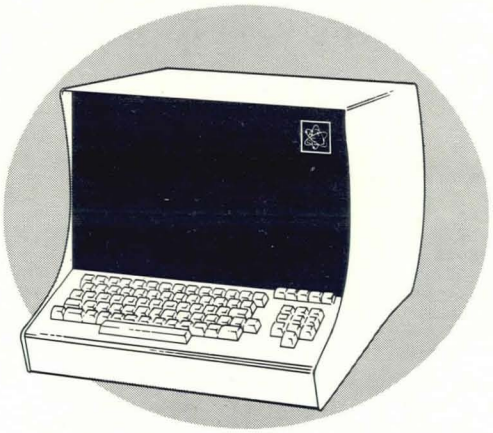
BEEHIVE TERMINALS

Beehive modularity again proves obsolescence obsolete!

LOWER CASE
and
THREE LEVEL PRIORITY BLINK

now added to Beehive's growing list of product improvement features available through *in-the-field* upgrading

The Lower Case option permits display and transmission of the full 128 ASCII character set. The standard Beehive Terminal already offers dual intensity characters for differentiating between displayed data and control characters. Now, to further assist the terminal user, the Priority Blink option permits displayed data to be highlighted or to be used as selective annunciators. Individual characters, words, lines, or the complete screen may be selected to blink, reverse the video (black on white), or to blink the reverse video.



BEEHIVE TERMINAL MODELS I, II or III

MODEL I
BASIC TIME SHARING

Provides all the minimum functional capabilities required of an alpha-numeric CRT display unit with a teleprinter style keyboard. Has 800 character storage and display (20 lines x 40 ch/line), parity detection and generation, composite video, output, four way control of non-destructive blinking cursor, home and clear, switchable baud rate, scroll overflow, RS 232B interface for full and half duplex operation. Can be changed to a Model II in the field!

MODEL II
BATCH PROCESSING

Has all the capabilities of Model I plus the following: erase screen, erase line, tab, tab set, tab clear, and block transfer. Can be changed to a Model III in the field! or upgraded from Model I.

MODEL III
SOPHISTICATED BATCH AND INQUIRY

Provides all the features and functions of the Model I and II, plus the features required in sophisticated time sharing environments and applications where full editing capabilities are necessary along with (split screen) protected field formatting.

ACCESSORIES

Stand-Alone Cassette
Teleprinter 20/60MA Current Loop Adapter

OPTIONS

MODEL I, II, III	80 Character Line Display Parallel I/O Adapter— Low and High Speed Upper/Lower Case Display 3 Level Priority Blink Export Model
MODEL II, III	Remote Printer Adapter

MODEL CHANGES

Model changes as well as options are possible in the field!

360 USERS ATTENTION!

The Beehive Model IV is plug-to-plug compatible with the IBM type 2845/2265 configuration.

•

Nationwide Maintenance Available
National Sales Representation

BEEHIVE MEDICAL ELECTRONICS, Inc.

1473 South 6th West • Salt Lake City, Utah 84104
801 / 487-0741

COMPUTER STOCK TRENDS

MONTH ENDED MAY 14, 1971

	EXCH	COMPANY	PRICE					VOLUME (IN 100'S)			EARNINGS	
			1971 RANGE (1)	1 YEAR AGO	CLOSE MAY 14 1971	MONTH NET CHG.	MONTH % CHG.	THIS MONTH (3)	LAST MONTH	AVG. VOLUME (2)	PER SHARE LATEST 12 MONTHS	PRICE–EARNINGS RATIO
COMPUTERS	N	BECKMAN	27- 46	29 5/8	46	+4	+9.5	2269	1246	2093	1.29	36
	N	BURROUGHS	105-138	120	131 5/8	+7 1/4	+5.8	7679	6023	9459	3.87	34
	N	CONTROL DATA	48- 83	39 1/4	67 1/2	+2 3/8	+3.6	15426	4592	9970	0.40	169
	O	DATA GENERAL	19- 45	23 1/2	41	+3 1/2	+9.3	(3)	-	-	0.44	93
	O	DATACRAFT	5- 9	N/A	8	+ 1/4	+3.2	(3)	-	-	-	-
	N	DIGITAL EQUIPMENT	53- 83	70 1/4	81 3/8	+13 3/8	+19.6	4195	3883	5535	1.19	68
	N	ELECTRONIC ASSOC	5- 9	5 1/4	8 3/4	+1 1/2	+20.6	2002	772	1576	-1.52	-
	O	GENERAL AUTOMATION	12- 26	14 1/2	19 3/4	-2 3/4	-12.2	(3)	-	-	-0.44	-
	N	GENERAL ELECTRIC	94-124	65 5/8	120 3/4	+4	+3.4	9650	8545	10251	5.11	24
	N	HEWLETT-PACKARD	30- 45	33 1/2	38 1/4	-2 1/8	-5.2	3727	5086	3807	0.87	44
	N	HONEYWELL	83-115	105 7/8	112 3/8	-2 1/4	-1.9	7526	4685	5880	2.92	38
	O	INTERDATA	6- 11	N/A	10	- 3/4	-6.9	(3)	-	-	0.02	500
	N	IBM	310-364	268 1/2	335 1/2	-21 1/4	-5.9	9903	4926	7209	9.09	37
	N	LITTON INDUSTRIES	20- 34	20	32 1/2	+1 1/2	+4.8	11132	8730	13998	1.45	22
	N	NCR	38- 47	55 3/4	43 7/8	- 1/4	-0.5	16060	11199	14871	1.23	36
	N	RCA	26- 40	22 1/8	38 3/4	+3 7/8	+11.1	13847	9952	13325	1.23	32
	N	RAYTHEON	27- 46	20 1/4	42 3/4	+3 1/8	+7.8	8585	4465	7149	2.36	18
	O	REDCOR	5- 9	13 1/4	7	- 5/8	-8.1	(3)	-	-	-2.81	-
	O	SCIENTIFIC CONTROL	1- 2	N/A	1 1/8	- 1/4	-18.1	(3)	-	-	-	-
	N	SPERRY RAND	25- 38	27 7/8	36 3/8	+ 1/4	+0.6	19808	15130	20197	2.11	17
	A	SYSTEMS ENGRG LABS	12- 18	18 1/4	12 1/4	-2 3/8	-16.2	3720	4244	4573	-0.11	-
	N	SYSTRON DONNER	10- 18	12	17 1/2	+1 3/4	+11.1	2595	1849	2135	0.59	30
	N	VARIAN ASSOCIATES	13- 18	15 3/4	15 1/2	-2 3/8	-13.2	5182	3725	5771	-0.49	-
	O	VIATRON	1- 4	N/A	7/8	- 3/8	-30.0	(3)	-	-	-	-
	N	WANG LABS	29- 50	27 1/4	48 1/4	+6 1/4	+14.8	1865	1789	1627	0.91	53
	A	WYLE LABS	4- 6	4 5/8	5 1/2	0	0.0	1049	813	1257	-	-
	N	XEROX	85-110	79	107 3/8	- 3/4	-0.6	13971	7896	11938	2.44	44
PERIPHERALS & COMPONENTS	O	ADVANCED MEMORY SYS	21- 37	N/A	23	-3	-11.5	(3)	-	-	-	-
	N	AMP	55- 73	45 5/8	68 3/8	-1 1/8	-1.6	1047	1960	1999	1.96	35
	N	AMPEX	17- 25	17 3/4	19 3/4	-4	-16.8	19322	7864	11489	0.53	37
	O	APPLIED MAGNETICS	14- 22	13 3/4	21 1/2	+4 5/8	+27.4	(3)	-	-	0.45	48
	O	ASTRODATA	1- 2	N/A	1 5/8	+ 1/2	+44.4	(3)	-	-	-	-
	O	ASTROSYSTEMS	4- 6	3 7/8	5 3/4	+1 1/4	+27.7	(3)	-	-	-	-
	N	BUNKER RAMO	10- 17	7 3/4	14 5/8	- 3/4	-4.8	16819	9749	11449	-	-
	A	CALCOMP	23- 33	15 7/8	26 3/4	-5 1/2	-17.0	3602	4002	4319	0.68	39
	O	CHALCO INDUSTRIES	2- 4	N/A	2 3/4	+ 3/4	+37.5	(3)	-	-	-	-
	O	CODEX	5- 10	N/A	7 7/8	- 1/8	-1.5	(3)	-	-	-	-
	O	COGAR	26- 71	46	33	-15	-31.2	(3)	-	-	-	-
	O	COGNITRONICS	5- 9	6 3/4	5 3/8	-1 3/4	-24.5	(3)	-	-	-0.40	-
	N	COLLINS RADIO	14- 20	16 3/4	18 3/4	- 1/8	-0.6	2117	2653	2735	-0.90	-
	O	COMCET	4- 9	N/A	9	+1 1/8	+14.2	(3)	-	-	-	-
	O	COMPUTER COMM	6- 19	15	11 3/4	-3 3/4	-24.1	(3)	-	-	-1.02	-
	O	COMPUTER CONSOLES	7- 11	9	8 1/4	0	0.0	(3)	-	-	-	-
	A	COMPUTEST	13- 20	17 1/2	14 1/8	-1 1/4	-8.1	891	1467	1141	0.72	20
	N	CONRAC	16- 29	14 1/4	28 1/2	+5 1/8	+21.9	1249	316	813	1.03	28
	O	DATA 100	8- 13	6 1/2	8 5/8	+ 5/8	+7.8	(3)	-	-	-	-
	A	DATA PRODUCTS	6- 10	12 7/8	7 3/4	- 5/8	-7.4	3992	5631	5796	-1.30	-
	O	DATARAM	1- 3	N/A	2 1/8	- 1/2	-19.0	(3)	-	-	-	-
	O	DATA RECOGNITION	3- 8	N/A	7	- 1/2	-6.6	(3)	-	-	-	-
	O	DATASCAN	4- 7	13	6 3/4	+2 1/4	+50.0	(3)	-	-	-	-
	O	DIGITRONICS	4- 8	5 1/2	5 1/8	+ 1/2	+10.8	(3)	-	-	-0.71	-
	A	ELEC ENG OF CAL	5- 9	6	8 1/4	+ 1/4	+3.1	290	217	364	-0.52	-
	N	ELEC MEMORIES + MAG	8- 17	16 1/8	16 1/2	+3 1/4	+24.5	14471	9351	10398	-2.91	-
	N	EXCELLO	20- 24	21 1/8	21	+ 3/4	+3.7	2798	1623	2080	1.45	14
	O	FABRI-TEK	2- 4	4 1/4	4	+ 5/8	+18.5	(3)	-	-	-0.51	-
	O	FARRINGTON MFG	1- 3	4	1 1/4	-1 1/8	-47.3	(3)	-	-	-2.16	-
	A	GERBER SCIENTIFIC	11- 16	10 1/2	14 1/4	+1 5/8	+12.8	654	640	679	-0.17	-
	O	GRAPHIC SCIENCES	15- 37	7 1/8	33 3/8	- 1/8	-0.3	(3)	-	-	0.12	278
	A	HI-G	5- 8	8 3/4	6 1/8	+ 1/8	+2.0	8373	155	2280	-0.45	-
	O	INFORMATION DISPLAYS	5- 8	6 1/4	6 1/8	-1 5/8	-20.9	(3)	-	-	-	-
	A	ITEL	15- 23	9 3/8	16 7/8	-4 5/8	-21.5	5844	4697	4566	1.28	13
	O	LOGIC	5- 13	N/A	11 1/4	+2 3/8	+26.7	(3)	-	-	-	-
	A	MILGO	18- 26	26 5/8	18 7/8	-1 3/8	-6.7	6277	2072	4626	0.44	43
	N	MOHAWK DATA SCIENCES	23- 47	38 1/8	41 3/8	+3 5/8	+9.6	9769	6301	6878	1.25	33
	O	NORTH ATLANTIC IND	2- 5	N/A	2 3/4	-1	-26.6	(3)	-	-	-	-
	O	OPTICAL SCANNING	13- 18	16	14 1/2	-2 1/2	-14.7	(3)	-	-	-1.74	-
	A	POTTER INSTRUMENTS	17- 25	27 1/2	21	-2 1/4	-9.6	3678	3404	3241	0.78	27
	O	RECOGNITION EQUIP	14- 26	27	21 3/4	0	0.0	(3)	-	-	-1.03	-
	N	SANDERS ASSOCIATES	13- 22	11	20 1/8	-1 3/4	-8.0	3762	3592	3945	0.19	106
	N	SANGAMO	14- 20	13 3/4	17 3/4	- 3/4	-4.0	1070	1065	1643	0.70	25
	O	SCAN-DATA	6- 11	10	6 3/4	- 3/8	-5.2	(3)	-	-	-	-
	A	SEALECTRO	4- 7	5 3/4	5	-1	-16.6	217	322	266	-0.05	-
	O	SYKES DATATRONICS	2- 6	5 1/2	5 1/2	+1	+22.2	(3)	-	-	-	-
	O	TALLY	11- 16	10 1/2	11 1/2	-2 1/4	-16.3	(3)	-	-	-	-
	N	TELEX	15- 22	15 1/8	18 3/4	-3	-13.7	18238	17766	23137	0.78	24
	N	TEXAS INSTRUMENTS	80-123	93 3/8	115 5/8	+6 3/8	+5.8	4678	2437	3540	2.72	43
	O	VARIFAB	1- 3	N/A	3/4	-1	-57.1	(3)	-	-	-	-

FOOTNOTES: (1) TO NEAREST DOLLAR
(2) AVERAGE MONTHLY TRADING VOLUME SINCE JANUARY 1, 1970
(3) VOLUME IS NOT REPORTED FOR OVER-THE-COUNTER ISSUES AND NEW LISTINGS

EXCH: N=NEW YORK EXCHANGE; A=AMERICAN EXCHANGE; O=OVER-THE-COUNTER; L=NATIONAL EXCHANGE;

TRADE*QUOTES

All statistics compiled, computed and formatted by TRADE*QUOTES Inc., Cambridge, Mass. 02139

	EXCH	COMPANY	PRICE					VOLUME (IN 100'S)			EARNINGS	
			1971 RANGE (1)	1 YEAR AGO	CLOSE MAY 14 1971	MONTH NET CHG.	MONTH % CHG.	THIS MONTH (3)	LAST MONTH	AVG. VOL-UME (2)	PER SHARE LATEST 12 MONTHS	PRICE–EARNINGS RATIO
	A	APPLIED DATA RESCH	5- 13	5 1/8	7 5/8	-2 3/4	-26.5	797	849	1381	-0.13	-
	O	APPLIED LOGIC	1- 3	N/A	1 3/8	- 1/4	-15.3	(3)	-	-	-	-
	O	ARIES	1- 2	N/A	1 1/8	- 1/4	-18.1	(3)	-	-	-	-
	N	AUTOMATIC DATA PROC	44- 60	27 1/4	57 5/8	+ 5/8	+1.0	1282	779	1295	0.82	70
	A	BOLT, BERANEK, NEWMA	6- 8	7 1/4	6 3/4	- 3/8	-5.2	379	131	223	0.24	28
	O	BOOTHE COMPUTER	13- 27	16	22 3/4	-2 7/8	-11.2	(3)	-	-	1.58	14
	O	BRANDON APPLIED SYS	1- 1	N/A	3/4	0	0.0	(3)	-	-	-	-
	O	COMP ENVIRONMENTS	1- 2	N/A	1	- 1/4	-20.0	(3)	-	-	-	-
	O	COMPUTER EXCHANGE	4- 9	4	5 5/8	+ 3/8	+7.1	(3)	-	-	-	-
	A	COMPUTER INVESTORS	8- 14	5 7/8	12 5/8	+ 1/4	+2.0	638	649	664	0.61	21
	O	COMPUTER METHODS	1- 2	N/A	7/8	- 1/4	-22.2	(3)	-	-	-	-
	O	COMPUTER PROPERTY	6- 11	N/A	9	+ 1/2	+5.8	(3)	-	-	-	-
	N	COMPUTER SCIENCES	9- 17	11 3/4	15 5/8	+2 1/4	+16.8	17829	6272	10698	0.03	521
	O	COMPUTER TECHNOLOGY	5- 11	N/A	7 3/4	-2 3/4	-26.1	(3)	-	-	-	-
	O	CTC COMPUTER	2- 4	4 1/2	2 1/8	-1 3/4	-45.1	(3)	-	-	-	-
	O	COMPUTER USAGE	5- 16	4 7/8	10	- 1/2	-4.7	(3)	-	-	-2.05	-
	A	COMPUTING + SOFTWARE	27- 45	26 3/4	37	-7 1/2	-16.8	2647	3115	2821	1.21	31
	O	COM-SHARE	4- 8	N/A	6 1/2	+ 5/8	+10.6	(3)	-	-	-	-
	O	CYBERNATICS	8- 11	7 1/2	10 1/2	+ 1/2	+5.0	(3)	-	-	-	-
	O	DATA AUTOMATION	1- 4	N/A	2 1/2	-1	-28.5	(3)	-	-	-	-
	O	DATA DYNAMICS	1- 4	N/A	3	- 1/2	-14.2	(3)	-	-	-	-
	N	DATA PROC FIN + GEN	11- 19	8 1/8	16 3/8	-1 1/4	-7.0	3845	5964	6063	0.64	26
	O	DATA SYSTEM ANALYSTS	1- 3	N/A	2 5/8	+ 7/8	+50.0	(3)	-	-	-	-
	O	DATRONIC RENTAL	2- 4	4 1/4	2 7/8	- 1/4	-8.0	(3)	-	-	-	-
	A	DEARBORN-STORM	24- 44	12 5/8	40	+3	+8.1	1384	771	1370	2.11	19
	O	DECISION SYSTEMS	1- 1	N/A	1 1/8	+ 1/2	+80.0	(3)	-	-	-	-
SOFTWARE	O	DIGITAL APPLICATIONS	1- 2	N/A	1 1/4	- 1/4	-16.6	(3)	-	-	-	-
&	O	DIGITEK	1- 4	N/A	2 3/8	+ 3/4	+46.1	(3)	-	-	-	-
	A	DPA, INC	4- 8	4 1/2	6 3/4	- 7/8	-11.4	1175	1369	1350	0.63	11
SERVICES	O	EFFICIENT LEASING	1- 7	N/A	6	+3 3/4	+166.6	(3)	-	-	-	-
	A	ELEC COMP PROG INST	3- 7	6	4 3/4	-1 1/4	-20.8	245	369	461	-0.30	-
	N	ELEC DATA SYSTEMS	60- 85	54	62	-17	-21.5	(3)	-	-	0.81	77
	A	GREYHOUND COMPUTER	7- 11	6 1/2	9 7/8	- 5/8	-5.9	672	428	730	0.78	13
	O	INFORMATICS	7- 15	5 7/8	13 1/2	+1 5/8	+13.6	(3)	-	-	0.13	104
	O	INTL COMPUTER	2- 6	N/A	3 1/2	-1 1/2	-30.0	(3)	-	-	-	-
	L	INTL COMPUTER SCI	1- 2	N/A	2	+ 1/4	+14.2	(3)	-	-	-	-
	N	LEASCO	16- 23	12 1/8	21 5/8	+1 3/4	+8.8	9286	6144	10175	0.03	721
	O	LEVIN-TOWNSEND	5- 9	4 1/4	7	- 1/4	-3.4	(3)	-	-	-0.74	-
	O	LMC DATA	1- 1	N/A	3/4	- 1/4	-25.0	(3)	-	-	-	-
	O	MGMT ASSISTANCE	1- 2	N/A	7/8	0	0.0	(3)	-	-	-	-
	A	MANAGEMENT DATA	8- 11	15 5/8	10 5/8	+1 1/8	+11.8	1130	312	549	0.56	19
	O	NATIONAL COMP ANAL	1- 4	N/A	2 3/4	- 1/4	-8.3	(3)	-	-	-	-
	N	PLANNING RESEARCH	16- 26	19 1/2	19 1/4	-4 3/4	-19.7	6017	7285	6436	0.68	28
	O	PROGRAMMING METHODS	18- 29	11 1/2	22 1/2	+2	+9.7	(3)	-	-	-	-
	L	PROGRAMMING SCIENCES	1- 3	N/A	3/8	+ 1/8	+50.0	(3)	-	-	-	-
	O	PROGRAMMING SYSTEMS	2- 4	3	2 5/8	- 3/4	-22.2	(3)	-	-	0.14	19
	O	SCIENTIFIC COMPUTER	2- 3	2	2 1/2	+ 3/8	+17.6	(3)	-	-	0.09	28
	O	SCIENTIFIC RESOURCES	1- 2	N/A	7/8	- 1/8	-12.5	(3)	-	-	-	-
	O	SYSTEMS CAPITAL	3- 6	N/A	5 1/4	+2	+61.5	(3)	-	-	-	-
	O	TIME SHARE	1- 2	N/A	1 1/4	0	0.0	(3)	-	-	-	-
	O	TRACOR COMPUTING	2- 4	3 3/8	3 1/2	- 1/8	-3.4	(3)	-	-	0.33	11
	A	URS SYSTEMS	7- 11	8 1/4	7 1/4	-1 1/4	-14.7	867	1004	1594	-0.21	-
	O	UNITED DATA CENTERS	2- 7	N/A	4 3/8	- 3/4	-14.6	(3)	-	-	-	-
	N	UNIVERSITY COMPUTING	21- 33	23 1/2	33	+2 3/4	+9.0	13166	9650	10741	-1.54	-
	O	US TIME SHARING	1- 3	N/A	2 1/8	+ 3/8	+21.4	(3)	-	-	-	-
	N	ADAMS MILLIS	14- 19	10 7/8	15 3/8	-1 3/8	-8.2	1113	942	1384	1.08	14
	O	BALTIMORE BUS FORMS	6- 10	N/A	8 1/2	-1 1/4	-12.8	(3)	-	-	-	-
	A	BARRY WRIGHT	8- 13	8 1/4	10	- 3/4	-6.9	704	1284	1144	0.32	31
	A	CAPITOL INDUSTRIES	13- 22	28 5/8	12 7/8	-4 5/8	-26.4	2744	1536	2033	0.33	39
	A	DATA DOCUMENTS	18- 29	22 1/2	25	- 1/4	-0.9	381	300	286	1.41	18
	O	DATA PACKAGING	7- 10	12 3/4	8 1/8	- 3/4	-8.4	(3)	-	-	-0.03	-
	N	DENNISON MFG	22- 32	15 1/2	31	- 1/4	-0.7	2973	2020	2723	1.96	16
	N	DUPONT	130-152	107 1/2	145 3/8	+ 7/8	+0.6	4829	2399	3580	6.35	23
SUPPLIES	N	ENNIS BUSINESS FORMS	10- 13	12	11	- 3/8	-3.2	3106	3136	2010	0.60	18
&	O	GENERAL BINDING	25- 32	20	31 1/2	+1 1/2	+5.0	(3)	-	-	0.86	37
ACCESSORIES	O	GRAPHIC CONTROLS	6- 13	10	11 3/4	+2	+20.5	(3)	-	-	-0.33	-
	O	LEWIS BUSINESS FORMS	10- 15	13 1/2	11 1/2	+ 1/2	+4.5	(3)	-	-	0.79	15
	N	MEMOREX	54- 78	80	55 5/8	-13 1/2	-19.5	7918	7573	7392	0.83	67
	N	3M	96-117	88 1/2	112 1/2	- 7/8	-0.7	4388	3113	4402	3.41	33
	O	MOORE CORP LTD	37- 42	N/A	37 1/4	-3 1/2	-8.5	(3)	-	-	-	-
	O	REYNOLDS + REYNOLDS	37- 52	31	47 3/4	-2 1/4	-4.5	(3)	-	-	1.61	30
	A	SAFEGUARD INDUSTRIES	10- 15	9 5/8	13 3/8	- 5/8	-4.4	1258	1032	1386	0.81	17
	O	STANDARD REGISTER	19- 23	24	22	+ 1/2	+2.3	(3)	-	-	1.53	14
	N	UARCO	25- 33	25 3/8	31 5/8	+3 1/2	+12.4	693	616	683	1.75	18
	N	WALLACE BUS FORMS	18- 26	15 3/4	20 1/2	-2 1/4	-9.8	572	363	457	1.18	17

AVERAGES	COMPUTER STOCKS	17–26	23.78	22.75	–0.39	–1.67		0.69	32.9
	DOW JONES INDUSTRIALS	831–951	733.63	936.06	+15.65	+1.70		3.04	18.3

"BISYNC" IS NOT A TWO-POSITION WASHSTAND

Communications Clinic is a regular monthly column written by the staff of **Berglund Associates, Inc.,** consultants in telecommunications. Readers are invited to submit questions on any aspect of communications or suggestions for future Clinics to:

Communications Clinic
c/o Berglund Associates, Inc.
1060 Kings Highway North
Cherry Hill, New Jersey 08034

One of the questions that comes to us periodically has to do with the meanings and inter-relationships of the terms start-stop, asynchronous, synchronous, STR (Synchronous Transmit-Receive), and BiSync or BSC (Binary Synchronous Communications).

To begin with, synchronous and asynchronous are high-order general adjectives usually applied to data sets and terminals as a means of broad classification. On the other hand, STR and BSC are procedures or disciplines for line coordination and control in systems involving synchronous terminals and data sets.

Let us begin with synchronous and asynchronous as general classifications. The concept of asynchronous operation in a terminal is usually described as start-stop operation. Start-stop is one of the nicer buzz words in our business because it so precisely evokes the correct image. Start-stop transmission involves sandwiching a character of data between a "start bit" and a "stop bit." Note that there is really no such thing as a "start-stop code." Virtually any code, i.e., any combination of ones and zeroes representing alphanumeric and control symbols, can be sent as a start-stop transmission. Furthermore, the duration of the stop element is not universally standard. It may be 1.42 bit times, as with many Baudot code teletypewriters; it may be two bits, as with Model 33 Teletype units; or it may be one bit, as with Teletype Model 37.

Originally, in electromechanical equipment, the start bit arriving at a printer released a magnet which, in turn, released a rotating mechanism to set up print selection bars corresponding to the ensuing code bits. The stop bit insured that the clutch magnet was back in place at the end of the character. Those who have heard a printer run "open," i.e., connected to a line which has constant space or logical zero on it, have heard the effect of the clutch magnet not being energized to re-engage and thus stop the rotor.

To further illustrate the meanings of synchronous and asynchronous, note that although each start-stop character is handled on a start-stop basis *asynchronously* (that is, they can follow each other immediately or at long intervals), the bits within the character have to arrive – and are interpreted – *synchronously*. The point is that *each* character carries the information with which the receiver can establish character phase for the character just received. As such, it is mandatory for any unbuffered system, e.g., conversational time-sharing.

The start-stop system has been very cost-effective for the many, many years of electromechanical terminal production. With the increasing trend towards lower-cost electronics, we are not sure that it will remain cost-effective in new generation terminals except in applications that do not lend themselves to buffering. Its disadvantage is its inefficiency. In a typical Model 33 or 35 teletypewriter system, 3 of every 11 bits sent are for start-stop synchronism – a 73% efficiency. Communication line charges being what they are, an increase to 95+% efficiency could pay for a lot of terminal development. A limiting factor in the growth of inexpensive synchronous terminals would be the imbedded cost of multiplexer/concentrators, and CPU ports designed for start-stop.

Synchronous transmission involves sending all bits of all characters, and all characters, at a constant or "synchronous" rate. There are no start or stop bits. Because of this, a receiving device cannot know where it is with respect to bit or character phase. Is it looking at a bit at the proper time? When it has assembled the number of bits pertaining to the code being used, has it got a character, or parts of two successive characters? To solve these problems, both bit synchronizing and character phasing are required. Bit synchronizing is achieved by having the transmitter drive the data set with a bit rate clock. The clock signal is recovered from the carrier at the receive location and passed on to the receiver. Note that in synchronous systems this clock signal may also be created by the data set at the transmitter site, clocking the bits from the business machine.

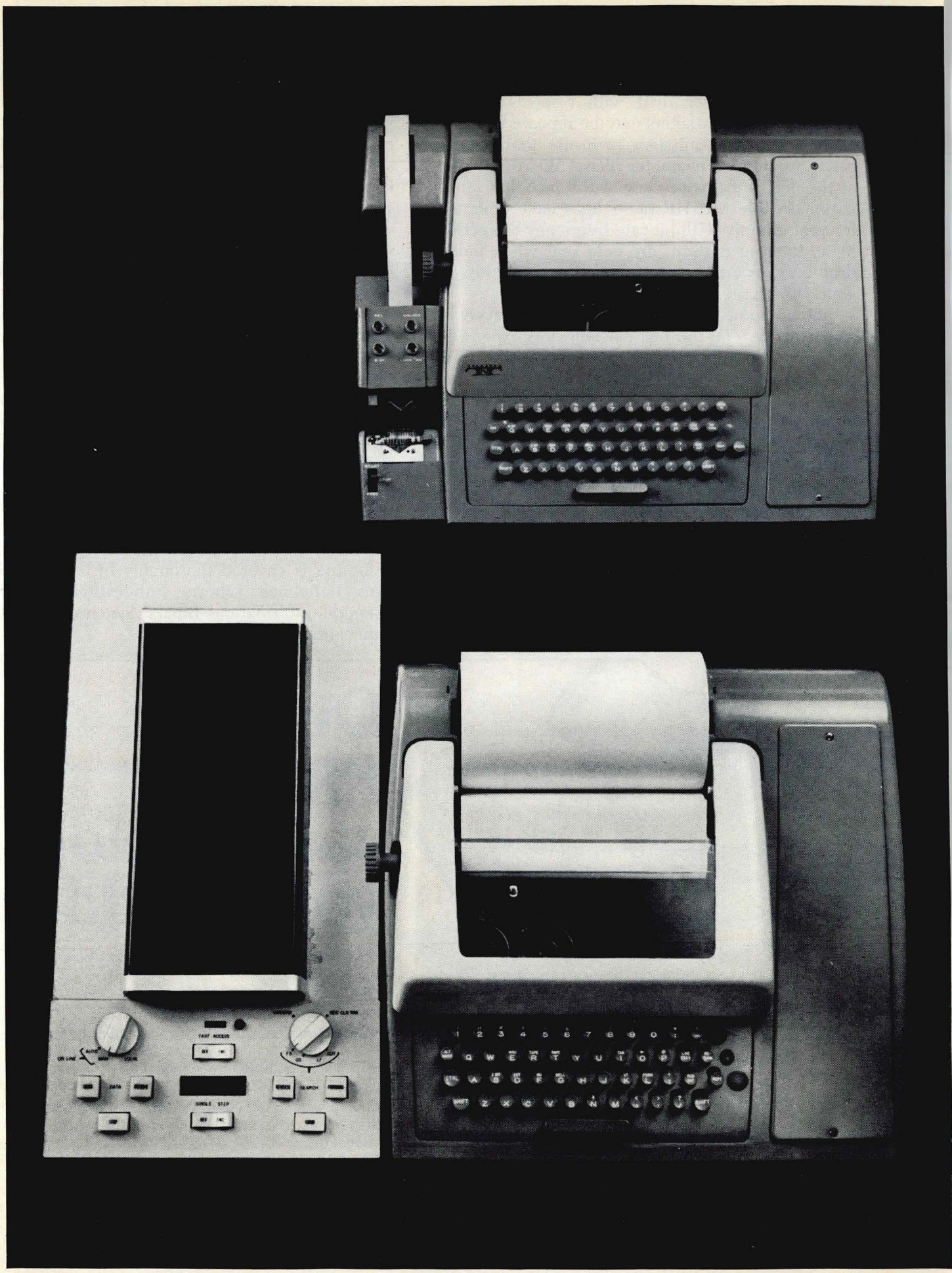
Character phasing is accomplished by preced-

ing each data message with one or two pre-defined "phasing" characters. The receiver senses these and phases its receive logic for the subsequent characters. Because the clocks of transmitter and receiver drift with respect to each other, phasing characters may be repeated periodically within transmissions to insure that the receiver remains in character phase. We're not sure of the need for this in view of the fact that international cable and HF radio links have operated for years simply with bit rate frequency correction logic. Phasing patterns are only sent when fades, drop-outs, or error patterns suggest actual loss of character phase.

Summarizing – and speaking very relatively – start-stop systems are less efficient, less expensive, and will generally resynchronize more quickly in the face of line bits. Synchronous systems can handle higher bit rates, require more expensive equipment, and pose the threat of block loss if phasing characters are mutilated.

Other semantic problems arise with these terms. The type 202 data set is an asynchronous data set. It provides no bit clock and can accept none. However, it can be used for synchronous transmissions if "short" blocks are used and the clocks at each end are "stable." If the clocks at each end are drifting with respect to each other – and if the block is too long – the system may be out of phase before the end of the block. The Mohawk transmission terminals operate quite successfully this way, frequently using type 202 data sets with a non-start-stop coded system. On the other hand, the 201 data set is a synchronous set, providing or accepting bit clocks. Yet the IBM 2260-2848 display complex operating in a remote environment can use the 201 at 2400 bps, but will transmit a start-stop code. It is simply using the higher speed capability of the 201 to transmit a start-stop coded system synchronously. What this points up is that we can have a synchronous *transmission* system with an asynchronous *data* sytem, and we can have an asynchronous *transmission* system with a synchronous *data* system.

Finally, and notwithstanding the above general breakdown, we have the types of line control or system operation, such as BSC and STR. Both of these are terms coined by IBM for operating procedures involving synchronous transmission in their teleprocessing operations. They involve proper use of coordination procedures, phasing characters, and other control characters such as STX (Start of Text), EOT (End of Text), DLE (Data Link Escape), etc. Between STR and BSC, the latter is currently the most widely used and promoted system. It is too involved for this column, and is covered thoroughly in the IBM Systems Reference Library Publication A27-3004, "General Information—Binary Synchronous Communications." ▲



THE EDP DP IN EUROPE

RICHARD PETTERSEN • European Editor

For whatever reasons, a growing number of Americans seem to be considering relocating to Europe. There are many distinct advantages to be gained — a pleasant way of life, clean, safe, and convenient cities, cultural opportunities, novelty, and perhaps adventure — but there are also some real problems involved in such a move which must be faced.

Richard Pettersen is an international consultant in EDP, presently headquartered in Paris. A Texan and a **magna cum laude** graduate of the University of Southern California (Phi Beta Kappa, among other honors), he has been actively involved with computers since 1959 in such various disciplines as technical writing/editing, logic design, circuit design, systems planning and development, customer engineering, and programming. (He also devoted several years to teaching retarded children to read, draw, and swim.) Mr. Pettersen has a working knowledge of 20 to 30 languages, including Sanskrit, Tibetan, Icelandic, and Classical Manchu, and has been European Editor of **MODERN DATA** since 1968.

FINDING A JOB

This is *the* problem, even in the EDP field where Americans might expect to have an advantage. EDP in Europe has become quite sophisticated, and any small technical superiority an American may have to offer can easily be offset by such things as ignorance of the language and customs of the country or by his demanding a salary which firms here consider outrageous. About $6000 a year is a common programmer/engineer salary, but it is supplemented by such things as full medical and dental coverage (as long as you consult only government-listed doctors and dentists), 4 to 6 weeks of vacation, bonuses, and numerous other benefits — most of which are non-taxable.

There are two reasonable approaches to obtaining a position in Europe. The first and best is to become employed by an American firm which will transfer you to its European operation or assign you to an associated European company on the basis of your special skills. This is the ideal solution, obviously. You not only keep your American salary (usually with an overseas bonus added) and have your relocation expenses taken care of, but you also avoid most of the headaches associated with obtaining your various Papers. Unfortunately, the current recession has made this solution rather difficult to implement.

The only other reasonable approach is to come over on your own to the country of your choice and investigate the possibilities on the spot. For this it is *absolutely* necessary to speak the language of the country. You must also have real and special abilities to offer — advanced capability and lots of experience — and you should be prepared to accept a cut in take-home pay. Personal acquaintances in the company which interests you are also a great help. As in the States, word-of-mouth recommendations are invaluable.

As for trying to find a position by remote operation — writing to companies or employment bureaus in Europe — forget it.

GETTING SETTLED

It's hard to get into America; it's hard to stay in Europe. A European traveling to the States — a businessman on a week-end trip, say — spends endless time and fills out endless forms to obtain a visa. (Among other things he must swear that he

Mr. Pettersen is a regular contributor to **European Report.**

has never had a mental illness, is not a drug addict or pusher, will not work, has never been arrested, and has never been a member of a constantly-changing list of political parties.) Once in the States, however, he's fairly free to stay where and do what he pleases.

An American has no difficulty whatever in getting into Europe, but if he decides to stay for more than a month or so in any one country he must obtain a Residence Permit. To obtain a Residence Permit he must prove outside income or must have a Work Permit – and to obtain a Work Permit he must have a Residence Permit plus a job. (And to obtain a job he must usually have a Work Permit.) In practice, a company which agrees to hire you will also arrange for you to obtain all the necessary papers.

LIVING

Living accommodations are fairly tight in most cities, and are also expensive. Madrid is the most economical of the major cities (and very pleasant as well), but EDP opportunities are very limited. Paris is certainly the most expensive – on a par with New York.

Residential suburbs are growing (including, God help us, "les villages Levitt") and are usually well-serviced by public transportation. Commuting by car involves obtaining a European driver's license (a ferocious process in some countries) and becoming accustomed to very different road rules and driving habits. Incidentally, if you insist on driving you may be well-advised to ship your old car over. Buying a car here for domestic use (i.e., not to be exported within 12 months) may entail taxes equal to half the purchase price.

As far as the family is concerned, your wife will find the kitchen small and under-equipped, and no frozen TV dinners in the supermarket (*if* you have a supermarket in your neighborhood – more likely separate little butcher, vegetable, canned goods, milk, and bakery shops); your children will find the schools excellent but strict. There are also American schools in most countries.

As indicated above, salaries range roughly a half to a third of U.S. equivalents. Other benefits far exceed those offered in the States. Taxes vary widely, but in most countries a reasonable amount of cheating is considered normal.

WHICH COUNTRY?

The above remarks oversimplify the situation, of course, but are generally applicable to the industrialized Western European countries. East Europe is very different indeed, but probably few Americans will consider locating there if only because of the political difficulties involved.

Germany and Holland are perhaps the most promising countries for the EDP specialist interested in Europe. Both are prosperous, technically advanced countries and have the added advantage of being very similar to the U.S. in customs and outlook. An American tends to feel at home immediately, especially if he cracks the language barrier. In France, many companies are a bit chauvinistic and try not to hire foreigners. England is, among other difficulties, in dire financial straits at the moment. Denmark and Sweden offer interesting but limited possibilities along with abominable weather (even worse than Holland).

IN SUMMARY

Europe is a civilized and decidedly pleasant part of the world, but it is not the Promised Land; it's not automatically going to welcome you for coming over. In EDP, top-notch engineers and programmers can find a worth-while slot if they're reasonably flexible, but such people tend to be already comfortably established. Everyone faces difficulties comparable to re-locating to an unfamiliar city in the States, plus strange laws, customs, and languages.

Europe is no escape. ▲

"Are you sure you have the computer programmed correctly, Dick?"

RE-INVENTION ISN'T VERY ORIGINAL

FRITZ KINDERHAUFEN • Lajitas Mgt. Assoc., Alpine, Texas

Can you guess where I got the following quotations?

"You can't discipline a creative person."

"You just can't expect a man to be an original thinker if you lay a bunch of constraints on him and still expect him to conform to the rules which apply to the rest of the herd."

"You can lead a horse to water, but you can't make him think."

"We are dealing with a different breed of men whose productivity cannot be scheduled and from whom we will obtain sudden bursts of productivity like lightening flashes."

HOGWASH!

COMPARATIVE ANALYSIS OF THE LASER

The greatest discoveries of humankind are useless curiosities unless, and until, they are applied to human problems. It is the application, not the concept, which can be cost analyzed and valued in terms of ROI (Return on Investment).

Much like the laser, we must concentrate creativity upon a specific target if expected benefit is to be derived. Like the laser, we must channel and focus our power upon a problem if we are ever going to solve it.

We can't allow our great minds to concentrate on improving the wheel, or to spin-off on queing theory for the company cafeteria lines, if we are to focus on the significant problems at hand. Creative effort, like the laser beam, must be channeled toward a worthwhile target.

THE TRUTH WILL OUT

"Ah, Ha!," you say, "This Kinderhaufen character is a regimentationalist!" You will conjure up thoughts of Prussian ranks, all marching to the beat of the *same* drummer! Ach! But wait . . .

Mr. Kinderhaufen is a regular contributor to **Up The System Down Time.**

Is it not the responsibility of the leader to single out *objectives* and to *channel resources* toward the solution of *existing* and *predictable problems*?

Does the EDP organization in your company hold a contract for *pure* research? Can you afford to look for the right answer to the wrong problem?

TEAMS NEED COACHES

I submit that companies which fail to channel resources toward productive ends are engaged in charity. A charity is commendable only to the extent that it is intentional. There is something sloppy about unintentional give-away programs which breed neither respect nor gratitude.

Proper direction of resources is the name of the game and too many EDP managers are losers. The situation calls for leadership and direction. The application methods for leadership have long been within the state-of-the-art.

THE CALCULATED GAMBLE

When I took over the "Up the System" Series, I was warned against suggesting any positive solutions to the system game. My predecessor claimed that systems people won't accept any solution they don't think up themselves and that any positive recommendations must never go beyond a clear explanation of the problem. I have considered this advice and have consciously decided to ignore it.

TECHNIQUES FOR MAKING OUT WITH AN UPDATE

The most re-invented wheel of the systems game is the file update and maintenance program. The ways to do this job now exceed the number of times that the payroll program was invented. Software people have waxed rich solving problems which systems men and programmers have

created from scratch with illogical file maintenance logic.

One wonders at the creativity of it all. Especially when one contemplates the fact that the only possible things that can be done to a file are to *put* information in it, *change* information in it, or *remove* information from it. Just those three things. The maximum possible complexity involves doing combinations of these things at once, or doing them together – technically magnificent but rarely necessary.

Rash though it may be, I venture to suggest that we *standardize our treatment of these basic things* and cease inventing unusual combinations of them purely for our intellectual satisfaction.

We go through amusing convolutions while editing the format (alphanumeric content and delimitors) of incoming messages. We even intermix value-testing exercises with format editing, just to test our originality. Those who re-invent the wheel for editing and validation problems are sure to find intellectual challenge when they try to update a file. This is because such problems are too simple to be addressed by complex solutions.

I will offer another suggestion. Why not do all the editing, then the validation, and finally, the updating?

If these suggestions seem over-simplified, maybe you haven't properly analyzed the problem. . . .

SIMPLIFICATION

Problems are complicated, solutions are simple. (Men who can't understand a solution are men who haven't understood the problem.) It follows, then, that the task of management is to codify the problems which haven't been solved and which need solving. If management will do that much, we geniuses can take care of the rest.

MORAL

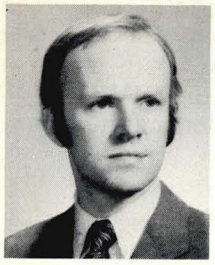
Computers do what they are asked to do, over and over and over again. They can't originate a creative idea; so we have to program them to do new things.

Systems men are creative and originate new ideas.

Systems men should solve original problems. They should leave problems which have already been solved to computers.

A man who solves a problem the first time makes a contribution. A man who solves a problem for the hundredth time has only one chance in one hundred of doing anything worthwhile. So don't be ashamed of applying existing solutions to routine management and programming problems. Re-invention isn't very original. ▲

DIAGNOSTIC SIMULATION



THOMAS DeMARCO • Independent Consultant

I always knew there must be simulations done somewhere for reasons other than amusement value or acceptability for the Master's thesis in computer sciences. But they are few and far between. One that has paid its own way is the Diagnostic Simulator developed by the Automatic Electric Company of Northlake, Illinois. Their simulator was implemented to support the development of a duplexed high-reliability telephonic switching system. Such telephonic system projects are plagued by a unique set of problems.

1. Invariably, processor development overlaps the software effort and there is a shortage of debugging machine time.

2. Maintenance programs (which comprise most of the software effort) are extremely hardware dependent. Accordingly, they don't lend themselves well to classical (instruction level) simulation techniques.

3. The system must be self-maintainable. This implies that all subsystems must be diagnosable; any fault must be detected and isolated by diagnostic programs. Unfortunately, the state-of-the-art of self-diagnosing systems is still largely empirical. A system is found to be self-diagnosing if it can diagnose itself as real faults turn up. It isn't if it doesn't.

The solution in this case was to simulate the system at the hardware logic element level. Both central processors, two sets of memories, all busses, and some relevant peripheral control circuits were simulated. Since some changes to hardware design were to be expected, the designers decided to generate the simulator directly from the hardware logic equations.

The user assembles and links a maintenance program and delivers it to the simulator. The program is loaded into simulated memory, then executed on simulated hardware. Each instruction execution is broken up into discrete timing intervals as it would by the hardware. All gate and flip-flop states, bus levels, register and memory location contents, etc. are simulated for each clock cycle. Through control cards, most machine elements can be initialized. The user can call for dumps at selected points within his run.

Simulation of a central processor diagnostic program provides the most interesting example. The real system would take one processor out of the active state before diagnosis. The active processor would then perform diagnostic tests on the standby machine during spare time. A typical test might be:

- Initialize a standby machine memory location with an illegal instruction; Inhibit standby interrupts;
- Outpulse data to standby machine program counter, causing the standby machine to start execution at that location;
- Check that the proper error level is generated in the standby machine.

Exactly this sequence can be tested with the diagnostic simulator. By analyzing the output, the programmer can detect program logic errors, processor-to-processor interface bugs, misunderstood timing, even hardware design errors. He has an available alternative to scarce prototype time for debugging. Just as important, system designers can get some early indication of how well the system will be able to diagnose itself.

The A. E. Diagnostic Simulator runs on a 360. It was written in PL/I "because it was there." The entire effort comprised about twenty man-months.

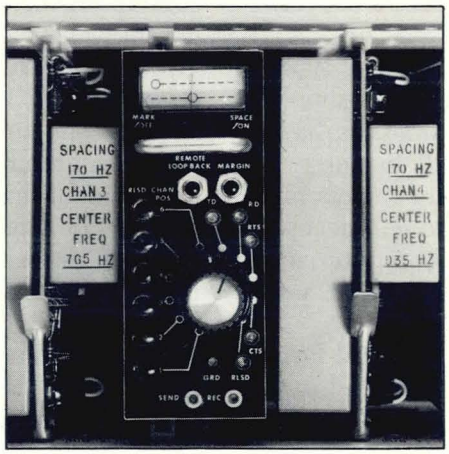
In spite of the success of simulation projects such as this one, there is good reason to be bearish on simulation in general. For every good system, there seems to be two boondoggles. Computers, like people, waste much of their time pretending to be what they aren't. ▲

Mr. DeMarco is a regular contributor to ***The Systems Scene.***

PRIVATE LINE DATA MULTIPLEX

What do you get for the money you spend?

TAKE A LOOK AT DIGINET-160 PRIVATE LINE MULTIPLEX--- THE ONE WITH THE BIG PLUS!



In terms of design, features and performance, DigiNet-160 Private Line Data Multiplex is second to none--and it's priced right too! Up to 17 terminals can have their own "private line" to the computer--even though they share a single telephone line * speeds to 600 bps * complete channel speed intermix capability * no data set required (interfaces directly with your telephone line) * channels are fully speed and code transparent * fully automatic * flexibility in mounting (rack mounted shelf, multi-channel cabinet, single channel cabinet)---just some of the features you get with a DigiNet-160 system.

THE BIG PLUS

It's called "GEBITS" (General Electric Built-In Testing System) and it represents the end to "Serviceman Roulette" when a computer port goes bad, a telephone circuit goes out, or a terminal acts up! The built-in GEBITS circuitry (patent pending) of the DigiNet-160 lets you pin-point the problem area in short order and call the right serviceman every time---and it doesn't require a technically trained person to use. GEBITS test procedures are as simple as pushing a button or throwing a switch--and will help you get back on-line in minimum time---and without running up charges for "false alarm" service calls.

Get the complete DigiNet-160 Private Line Data Multiplex story from any of the following:

R. G. E. Hoffman
625 Delaware Avenue
Buffalo, N. Y. 14240
(716) 883-9210

M. E. Donlon
177 Columbia Turnpike
Florham Park, N. J. 07932
(201) 377-0720

D. A. Miles
Suite 821, Wyatt Bldg.
777 14th St., N. W.
Washington, D. C. 20005
(202) 393-3600

F. A. Duran
999 Elmhurst Road
Mount Prospect, Ill. 60056
(312) 255-3200

R. W. Dunn
6300 Hillcroft-Suite 617
Houston, Texas 77036
(713) 771-5334

G. W. Brennan
2154 N. E. Broadway
Suite 110
Portland, Ore. 97232
(503) 228-0281, Ext. 237

J. M. Burt
P. O. Box 4778
Sacramento, Calif. 95825
(916) 927-0163

R. J. Chapple
3636 - 5th Avenue
P. O. Box 3337
San Diego, Calif. 92103
(714) 297-2911

Mountain View Road
Lynchburg, Va. 24502
(703) 846-7311, Ext. 429

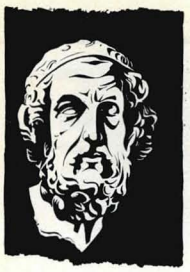
W. G. Packham
125 Tycos Drive
Toronto 395, Ontario, Canada
(416) 789-3281

DATA COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY, LYNCHBURG, VIRGINIA 24502

GENERAL ELECTRIC

CIRCLE NO. 17 ON INQUIRY CARD

THE MAGIC CASH REGISTER



J.P. TIRESIAS • New York, N.Y.

Off-beat situations are much in vogue on Wall Street these days. One of the latest flirtations is with point-of-sale recorders, sometimes called computerized, or "magic," cash registers. Frankly, the magic of these devices eludes me. They are worth a look, however, for several reasons.

To understand the affinity of investment types toward anything in the retail field, one should keep in mind that the securities business is basically a retail trade. (In the end, *all* business is retail!) Like most retailers, customer's men are looking for products which the public will accept. Today's specialty sale item is the computerized cash register — and it's easier to sell what you know best.

It seems that the happy ring of the old-fashioned cash register bell isn't long to be heard throughout the land. No, sir! Today the whir and beep of a point-of-sale terminal directly linked to a computer, or even containing its own little minicomputer, is going to record your purchase, check your credit, update the retailer's inventory, generate sales reports, check employees against theft and error, and figure taxes, discount, and change. And, if that isn't enough, NCR (formerly known as The National Cash Register Company but by now everybody knows "NCR Means Computers") has introduced a real "magic wand" which optically "reads" tags and credit cards.

Let's not knock NCR. The company retains seventy percent of the cash register market (too bad they lost Watson and the largest chunk of the computer industry to IBM), and may very well have the best sales and service organization in the industry. Its R&D is great, and its computer is impressive too. Yet the nostalgia for cash registers lingers on.

Comers are now invading the cash register field with automated devices because, technologically speaking, a gap has long existed. There are reasons for this. The first is NCR's hold on the field. Second, the retail business has, they tell us, a very low margin of profit — about one percent. This has made retailers understandably reluctant to invest huge sums in equipment to be used only for checking-out customers. Third, retailers are a suspicious lot (Macy's still doesn't tell Gimbel's!) Consequently, standardization efforts, on the part of manufacturers, the National Retail Merchants Association, and the American Bankers Association, have been virtually impossible.

Other companies now have been encouraged to introduce new concepts in retail automation. The second largest cash register manufacturer is Sweda, a division of Litton Industries, which recently introduced the "Sweda 700" electronic register and data collection system. Also seriously contending in this market are Singer-Friden, Pitney Bowes-Alpex, Unitote (a division of American Totalizator Co.), American Regitel Corp., IBM, RCA, Olivetti Underwood, and half a dozen or so smaller companies.

Why all the fuss? The potential original sale and replacement market for automated ("magic") cash registers among some one and a half to two million stores is estimated at between $500 million to $1 billion by 1975. It costs around $50,000 for a basic system and $3,000 for each terminal/register. The big question among investors is who is going to get how much of this pie. NCR's portion of this *new* market is considered to be about 50 percent. The drive for an on-line, real-time, cashless, checkless, moneyless (dare I say soul-less), society will mean dollars for somebody.

Those who are taking bets say there will be an increase in many types of retail operations, such as the larger department, discount, supermarket, and variety stores. To those we can add the shoe stores, restaurant chains, drug stores, and fast food franchisers. Speculators are even insisting that some manufacturers (or even banks) will lease magic cash registers to "momma and poppa" proprietorships. The rate of increase of new stores is estimated at somewhere between four to six percent annually after 1971, and it is easier to install equipment in new outlets. Manufacturers are getting to the point where they can *prove* that they can save the retailer money.

The startling thing is that, because dramatic technical changes and effective systems are really being introduced, there is legitimate reason for excitement among investors. (Pitney Bowes-Alpex is probably the most outstanding recent example of this.) But no one is going to know for sure if these companies can produce the goods in the magic cash register market until they report performance by product line in their annual financial reports. ▲

Mr. Tiresias is a regular contributor to ***Wall Street Interface.***

At ACM'71 in Chicago August 3-5, he'll meet the men who designed it.

Mel Schwartz manages software development and teaches computer science at Northwestern University. He's an active ACM member and Technical Program Chairman of ACM'71, our annual conference to be held August 3-5 in Chicago.

Reading about computers is almost a hobby to Mel. "Even before I joined ACM, I borrowed and read every copy of *Communications* I could lay my hands on," he says. "I think I've read most of the classic articles on computing. Now I'll get a chance to meet most of the authors–at ACM'71.

"It'll be like a gathering of eagles, with every 'name' in computing you can think of, including Eckert and Mauchly, who designed Univac I.

"Meeting people you've read and respected is the best part of a conference," says Mel. "And asking an author questions he probably didn't think of himself when he wrote a paper or an article. At ACM'71, we're introducing new technical session formats to maximize this kind of interaction."

A conference like ACM'71 isn't the only reason to join ACM. There are many others. Like technical publications, seminars and special interest groups. And the pride of belonging to the oldest, most respected professional society in the field.

Look into joining ACM before ACM'71. Send in the coupon today.

Association for Computing Machinery
1133 Avenue of the Americas
New York, New York 10036

I would like to consider joining ACM.
Please send more information.

Name _____

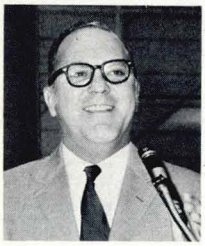
Position _____

Address _____

City _____ State _____ Zip _____

acm
Association for Computing Machinery

WHAT IS "THE COMPUTER INDUSTRY"?



Leonard J. Palmer, Pres. • CompuTerminal Corp., San Francisco, Cal.

The attitude of most people toward "the computer business" is either good or bad, but very seldom is any distinction made between the vastly different segments of the business. To put it another way, there has been a total lack of understanding as to the way in which the industry breaks into subsets and definitions upon which everyone can agree. Also, there is little recognition that each has a vastly different function and diverse performance record.

It is not necessarily valid to maintain that even if economic conditions over the next three years indicate "hard times" for the hardware manufacturing segment of the industry, that *de facto* "hard times" must necessarily exist for the services industry. Neither would the reverse be true. I believe that the overall industry is now mature and established enough to make distinctions between the various segments and that users and investors should analyze each aspect individually.

One of the broadest categories of the computer industry is "General/Commercial Manufacturing." Under this heading are the subsets "mainframe manufacturing" and "peripheral manufacturing." Each of these could be broken again into smaller subsets which would more closely define large-scale computer systems, full-line systems (e.g., System 370), mini-computer hardware and, in peripherals, plug-to-plug compatibles, and so forth.

Another full category is the service field. The essential difference here is between the manufacturing and sale of hardware and the development and sale of services. The service industry itself breaks down to General/Commercial Batch Processing, Applications Package Development, Custom Software Development, Facilities Management, and General/Commercial Time-Sharing.

In the time-sharing area — and we are still speaking here of the general/commercial market — there are further breakdowns yet: **1**) Unique data bases with standardized user programs; **2**) General data bases with unique user programs; and **3**) Unique user programs. The third breakdown, of course, is the remote job entry or installation replacement area of commercial time-sharing.

The point of this recitation is that the concept of a near-term outlook for the "computer industry" is meaningless and that each of these segments should be analyzed and evaluated with respect to its own particular place in the scheme of things; and that each has its own individual outlook over the next five years. In other words, a view of each of the isolated segments, with the subtleties within each segment, doesn't necessarily create a composite of the entire computer industry.

An evaluation of any of these areas would have to include three considerations. The first is the extent to which further capital development is required. The hardware area requires relatively the least, on-line commercial services will require relatively the most. The second consideration is profit potential. In this respect, hardware manufacturing, in both the mainframe and peripherals areas, is highly vulnerable to the posture of IBM which, as we have seen of late, is increasingly inclined to "get tough." The final consideration is ultimate market potential. Here again, the market potential for hardware *per se* is relatively easily

Leonard J. Palmer is President of CompuTerminal Corp., San Francisco, Cal., and a former President of the Association of Data Processing Services Organizations (ADAPSO).

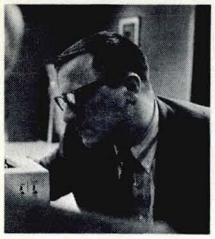
defined. The major question is the extent to which individual manufacturers will be able to sustain competition and obtain a reasonable share of the market. Conversely, the ultimate market potential is far more difficult to define accurately in an area such as remote job entry since that field is as yet virtually untapped.

The last year has served to redirect the thinking of the computer-related entrepreneurs towards profit, return on investment, and a new emphasis on professional management. Certainly, it should have served to put a real damper on the kinds of projections that were being bandied about during the late '60s. While these projections were certainly the responsibility of those of us in the computer-related fields, the professional investment community showed little ability to evaluate them within the context of the particular area of the industry being proposed. Until the public learns to differentiate the subsets of the industry, the investment climate is not apt to change much from its present low.

To make judgments and predictions on the "computer field" is about the same as making judgments and predictions on the "manufacturing field." The investment community has come to fully appreciate the difference between manufacturing textiles and manufacturing automobiles. It is time that the community came to see the differences between manufacturing computer mainframes and developing on-line remote services; between scientifically-oriented time-sharing and general/commercial remote-access. These are very significant differences, and each is deserving of analysis and evaluation on its own merits. ▲

"I'll have the scoop for you in a minute, dearie."

S/370 FROM A SOFTWARE POINT OF VIEW



KEN FALOR • Cullinane Corp., Boston, Mass.

I attended the recent announcement of the IBM 370/135. Besides being a most interesting addition to the 370 product line, it served to crystallize the emerging pattern of what this new generation will be, and software has a lot to do with it.

The 370/135 surprised most of us on two counts — power and price. The teleprocessing, multichannel, dynamic emulation, and OS capabilities of the large 370s have been extended down to the 135, yet the rental for the CPU is only $5,250 for 98K (though OS would take a good chunk of this) to $7,950 for 246K. The 2319 3-disk pack unit is a nice $1,475.

Characteristics of the 135 and the prepared presentation that went along with it permit generalizations about the 370s to be more safely made.

THE COMPATIBLE GENERATION

First of all, IBM seems to have gotten the message, and the strong feelings which accompany it, about compatibility. In fact, the evidence so far indicates an exemplary attitude in that the dynamic emulation afforded by the 370s makes DOS emulation easy, and makes second-generation emulation much easier than it was. No longer does a whole machine have to be turned over to an emulation mode.

However, DOS emulation does take place in an OS/MFT partition which is set up at IPL and is not changeable except by re-IPLing. In other words, DOS emulation does not require a dedicated *machine*, but it does require a dedicated *partition* — and for those who do not plan to run DOS programs frequently, emulation could sometimes be clumsy. It would have been more convenient to have had the emulator under Job Control, so that it could be called in via JCL just like calling in an assembler or compiler, but apparently IBM's emulation is not that controllable as yet.

Mr. Falor is a regular contributor to ***Software Forum.***

IBM also will not guarantee the correct emulation of timing-dependent programs. For banks especially, this means that their proof and transit programs probably won't emulate, because these typically depend on driving one or more MICR reader-sorters (1419s) under DOS, and the 1419 is very timing-dependent indeed. OS now supports the 1419, but a lot of banks feel the reprogramming involved would be considerable. Thus, for 1419 programs, the rather unhappy choice seems to be between hanging on to a 360 or reprogramming for OS.

DOS to OS conversion can be a big problem. At least one big DOS user we know says that if he has to think of going to OS he'll also look into going to some other manufacturer. Maybe it's an exaggeration to think that going to OS will be as costly as switching manufacturers, but IBM will have a lot of built-in skepticism to overcome if they make DOS to OS conversion out to be trivial, painless, or routine.

Compatibility can be to IBM's interest in important ways other than customer molification. For one thing, it obviates the need to build a large library of new application programs. As you know, the availability of much 360 software, from both IBM and the independents, has always been a big plus for IBM. Now that asset will be retained. The new generation thus has an instant program library.

THE OS GENERATION

It is clear that OS is going to be the operating system of the '70s. Not only can we expect that further enhancements (and releases) of 360 DOS will eventually be terminated, but now 370 OS extends all the way down to the 135. In fact, 370 OS is more like the upcoming 360 TSO (OS with time-sharing), even at the 135 level. So everyone who hasn't learned about OS will have to start

learning. We must accept its coming as a fact, so we can start fighting to influence how future versions of it might evolve to our benefit. Needless to say, the additional complexity of OS requires better skilled and higher salaried programmers and operators — and with the 370, this can start even with the smaller machines.

THE TP GENERATION

Between TSO, 370 OS, and the new disk-pack, 370 multichannel and integrated teleprocessing capabilities, it is also clear that TP will be big in the '70s, even for small computer users. Besides its availability even on the 135, the integrated (no separate controllers) TP is the prime tipoff to this, as is the new line of disk systems. These disk systems are not only more capable, but, as IBM prices go, remarkably inexpensive as well. Add to this the 3735 63-146K programmable terminals, also available for the 135, and you have the cast for some interesting new systems. In the '70s, TP will be everywhere.

THE IMS GENERATION

The pitch for use of the 370/135 with a centralized data base was quite strong at the 370/135 presentation. This, naturally, tends to come along with the TP capabilities, OS, and the new, big, less-expensive disk systems. The type of data base was discussed in more detail than one would expect for a hardware pitch, and it sounded like IBM's IMS system to me (see *Software Forum*, MODERN DATA, April, 1970). Briefly, the IMS data base management system concept is that of a dynamically changeable central file (on lots of fast disk packs) that interfaces with normal Cobol, assembly, and PL/1 programs via a special call instruction. Apparently, IBM is hoping that it will be a big thing in the '70s, even for smaller users.

Will IBM succeed? Will it sell OS, TP, IMS, etc. to the user who still regrets the passing of intelligible memory dumps, who still misses the 1401 address halt, who doesn't want the power and flexibility of OS JCL because he wants his jobs run the same way day after day with the same operator who has been on his payroll? Who needs floating point precision to 28 hexadecimal digits, binary synchronous communication devices, one micro-second resolution on the time-of-day clock? Perhaps not the 360/30 user who was hoping for more reliability, lower price, less overhead, and fewer manuals and error codes.

In any case, we think that the 370s are going to (gradually) affect us all a lot more than we realized when they were first announced.

Are you ready? ▲

THE TELEPHONE WARS

ROBERT F. GUISE, Jr. • Com-Share, Inc., Ann Arbor, Mich.

The Computer Time-Sharing Services Section of ADAPSO has been engaged over the past year or so in what amounts to guerilla warfare against Ma Bell. I know it's not nice to knock mother, but when she becomes more obstreperous than her children, it's time to take some action.

The battle between computer service companies and the telephone monopoly is a boon to both the industry and the user. What it amounts to involves a number of details which are much too numerous to go into here. Specific action has taken place, however, in Ohio, Illinois, and California. Thanks to John Duffendack, chairman of ADAPSO's data communications committee, and others, the she-wolf has been checked. But, as Duffendack says in his latest report to ADAPSO, "This issue is by no means dead and further action will be taken by the Bell System sometime in the future. We should, therefore, continue to deal with this issue when it again arises."

The disturbing thing about this to me is that only a few independent time-share users, GE time-sharing (only), an activist association like ADAPSO, and a handful of others have come forward to carry on this campaign against the telephone companies. Surely the vast resources of the Bell System can be brought to play with little effect felt on the dividend to stockholders. Such is not the case with those who are struggling for survival in a new industry which has tremendous potential to the telephone companies' revenues in the very near future by nothing but the sheer volume of work made possible by the advent of time-sharing. Is the Bell System really so short-sighted and greedy that it must have its pound of flesh today?

Whether we like it or not, tariff increases on data, or "business communications" (as Bell prefers to call it), must eventually be extracted from the users if they want to continue to have this service available. Those of us affected are somewhat mystified by Bell's behavior. We remember the long hard struggle with the Carterfone case, which practically broke Tom Carter and ate a large portion of his company and personal fortune. Must we again have an example set against super-business in America at the sacrifice of struggling young companies and dedicated individuals against the monolithic force of monied Ma Bell?

I, for one, am personally and professionally beyond indignation that this condition should be allowed to exist. It is high time that the FCC, which has proven reasonable for both sides in many of its past decisions, considers the issue forthwith, and requires all interested parties, including Bell, to justify their claims. They should determine the legitimacy of these local skirmishes and be done with this issue once and for all.

The first thing to be clarified is what the Bell System means when it refers to "business service." (Is it only data communications? Is it PBX or Centrex service? Is it reservation services? Is it automatic voice answer-back systems?) The next thing is to determine if it is fair to discriminate against data communications customers. We have found in our investigations that some users are paying twice for digital data received over wires, both at the originating and terminal locations. We have found that the telephone companies would like to convert these charges from time or volume rates to a flat monthly charge, which, in some cases, would increase customers's communications bills by as much as 650 percent.

Finally, I make the statement that this issue properly belongs in the FCC bailiwick because certain data communications messages cross state boundries and this will affect computer utility development. It will also, in some way, involve the use of microwaves in data communications, an issue currently under study by the FCC.

I hope that this plea is heard and reinforced by service organizations, manufacturers, and customers alike. It is high time that this problem be solved fairly in the proper forum for discussion and where it can do the most good. ▲

Robert F. Guise, Jr., is Chairman of the Board, Com-Share, Inc., Ann Arbor, Mich., and Pres. of the Computer Time-Sharing Services Section of the Assoc. of Data Processing Services Organizations (ADAPSO).

Want large computer capability and 16-bit prices?

Maybe you've been shopping around for the hardware to perform fast Fourier analysis, or integration, differentiation, convolution, auto and cross correlation, and signal averaging. Raytheon Computer will give you this large computer capability, and at minicomputer prices.

Our new Array Transform Processor has made high speed array processing and analysis practical and inexpensive. The ATP hardware is ready to go to work immediately. FFT range is from 2 to 8192 complex data points. Typically, the ATP with our Raytheon 704 mini will run an FFT with 2048 complex points in only 150 milliseconds.

And you can use the 704 computer for other tasks while it's processing arrays. The 704 has 74 instructions, a real-time automatic priority interrupt system, direct I/O to the CPU and 4 programmable registers. It also has a software library of over 600 field-proven programs to choose from.

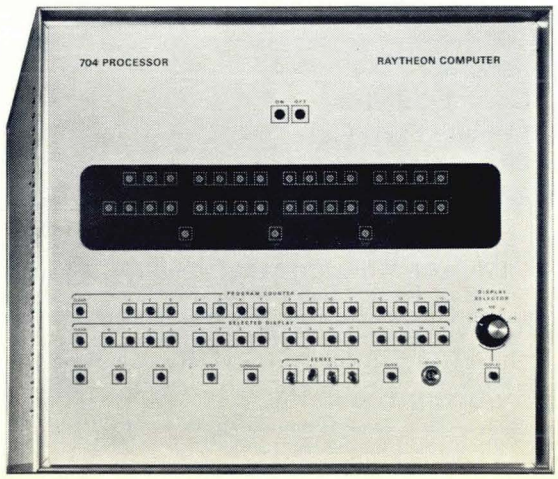
The ATP complete with a Raytheon 704 general purpose computer costs about $40,000. If you don't need real time processing, we have an ATP software simulator for our 704 computer which will compute FFT's for less than $20,000.

So write today for Data File C-201. We'll send you all the facts and figures you'll need to do high speed signal processing at prices you can afford.

Raytheon Computer, Raytheon Data Systems Company, 2700 S. Fairview St., Santa Ana, Calif. 92704. (714) 546-7160.

RAYTHEON

With Raytheon Computer's ATP you can have both.



Raytheon Computer. We're working for you.

WHAT HATH BABBAGE WROUGHT Dept.

"THEN PICK 'EM UP, DUMMY!"

In 1958, the computer was viewed with awe by many persons. Not only its physical size, but its "brain" billing and show-window display contributed to such feelings.

One of the most impressive of these early systems was located in the Pentagon, and the second shift for this installation was reserved for testing and the printing-out of diagnostic comments on the system's teleprinter. The floor of the machine room was mopped by an elderly janitor, who invariably stopped and read the "brain's" comments. Noting his curiosity, the computer maintenance engineers prepared a "canned" message which they activated remotely as the janitor approached the teleprinter.

You can imagine the janitor's wide-eyed amazement as he read "BE CAREFUL, MAN. YOU'RE GETTING MY FEET WET."

Submitted by:
Don Smith
Red Lion, Vincentown, N.J.

A BOOKSTORE THAT UNDERSTANDS

The College Book Store in Westwood Village, next to UCLA, has a large, well-stocked COMPUTERS section. In the midst of this section, and surrounded by books on languages, systems design, hardware, etc.—are two copies of Personal Resume Preparation by Jaquish.

Hard times have arrived.

Submitted by:
Gary A. Sigafoos
Canoga Park, Cal.

MODERN DATA will pay $10.00 for any computer- or EDP-related item published in our **WHAT HATH BABBAGE WROUGHT Dept.** Humorous 'information' for consideration may include weird memos or operating instructions, unusually incongruous documentation, and off-beat items of a general nature (for review by our off-beat editors). Send all submissions to:
WHBW
MODERN DATA
3 Lockland Ave., Framingham, Mass. 01701
All entries become the property of **MODERN DATA.**

THE PROGRAMMER'S PRAYER

Our operator, who art in the machine room,
hallowed be thy name.
Thy kingdom come, thy will be done,
by the programmers as it is by the analysts.
Give us this day our daily run
and forgive us our estimates
as we forgive those who cancel our jobs.
And lead us not into I/O errors
but deliver us from program check interruptions.
For thine is the printer, the reader,
and all the disk drives, forever and ever.
EOJ

Submitted by:
Len Ash and Dan Miller
Ohio Edison Co.
Akron, Ohio

BUGS

(*With profound apologies to Joyce Kilmer*)

I THINK THAT I SHALL NEVER SEE
A SUBROUTINE THAT WORKS FOR ME
A MACRO OR A ZERO TEST
THAT ISN'T JUST A RODENTS' NEST
A STRING THAT DOESN'T ALWAYS STRAY
AND MIX UP BITS IN WILD ARRAY
A PROCESS WITH RE-ENTRANT FLAIR
THAT ISN'T JUST A LOOPING SNARE
ROUTINES WHOSE TIMINGS ARE NOT SLAIN
WHEN INTERRUPTS BEGIN TO RAIN
MAYBE GOD CAN MAKE A TREE,
BUT BUGS ARE MADE BY GUYS LIKE ME!

Submitted by:
Gerald Wille
Delco Electronics Div. of GMC
Milwaukee, Wisc.

That's a cool price. The coolest yet. It buys more computer power per OEM dollar than you can get anywhere else. But we're willing to go even lower. For less than $1600 in OEM quantities we'll let you strip the Micro 400 down to a CPU and Ik x 8 of memory. Maybe you don't even need the memory. If so, keep stripping. You can have the CPU alone as a logic module replacement for less than $700 in OEM quantities. All we want you to do is buy what you need. No more. No less. It doesn't matter which way you go. You'll always get the computer power you need and then some. The 400 has power to burn.

Let's see where some of that performance comes from. To start with system installation is quick and easy. There is no complicating backplane, just a 50-conductor flat cable which interconnects the processor, memory and I/O system. Once installed, the 400 becomes a speedy general-purpose problem solver with a 1.6 microsecond cycle time and 105 basic instructions. Programming is facilitated by index addressing and by direct addressing to 4096 bytes. And the I/O system includes 64 standard interrupts which help you get the job done with 30% less core. Everything else you'll need to know is in our Micro 400 brochure. Write for it. Microdata Corporation. 644 East Young Street. Santa Ana, CA. 92705. (714) 540-6730

A $1995 MINI WITH POWER TO BURN

Microdata

CIRCLE NO. 21 ON INQUIRY CARD

INTERACTIVE CRT TERMINALS
Part I—Full Graphic CRT Terminals & Systems

JOHN A. MURPHY, Associate Editor • Modern Data

This ***Product Profile*** *on graphic CRT terminals and systems is the first of a two-part series on the use of interactive CRT with computer systems; it updates previous Profiles on graphic CRT equipment which were published in the July, 1970 and July, 1968 issues of* MODERN DATA.

The two-part series presents information on the applications and characteristics of alphanumeric and graphic CRT terminals and systems, together with complete tabulations of the terminal models and companies engaged in their manufacture.

In this issue, Part 1 of the series discusses the users and application areas for graphic CRT equipment, and tabulates terminal characteristics. Part 2, appearing next month, will cover alphanumeric CRT terminals and their role in computer communications.

Interactive full graphic CRT terminals and systems provide dynamic and manipulatable visual displays of data, graphs, flow charts, schematics, and geometric projections in two or three dimensions. Such display images or segments of the image may be magnified, shifted, rotated, modified, or erased using terminal keying and pointer devices (light pens, trackballs, joysticks, etc). The display may be controlled by processors and function generators external or internal to the CRT terminal or by a combination of both.

Manufacturers of full graphic CRT equipment offer a number of different terminals or terminal systems, with a wide variety of hardware, software, and peripheral device options for each. The manufacturers supply graphic CRT terminals that can be incorporated into existing computer systems on a user-configured and user-programmed basis; they also supply graphic CRT terminal systems that have internal processing power and can operate on a stand-alone basis. Some manufacturers offer graphic terminal systems that are dedicated to a specific application; these terminal systems may be configured — via hardware, software, and peripheral device options — from a basic terminal module, or may be designed and marketed as special-purpose graphic CRT systems.

The prospective user of full graphic CRT has a variety of terminals to choose from; equipment and software options allow for the configuration of a graphic system with as much (or little) flexibility and bundling as desired.

GRAPHIC CRT USERS

There are over 1250 **graphic** CRT installations in the U.S. today, employed in applications ranging from the design of automotive components to the simulation of complex crystal structures. The major user of graphic CRT systems is the Federal Government — the defense, air traffic control, and space agencies comprising over 50% of the existing installations. The next largest user segment is the aerospace and automotive industries; graphic CRTs are utilized in these industries for the computer-aided design of automobiles and airframes. The petrochemical, power utility, and machine tool industries, plus educational and research facilities, account for most of the remaining installations.

This predominance of the Federal Government as the major user of graphic CRT systems is declining. The advent of low-cost and highly flexible equipment has made graphic CRT more attractive to non-government organizations; new installations tend to be in the more general manufacturing, service, and financial areas. The decline in Federal predominance has also been accelerated by the cut backs in defense and aerospace spending.

The areas where graphic CRT terminals and systems are employed by business, industry, research and educational facilities, and by governmental agencies are outlined below.

COMPUTER-AIDED DESIGN

Computer-aided design (CAD) is the most prominent, non-governmental application area for full graphic CRT. Described below are CAD applications to which graphic CRT terminals are applied.

MECHANICAL & STRUCTURAL DESIGN — Drawings of the complete structure or assembly, or of the individual members, sections, or parts of the complete structure, can be created, stored in memory, retrieved, displayed, and manipulated by an operator at the terminal site. Area details are magnified by light pen or pointer command by simply defining the area and calling up the display data from memory. Such images are modified or deleted by pointer command, the resulting display being stored for future reference or immediately printed out using hard-copy or plotter peripheral devices.

NUMERICAL CONTROL TAPE VERIFICATION — Numerical control paper tapes that are used in over 25,000 machine tool installations can be generated and verified on-line using graphic CRT. The tape control information is displayed, together with the appropriate graphics denoting motion, tool changes, tool paths, etc. Segments of the tool bed (as well as the whole bed) can be displayed, and the complete tape program verified in less time than that usually spent in verification upon the actual machine tool or an off-line plotter.

NETWORK AND CIRCUIT LAYOUT — Layouts or flow charts of networks, circuits, or production processes can be generated and updated. Printed circuit and wiring layouts, integrated and thin film circuit masks, production line flow charts, process plant layouts, and power distribution grids are designed through using interactive CRT graphics.

ARCHITECTURE & CONSTRUCTION — Drawings of highway layouts, bridges, buildings, and other structures can be stored and displayed. Interaction with computer memory through graphic terminals allows speedy and easily effected drafting or revision of plans for structural and floor designs, electrical wiring, heating duct, and plumbing layouts.

COMPUTER PROGRAMMING — A CAD application of CRT graphics closer to the heart of the computer community is the dynamic editing, correction, and modification of programs. A complete program can be evaluated, changed, and then completely documented with updated flow charts and listings using graphic CRT.

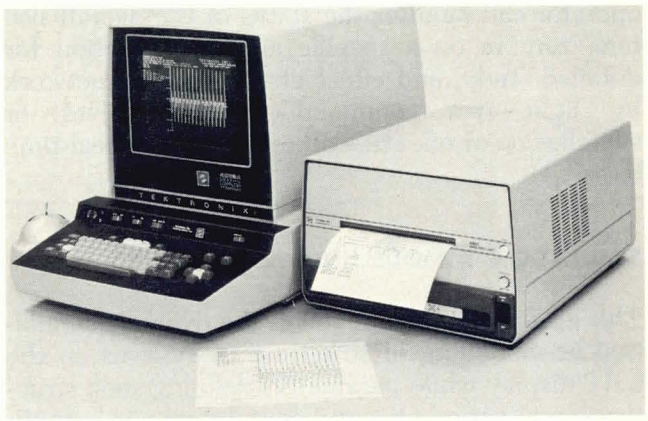


Figure 1—The Tektronix 4002A Graphic Computer Terminal with companion 4601 Hard Copy Unit and 4951 joystick.

COMMAND/CONTROL SYSTEMS

The greatest number of graphic CRT terminals are applied to command/control systems due to their use in defense, air traffic control, and space flight control systems.

MILITARY & GOVERNMENT SYSTEMS — The military employ CRT graphics in command/control systems involving situation reports on air and naval activities, disposition of forces and equipment, logistics, and weather forecasting. Other applications cover the monitoring and control of missile and weapons systems.

The FAA uses displays in the many flight control centers throughout the U.S. The thousands of aircraft that are airborne at any given instant are monitored and controlled by these centers. Relative position, elevation, and speed of each aircraft are tracked, processed, and displayed. Similar flight control systems using CRT graphics are used by NASA to monitor missile launches and space flights.

Local or state police, fire, and civil defense agencies employ computer graphics to display the disposition of personnel and equipment, situation reports on criminal activity or civil emergencies, and vehicular traffic patterns.

INDUSTRIAL CONTROL — CRT displays can be used in the control of various petrochemical, metallurgical, or other industrial processes to monitor the past, present, and projected future status of the many process or production variables. Computer graphics are especially applicable to dis-

tribution networks involving the flow of petrochemicals (valves, pipelines, pumps, storage tanks), and electric power (switches, transmission lines, power stations). In such a network control, the operator can monitor the status of the overall system, zero in on a specific area or operation for detailed study, and effect changes in the network by light pen command – turning valves or switches on or off, etc – all on an on-line, real-time basis.

SIMULATION & MODELLING

This application area involves the dynamic simulation or modelling of structures or systems on the CRT display while parameters defining such structures are varied. Scientific and technical applications concern the analysis of electrical, mechanical, and other physiochemical systems under dynamic conditions.

CIRCUIT ANALYSIS – A circuit diagram can be displayed on the CRT screen along with its associated frequency response curve. The operator changes circuit component parameters and observes how the response curve is effected, optimizing his design in a minimum of time. Similar design iterations using CRT graphics can be applied to microwave and antenna design.

SYSTEM DYNAMICS – Time and frequency domain analysis involving vibration and system dynamics problems can be solved using computer graphics. Data from dynamic tests on space vehicles has been used to simulate flight conditions, and then employed in the design of the vehicle structure and flight guidance systems. Other applications cover aircraft and bridge structure design, and control system design.

CRYSTAL & MOLECULAR STRUCTURE – The ability to construct and manipulate structural models of complex crystals or molecules is of prime importance to researchers in physics, chemistry, biology, and medicine. Such complex structures can be displayed and manipulated on graphic CRT terminals, allowing the structure to be rotated and observed in two- and three-dimensional plots; stereo presentations are even available using hard-copy output and a stereoscope.

OTHER GRAPHIC CRT SIMULATIONS – Simulation or modelling using computer graphics has been used in pilot training. The pilot views an image of a carrier flight deck on a take-off or landing approach basis; he dynamically interacts with the display image, the image being simulated by a computer responding to commands generated from the pilot's flight controls. Other simulations involve visibility problems in designing aircraft or automobiles, and computer animations.

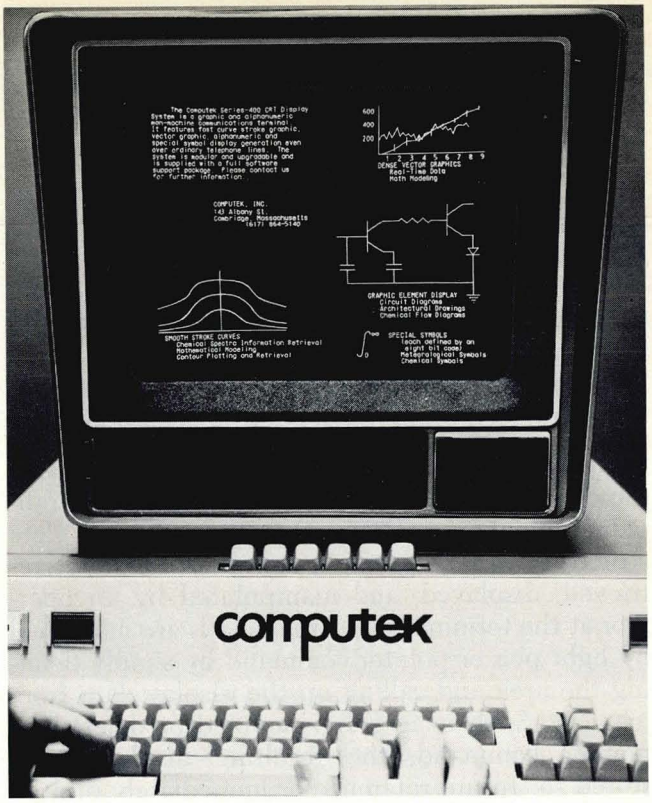


Figure 2—Computek Series 400 CRT Display with examples of various graphic display images.

DATA ANALYSIS

Data analysis applications utilize CRT graphics in the evaluation and reduction of data on business or financial operations, and on experimental tests. The data can be translated, scaled, rotated, and fitted to equations or boundary conditions using computer graphics. An example of such data analysis involves management information systems where sales, inventory, production, and market information is intercorrelated, plotted, and manipulated both by the user and the computer; the output can provide forecasts on future product sales, manufacturing costs, and production schedules. Other data analysis applications of graphic terminal systems concern medical test data (X-Ray, EKG, and other clinical data); seismic, sonar, and geomagnetic test data; nuclear experimentation (particle tracks, scattering plots, etc.); and space satellite data.

OTHER APPLICATIONS

Graphic CRT terminals are also being used in computer-aided instruction (CAI) and computer-based composition and editing. Cost is the limiting factor for CAI due to the multi-terminal require-

TABLE 1 • GENERAL-PURPOSE GRAPHIC CRT TERMINALS & SYSTEMS

COMPANY	ADAGE				COMPUTEK
MODEL	ARDS 100B	AGT 110	AGT 130	AGT 150	400 Display System
DISPLAY Size (inches)	6.5 X 8.5	13 X 14	13 X 14	13 X 14	8.25 X 6.4
Char Capacity	4160	3840	3840	3840	3400
Char/Line	80 or 40	96	96	96	85
Total Lines	52 or 26	40	40	40	40
No Char & Code	96; 192 (opt)	64/96 ASCII	64/96 ASCII	64/96 ASCII	96 ASCII
Char Generation	7 X 9 Dot	Stroke	Stroke	Stroke	Stroke
Refresh Rate (Hz)	ST - See 1	60 (variable)	60 (variable)	60 (variable)	ST
DATA ENTRY Insert/Delete	Line Delete (opt)	Char & Line (std)	Char & Line (std)	Char & Line (std)	———
Tabulation	Horz (opt)	Horz & Vert (std)	Horz & Vert (std)	Horz & Vert (std)	———
Formatting	———	std	std	std	———
Page Roll	———	std	std	std	———
Split Screen	———	std	std	std	———
Other	See 1, 2, 3	———	———	———	See 1
GRAPHICS Visible Raster	1169 X 1501	13 X 14 inch	13 X 14 inch	13 X 14 inch	1,024 X 800
Max Component	1023 raster units	10 inches	10 inches	10 inches	———
Positioning Modes	Absolute	Absolute	Absolute	Absolute	———
Vector Modes	———	Absolute	Absolute	Absolute	Absolute & Relative
View Manipulation	See 1	Shift, 2D Zoom (std)	Shift, Rotate, 2D & 3D Zoom (std)	Shift, Rotate, 2D & 3D Zoom (std)	———
Pointers	All Types	All Types	All Types	All Types	Light Pen, Tablet Joystick
Other	See 4	———	See 1	See 1	———
INTERFACING Interface	———	RS 232 B Parallel Computer	RS 232 B Parallel Computer	RS 232 B Parallel Computer	RS 232
Transmission Rate	50 Kbps	to 1 Mbps	to 1 Mbps	to 1 Mbps	to 9600 bps
Mode	Half/Full-Duplex Echoplex	Half/Full Duplex	Half/Full-Duplex	Half/Full-Duplex	Half/Full-Duplex
Other	See 5	301B; 203	301B; 203	301B; 203	———
INTERNAL PROCESSOR	———	Adage DPR-4 8K X 30 32K Expandable	Adage DPR-4 8K X 30 32K Expandable	Adage DPR-4 8K X 30 32K Expandable	———
OPTIONS	PC	PC, LP, PT, MT, DD	PC, LP, PT, MT, DD	PC, LP, PT, MT, DD	———
PRICING	$8,700	$98,000	$147,000	$167,000	$6,700
REMARKS & OTHER FEATURES	[1]Refresh Mode Editing & Dynamics [2]Keyboard Cursor Control (opt) [3]Repeat Key (opt) [4]HW Dashed Lines [5]TTY-, IBM 360-Compatible	———	[1]HW Array Transformation for: Object Scale; Picture Scale; 3D Translation & Rotation; Depth Cueing; Intensity Scale & Displacement.		[1]Keyboard Cursor Control

ABBREVIATIONS OPTIONS: PC - Printer/Copier (Thermal, Optical, Electrostat.) • LP-Line Printer • PLT - Plotter • PT - Paper Tape • MT - Magnetic Tape Transport • DD - Disk Drive
OTHER: ST - Storage Tube Display • HW — Hardware Feature

TABLE 1 • GENERAL-PURPOSE GRAPHIC CRT TERMINALS & SYSTEMS . . . . . Cont'd

COMPANY	CONOGRAPHIC	CONTROL DATA			CORNING
MODEL	CONOGRAPH/10	240; 9820/9821	250	270	CORNING 904
DISPLAY Size (inches)	8.3 X 6.5	12 X 12	11.3 X 11.3	20 (round)	8.5 X 11
Char Capacity	———	12288	8704	14892	4608
Char/Line	to 341	64/86	136	146	72
Total Lines	to 158	43/64	64	102	64
No Char & Code	96 ASCII	64 BCD	128 BCD	Software	128 ASCII
Char Generation	Stroke	7 X 9 Stroke	7 X 9 Stroke	Stroke	5 X 7 Dot
Refresh Rate	ST - See 1	50 (programmable)	50	50	ST
DATA ENTRY Insert/Delete	———	Char & Line (std)	Char & Line (std)	Char & Line (std)	———
Tabulation	Horz & Vert (opt)	Vert (std)	Horz & Vert (std)	Horz & Vert (std)	Horz (std)
Formatting	———	std	std	std	See 1
Page Roll	———	opt	opt	opt	———
Split Screen	———	opt	opt	opt	———
Other	———	———	———	———	———
GRAPHICS Visible Raster	2048 X 1558	12 X 12 inch	11.3 X 11.3 inch	20 inch	1024 X 793
Max Component	2048 raster units	1024 raster units	1024 raster units	7 raster units	———
Positioning Modes	Absolute & Relative	Absolute & Relative	Absolute & Relative	Absolute & Relative	Relative
Vector Modes	Absolute & Relative	Absolute & Relative	Absolute & Relative	Absolute & Relative	Relative
View Manipulation	Shift, Rotation (std) See 2	Shift (std) Rotate (opt)	Shift (std); Rotate, 2D & 3D Zoom (opt)	Shift, Rotate, 2D Zoom (opt)	———
Pointers	Tablet, Mouse Joystick	Light Pen	Light Pen	Light Pen, Tablet	Joystick, Mouse
Other	See 3	———	———	———	See 1
INTERFACING Interface	RS 232 C Parallel Computer	RS 232 B Parallel Computer	Parallel Computer	Parallel Computer	RS 232 B
Transmission Rate	———	———	———	———	110/150/300
Mode	Half/Full-Duplex	Full-Duplex	———	———	Half/Full-Duplex Echoplex
Other	TTY Compatible	201 A/B; 301 B	———	———	———
INTERNAL PROCESSOR	Conographic 16 4K X 16	CDC 241/242/243 4K X 12 12K Expandable	CDC 3398 4K X 24 8K Expandable	CDC 3344/1744 4K X 16 16K Expandable	———
OPTIONS	PC	PC, LP, PT, MT, DD	16/35 mm Microfilmer PC	———	PC (std), PT
PRICING	$8,950	$68,900	$137,800	$91,160	$19,650
REMARKS & OTHER FEATURES	[1]40 Hz Refresh Mode [2]Scaling 1 to 15X [3]HW Point, Vector Curve, Figure, Char & Symbol Generators	———	———	———	[1] Film Slide Overlay Capability

ABBREVIATIONS OPTIONS: PC - Printer/Copier (Thermal, Optical, Electrostat.) • LP-Line Printer • PLT - Plotter • PT - Paper Tape • MT - Magnetic Tape Transport • DD - Disk Drive
OTHER: ST - Storage Tube Display • HW — Hardware Feature

TABLE 1 • GENERAL-PURPOSE GRAPHIC CRT TERMINALS & SYSTEMS . . . . . Cont'd

COMPANY	DATA DISC		DIGITAL EQUIPMENT	EVANS & SUTHERLAND	HAZELTINE
MODEL	6500	6600	GRAPHIC 15	LDS-1	DDG-1
DISPLAY Size (inches)	TV Monitor	TV Monitor	9.5 X 12	———	TV Monitor
Char Capacity	4335	3200	3000	2000	7738
Char/Line	85	80	72	50	146
Total Lines	51	40	55	40	53
No Char & Code	64 ASCII	96 ASCII	ASCII	256	128
Char Generation	5 X 7 Dot	7 X 10 Dot	Stroke	Stroke	to 32 X 32 Dot
Refresh Rate (Hz)	30	30	30	30	30
DATA ENTRY Insert/Delete	———	———	———	———	Char (std)
Tabulation	———	———	———	———	———
Formatting	———	———	———	———	———
Page Roll	———	———	———	———	———
Split Screen	opt	opt	———	———	———
Other	See 1	See 1	———	———	See 1
GRAPHICS Visible Raster	512 X 512	640 X 480	1024 X 1024	4096 X 4096	1024 X 480
Max Component	———	———	1024 raster units	262 raster units	1024 raster units
Positioning Modes	———	———	Absolute	Absolute & Relative	Absolute
Vector Modes	———	———	Relative	Absolute & Relative	Absolute
View Manipulation	———	———	Shift, 2D Zoom (std)	Shift, Rotate, 2D & 3D Zoom (opt)	Shift (std)
Pointers	Light Pen, Trackball	Light Pen, Trackball	Light Pen, Tablet	Tablet	———
Other	See 2	See 2	See 1, 2	See 1	See 2, 3
INTERFACING Interface	Parallel Computer	Parallel Computer	RS 232 B Current Loop	Parallel Computer	Parallel Computer
Transmission Rate	———	———	———	———	9 Mbps
Mode	———	———	———	———	———
Other	———	———	———	———	———
INTERNAL PROCESSOR	———	———	DEC PDP-15 4K X 18 128K Expandable	See 2	Hazeltine 20K X 32
OPTIONS	PC	PC	PC, LP, PT, MT, DD	———	PC
PRICING	———	———	$36,000	$60,000	———
REMARKS & OTHER FEATURES	[1]Cursor is Option [2]Color, Grey Scale, Special Characters (opt)		[1]Scissoring, 16 Scales [2]Software Rotate & 3D	[1]Clipping Divider, Color & Stereo Display, Char. Generators (opt) [2]Controller Uses Host Computer Memory	[1]Random Selective Update/Erase of Char. & Lines [2]Storage of 8 Programmable Graphs [3]10 Displays/System

ABBREVIATIONS OPTIONS: PC - Printer/Copier (Thermal, Optical, Electrostat.) • LP-Line Printer • PLT - Plotter • PT - Paper Tape • MT - Magnetic Tape Transport • DD - Disk Drive
OTHER: ST - Storage Tube Display • HW — Hardware Feature

TABLE 1 • GENERAL-PURPOSE GRAPHIC CRT TERMINALS & SYSTEMS . . . . . Cont'd

COMPANY	HAZELTINE (Contd)		HONEYWELL	IBM	IMLAC
MODEL	DDG-3	DDG-5	316/516 – 7420	2250	PDS-1
DISPLAY Size (inches)	TV Monitor	TV Monitor	12 X 12	12 X 12	8 X 10
Char Capacity	7738	4176	———	3848	3200
Char/Line	146	87	———	74	80; 128 (opt)
Total Lines	53	48	———	52	40
No Char & Code	128	128	64 ASCII	63	96 ASCII; EBCID
Char Generation	to 16 X 16 Dot	to 14 X 20 Dot	Stroke	Stroke	7 X 9 Stroke
Refresh Rate (Hz)	30	30	40	30	40
DATA ENTRY Insert/Delete	Char & Line (std)	———	———	———	Char & Line (std)
Tabulation	Horz & Vert (std)	———	———	———	Horz & Vert (std)
Formatting	std	———	———	———	std
Page Roll	std	———	———	———	std
Split Screen	std	———	———	———	std
Other	———	———	———	———	———
GRAPHICS Visible Raster	1024 X 480	612 X 439	1024 X 1024	1024 X 1024	1024 X 1026
Max Component	1024 raster units	945 raster units	———	———	1024 raster units
Positioning Modes	Absolute	Absolute	Absolute & Relative	Absolute & Relative	Absolute & Relative
Vector Modes	Absolute & Relative	Absolute	Absolute & Relative	Absolute & Relative	Relative
View Manipulation	———	———	———	———	Shift (std)
Pointers	Light Pen	———	Light Pen	Light Pen	Light Pen, Tablet, Mouse
Other	See 1	See 1, 2	See 1	———	See 1
INTERFACING Interface	Parallel Computer	Parallel Computer	Parallel Computer	Parallel Computer	RS 232 B Parallel Computer
Transmission Rate	9 Mbps	3.2 Mbps	———	———	1.6 Mbps
Mode	———	———	———	———	Half/Full Duplex Echoplex
Other	IBM 2701	IBM 2701	Honeywell Series 16	IBM 1130	TTY & IBM Compatible
INTERNAL PROCESSOR	Hazeltine 32K X 16	Hazeltine 16K X 48	———	IBM 2K X 16 4K Expandable	IMLAC 4K X 16 32K Expandable
OPTIONS	PC	DD	LP, PLT, PT, MT, DD	PC, LP, MT, DD	PC, LP, PT, MT, DD
PRICING	———	———	———	$120,000	$9,620
REMARKS & OTHER FEATURES	[1]20 Displays/System, 2 Interactive	[1]8 Displays/System [2]1975 Stored Backgrounds for Call Up	[1]HW Char., Plotting, Circle, Line Generators (opt)	———	[1]Software Controlled Graphics (std)

ABBREVIATIONS OPTIONS: PC - Printer/Copier (Thermal, Optical, Electrostat.) • LP-Line Printer • PLT - Plotter • PT - Paper Tape • MT - Magnetic Tape Transport • DD - Disk Drive
OTHER: ST - Storage Tube Display • HW – Hardware Feature

TABLE 1 • GENERAL-PURPOSE GRAPHIC CRT TERMINALS & SYSTEMS . . . . . Cont'd

COMPANY	INFORMATION DISPLAYS		LUNDY	MONITOR DISPLAYS	
MODEL	IDIgraf	IDIIOM	System 32	5205	8100
DISPLAY Size (inches)	10 X 10	13 X 13	20 (round)	TV Monitor	12 X 12
Char Capacity	2048	2048	6000	3456	4000
Char/Line	73	128	160	72	80
Total Lines	51	85	80	48	50
No Char & Code	128 ASCII	128 ASCII - See 1	96/192 ASCII; EBCDIC	96 ASCII	64 ASCII
Char Generation	16 X 16 Stroke	7 X 9 Stroke	Stroke	5 X 5 Dot	Stroke
Refresh Rate (Hz)	30	30/20	10 to 100	50	10 to 60
DATA ENTRY Insert/Delete	Char & Line (opt)	Char & Line (std)	———	Char & Line (std)	Char & Line (std)
Tabulation	Horz & Vert (opt)	Horz & Vert (std)	———	Horz & Vert (std)	Horz & Vert (std)
Formatting	opt	std	———	std	std
Page Roll	opt	std	———	std	———
Split Screen	opt	std	———	———	———
Other	———	———	———	See 1	———
GRAPHICS Visible Raster	1024 X 1024	1024 X 1024	1430 X 1430	576 X 288	1024 X 1024
Max Component	1024 raster units	1024 raster units	2047 raster units	———	1024 raster units
Positioning Modes	Absolute & Relative	Absolute & Relative	Absolute & Relative	Relative	Absolute
Vector Modes	Absolute & Relative	Absolute & Relative	Absolute & Relative	———	Relative
View Manipulation	Shift, Rotate (opt)	Shift, Rotate, 2D & 3D Zoom (std)	Shift & Rotate (std) 3D Zoom (opt)	———	———
Pointers	Light Pen, Tablet	Light Pen, Track-ball, Joystick	Light Pen, Tablet, Trackball, Joystick	Light Pen, Track-ball, Joystick	Light Pen
Other	———	See 2	See 1, 2	See 1	See 1
INTERFACING Interface	RS 232 B Current Loop	Parallel Computer	RS 232 B Parallel Computer	RS 232 B Parallel Computer	Parallel Computer
Transmission Rate	5 Kbps	50 Kbps	4800 bps	454 Kcps	3.2 Mbps
Mode	Full-Duplex	Full-Duplex	———	———	Half-Duplex
Other	———	———	IBM 2250 Compatible	———	———
INTERNAL PROCESSOR	ID 1K X 10 8K Expandable	Varian 620/f 4K X 16 32K Expandable	Lundy 8K X 16 16K Expandable	4K X 12 per Channel	Varian 620/i 8K X 16 32K Expandable
OPTIONS	———	PC, LP, PT, MT, DD	LP, PT, MT	———	LP, PT, MT
PRICING	$8,000	$65,000	$48,000	$14,000	$65,000
REMARKS & OTHER FEATURES	Up to 4 Displays per Controller	[1]Plus 64 Programmable [2]HW Char, Circle Generators	[1]HW Char, Circle, Ellipse, Rectangle, Dot/Dash Generators [2]Stand-Alone or Multi-Display Systems	[1]7-Color Display	[1]HW Char, Circle, Arc, Dot/Dash Gen-erators

ABBREVIATIONS

OPTIONS: PC - Printer/Copier (Thermal, Optical, Electrostat.) • LP-Line Printer • PLT - Plotter • PT - Paper Tape • MT - Magnetic Tape Transport • DD - Disk Drive
OTHER: ST - Storage Tube Display • HW — Hardware Feature

TABLE 1 • GENERAL-PURPOSE GRAPHIC CRT TERMINALS & SYSTEMS . . . . . Cont'd

COMPANY	PRINCETON	SANDERS	SYSTEMS CONCEPTS		SYSTEMS ENGR. LABS
MODEL	PEP-801	ADDS/900-960	DELTA-1/SC-2	DELTA-2/SC-2	80-816
DISPLAY Size (inches)	10 X 14	14 X 14	12.5 X 12.5	10 X 10	10 X 10
Char Capacity	4250/8000	———	8192	8192	2380
Char/Line	85/128	112	128/85/64/43	128/85/64/43	85
Total Lines	50/64	74	64/43/32/22	64/43/32/22	64
No Char & Code	128 ASCII	128 ASCII	96/128 ASCII	96/128 ASCII	128 ASCII
Char Generation	7 X 9 Dot	Stroke	14 X 10 Stroke	14 X 10 Stroke	5 X 7 Stroke
Refresh Rate (Hz)	ST	60	30	30	30/60
DATA ENTRY Insert/Delete	Char (std); Line (opt)	———	Char & Line (opt)	Char & Line (opt)	———
Tabulation	———	———	Horz & Vert (opt)	Horz & Vert (opt)	———
Formatting	std	———	opt	opt	———
Page Roll	std	———	opt	opt	———
Split Screen	———	———	opt	opt	———
Other	———	———	———	———	———
GRAPHICS Visible Raster	1024 X 1024	1024 X 1024	1024 X 1024	512 X 512	1024 X 1024
Max Component	———	———	1024 raster units	512 raster units	———
Positioning Modes	Absolute & Relative	Absolute & Relative	Absolute & Relative	Absolute & Relative	Absolute
Vector Modes	Absolute & Relative	Absolute & Relative	Absolute & Relative	Absolute & Relative	Relative
Manipulation	2D Zoom (std)	Shift, Rotate (opt)	Shift (opt)	Shift (opt)	———
Pointers	Tablet, Joystick	Light Pen, Track-ball, Joystick	Light Pen, Joy-stick, Mouse	Light Pen, Joy-stick, Mouse	Light Pen, Trackball
Other	———	See 1	———	———	———
INTERFACING Interface	RS 232 B Parallel Computer	RS 232 B	Parallel Computer	Parallel Computer	Parallel Computer
Transmission Rate	2400 bps	———	———	———	5 Mbps
Mode	Half/Full-Duplex Echoplex	———	———	———	———
Other	———	IBM 360	———	———	SEL 800
INTERNAL PROCESSOR	———	Varian 620/i 4K X 16 32K Expandable	SC-2 4K X 18 65K Expandable	SC-2 4K X 18 65K Expandable	———
OPTIONS	LP	PT	LP, PT, MT, DD	LP, PT, MT, DD	———
PRICING	$6,500	———	$60,000	$33,000	$26,000
REMARKS & OTHER FEATURES	———	[1]HW Char, Vector, Conic Generators	———	———	———

ABBREVIATIONS OPTIONS: PC - Printer/Copier (Thermal, Optical, Electrostat.) • LP-Line Printer • PLT - Plotter • PT - Paper Tape • MT - Magnetic Tape Transport • DD - Disk Drive
OTHER: ST - Storage Tube Display • HW – Hardware Feature

Only TelTerm can recover the rolloffs.

If you've ever experienced top line rolloff, you'll really appreciate TelTerm's exclusive PAGING feature. It puts the rolloffs into memory, instead of into oblivion. And permits recovery at the push of a button. That means you have 3000 characters of display at your fingertips. In any format. Without going into a computer. And that means program preparation with less effort, in less time, and at less cost. Same goes for editing text, or entering inventory, reservations or business form data.

Of course, our other features match those offered by other video terminals, with one big difference: we've put the best of all into TelTerm. Like the most readable upper/lower case character set you can buy. And addressable cursor, blinking, underlining, formatting and line drawing capabilities. With more too. There's also a long list of useful accessories, such as a light pen, built-in acoustic coupler, hard copy printers, cassette recorders and multiplexers.

End the disappearing data act now. Ask for more information, demonstration, or applications assistance. Or ask about our Delta 1 color display. DELTA DATA SYSTEMS Corporation, Woodhaven Industrial Park, Cornwells Heights, Pa. 19020; telephone (215) 639-9400.

Delta Data Systems

UNITS AVAILABLE ON 30-DAY DELIVERY

CIRCLE NO. 22 ON INQUIRY CARD

TABLE 1 • GENERAL-PURPOSE GRAPHIC CRT TERMINALS & SYSTEMS . . . . . Cont'd

COMPANY	SYSTEMS ENGR. (cont'd)	TEKTRONIK	UNIVAC	VECTOR GENERAL	XEROX
MODEL	**80-821**	**T-4002A**	**1557/1558**	**Graphics Display**	**7580**
DISPLAY Size (inches)	12.3 X 12.3	8.3 X 6.5	12 X 12	13 X 14	10 X 10
Char Capacity	2380	3315	———	7200	———
Char/Line	85	85	———	120/80/60/32	———
Total Lines	64	40	———	60/40/30/16	———
No Char & Code	128 ASCII	ASCII	64 ASCII	192 ASCII	64 ASCII
Char Generation	5 X 7 Stroke	7 X 9 Dot	Stroke	3 X 2 Stroke	Stroke
Refresh Rate	———	ST - See 1	———	30	———
DATA ENTRY Insert/Delete	———	Char & Line (std)	———	Char & Line (std)	———
Tabulation	———	Horz (std)	———	Horz & Vert (std)	———
Formatting	———	std	———	std	———
Page Roll	———	———	———	opt	———
Split Screen	———	std	———	opt	———
Other	———	See 1	———	———	———
GRAPHICS Visible Raster	1024 X 1024	1024 X 1024	1024 X 1024	4096 X 4096	1024 X 1024
Max Component	———	1024 raster units	1024 raster units	4096 raster units	1024 raster units
Positioning Modes	Absolute	Absolute & Relative	Absolute & Relative	Absolute & Relative	———
Vector Modes	Absolute	Absolute & Relative	Absolute & Relative	Absolute & Relative	———
View Manipulation	———	———	———	Shift, Rotate, 2D & 3D Zoom (opt)	———
Pointers	Light Pen Trackball	Tablet, Mouse	Light Pen	Light Pen, Tablet, Mouse	Light Pen
Other	———	———	See 1	See 1	———
INTERFACING Interface	Parallel Computer	RS-232 B	RS 232 B	Parallel Computer	———
Transmission Rate	5 Mbps	———	———	———	———
Mode	———	———	———	———	———
Other	SEL 800	See 2	UNIVAC 1100	———	Sigma 5 & 7
INTERNAL PROCESSOR	———	———	UNIVAC 1557 8K X 18 16K Expandable	4K X 16 128K Expandable	———
OPTIONS	———	PC	———	PC, LP, PT, MT, DD	———
PRICING	$30,000	$8,800	———	$19,800	———
REMARKS & OTHER FEATURES	———	[1]Refresh Scratch Pad Areas @ 40 Hz for 85 Char. [2]TTY-Port Interfaces for Minicomputers, IBM 360	[1]Controller Drives 1 to 3 Displays	[1]16 Intensity Levels	———

ABBREVIATIONS OPTIONS: PC - Printer/Copier (Thermal, Optical, Electrostat.) • LP-Line Printer • PLT - Plotter • PT - Paper Tape • MT - Magnetic Tape Transport • DD - Disk Drive
OTHER: ST - Storage Tube Display • HW — Hardware Feature

TABLE 2 • SPECIAL-PURPOSE GRAPHIC CRT TERMINALS & SYSTEMS

COMPANY & MODEL	Description
COMPUTERVISION INTERACTgraphic I (Plotting System)	• 6.4 X 8.3 Inch CRT with 94 ASCII Characters, Visible Raster of 1081 X 1481, Joystick Pointer, and Thermal Printer • 34 X 44 inch Flat-Bed Plotter/Digitizer with Resolution of ± 0.002 Inches, Accuracy of 0.05 inches, and Plotting Speed of 14 Inches/Second
GRAPHIC DISPLAYS ETOM 2000 (Plotting System)	• 12 X 12 Inch CRT with 64 ASCI Characters, Visible Raster of 512 X 512, Light Pen and Tablet Pointers • 8.5 X 11, 11 X 17, 17 X 22 or 22 X 34 Plotter with Increment Sizes of 0.010 to 0.005 Inches, and Plotting Speeds of 300 to 1200 Increments/Second
HAZELTINE ANG-3 (Target Tracking System)	• 16/20 Inch-Round CRT with Capacity of 6424 Characters, 73 char/line at 88 lines, 64 ASCII Characters, Visible Raster of 512 X 800, Shift and 2D Zoom Manipulation, Trackball Pointer and 4K X 18 Processor

ments. Composition and editing systems using both alphanumeric and graphic CRT terminals are just entering the market. Advantages of such computer-controlled systems will be gained in page layout of text and graphics, and in text revisions via an interactive display system.

Tables 1 and 2 present some of the characteristics of full graphic CRT terminals and systems. The manufacturers offer a wide range of equipment modules and options for many of the models tabulated; therefore graphic CRT terminals have not been separated from graphic terminal systems that contain processors controlling one or more displays.

The Data Entry section of Table 1 covers characteristics that are common to both full graphic and alphanumeric terminals. Omissions (dashes) should not be interpreted as features that cannot be provided; hardware options and software can provide, in most instances, any data entry features. The same holds true for the Graphics section of the Table. ▲

Further information on full graphic CRT terminals and systems described in Tables 1 and 2 may be obtained by referencing Table 3, and using the Reader Service Card.

TABLE 3 • REFERENCE LITERATURE

For additional information on full graphic CRT terminals and systems referenced in Table 1 and 2, circle the appropriate numbers listed below on the reader service card.

Company	Reader Service Card Number
Adage, Boston, Mass.	200
Computek, Cambridge, Mass.	201
Computervision, Burlington, Mass.	202
Conographic, Cambridge, Mass.	203
Control Data, St. Paul, Minn.	204
Corning Data Systems, Raleigh, N.C.	205
Data Disc, Palo Alto, Cal.	206
Digital Equipment, Maynard, Mass.	207
Evans & Sutherland Computer, Salt Lake City, Utah	208
Hazeltine, Little Neck, N.Y.	209
Honeywell, Waltham, Mass.	210
IBM, White Plains, N.Y.	211
Imlac, Waltham, Mass.	212
Information Displays, Mt. Kisco, N.Y.	213
Lundy Electronics, Paramus, N.J.	214
Monitor Displays, Ft. Washington, Pa.	215
Princeton Electronic Products, N. Brunswick, N.J.	216
Sanders Data Systems, Nashua, N.H.	217
Systems Concepts, San Francisco, Cal.	218
Systems Engineering Labs., Ft. Lauderdale, Fla.	219
Tektronix, Beverton, Ore.	220
Univac, Blue Bell, Pa.	221
Vector General, Canoga Park, Cal.	222
Xerox Data Systems, El Segundo, Cal.	223

Robert H. Branch and **John W. Hoag, Jr** • Computer Control Div. of Honeywell, Inc.

IN PROCESS CONTROL, THINK SMALL

Perhaps you should think twice before putting all your control function eggs in one computerized basket.

It has been the practice to expect process control computer systems to perform all control functions single-handedly. And we've even piled on additional responsibilities (such as background compiling) to justify their expense. This is like expecting the entertainer in a one-man band to wait on tables while amusing the audience.

The cost of individual computers in the past dictated this approach. Even though you naturally preferred to get one part of a process under computer control before another, the control systems for each subprocess involved a $300-500K expenditure. Now you didn't casually tell your boss you needed two or more of these! So, working with the computer manufacturer, you agreed that all portions could be controlled by the same machine. It cost a bit more and took a bit longer than having several machines, but it could do the job.

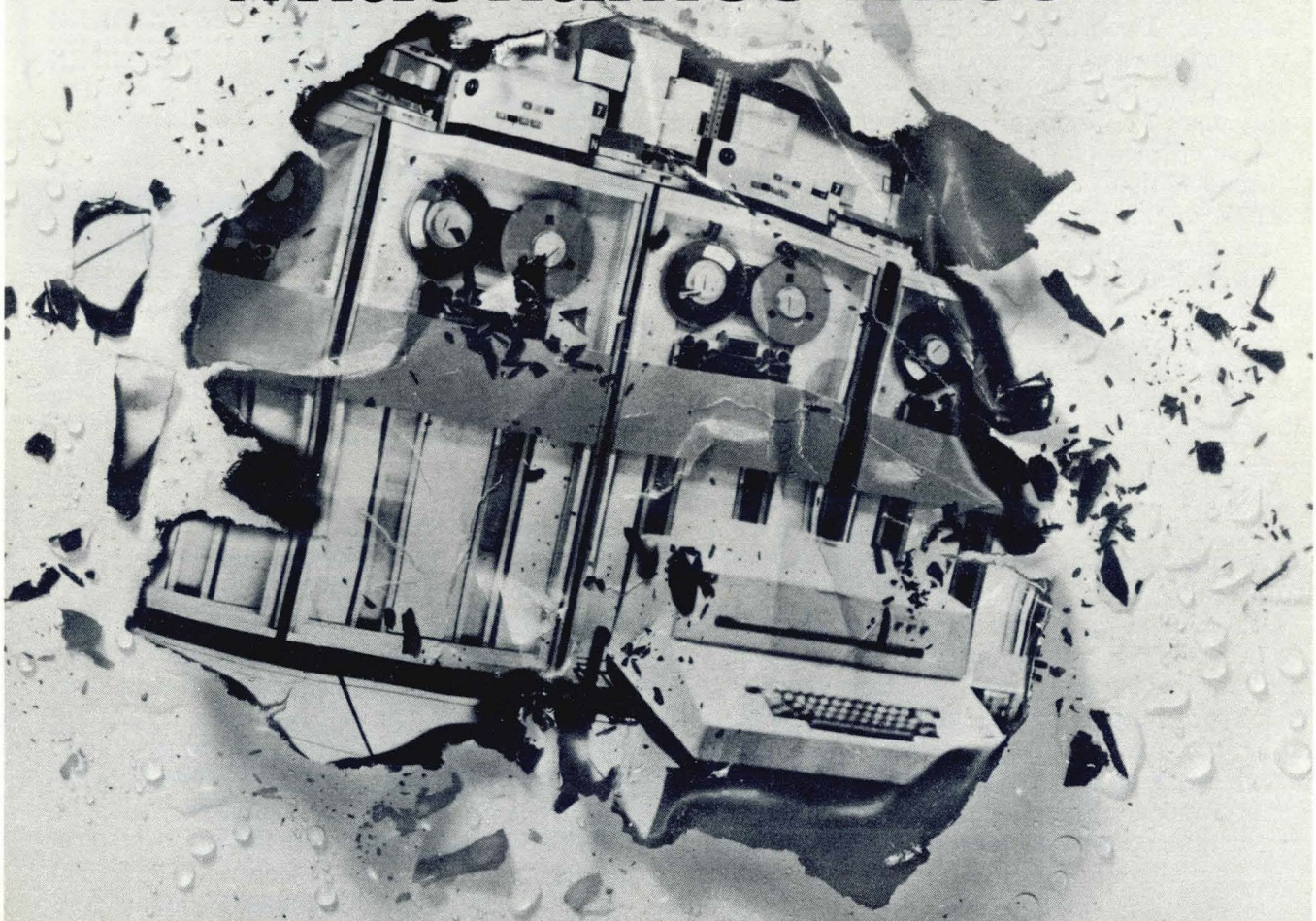
After a seemingly endless wait (usually long after due date or startup of process) you finally got a system that did a lot of what was wanted. But if you then decided that a minor programming change had to be made, it could bomb the rest of the program and take hours to get back to where you started. Also, the background programming often turned out to be harder than you thought, so you had to shut down to do compiling or go to another machine to debug your new program. An alternative – and often preferable – approach is now available: a number of computers, each doing its own thing. Today the prices of process control systems are down to $60-75K without programming. You can buy three or four and still be under the $300K/price tag of a single earlier system. By breaking the process into three or four subprocesses, you can put a computer on each. These "dedicated" computers can even be bought one at a time and soon the whole process will be computer-controlled. And if you want the ultimate, you can get a "hierarchical" system to coordinate the activities of the subprocess controllers. (Tip: By picking the easiest subprocess first, you can get the system in and controlling within 6-8 months. This convinces management that you're a genius. So you get a raise and approval for the next computer system!) You may now have equalled the one-computer-for-everything cost, but look what you've gained:

- Simple programs in each computer;
- In case of shutdown, only a part of the process needs manual intervention (and the system can probably be fixed more quickly!);
- It's easier to do background programming on the coordinating computer – it has more leisure time;
- Each operating group can have its own computers;
- Throughput is improved by having part of your process under computer control before the whole system is installed;
- If changes are required in one subprocess, you don't have to mess up programs for others;
- You can save a lot on installations costs because each computer can be nearer its portion of the process – thus shortening the cables needed.

This "dedicated" approach to computer control is now preferable from almost any point of view – flexibility, reliability, throughput, etc. Let's face it –the computer is a tool to help make more and better products. Other tools are purchased on a work-distributing basis, so why not computers? The moral is this: small, dedicated computer systems now available are as powerful as and more reliable than, the complex systems used in the past. Thinking small can pay off big! ▲

Robert H. Branch (at right) and **John W. Hoag, Jr.** are, respectively, the market and product managers for data acquisition and control systems at Honeywell's Computer Control Division in Framingham, Mass.

Stop fires dry in seconds before water damages what flames miss.



A computer center is no place to fight fire with water. Or with any other corrosive or conductive suppressant.

So Fenwal, leading developers of explosion suppression systems for industry, came up with an absolutely dry idea. The Fenwal high-speed fire suppression systems.

Using super-sensitive, solid state detectors to spot fire, smoke or temperature rise, these sensors instantly activate the discharge of a dry, colorless, non-corrosive gas to knock out fire in seconds! This leaves the entire area clean, dry, safe-for-people. In short, ready for immediate reuse. Which eliminates downtime, equipment loss, and costly increases in insurance rates. Now doesn't that make sense?

We'll be glad to show you this system in action. Just call Mr. George Grabowski, Division Manager, to arrange a showing of the color film, "The Fireaters," at your plant or office. Fenwal Incorporated, Ashland, Mass. Phone (617) 881-2000. A Division of Walter Kidde & Company, Inc.

FENWAL

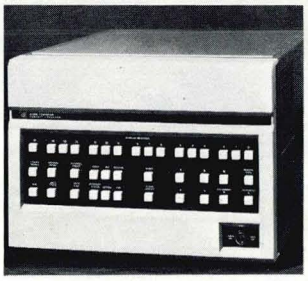
MINICOMPUTERS

JOHN A. MURPHY, Associate Editor • Modern Data

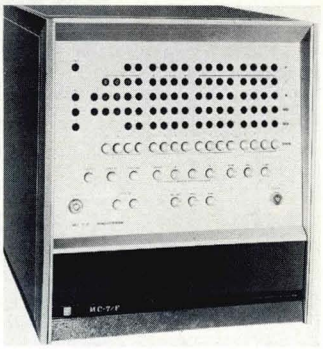
Lots of minis have come down (or crashed on) the pike since **MODERN DATA'S** last Profile on minicomputers. Twenty-six manufacturers and over forty models were described in the August, 1969 Profile; we now have forty manufacturers and over eighty models covered in this present Product Profile – and this coverage does not include companies and models that have come onto and then faded from the mimicomputer scene during the twenty month interval between our Profiles.

This proliferation of minicomputers was, in part, sustained by the euphora that accompanied the past economy and its "high growth areas". Easy funding, a high demand index for engineers, and the "end-less" markets for minicomputers – a chicken roasting in every pot being controlled by a minicomputer in every garage – provided the impetus for founding one's very own minicomputer company. Speculative money was going begging and another job was always available – why not incorporate and make a million?

The halcyon days have past. The fall-out during the recent economic "adjustment" has pruned most of the speculative ventures from the lists of active minicomputer manufacturers. A few remaining are dormant awaiting a return of Camelot or reasonable facsimile in the guise of a merger with another, more prosperous company. The stronger mini manufacturers are now building on a somewhat more conservative estimate of the market and their own production capabilities.



The recently announced Hewlett-Packard 2100A, a 16-bit, 4K to 32K mini with a cycle time of 0.98 microseconds.



Japan's recent entry, the Panasonic MC 7F, a 16-bit mini with memory expandable to 16K and a cycle time of 0.60 microseconds.

Figure 1 • New Minicomputers On The Scene

THE MARKET

The demand for minicomputers, as for most other capital equipment, has seesawed since the summer of 1970. Inventories have increased, prices have decreased. Performance advantages more in tune with proven technologies, rather than "advances" in the state-of-the-art, have improved the minicomputer price-performance ratio.

Concurrently, a shift has started away from the OEM market (you buy the mini, you configure the system, you write the software) to an end-user market (you buy, they configure, they program) on the part of the larger mini manufacturers. This shift is being caused by the large-quantity OEMers building their own special minis, by the end-users demanding a more one-vendor oriented, semi-bundled approach to mini systems, and by the mini manufacturers themselves recognizing the potential profits gained by the sale of minicomputer peripherals along with the minicomputer. Disk and drum storage, magnetic tape transports, cassette or cartridge mag tape systems, paper tape and punch card equipment, line or page printers, teleprinting and CRT terminals, plotters, and other peripheral or interface options, as well as software packages, are being supplied by the manufacturer.

OEM markets have not (and will not) dry up, however. Of the 17,000 processors in operation today that can roughly be defined as minicomputers, nearly 40% were sold on an OEM basis. This percentage, based on the total number of processors sold, is not the same as the percentage of dollars spent on minicomputer systems. The amount of money spent on the purchase of the minicomputer peripherals mentioned above usually exceeds that spent on the mini itself; dollar percentages of total mini sales reflect or lean more towards an end-user market where a total system is purchased.

APPLICATIONS

Writing on the applications of computers is similar to Hercules slaying Hydra; we have no sooner penned to death one application when two more come to mind. What will be attempted is the brief description of the major areas where minicomputers are applied.

TABLE 1 • MINICOMPUTER CHARACTERISTICS

COMPANY	ATRON	CINCINNATI MILACRON	CLARY DATACOMP	COMPUTER AUTOMATION		
MODEL	501 Datamanager	CIP/2100	CDS 404	ALPHA-8/NAKED MINI-8	108	208
MEMORY Word Size (bits)	8	8 or 9	16	8	8	8
Memory Size (words)	4K to 32K	4K to 32K	1K to 65K	4K to 32K	4K to 16K	4K to 16K
Cycle Time (μsec)	2.00	1.10	2.00	1.60	1.60	2.60
Parity Check	Option	Option	———	Option	———	———
Memory Protect	Option	Option	Option	Option	Option	Option
Direct Addressing (words)	32K	32K	1K	512	512	512
Indirect Addressing	Single-Level	Multi-Level	Multi-Level	Multi-Level	Multi-Level	Multi-Level
CPU Registers	Variable	15 Gen. Purpose 1 Index	4 Gen. Purpose 2 Index	1 Gen. Purpose	1 Gen. Purpose	1 Gen. Purpose
Hardware Multiply-Divide	———	Standard	Standard	———	———	———
Immediate Instructions	Standard	Standard	Standard	———	———	———
Double Word Instructions	———	Standard	Standard	Standard	Standard	Standard
Byte Processing	Standard	Standard	Option	Standard	Standard	Standard
INPUT/OUTPUT I/O Word Size (bits)	8 + Parity	16 in 2 bytes	16/32/48/64	8	8	8
Priority Interrupt Levels	Variable	8 to 64	16	3	3	3
Direct Memory Access Channel	Option	Option	Option	Standard	Standard	Standard
I/O Maximum Word Rate (word/sec)	500 kHz	900 kHz (bytes)	———	120 kHz	120 kHz	68 kHz
OTHER FEATURES Real Time Clock	Option	Option	Option	Option	Option	Option
Power Fail/Restart	Standard	Option	Option	Option	Option	Option
Peripheral Device Options	DD, MT, PT, PC, LP, TP	DD, MT, CT, PT, LP, TP, CRT	MT, CT, PT, LP, TP	MT, CT, PT, PC, LP, TP, CRT, PLT	MT, CT, PT, PC, LP, TP, CRT	MT, CT, PT, PC, LP, TP, CRT
Software	Assembler	———	Basic	———	———	———
PRICE Computer with Basic Memory	$7,475	$4,565	$8,000	$2,800 (Alpha 8) $1,975 (Naked Mini 8)	$5,490	$5,190
Add-On Memory Increment	$1,250/4K	$1,700/4K X 8 $1,800/4K X 9	$3,500/4K	$1,700/4K	$2,600/4K	$2,600/4K
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd

COMPANY	COMPUTER AUTOMATION (Cont'd)				COMPUTER LOGIC SYSTEMS	CONTROL DATA
MODEL	808	ALPHA-16/NAKED MINI-16	116	216	CLS-18	SC-1700
MEMORY Word Size (bits)	8	16	16	16	18	18
Memory Size (words)	4K to 16K	2K to 32K	4K to 32K	4K to 32K	4K to 265K	4K to 32K
Cycle Time (μsec)	8.00	1.60	1.60	2.60	0.96	1.50
Parity Check	———	Option	———	———	———	Standard
Memory Protect	Option	Option	Option	Option	Standard	Standard
Direct Addressing (words)	512	1K	1K	1K	512	32K
Indirect Addressing	Multi-Level	Multi-Level	Multi-Level	Multi-Level	Multi-Level	Multi-Level
CPU Registers	1 Gen. Purpose ———	2 Gen. Purpose 1 Index	2 Gen. Purpose 1 Index	2 Gen. Purpose 1 Index	8 to 32 Gen. Purpose 4 to 16 Index	9 Gen. Purpose 2 Index
Hardware Multiply-Divide	———	Standard	Standard	Standard	Option	Standard
Immediate Instructions	———	Standard	Standard	Standard	Standard	Standard
Double Word Instructions	Standard	Standard	Standard	Standard	Standard	———
Byte Processing	Standard	———	———	———	Standard	Option
INPUT/OUTPUT I/O Word Size (bits)	8	16	16	16	18	16 + Parity & Protect
Priority Interrupt Levels	3	3	3	3	8	16
Direct Memory Access Channel	Standard	Standard	Standard	Standard	Standard	Option
I/O Maximum Word Rate (word/sec)	25 kHz	714 kHz/625 kHz	714 kHz	714 kHz	1.0 MHz	300 kHz
OTHER FEATURES Real Time Clock	Option	Option	Option	Option	Option	Option
Power Fail/Restart	Option	Option	Option	Option	Option	Standard
Peripheral Device Options	MT, CT, PT, PC, LP, TP, CRT	All Types	All Types	All Types	———	DD, DRD, MT, PT, PC, LP, TP, CRT
Software	———	Basic, Fortran	Basic, Fortran	Basic, Fortran	Assembler	Fortran, Autran
PRICE Computer with Basic Memory	$4,990	$3,550/4K (Alpha-16) $2,500/4K (Naked Mini)	$8,490	$7,990	$9,870	$15,900
Add-On Memory Increment	$2,700/4K	$2,200/4K	$3,800/4K	$3,800/4K	$3,200/4K	$4,500/4K
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

OEM APPLICATIONS

There are numerous and varied definitions of what OEM (Original Equipment Manufacturer) markets or applications are – or ought to be. The definitions range from "if he buys more than one of anything, he's OEM" to "he's got to to buy 100, then he's OEM". The basis for the nebulous approach to defining OEM lies in the business practicalities of assigning sales forces, giving discounts, etc. Adding to Webster's dilemma, our own definition of OEM would be a market or application where one or more minicomputer mainframes with main memory and/or interfacing is sold to a buyer/user for application in a system not produced or offered by the mini manufacturer or manufacturing division. The buyer/user must do the configuring and programming, incorporating the mini into a system of his own design.

Within the limits of the above definition, all of the minicomputer or mini system applications that follow may be OEM. The degree, however, varies. Mini applications to satellite peripherals is highly OEM oriented, while process control systems are either configured by the computer maker or by an independent control company that produces minis

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd

COMPANY	DATA GENERAL			DATACRAFT	DATAMATE COMPUTER SYSTEMS	
MODEL	NOVA 1200	NOVA 800	SUPERNOVA SC	DC 6024/5	DM-16	DM-70
MEMORY Word Size (bits)	16	16	16	24	16	16
Memory Size (words)	2/4K to 32K	2/4K to 32K	4K to 16K	4K to 32K	8K to 32K	4K to 32K
Cycle Time (μsec)	1.20	0.80	0.30	1.20	1.00	1.00
Parity Check	———	———	———	Standard	———	———
Memory Protect	———	———	———	Option	———	———
Direct Addressing (words)	1K	1K	1K	32K	512	1K
Indirect Addressing	Multi-Level	Multi-Level	Multi-Level	Multi-Level	Multi-Level	Multi-Level
CPU Registers	4 Gen. Purpose 2 Index	4 Gen. Purpose 2 Index	4 Gen. Purpose 2 Index	5 Gen. Purpose 3 Index	2 Gen. Purpose 1 Index	4 Gen. Purpose 2 Index
Hardware Multiply-Divide	Option	Option	Option	Standard	Standard	Option
Immediate Instructions	———	———	———	Standard	Standard	Standard
Double Word Instructions	———	———	———	Standard	Standard	———
Byte Processing	Standard	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT I/O Word Size (bits)	16	16	16	8/24	16	16
Priority Interrupt Levels	16	16	16	16	8 to 64	64
Direct Memory Access Channel	Standard	Standard	Standard	Option	Standard	Standard
I/O Maximum Word Rate (word/sec)	833 kHz	1.25 MHz	1.25 MHz	833 kHz	1.0 MHz	1.0 MHz
OTHER FEATURES Real Time Clock	Option	Option	Option	Option	Option	Option
Power Fail/Restart	Option	Option	Option	Option	Standard	Standard
Peripheral Device Options	DD, MT, PT, PC, LP, TP, PLT	DD, MT, PT, PC LP, TP, PLT	DD, MT, PT, PC LP, TP, PLT	DD, MT, PT, LP, TP, PLT	DD, MT, CT, PT, PC, LP, TP, CRT, PLT	DD, MT, CT, PT, PC LP, TP, CRT, PLT
Software	Algol, Basic, Fortran	Algol, Basic, Fortran	Algol, Basic, Fortran	Fortran	Fortran	———
PRICE COMPUTER with Basic Memory	$5,100	$6,600	$11,500	$15,500	$14,900	$8,500
Add-On Memory Increment	$2,200/2K 2,700/4K	$2,500/2K $3,000/4K	$2,800/1K (SC) $3,650/2K (SC) $5,950/4K (SC) $3,650/4K (core)	$4,800/4K	$4,000/4K	$2,700/4K
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

only for use in its own control systems. Special test or data acquisition systems may also be OEM; with a limited market for some test systems, the mini maker sees no profit advantage and defers to the OEMer or independent.

SATELLITE PERIPHERALS

The input/output needs of large computer systems have yet to be satiated by on-line peripherals. A full line of minicomputer controlled, semi-autonomous or independent peripheral systems that can operate on an on-line and off-line basis are employed to alleviate this data I/O bottleneck. The manufacturers of these satellite peripherals are, in the main, OEM users of minicomputer mainframes.

OCR document reading systems are configured around a minicomputer controlled reader with forms transport, magnetic tape transport and other devices attached. Programs stored in the minicomputer memory can be used to recognize various character fonts, to format read areas on the source document, to accumulate totals on account categories, to rescan or flag poorly imprinted data,

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd

COMPANY	DIGITAL COMPUTER CONTROLS				DIGITAL EQUIPMENT	
MODEL	**D-112**	**D-112H**	**D-116**	**D-216**	**PDP-8/I**	**PDP-8/L**
MEMORY Word Size (bits)	12	12	16	16	12	12
Memory Size (words)	4K to 32K	4K to 32K	4K to 32K	4K to 32K	4K to 32K	4K to 8K
Cycle Time (μsec)	1.20	0.30	1.20	1.20	1.50	1.60
Parity Check	Option	Option	———	———	Option	Option
Memory Protect	Standard	Standard	Option	Option	Option	Option
Direct Addressing (words)	256	256	32K	32K	256	256
Indirect Addressing	Single-Level	Single-Level	Single-Level	Single-Level	Single-Level	Single-Level
CPU Registers	2 Gen. Purpose 8 Auto Index	2 Gen. Purpose 24 Auto Index	4 Gen. Purpose 4 Index	8 Gen. Purpose 8 Index	4 Gen. Purpose 8 Auto Index	4 Gen. Purpose 8 Auto Index
Hardware Multiply-Divide	Option	Option	Option	Option	Option	———
Immediate Instructions	———	———	Standard	Standard	———	———
Double Word Instructions	Option	Standard	———	Standard	———	———
Byte Processing	———	Standard	———	Standard	———	———
INPUT/OUTPUT I/O Word Size (bits)	12	12	16	16	6	6
Priority Interrupt Levels	1	1	16	4	4	4
Direct Memory Access Channel	Option	Option	Standard	Standard	Standard	Standard
I/O Maximum Word Rate (word/sec)	833 kHz	3.3 MHz	833 kHz	833 kHz	666 kHz	625 kHz
OTHER FEATURES Real Time Clock	Option	Option	Option	Option	Option	Option
Power Fail/Restart	Option	Option	Option	Option	Option	Option
Peripheral Device Options	DD, DRD, MT, CT, PT, LP, TP, PLT	DD, DRD, MT, CT, PT, LP, TP, PLT	DD, DRD, MT, CT, PT, LP, TP, PLT	DD, DRD, MT, CT, PT, LP, TP, PLT	All Types	All Types
Software	Algol, Basic, Cobol, Fortran	Algol, Basic, Cobol, Fortran	Algol, Basic, Cobol, Fortran	Algol, Basic, Cobol, Fortran	Algol, Basic, Cobol, Fortran	Algol, Basic, Cobol, Fortran
PRICE Computer with Basic Memory	$3,990	$6,800	$4,000	$4,300	$12,800*	$8,500*
Add-On Memory Increment	$2,700/4K	$700/256	$2,700/4K	$2,700/4K	$4,000/4K	$4,000/4K
OTHER REMARKS					*with ASR-33	*with ASR-33
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

etc. – all the while controlling forms flow through the reader and providing magnetic tape output for future imput to a large central processor.

Another data entry application involves shared-processor, key-to-disk/tape systems. Keyed data input from many keyboard consoles is formatted and preprocessed by minicomputers. Editing tasks handled by the mini in this off-line application include limit, character, and field checks and quantity subtotals and totals. Operator performance can also be monitored and job thruput analyzed.

Computer output microfilm systems employ minicomputers in the on-line and off-line generation of microfilm images for high-speed data output. Character generation, frame format, frame coding and other procedures are controlled by minicomputers internal to the COM system.

Interactive, full graphic CRT systems (also Profiled in this issue) use minicomputers in the generation and manipulation of complex multi-dimensional images on a CRT display.

Large, stand-alone or on-line plotters or drafting machines utilize minis in the control of the various plotting, digitizing, pen-motion, and information

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd

COMPANY	DIGITAL EQUIPMENT (Cont'd)				DIGITAL SCIENTIFIC	ELECTRONIC ASSOCIATES
MODEL	PDP-8/E	PDP-11/20	PDP-11/15	PDP-15	META 4-16/4001	EAI 640
MEMORY Word Size (bits)	12	16	16	18	18	16
Memory Size (words)	4K to 32K	1K to 124K	1K to 32K	4K to 32K	4K to 65K	8K to 32K
Cycle Time (μsec)	1.20/1.40	0.95	0.95	0.80	0.90	1.65
Parity Check	Option	Option	Option	Option	Standard	———
Memory Protect	Option	———	———	Option	Standard	Standard
Direct Addressing (words)	256	32K	32K	———	65K	512
Indirect Addressing	Single-Level	Multi-Level	Multi-Level	———	Single Level	Multi-Level
CPU Registers	5 Gen. Purpose 8 Auto Index	8 Gen. Purpose 8 Index	8 Gen. Purpose 8 Index	20 Gen. Purpose 1 Index	32 Gen. Purpose ———	8 Gen. Purpose 1 Index
Hardware Multiply-Divide	———	Option	Option	Option	Standard	Standard
Immediate Instructions	———	Standard	———	———	Standard	Standard
Double Word Instructions	———	———	———	———	Standard	Standard
Byte Processing	———	Standard	Standard	———	———	———
INPUT/OUTPUT I/O Word Size (bits)	6	16	16	18	16	16
Priority Interrupt Levels	12	4	1	4	Variable	64
Direct Memory Access Channel	Standard	Standard	Standard	Standard	Standard	Standard
I/O Maximum Word Rate (word/sec)	833 kHz	2.5 MHz	2.5 MHz	1.0 MHz	1.0 MHz	600 kHz
OTHER FEATURES Real Time Clock	Option	Option	Option	Option	Option	Option
Power Fail/Restart	Option	Standard	Option	Option	———	Standard
Peripheral Device Options	All Types	All Types	All Types	All Types	DD, DRD, MT, PT, LP, TP, PLT	DD, MT, CT, PT, LP, TP, CRT, PLT
Software	Algol, Basic, Cobol, Fortran	Basic, Fortran	Basic, Fortran	Algol, Fortran	Fortran	Basic, Fortran
PRICE Computer with Basic Memory	$6,500*	$10,800*	$6,200	$16,500	$25,000* & 2K ROM	$24,500*
Add-On Memory Increment	$3,000/4K	$3,500/4K	$3,500/4K	$8,000/4K	$5,550/4K	$15,000/8K
OTHER REMARKS	*with ASR-33	*with ASR-33			*with I/O Typer	*with ASR-33
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

transfer operations involved with the production of detailed drawings or graphs. The minicomputer can prepare precise and concise plotter instructions, minimizing pen movement for optimum rough data to finished drawing thruput.

INDUSTRIAL CONTROL

This application area has the minicomputer maker or independent supplying a system for the monitoring and control of industrial processing or manufacturing operations. Such mini systems may be incorporated into an already functioning system, using existing end-user supplied equipment.

Petrochemical Systems

The minicomputer system is used to monitor and control the many process operations involved in the production of petrochemicals. The degree to which minis are employed ranges from simple scan, log and alarm functions to complex produc-

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd						
COMPANY	ELECTRONIC PROCESSORS	GENERAL AUTOMATION			GRI COMPUTER	
MODEL	EPI-118	SPC-12	SPC-16	18/30 System	GRI-909/10 & 20	GRI-909/30 & 40
MEMORY Word Size (bits)	18	8	16	18	16	16
Memory Size (words)	4K to 32K	4K to 32K	4K to 32K	4K to 32K	1K to 4K	4K to 32K
Cycle Time (μsec)	0.90	0.60	0.96	0.96	1.30	1.30
Parity Check	———	———	———	Standard	———	———
Memory Protect	Standard	———	———	Standard	Option	Option
Direct Addressing (words)	32K	16K	32K	32K	4K	32K
Indirect Addressing	Single-Level	Single Level	Multi-Level	Multi-Level	Single Level	Single Level
CPU Registers	2 Gen. Purpose ———	6 Gen. Purpose 3 Index	16 Gen. Purpose 3 Index	20 Gen. Purpose 3 Index	2/8 Gen. Purpose ———	2/8* Gen. Purpose ———
Hardware Multiply-Divide	Option	———	Option	Standard	Option	Option*
Immediate Instructions	———	Standard	———	Standard	Standard	Standard
Double Word Instructions	———	Standard	———	Standard	Standard	Standard
Byte Processing	Standard	———	Standard	———	Option	Option
INPUT/OUTPUT I/O Word Size (bits)	21	12	16	16	16	16
Priority Interrupt Levels	18	1	64	61	———	———
Direct Memory Access Channel	Standard	Option	Standard	Standard	Standard	Standard
I/O Maximum Word Rate (word/sec)	900 kHz	460 kHz	520 kHz	833 kHz	568 kHz	568 kHz
OTHER FEATURES Real Time Clock	Option	Standard	Standard	Standard	Standard*	Option
Power Fail/Restart	Standard	Standard	Standard	Standard	Standard*	Option
Peripheral Device Options	DD, MT, CT, PT, LP, CRT, PLT	MT, CT, PT, LP, TP, CRT, PLT	All Types	All Types	DD, MT, CT, PT, LP, TP, CRT	DD, MT, CT, PT, LP, TP, CRT
Software	Basic	Fortran	Fortran	Fortran	Assembler	Assembler
PRICE Computer with Basic Memory	$5,900	$3,700 (est.)	$9,500 (est.)	$18,000 (est.)	$3,500 (10) $3,950 (20)	$5,650 (30) $6,850 (40)
Add-On Memory Increment	$2,650/4K	$1,800/4K (est.)	$3,600/4K (est.)	$4,000/4K (est.)	$995/1K	$2,950/4K
OTHER REMARKS					*Option on 20	*Standard on 40
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

tion reporting, maintenance scheduling, optimization and supervisory control. The mini system may operate alone, with other minis, or with a larger central computer.

Power Generation Systems

Power utilities employ mini systems to monitor and control hydroelectric, steam or nuclear generation plants and power-transmission networks.

A particular application involves the monitoring of a series of hydroelectric generators located at three different dam sites, and the subsequent control of sluice gates, generators and the interconnecting power transmission grid. Transducers monitor the status of generator bearings and windings, power transformers, power loads, voltage and phase conditions, and the water levels at the three dams. Microwave links transmit the data to a central station for analysis, and then return control information, relating the overall power loads, seasonal water levels, and maintenance schedules for generators at each site to the present operation status of the three dam complex.

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd						
COMPANY	HEWLETT PACKARD			HONEYWELL		INTERDATA
MODEL	2114B	2116C	2100A	H316	DDP-516	Model 1
MEMORY Word Size (bits)	16	16	16	16	16	8
Memory Size (words)	4K to 16K	8K to 32K	4K to 32K	4K to 32K	4K to 32K	2K to 16K
Cycle Time (μsec)	2.00	1.60	0.98	1.60	0.96	1.00
Parity Check	Option	Option	Standard	Option	Option	Option
Memory Protect	———	Option	Standard	Option	Option	———
Direct Addressing (words)	2K	2K	2K	1K	1K	512
Indirect Addressing	Multi-Level	Multi-Level	Multi-Level	Multi-Level	Multi-Level	Single Level
CPU Registers	2 Gen. Purpose	2 Gen. Purpose	2 Gen. Purpose	2 Gen. Purpose 1 Index	2 Gen. Purpose 1 Index	1 Gen. Purpose 8K Index
Hardware Multiply-Divide	———	Option	Standard	Option	Option	———
Immediate Instructions	———	———	———	———	———	Standard
Double Word Instructions	———	Option	Standard	Option	Option	Standard
Byte Processing	———	———	———	Standard	Standard	Standard
INPUT/OUTPUT I/O Word Size (bits)	16	16	16	16	16	8
Priority Interrupt Levels	56	48	56	49	49	255
Direct Memory Access Channel	Option	Option	Option	Option	Option	Option
I/O Maximum Word Rate (word/sec)	500 kHz	633 kHz	1.1 MHz	312 KHz	1.0 MHz	1.0 MHz
OTHER FEATURES Real Time Clock	Option	Option	Option	Option	Option	Standard
Power Fail/Restart	Option	Option	Standard	Option	Option	Option
Peripheral Device Options	All Types	All Types	All Types	All Types	All Types	All Types
Software	Algol, Basic, Fortran	Algol, Basic, Fortran	Algol, Basic, Fortran	Basic, Fortran	Basic, Fortran	Fortran
PRICE Computer with Basic Memory	$7,000	$14,000	$6,900	$8,400	$23,800	$3,750
Add-On Memory Increment	$3,500/4K	$8,000/8K	$3,500/4K	$3,500/4K	$8,000/4K	$900/2K
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

Other minicomputer applications in electric power systems cover nuclear reactor core start-up (fuel insertion and rod control), remote site unattended power station operation, steam-electric power plant control, and power transmission grid control.

Other Industrial Applications

Minicomputer systems are applied to many other industrial processes involving the monitoring functions of scanning, logging, and alarm, and the control functions of system supervision and optimization. Among such applications are glass making, paper fabrication, metals and materials processing, oil or gas field and pipeline management, production line control, and gas chromatography.

DATA ACQUISITION & TEST APPLICATIONS

These applications involve the use of minicomputer systems in the analysis of scientific and technical test data. The overall system may be configured by the mini manufacturer, since their

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd

COMPANY	INTERDATA (Cont'd)	LOCKHEED ELECTRONICS		MICRODATA		
MODEL	Model 5	MAC Jr.	MAC 16	MICRO-400	MICRO-800	MICRO-810 & 820/S
MEMORY Word Size (bits)	16	16	16	8	8	8
Memory Size (words)	4K to 65K	4K to 65K	4K to 65K	1K to 65K	1K to 32K	4K to 32K
Cycle Time (μsec)	1.00	1.00	1.00	1.60	1.10	1.10
Parity Check	Option	Option	Option	———	Option	Option
Memory Protect	Option	Option	Option	———	———	———
Direct Addressing (words)	65K	1K	1K	4K	32K	32K
Indirect Addressing	———	Multi-Level	Multi-Level	———	———	Single Level
CPU Registers	16 Gen. Purpose 15 Index	1 Gen. Purpose 4 to 16 Index	1 Gen. Purpose 8 to 64 Index	2 Gen. Purpose 2 Index	16 Gen. Purpose 16 Index	2 Gen. Purpose 1 Index
Hardware Multiply-Divide	Standard	Option	Option	———	———	Standard*
Immediate Instructions	Standard	Standard	Standard	———	Standard	Standard
Double Word Instructions	Standard	Standard	Standard	Standard	———	Standard
Byte Processing	Standard	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT I/O Word Size (bits)	8/16	8/16	8/16	8	8	8
Priority Interrupt Levels	255	4 to 16	8 to 64	64	———	16
Direct Memory Access Channel	Option	Standard	Standard	Option	Option	Option
I/O Maximum Word Rate (word/sec)	500 kHz (bytes)	1.0 MHz	1.0 MHz	625 kHz	910 kHz	910 kHz
OTHER FEATURES Real Time Clock	Option	Option	Standard	Option	Option	Option
Power Fail/Restart	Option	Option	Standard	Option	Option	Option
Peripheral Device Options	All Types	All Types	All Types	MT, CT, PT, LP, TP	DD, MT, CT, PT, LP, TP	DD, MT, CT, PT, LP, TP
Software	Fortran	Fortran	Fortran	———	———	Basic
PRICE Computer with Basic Memory	$10,500	$7,900	$11,200	$2,870	$4,800	$6,040 (810) $5,500 (820/S)
Add-On Memory Increment	$3,200/4K	$3,100/4K	$3,100/4K	$1,025/1K $1,350/4K $1,900/8K	$1,860/4K $2,860/8K	$1,860/4K $2,860/8K
OTHER REMARKS						*Option on 820/S
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

use is general enough to allow for sales to more than just a few researchers, or may be produced on an OEM or independent basis.

Engine Testing

Minicomputers are applied in modularly expandable systems to monitor and control real-time tests on gas turbine and jet engines. Parameters monitored, analyzed, and stored relate to engine ignition, start-up, power levels and fuel consumption. Concurrent testing and control of a multiple number of engines is available on a time-shared basis, and a reduction in unit testing costs and catastrophic test failures is attained.

Biomedical Applications

The diagnoses of various organic disorders, employing radioactive isotopes, uses a minicomputer to analyze scintiscanner data by an iterative smoothing process. The disorder is displayed via a

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd

COMPANY	MICRODATA (Cont'd)	MODULAR COMPUTER SYSTEMS			MOTOROLA	NUCLEAR DATA
MODEL	MICRO-1600	MODCOMP I	MODCOMP II	MODCOMP III	MDP-1000	ND 812
MEMORY Word Size (bits)	8	16	16	16	8	12
Memory Size (words)	4K to 65K	4K to 16K	4K to 32K	4K to 64K	4K to 16K	4K to 16K
Cycle Time (μsec)	1.00	0.80	0.80	0.80	2.16	2.00
Parity Check	———	Option	Option	Standard	———	———
Memory Protect	———	———	———	Option	———	———
Direct Addressing (words)	65K	16K	32K	64K	4K	16K
Indirect Addressing	———	Single Level	Single Level	Single Level	Single-Level	Single-Level
CPU Registers	30 Gen. Purpose 30 Index	3 Gen. Purpose 3 Index	15 Gen. Purpose 7 Index	15 Gen. Purpose 7 Index	4 Gen. Purpose 4 Index	6 Gen. Purpose 2 Index
Hardware Multiply-Divide	———	———	Option	Option	———	Standard
Immediate Instructions	Standard	Standard	Standard	Standard	Standard	Standard
Double Word Instructions	———	———	Option	Standard	Standard	Standard
Byte Processing	Standard	Standard	Standard	Standard	Standard	———
INPUT/OUTPUT I/O Word Size (bits)	8/16/24/32	16	16	16	12	12/24
Priority Interrupt Levels	16 to 64	1	8	32	2 to 256	4
Direct Memory Access Channel	Option	Option	Option	Option	Option	Standard
I/O Maximum Word Rate (word/sec)	1.0 MHz	200 kHz	200 kHz	1.25 MHz	460 kHz (bytes)	500 kHz
OTHER FEATURES Real Time Clock	Standard	Option	Option	Option	Option	Option
Power Fail/Restart	Standard	Option	Option	Standard	Option	Option
Peripheral Device Options	DD, MT, CT PT, LP, TP	DD, MT, PT, PC, LP, TP	DD, MT, PT, PC, LP, TP	DD, MT, PT, PC, LP, TP	MT, PT, PC, LP, TP	DD, MT, CT, PT, PC, LP, TP, PLT
Software	———	———	Fortran	Fortran	Assembler	Nutran
PRICE Computer with Basic Memory	$5,000 (est.)	$5,200	$8,000	$13,500	$6,900	$7,300
Add-On Memory Increment	———	$2,600/4K	$2,600/4K	$4,000/4K	$3,000/4K	$2,750/4K
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

teleprinter printout for further study.

Cardiac research data on laboratory test animals is being monitored and analyzed by a minicomputer system. Implanted electrode sensors monitor a variety of cardiac parameters under minicomputer control; the data so gathered is further analyzed for dynamic changes in ventricular, aortic and other cardio-vascular properties.

Other applications of minicomputer systems to biomedicine cover clinical lab data analysis, intensive care monitoring and EKG analysis.

Other Test Applications

Minicomputers are applied to automatic electrical component, circuit or sub-assembly testing; seismic data logging and analysis; the dynamic analysis of mechanical or hydraulic systems; spectrum analysis; and other areas where data acquisition, analysis and storage is needed.

Note: Consult the January, 1970 issue of MODERN DATA for a staff survey of 10 off-the-shelf data acquisition systems.

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd						
COMPANY	OMNICOMP COMPUTER	OMNITEC	PANASONIC		RAYTHEON DATA SYSTEMS	
MODEL	OMNUS-1	BIT 483	MC 7S	MC 7F	703	704
MEMORY Word Size (bits)	16	8	16	16	16	16
Memory Size (words)	2K/4K to 32K	8K to 65K	2K to 16K	4K to 16K	4K to 32K	4K to 32K
Cycle Time (μsec)	1.20	0.98	4.00	0.60	1.00	1.00
Parity Check	———	Option	Standard	Standard	———	Option
Memory Protect	Option	Standard	———	Standard	———	Option
Direct Addressing (words)	32K	512	256	256	2K	2K
Indirect Addressing	———	Single-Level	Single-Level	Multi-Level	———	———
CPU Registers	2K Gen. Purpose 2K Index	——— ———	1 Gen. Purpose 3 Index	1 Gen. Purpose 3 Index	1 Gen. Purpose 1 Index	1 Gen. Purpose 1 Index
Hardware Multiply-Divide	Option	Option	———	———	Option	Option
Immediate Instructions	Standard	———	———	———	Standard	Standard
Double Word Instructions	Standard	Standard	———	———	Option	Option
Byte Processing	Standard	Standard	———	———	Standard	Standard
INPUT/OUTPUT I/O Word Size (bits)	8/16	8	16	16	16	16
Priority Interrupt Levels	32 to 256	8 to 32	———	———	16	16
Direct Memory Access Channel	Standard	Standard	Option	Standard	Option	Option
I/O Maximum Word Rate (word/sec)	833 kHz	1.02 MHz	60 kHz	450 kHz	586 kHz	1.0 MHz
OTHER FEATURES Real Time Clock	Option	Option	Option	Standard	Option	Option
Power Fail/Restart	Standard	Standard	Option	Standard	Option	Option
Peripheral Device Options	DD, MT, CT, PT, LP, TP, PLT	All Types	All Types	All Types	All Types	All Types
Software	———	Fortran	Basic, Fortran	Basic, Fortran	Fortran	Fortran
PRICE Computer with Basic Memory	$5,300/2K $6,100/4K	$7,900	$7,500/4K (est.)	$11,000/8K (est.)	$12,750*	$8,000
Add-On Memory Increment	$2,650/2K $3,450/4K	$4,500/8K	$3,000/4K (est.)	$4,000/4K (est.)	$5,000/4K	$3,500/4K
OTHER REMARKS					*with ASR-33	
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

COMMUNICATIONS

This mini application area encompasses a broad range of systems which may operate satellite to a larger computer or completely off-line on a stand-alone basis. The basic similarity between the various types of communications systems is their ability to handle the flow of data from a number of input sources, concentrate or otherwise process the information, and pass it on to another computer or group of output terminals. As in the case of data acquisition and test systems, minicomputer communication systems are either configured by the mini maker himself, by an independent specializing in communications processors, or by the user on an OEM basis.

Communications Concentrators

The minicomputer is employed in concentrator applications to relieve large central processors from the tasks of message switching, buffering, and formatting. The minicomputer communications concentrator receives messages from a large number of interactive I/O terminals (teleprinters and CRTs), concentrates or assembles the information

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd

COMPANY	RAYTHEON DATA SYSTEMS (Cont'd)	REDCOR	ROLM	SPIRAS SYSTEMS	SYS COMPUTER	SYSTEMS ENGRG. LABS
MODEL	706	RC-70	1601	SPIRAS-65	SYS 1000	72
MEMORY Word Size (bits)	16	16	16	16	24	16
Memory Size (words)	4K to 32K	4K to 32K	4K to 32K	4K to 65K	4K to 32K	4K to 65K
Cycle Time (μsec)	1.00	0.86	2.60	1.80	2.00	0.88
Parity Check	Option	Standard	———	———	Option	Option
Memory Protect	Option	Standard	———	Option	Standard	Standard
Direct Addressing (words)	2K	32K	1K	65K	32K	128
Indirect Addressing	———	Single Level	Multi-Level	Multi-Level	Multi-Level	Single-Level
CPU Registers	1 Gen. Purpose 1 Index	5 Gen. Purpose 1 Index	——— 3 Index	3 Gen. Purpose 2 Index	16/32 Gen. Purpose ———	8 Gen. Purpose 2 Index
Hardware Multiply-Divide	Option	Standard	Option	Standard	Option	Option
Immediate Instructions	Standard	———	Standard	Standard	Standard	———
Double Word Instructions	Option	Standard	———	Standard	Standard	Standard
Byte Processing	Standard	———	Standard	———	Standard	Standard
INPUT/OUTPUT I/O Word Size (bits)	16	16	16	16	8	16
Priority Interrupt Levels	16	32	16	64	———	384
Direct Memory Access Channel	Option	Option	Standard	Option	Standard	Option
I/O Maximum Word Rate (word/sec)	1.1 MHz	1.1 MHz	285 kHz	500 kHz	100 kHz	1.0 MHz
OTHER FEATURES Real Time Clock	Option	Standard	Option	Option	Standard	Option
Power Fail/Restart	Option	Standard	Standard	Option	Standard	Option
Peripheral Device Options	All Types	DD, MT, PT, LP, TP, PLT	DD, MT, CT, PT, LP, TP, PLT	DD, MT, PT, PC, LP, TP, CRT, PLT	All Types	DD, MT, PT, LP, TP, PLT
Software	Fortran	Fortran	Algol, Basic, Fortran	Basic, Fortran	———	Basic, Fortran
PRICE Computer with Basic Memory	$19,000*	$15,000	$18,490	$9,800	$1,000 (OEM)	$18,995
Add-On Memory Increment	$6,600/4K	$6,000/4K	$7,940/4K	$3,400/4K $9,300/8K	$500/2K (OEM)	$4,500/4K
OTHER REMARKS	*with ASR-33					
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

in a format compatible to the central processor and transmission media, and then forwards the data on to the central processing site. Economies result in that multi-line telephone hook-ups are reduced to a single-line rental, and the CPU time spent on communications tasks is eliminated.

Batch and Terminal Systems

These types of minicomputer applications are also used in support of a larger central processor. Differences involve their ability to operate off-line as satellite systems.

A group of peripherals devices (tape drives, card readers, printers, etc.) are operated under minicomputer control to handle routine input/output tasks on an off-line basis. Input data can be processed and either printed out or stored on tape for future input to a central processor.

Minicomputers are used to control multi-terminal CRT systems that are interfaced to large data bases. The terminal system can operate off-line to the central processor, using storage devices and other peripherals, as an autonomous data base

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd

COMPANY	TEMPO COMPUTERS	TEXAS INSTRUMENTS		UNICOM	UNICOMP	VARIAN DATA MACHINES
MODEL	TEMPO I	960	980	CP-8	COMP-16 & 18	520/i
MEMORY Word Size (bits)	16	16	16	8	16/18	8
Memory Size (words)	4K to 65K	4K to 65K	4K to 65K	1K to 32K	4K to 262K	4K to 32K
Cycle Time (μsec)	0.90	1.00	1.00	1.75	0.80	1.50
Parity Check	———	Standard	Standard	Standard	———	Option
Memory Protect	Option	Standard	———	Standard	Option	———
Direct Addressing (words)	65K	65K	65K	4K	256/1K	4K
Indirect Addressing	Single-Level	Single-Level	Single-Level	Single-Level	Single-Level	Multi-Level
CPU Registers	16 Gen. Purpose 15 Index	16 Gen. Purpose 16 Index	7 Gen. Purpose 1 Index	16 Gen. Purpose 1 Index	1 Gen. Purpose 6 Index	6 Gen. Purpose 2 Index
Hardware Multiply-Divide	Option	Option	Standard	Option	Option	———
Immediate Instructions	Standard	Standard	Standard	Standard	Standard	———
Double Word Instructions	Standard	Standard	Standard	Standard	———	Standard
Byte Processing	Standard	———	———	———	———	Standard
INPUT/OUTPUT I/O Word Size (bits)	8/16	16	16	8	16/18	8
Priority Interrupt Levels	4 to 22	3	3	4	64	4
Direct Memory Access Channel	Option	Standard	Standard	Option	Standard	Option
I/O Maximum Word Rate (word/sec)	700 kHz	1.0 MHz	1.0 MHz	45 kHz	1.1 MHz	660 kHz
OTHER FEATURES Real Time Clock	Option	Option	Option	Option	Option	Option
Power Fail/Restart	Option	Standard	Standard	Option	Option	Option
Peripheral Device Options	DD, DRD, MT, PT, PC, LP, TP	DD, MT, PT, PC, LP, TP	DD, MT, PT, PC, LP, TP	MT, PT, LP, TP	Any Type	DD, MT, PT, PC, LP, TP, PLT
Software	Fortran	Fortran	Fortran	———	Basic, Fortran	———
PRICE Computer with Basic Memory	$13,800	$8,450	$9,580	$3,250	$7,750 (16) $8,450 (18)	$6,000
Add-On Memory Increment	$5,900/4K	$3,000/4K	$3,000/4K	$695/1K $1,700/4K	$3,150/4K	$1,300/4K
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters					

with all CRT terminal functions and processing under minicomputer control. It can also operate on-line, using the mini in much the same way as the communications concentrator described above.

Time-Sharing Systems

Expanding further the number of storage units and other peripherals tied into a minicomputer, a full-fledged time-sharing system may be configured. Such systems, employing one or more minis, can be used on an in-house or intra-company basis, eliminating external vendor time-sharing or batching costs.

User Applications

Minicomputer communications systems are applied to a variety of user tasks. Management may employ such systems to process and analyze standard business data (sales, purchases, inventory

TABLE 1 • MINICOMPUTER CHARACTERISTICS . . . . Cont'd

COMPANY	VARIAN DATA MACHINES (Cont'd)			WESTINGHOUSE	XEROX DATA SYSTEMS
MODEL	620/f	620/i	620/L	2500	CF16A
MEMORY Word Size (bits)	16	16/18	16	16	16
Memory Size (words)	4K to 32K	4K to 32K	4K to 32K	4K to 65K	4K to 32K
Cycle Time (μsec)	0.75	1.80	1.80	0.75	1.60
Parity Check	Option	Option	———	Option	———
Memory Protect	Option	Option	Option	Option	Option
Direct Addressing (words)	2K	2K	2K	256	768
Indirect Addressing	Multi-Level	Multi-Level	Multi-Level	Single-Level	Multi-Level
CPU Registers	2 Gen. Purpose 2 Index	9 Gen. Purpose 2 Index	4 Gen. Purpose 2 Index	6 Gen. Purpose 2 Index	2 Gen. Purpose 1 Index
Hardware Multiply-Divide	Option	Option	Option	Standard	Standard
Immediate Instructions	———	Standard	Standard	———	Standard
Double Word Instructions	Standard	Standard	Standard	Standard	Standard
Byte Processing	———	———	———	———	Standard
INPUT/OUTPUT I/O Word Size (bits)	16	16/18	16	16	16
Priority Interrupt Levels	64	64	64	120	66
Direct Memory Access Channel	Standard	Standard	Standard	Option	Option
I/O Maximum Word Rate (word/sec)	1.33 MHz	200 kHz	200 kHz	———	625 kHz
OTHER FEATURES Real Time Clock	Option	Option	Option	Option	Option
Power Fail/Restart	Option	Option	Option	Option	Option
Peripheral Device Options	Any Type	Any Type	Any Type	DD, MT, PT, LP, TP	DD, DRD, MT, PT, LP, TP, CRT, PLT
Software	Basic, Fortran	Basic, Fortran	Basic, Fortran	Basic, Fortran	Fortran
PRICE Computer with Basic Memory	$10,500	$9,950	$5,400	$9,950	$7,990
Add-On Memory Increment	$4,500/4K	$4,500/4K	$2,300/4K	$3,800/4K	$3,800/4K
Abbreviations	• DD – Disk Drives • DRD – Drum Drives • MT – Mag Tape Transports • CT – Cassette/Cartridge Transports • PT – Paper Tape Equip. • PC – Punch Card Equip. • LP – Line/Page Printers • TP – Teleprinters • CRT – CRT Displays • PLT – Plotters				

levels, etc.) on multi-site retail or warehouse locations.

Supermarket and department store chains are using on-site minicomputers to automate purchase procedures at the cash register, and to completely process transaction data at on-site and central office locations. The on-site mini processes cash register data, provides the store manager with real-time business reports, and forwards the information to a central data center for further processing and evaluation. A more exotic use of communications systems is an automated bookmaking system. The mini takes ticket window input data and provides on-line tote board displays, as well as the usual bookkeeping and management records. With the expansion of state governments into bookmaking operations, such systems are "a natural".

THE TABLES

The Tables provide an overview of minicomputer characteristics, and list the companies engaged in their manufacture and in the manufacture of the major minicomputer peripheral devices. Complete Profiles on such peripherals have either been published (see heading notes in Table 3) or will appear this year in MODERN DATA.

TABLE 2 • REFERENCE LITERATURE
MINICOMPUTERS

For additional information on minicomputers described in Table 1, circle the appropriate numbers listed below on the Reader Service Card.

COMPANY	READER SERVICE CARD NO.
Atron, St. Paul, Minn.	224
Cincinnati Milacron, Lebanon, Ohio	225
Clary Data Comp, San Gabriel, Cal.	226
Computer Automation, Newport Beach, Cal.	227
Computer Logic Systems, Waltham, Mass.	228
Control Data, Minneapolis, Minn.	229
Data General, Southboro, Mass.	230
Datacraft, Ft. Lauderdale, Fla.	231
Datamate Computer Systems, Big Spring, Texas	232
Digital Computer Controls, Fairfield, N.J.	233
Digital Equipment, Maynard, Mass.	234
Digital Scientific, San Diego, Cal.	235
Electronic Associates, West Long Branch, N.J.	236
Electronic Processors, Englewood, Col.	237
General Automation, Anaheim, Cal.	238
GRI Computer, Newton, Mass.	239
Hewlett-Packard, Palo Alto, Cal.	240
Honeywell, Waltham, Mass.	241
Interdata, Oceanport, N.J.	242
Lockheed Electronics, Los Angeles, Cal.	243
Microdata, Santa Ana, Cal.	244
Modular Computer Systems, Ft. Lauderdale, Fla.	245
Motorola, Phoenix, Ariz.	246
Nuclear Data, Palatine, Ill.	247
Omnicomp Computer, Santa Ana, Cal.	248
Omnitec, Phoenix, Ariz.	249
Panasonic, New York, N.Y.	250
Raytheon Data Systems, Santa Ana, Cal.	251
Redcor, Canoga Park, Cal.	252
Rolm, Cupertino, Cal.	253
Spiras Systems, Waltham, Mass.	254
SYS Computer, Hackensack, N.J.	255
Systems Engineering Labs, Ft. Lauderdale, Fla.	256
Tempo Computers, Anaheim, Cal.	257
Texas Instruments, Houston, Texas	258
Unicom, Fairfield, N.J.	259
Unicomp, Northridge, Cal.	260
Varian Data Machines, Irvine, Cal.	261
Westinghouse, Orlando, Fla.	262
Xerox Data Systems, El Segundo, Cal.	263

TABLE 3 • MINICOMPUTER PERIPHERALS

In addition to the minicomputer manufacturers, the following companies provide peripherals or memories that will interface with many of the minicomputer models described in Table 1.

MINICOMPUTER MEMORY

Advanced Memory Systems, Sunnyvale, Cal.
Ampex, Culver City, Cal.
Cambridge Memories, Newton, Mass.
Datapac, Santa Ana, Cal.
Electronic Memories, Hawthorne, Cal.
Fabri-Tek, Minneapolis, Minn.
Ferroxcube, Englewood, Col.
Information Control, Los Angeles, Cal.
Memory Systems, Hawthorne, Cal.
Memory Technology, Sudbury, Mass.
Nemonic Data Systems, Denver, Col.
Quadri, Phoenix, Ariz.
Standard Memories, Sherman Oaks, Cal.

MINICOMPUTER DISK & DRUM STORAGE

(See also Profiles on Disk & Drum Drives in the Feb. and Mar. 1971 Issues of MODERN DATA)

Applied Magnetics, Goleta, Cal
Bryant Computer Products, Walled Lake, Mich.
Computer Memory Devices, Glendale, Ariz.
Data Disc, Palo Alto, Cal.
Datum, Anaheim, Cal.
Dynacoustics, Hayward, Cal.
EDP Technology, Orlando, Fla.
Engineered Data Peripherals, Santa Monica, Cal.
Infotechnics, Van Nuys, Cal.
Iomec, Santa Clara, Cal.
Per Data, Hicksville, N.Y.
Systems, Peripherals Div., San Diego, Cal.
Vermont Research, N. Springfield, Vt.
Wabash Computer, Phoenix, Ariz.
Xebec Systems, Mountain View, Cal.

MINICOMPUTER MAGNETIC TAPE TRANSPORTS

Ampex, Culver City, Cal
Bright Industries, San Francisco, Cal.
Bucode, Hauppauge, N.Y.
Cipher Data Products, San Diego, Cal.
Datacom, Ft. Walton Beach, Fla.
Datran, Norwalk, Conn.
Digi-Data, Bladensburg, Md.
Dynacoustics, Hayward, Cal.
Infotec, Plainview, N.Y.
Kennedy, Altadena, Cal.
PEC, Chatsworth, Cal.
Per Data, Hicksville, N.Y.
Potter Instruments, Plainview, N.Y.
Precision Instrument, Palo Alto, Cal.
Wang Labs, Los Angeles, Cal.
Willard Labs, Los Angeles, Cal.

MINICOMPUTER CASSETTE/CARTRIDGE TAPE SYSTEMS

(See Also Profile on Cas/Cart Transports in Aug. 1970 Issue of MODERN DATA)

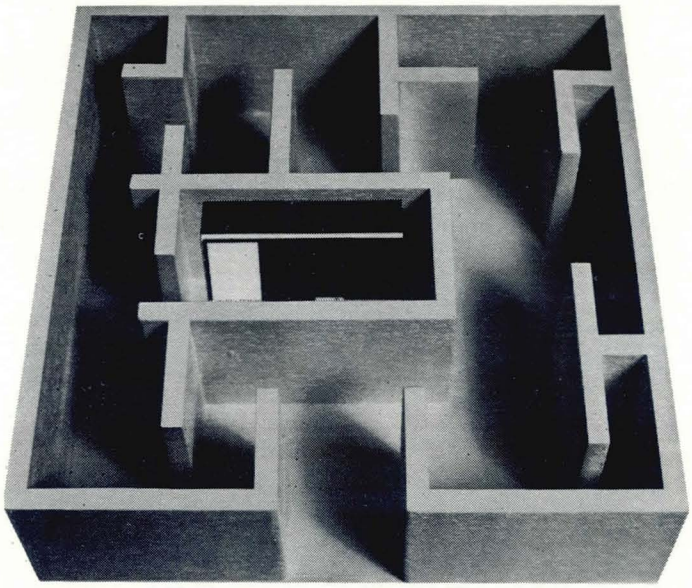
Canberra Industries, Meriden, Conn.
Dicom Industries, Sunnyvale, Cal
EDP Technology, Orlando, Fla
Incre-Data, Albuquerque, N.M.
International Computer Products, Dallas, Texas
Mobark Instruments, Sunnyvale, Cal.
Sykes Datatronics, Rochester, N.Y.
Tennecomp, Oak Ridge, Tenn.
Tri-Data, Mountain View, Cal.

MINICOMPUTER LINE/PAGE PRINTERS

(See Also Profiles on Printers in the Feb., Mar., and May 1971 Issues of MODERN DATA)

Data Printer, Cambridge, Mass.
A. B. Dick, Chicago, Ill.
Eclectic, Dallas, Texas
Gould, Graphics Div., Cleveland, Ohio
Leigh Instruments, Ottawa, Canada
Odec Computer Systems, E. Providence, R.I.
Per Data, Hicksville, N.Y.
Potter Instruments, Plainview, N.Y.
Syner-Data, Beverly, Mass.
Versatec, Cupertino, Cal.
Vogue Instrument, Richmond Hill, N.Y.

The data modem maze. How UBC leads you through it safely.



With over 200 companies manufacturing data modems, how do you choose the right one?

UBC can lead you through this maze safely.

Our skilled applications engineers evaluate your data transmission needs. Then a proposal is prepared. In this proposal, we'll answer all your questions—solve your data transmission problems—before-the-fact.

We'll tell you which of the data modems manufactured by our subsidiary company, Rixon Electronics, best fits your requirements.

And we have a wide choice available. Thoroughly proven, low maintenance, quality data modems ranging from 1800 to 9600 bps. Modems with features such as built-in diagnostics that enable even non-technical people to isolate and correct a transmission problem in minutes.

OEM quantities or single, stand alone units, we usually fill your order from stock. However—when necessary—we can engineer our modems to your configuration and specifications.

Once your order is booked, our strategically located network of sales and service offices takes over.

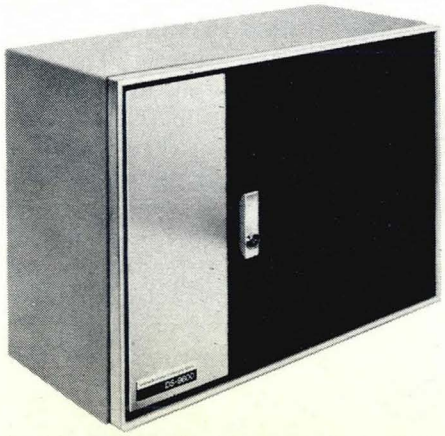
Our own engineers, installation and service people stay with you every step of the way. We consider training, trouble-shooting, testing and maintenance part of the sale.

Consider one more thing. We're not *just* data people. Our parent, United Utilities, Incorporated, operates the nation's third largest telephone system. So, we do know quite a bit about telephone lines. And this is often the key to effective modem utilization.

If all this doesn't convince you that UBC offers more than the ordinary, garden-variety data modem manufacturer, write and we'll tell you more. We'll also send your our *free telephone line conditioning guide,* a handy tool whether you buy from us or not.

Write: General Sales Manager
UBC, Dept. MD-9-6
6405 Metcalf, Shawnee Mission, Kansas 66202.
Telephone (913) 362-5300.

To pick the right data modem, pick the right modem company.



United Business Communications

Subsidiary of United Utilities, Incorporated

Sales and service offices in: Atlanta / Burlington, Mass. (Boston) / Chicago / Dallas / Kansas City / Los Angeles / New Haven, Conn. (New York) / Pittsburgh / Silver Spring, Md.

NEW PRODUCTS

96-COLUMN CARD READER

The 9625, a 300-card-per-minute tabletop reader, is designed for original equipment manufacturers. Two models of the 9625 are available. The 9625-01 includes all read sensing and basic electronics, read checking, 96-column buffer, motor controls, transport, and 600 card capacity input and output stackers. The 9625-02 includes read sensing circuits, transport, input and output stackers, and casework. Weighing approximately 30 pounds, the 9625 is an ideal card reader for communication terminals. List price for the 9625-01 is $1,200 and for the 9625-02 $800, with OEM quantity discounts available. *Decision Data, Warminster, Pa.*

Circle No. 332 on Inquiry Card.

CARTRIDGE PAPER TAPE MEMORY

The multi-channel cartridge paper tape reader provides random access, read-only batch memory for minicomputers, process control systems, automatic typewriters, and any other device accepting digital input. A single cartridge for the Model 560 Multi-Channel Tape Reader stores up to 100 different varying length programs, or a total of 12K characters, on an endless-loop paper tape. The unit reads one-inch, 8-track punched tape at speeds of 320 or 640 cps. The cost of the 560 Reader is $1,900, with cartridges priced at $25 each in quantity. *Data Test Corp., Concord, Cal.*

Circle No. 334 on Inquiry Card.

45 IPS TAPE TRANSPORT

The Kennedy Series 3112 Synchronous Magnetic Tape Transports allow 45 ips operation with minicomputers, data terminals, and data acquisition systems. Other models operate at standard speeds of 25 ips and 37.5 ips. All are capable of writing and reading tapes to IBM and ASCII format specifications. The 3112 series has a rewind speed of 150 ips, a start/stop time of 15 msec at 25 ips, inversely proportional to tape speed. The tape unit interface is DTL/TTL Low True. The series is equipped with 10½", 2400' reels. *Kennedy Co., Altadena, Cal.*

Circle No. 337 on Inquiry Card.

MEMORY EXERCISER

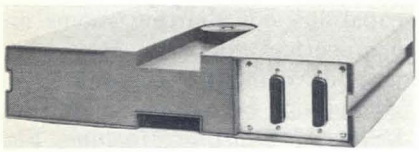
The SP-50 Portable Memory Exerciser provides all necessary interface signals to test disk and drum storage devices. SP-50 is capable of providing up to eight channels of parallel write data and comparing the resultant memory system read data for errors. The data generator may be programmed to output respective track addresses and a fixed or variable 15 bit repetitive data pattern. The exerciser will provide up to twelve address lines capable of sequentially addressing all or part of 4096 data tracks. Controls are provided for setting up such variable memory system parameters as preamble length and polarity, read delay, and the read recovery interval following track switching or writing. Unit price for the SP-50 is $9,275. *Digital Development, San Diego, Cal.*

Circle No. 338 on Inquiry Card.

PORTABLE TELEPRINTER

The 28 lb teleprinter provides 80 characters per line, alphanumeric printout at 10 or 15 cps. The terminal produces up to six copies, has an integral acoustic coupler, and generates the full 128 ASCII characters in transmit mode. Standard features include automatic carriage return and line feed, parity check, and switch-selectable half- or full-duplex operation. The portable costs $1,999 (less case). *Compudata Corp., Providence, R.I.*

Circle No. 335 on Inquiry Card.



DISK SYSTEM

Disc Cell is a sealed disk unit containing a complement of head-per-track read-write heads. Two Cells are controlled by a common carrier unit, the Twin Carrier, which provides all the mechanics and electronics for driving each pair. The Cells are completely interchangeable and are capable of storing up to 6 million bits, with an access time of 12.5 msec and transfer rate of 2 Mbps. *Dataflux Corp., San Jose, Cal.*

Circle No. 331 on Inquiry Card.

TELETYPE ENCLOSURE

The Model 331 acoustic enclosure is designed to reduce the sound level of 33 TTYs at least 10 decibels, permitting Teletype operation in office environs. The enclosures are simply installed over the Teletype assembly, and cost $175 in single unit quantities. *Compro, Santa Ana, Cal.*

Circle No. 336 on Inquiry Card.

NEW SOFTWARE AND SERVICES

COBOL DEBUGGING

COSYBUG is a program development tool which permits Cobol programmers to reduce debugging time. The programmer can locate the point in the Cobol source program at which a program interrupt has occurred, examine or alter data, suspend or resume program execution at any point in the program, determine calling locations of "performed" paragraphs, and determine the status of each file. COSYBUG utilizes a command language whose syntax is closely related to Cobol's English-like structure. The average Cobol programmer can become a proficient user of COSYBUG within thirty minutes. The package, priced at $15,000, has been installed on a time-sharing system utilizing an IBM 360/67 computer. *PDA Systems, New York, N.Y.*

Circle No. 385 on Inquiry Card.

INTERACTIVE DESIGN

The MASK System represents an integrated configuration of hardware and software designed to aid in the graphic layout and manipulation of hybrid, MOS, and bipolar circuity. The MASK software is machine-independent and can be adapted to any computer system which has a 16K x 16 memory, 250K words of mass storage, and an interactive graphics terminal. MASK expands the use of interactive graphics beyond the presently available editing systems to include the creative design and layout assistance necessary in complex circuit technology. The features making this possible are special interconnection modes and a flexibility in the creation, manipulation, and utilization of cells. *Systems, Science and Software, La Jolla, Cal.*

Circle No. 386 on Inquiry Card.

DRAFTING LANGUAGE

UDRAFT-8 is a simple language that can be used by people without knowledge of computer programming. Based on the highly successful UDRAFT language, UDRAFT-8 is intended for use on Universal Drafting Machine Corp.'s Orthomat systems. Using simple statements, combined with a macro library, alphanumeric capability and other features, the draftsman can use this language to produce complex drawings with a minimum of effort. By implementing UDRAFT-8 on the drafting system's computer, users are less dependent upon tape preparation and editing by a remote computer, and brings tape preparation under local departmental control. This feature provides true stand alone capability for drafting rooms and engineering departments where lack of computer capability prevented use of automatic drafting. *Universal Drafting Machine, Bedford Heights, Ohio.*

Circle No. 380 on Inquiry Card.

CONTOUR PLOTTING

CPS-1 is a modular, verb-oriented programming language for contour plotting, intended for use on medium-to-large computers equipped for graphics output (drum, flatbed, CRT, etc.). With the basic package, the user specifies the functions which generate a precision contour plot of a surface from a set of irregularly spaced control points. This basic version also provides for plot annotation, data editing, and file management. With the addition of the multiple surface option, CPS-1 can mathematically reconstruct up to 20 surfaces simultaneously. Versions of CPS-1 are operating on CDC 6600, IBM 360/65, GE 635, and Univac 1108 computers at a cost of $8500 for the basic system. *Unitech, Inc., Austin, Texas.*

Circle No. 387 on Inquiry Card.

COMPUTER UTILIZATION

FOCUS (FOrecasting Computer Utilization and Scheduling System) can be used as a data processing management tool to improve the operation and effective use of computers. The system consists of eleven program modules that produce reports by computer, shift, and partitions to tell what jobs have to be run today, what was run yesterday, and what was scheduled to be run yesterday but not run. The system is fully documented with installation, usage, and operation instructions. FOCUS can run on any 360/25 with 32K or larger using DOS Cobol. *Neoterics, Cleveland, Ohio.*

Circle No. 381 on Inquiry Card.

620/i TEXT EDITOR

The Editor provides 620/i users who have a COI LINC Tape Mass Memory Peripheral the capability to generate and edit source text on LINC Tape. The Editor is both line number and context oriented. The Editor allows correcting and updating source text tape through keyboard control from the Teletype. Edited programs may then be assembled, loaded, and executed automatically. *Computing Operations, Beltsville, Md.*

Circle No. 383 on Inquiry Card.

TIME-SHARE SERVICE

CROSSBOW is a multiple service that places almost unlimited computing power at the users' disposal and allows the user to select the most economical method of processing and turnaround priority, through remote terminal access. The service offers a choise of processing options to match user problem solving, data-base inquiry, and production batch needs. It blends time-sharing, remote job entry, and conversational remote job entry under one integrated system to accommodate a full range of data processing requirements. *ITT Data Sciences, Paramus, N.J.*

Circle No. 376 on Inquiry Card

NEW LITERATURE

PRINTERS

A series of data sheets and brochures are available, describing Datalog's line of strip, digital, and page printers. *Litton/Datalog, Melville, N.Y.*

Circle No. 410 on Inquiry Card.

RECORD RETRIEVAL

The Info-Trieve 10, a self-contained electronic information management system that requires no programming, is outlined in an 8-page brochure. *BCD Computing, Buffalo, N.Y.*

Circle No. 407 on Inquiry Card.

POLLUTION CONTROL DATA SYSTEM

Use of a computer interface system to collect and control data from pollution monitoring stations is described in an application note. *Princeton Applied Research Corp., Princeton, N.J.*

Circle No. 415 on Inquiry Card.

620/L MINICOMPUTER

Varian's new 620/L – with a more compact memory, lower price, larger capacity power supply, and new console – is documented in a new 8-page brochure. *Varian Data Machines, Irvine, Cal.*

Circle No. 402 on Inquiry Card.

TRAINING PROGRAM

A 4-page brochure describing the Basic Systems Course, a 25-week systems training program for managers, supervisors, and new systems analysts, is available. *Systemation, Colorado Springs, Colo.*

Circle No. 417 on Inquiry Card.

MODEM

The 4800 bps MARQ-48 modem is reviewed in a new brochure. *Paradyne Corp., Clearwater, Fla.*

Circle No. 421 on Inquiry Card.

REAL-TIME COMPUTER

The 16-page brochure is addressed to users who may require a real-time computer to perform a single dedicated task, or one to handle a combination of real-time processes intermixed with data processing jobs. *Systems Engineering Labs, Ft. Lauderdale, Fla.*

Circle No. 411 on Inquiry Card.

TWX CAPABILITY

A four-page capability brochure about TWX, Western Union's Teletypewriter Exchange service, has been published. *Western Union, New York, N.Y.*

Circle No. 422 on Inquiry Card.

OEM PRODUCTS

A 16-page booklet describing CDC's products designed for original equipment manufacturers, contains specifications on products ranging from disk packs and tape transports to line printers, display terminals, OCR page and document readers, and complete computer systems. *Control Data, Minneapolis, Minn.*

Circle No. 416 on Inquiry Card.

RO DATA TERMINAL

The receive-only module in its Inktronic line of high-speed electrostatic data communications terminals is described in a 12-page catalog available from Teletype. The Inktronic 2101 (RO) terminals print up to 120 cps using either ASCII or five level code. *Teletype Corp., Skokie, Ill.*

Circle No. 404 on Inquiry Card.

CREDIT AUTHORIZATION

An 8-page brochure is available from Datatrol, describing their Credit System 1400, a dedicated, stand-alone Credit Authorization System for retail stores. *Datatrol, Hudson, Mass.*

Circle No. 424 on Inquiry Card.

DATA TERMINAL

The SR-030 teleprinter, a 30 cps send-receive conversational data communications terminal, is described in a spec sheet. *Singer/Friden, San Leandro, Cal.*

Circle No. 420 on Inquiry Card.

MODEM TEST SET

Full product specification and application literature for the Range Rider series of modem communications system test equipment is available. *International Data Sci., Providence, R. I.*

Circle No. 412 on Inquiry Card.

GRAPHICS SOFTWARE

A revised reference manual for the EZPERT automatic PERT and CPM network graphics system, is available. *Systonetics, Anaheim, Cal.*

Circle No. 423 on Inquiry Card.

MANAGEMENT SYSTEMS

An 8-page brochure from Cincom Systems, develops, in management-oriented terms, the major and essential requirements of a Data Base Management System (DBMS) and discusses the reasons why the DBMS approach is the key to success in MIS implementations. *Cincom Systems, Cincinnati, Ohio.*

Circle No. 406 on Inquiry Card.

MAG CARD-TO-TAPE

A product spec sheet is available for the System 22. The 22 converts IBM MCST mag card data to IBM-compatible mag tape. *Digi-Data, Bladensburg, Md.*

Circle No. 425 on Inquiry Card.

PLOTTING SYSTEM

RALPH, an automatic electronic packaging and layout plotting system/service for PCB masters, is reviewed in a product brochure. *Autologic Inc., San Francisco, Cal.*

Circle No. 408 on Inquiry Card.

DATA PRINTER

A ten-page booklet is available, describing the Kleinschmidt Model 311 Receive-Only Electronic Data Printer Interface, complete with circuits and timing diagrams. *Kleinschmidt, Div. SCM, Deerfield, Ill.*

Circle No. 409 on Inquiry Card.

PLOTTER

The Brush 1000 X-Y plotter, accessories, and supplies are described in a 4-page bulletin. *Gould/Brush Div., Cleveland, Ohio.*

Circle No. 413 on Inquiry Card.

DATA BASE MANAGEMENT

The CODASYL Systems Committee announces the availability of a 500 page report entitled "Feature Analysis of Generalized Data Base Management Systems." The report discusses data structure concepts and the data definition language facilities used to define such structures. The functions of interrogation and updating are discussed for self-contained systems. Other major topics are data base creation, programmer facilities, data administration functions, and storage structure. The report is being distributed by the Association for Computing Machinery, from whom copies may be ordered at $8. *ACM, N.Y., N.Y.*

Circle No. 426 on Inquiry Card.

APL TIME-SHARING

A pocket-sized reference card contains a summary of all primitive (built-in) operations in the APL PLUS time-sharing service, system commands, file commands, and report formatting control-codes. *Scientific Time Sharing, Washington, D.C.*

Circle No. 427 on Inquiry Card.

TELETYPE CODE CARD

The Teletype code card shows 5-level Baudot code on one side and 8-level ASCII code on the other. *Pulsecom, Alexandria, Va.*

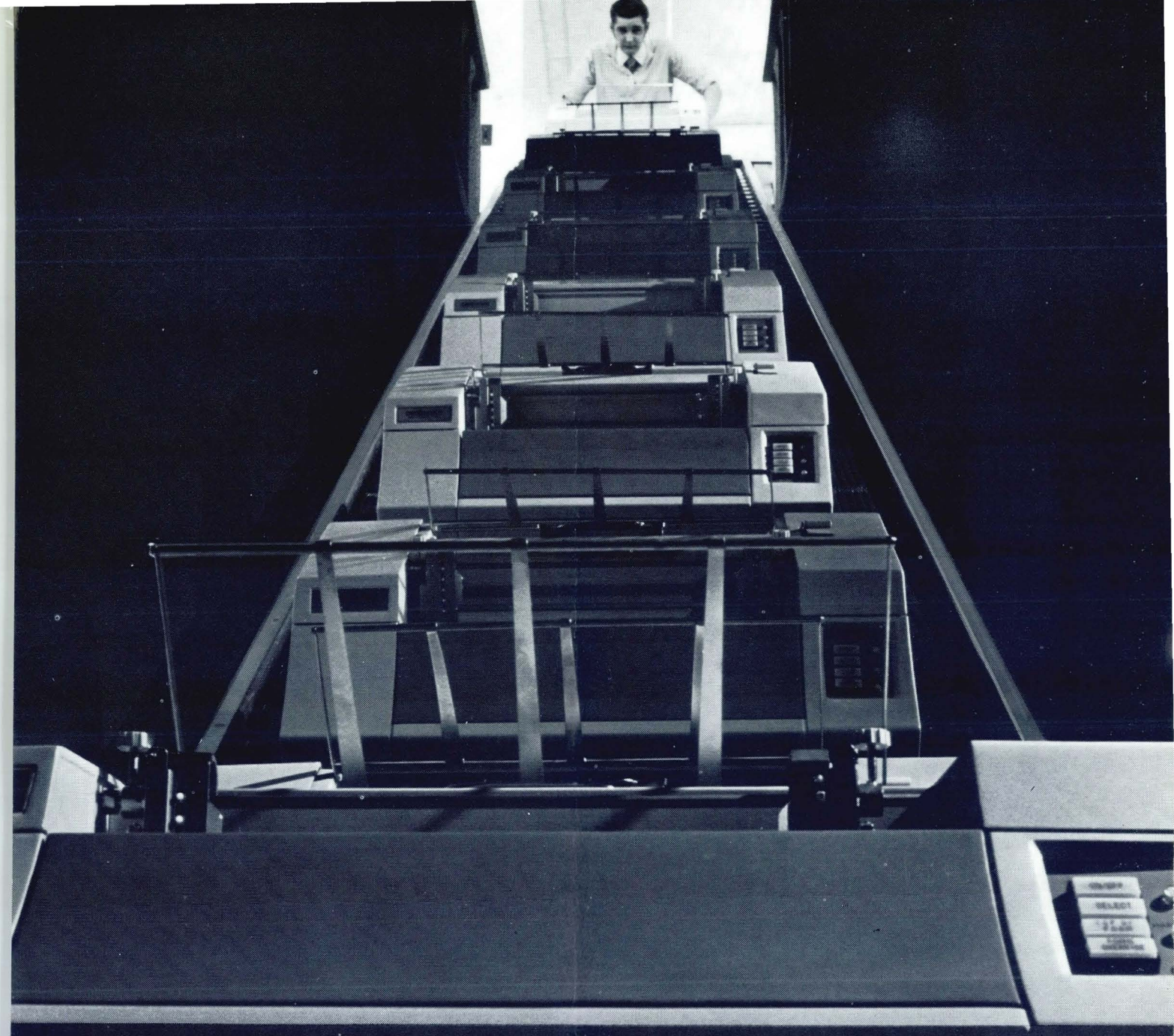
Circle No. 429 on Inquiry Card.

BATCH/CONVERSATIONAL TERMINAL

A new batch/conversational data terminal, System 3700, is detailed in a new bulletin. The system emulates the IBM 2780 using existing IBM 360 software, and allows a question-answer dialog with a computer; data is displayed on a CRT. *Digital Information Devices, Lionville, Pa.*

Circle No. 428 on Inquiry Card.

INDEX TO ADVERTISERS



YOU KEEP ORDERING. WE KEEP DELIVERING.

In early 1971 we started shipping Model 101 line printers to a few sophisticated users of peripheral devices. Now we are shipping many 101's to many sophisticated users. And for good reasons. The 101 is easy to build and maintain. It performs very reliably. Its matrix print quality is excellent, even on the fifth copy. It interfaces readily to almost any computer or terminal. And its low price is setting a new standard in the industry.

CENTRONICS

because you don't want to spend more than you have to.

Centronics Data Computer Corp., One Wall Street, Hudson, N.H. 03051
(603) 883-0111

CIRCLE NO. 31 ON INQUIRY CARD

Overseas deliveries

The SPD™ 10/20 is being seen in all the right places . . . in the reservations network of the world's largest travel club . . . in two of the richest banks in the Common Market . . . helping manage France's gas and electric utility . . . not to mention a half dozen of the world's busiest airlines.

And we just signed an agreement with the TRANSAC Division of CIT-ALCATEL, part of Compagnie Generale d'Electricite, involving at least $15 million in Common Market sales over the next 48 months. That's for a start.

There are some good reasons.

The SPD 10/20 is a fully programmable Stored Program Display with a small, powerful computer (4K byte memory) built right into the terminal. That means it can listen to your problems . . . in whatever language you speak . . . and respond with complete sympathy. All this at the touch of a button, without the slightest reason for disturbing your central site software.

This same versatility means that when the SPD 10/20 becomes obsolete, it simply replaces itself.

The SPD 10/20 can validate, qualify and format operator input at the source. It can change characteristics to do new jobs, learn new languages, assume any number of clever disguises.

Result: the ultimate Applications Machine . . . for airlines, hospitals, financial institutions, insurance companies, data utilities, all levels of government . . . you name it. It can make friends anywhere. And it can make heroes.

You could be one of them (a friend *and* a hero). Why not give us a call . . . we guarantee to be a good listener. And we'd welcome the chance to tell you in detail how the SPD 10/20 can meet your present requirements, better, and for less money, than any other system of its kind.

INCOTERM™ CORPORATION

. . . the international computer terminals people.

Hayes Memorial Drive / Marlborough, Massachusetts 01752
Tel.: (617) 481-2000

Atlanta, Georgia / (404) 451-2306 • New York, N.Y. / (212) 868-7557 • San Antonio, Texas / (522) 734-7016 • Minneapolis, Minnesota / (612) 884-6767

CIRCLE NO. 32 ON INQUIRY CARD