

## If your communications problems are more complex, we've got a solution

It's Varian's 620/f-DC Data-Communications System. Remember, as a kid, when your biggest problem in tin-can communications was not letting the string touch anything? Today you're more sophisticated—and your problems more complex. We can help.

Varian's new 620/f-DC is a total data-communications system that offers economy and speed for communications networks. As a com-

munications preprocessor, it relieves the large computer of mundane tasks by collecting data from many sources and feeding it directly and efficiently into your large computer. The 620/f-DC, as a data concentrator or message switcher, handles up to 64 data lines at higher throughputs than any other system available.

Consider all its capabilities—from speed to modularity to reducing

overhead—and it becomes one of the most economical data communicators available.

Our 620/f-DC won't beat the low cost of tin-can and string, but it will make your communications dollar stretch. Write the Big Company in Small Computers.



**varian**  
**data machines**

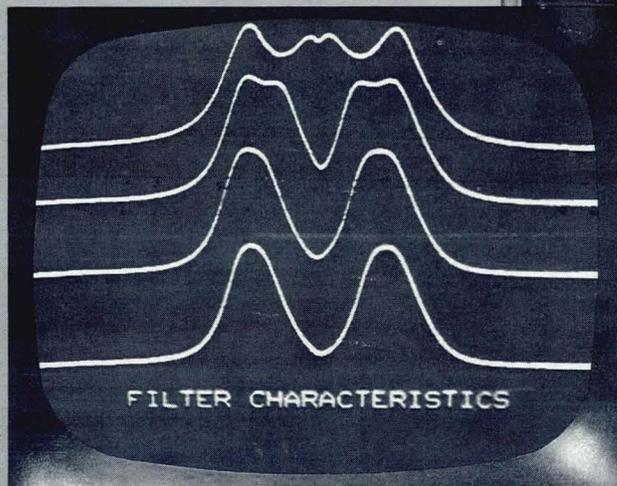
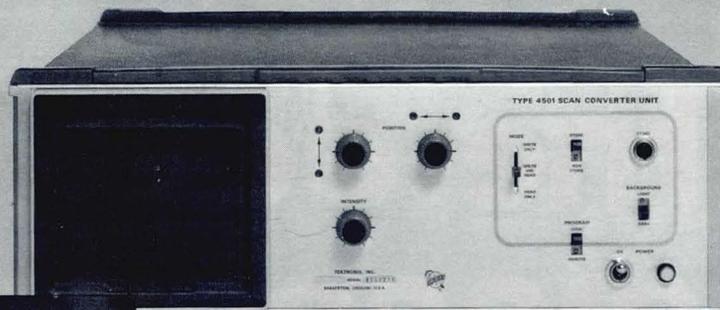
The Big Company in Small Computers

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), Syracuse (315-437-6595), 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.

CIRCLE NO. 1 ON INQUIRY CARD

# Large Screen Displays

Link your data or signal source to TV display systems with Tektronix scan conversion . . .



for convenient viewing in labs, classrooms, production lines, hospitals, computer installations and many other areas.

## The display size depends only upon your choice of TV monitor or receiver.

The 4501 Scan Converter accepts alphanumeric and graphic data—in the form of analog inputs—and converts it to displays on TV receivers and monitors. The hi-contrast TV displays are ideal for individual or group viewing—even under bright light conditions. The displays may be viewed as light data on a dark background or as dark data on a light background, selected from the 4501 front panel.

The 4501 uses a Tektronix bistable storage CRT. Data may be written once on the storage CRT and retained for an hour *without refreshing*. The results are: call for your data once, then view it as long as one hour on a TV-size display. Besides that, the 4501 transfers continuously written data to your TV display.

**MULTIPLE DISPLAYS**—The 4501 will drive multiple, inexpensive receivers and monitors. The units may be located locally or remotely. Outputs from a TV camera can be mixed with

data from the 4501 to produce a picture that is an overlay of the two signal sources. With overlaying, you can instantly compare data from two different sources.

The uses for the 4501 are virtually unlimited. For a demonstration, contact your local Tektronix Field Engineer or write Tektronix, Inc., P. O. Box 500, Beaverton, Oregon 97005. See your current Tektronix catalog for specifications.

4501 Scan Converter . . . . . \$2500

Available in U.S. through the Tektronix lease plan  
U.S. Sales Price FOB Beaverton, Oregon



# TEKTRONIX®

committed to technical excellence

# TOTAL: the data base management system.

A complete integrated data base management system which performs all functions of data base maintenance, update, retrieval and data integrity *with any host language at the "call" level.* That's Cincom Systems' TOTAL.

With TOTAL, data is structured logically, non-redundantly in network-structured multi-file, multi-linkage environments. Requirements for demand and batch processing are optimally served.

The system is continually self-optimizing. Eliminates both performance degradation and the requirement for periodic data base reorganization.

A Data Base Definition Language (DBDL) is provided for the definition and structuring of the data base. As data requirements change, new data elements and associations may be added without affecting application programs. Data independence is provided down to the data element or grouped data element level.

Application programs are insulated from their environment. So changes in operating system, hardware, language or processing mode have little or no effect on operating application programs.

With TOTAL, modular and evolutionary growth is facilitated. Conversion is eliminated as a way of life.

A Data Manipulation Language (DML) is invoked by the host language programmer at the "call"

level for all communication with the data base.

Powerful commands make complex data manipulation easy. Control functions monitor and virtually eliminate error possibilities. The user programmer is presented *only* with data elements requested. Communication is always fast, flexible, secure.

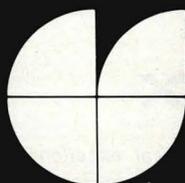
Hardware enhancing features minimize core and direct storage requirements. For example, I/O Pool Sharing allows sharing of common I/O areas providing more usable core. External indexes, directories and fixed overflow areas are eliminated, providing more usable disk space.

TOTAL functions in any environment. Provides facilities for processing in direct (demand) environments or batch serial modes.

Facilities include protection from Concurrent Updating, Dynamic Logging of Transactions, Automatic Data Base Recovery and Restoration for processing in dynamic environments.

These are some of the reasons why we call it TOTAL.

We'd like to show you why TOTAL has become the most widely and successfully used system of its kind in existence today. If you'd like more information or a personal presentation, write on your company letterhead to Cincom Systems, Inc., 2181 Victory Parkway, Cincinnati, Ohio 45206. 513/961-4110.



**Cincom Systems Inc. We create efficiency.**

## TECHNOLOGY PROFILE

**40 PRINTERS — PART I**  
**Medium- & High-Speed Printers**

*This Profile covers the features of printers having print rates of from 100 to 5000 lines per minute and capable of on- or off-line operation.*

## TECHNOLOGY PROFILE

**68 DISK & DRUM DRIVES — PART II**  
**Large-Scale Drives**

*In last month's issue, Part I discussed removable disk-pack drives that were plug-to-plug compatible with IBM 2311 and 2314 devices. This month, Part II covers large-scale disk and drum drives having capacities in excess of 50 million bits. The last part of the series coming next month will cover disk and drum devices having capacities equal to or under 50 million bits.*

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MEMORY DATA



PARITY ERRORS



## Our New Time Division Multiplexer Is a Bit of a Character.

A bit of a character because it can do what no other time division multiplexer can. Our Timeline 220 can either bit multiplex (for echo-back operation) or character multiplex (for maximum channel capacity). Or both, *simultaneously*. The others can only bit or character multiplex. They can't do both.

If you're looking to cut your communications costs, here's another surprise. Infotron Systems' Timeline 220 multiplexer gives you the greatest possible number of simultaneously operating speedmixed channels. For example, with the high speed line operating at 2400 baud, the Timeline 220 can provide simultaneously 12 110 baud channels (TTY 33,35), 5 134.5 baud channels (IBM 2741), and 2 300 baud channels (GE TermiNet 300).

Most multiplexers have a diagnostic capability that isolates problems within the multiplexer equipment. But that's where it stops. If you're really worried about down time problems—forget it with the 220. Our system features a built-in diagnostic panel that locates trouble spots, not only in the multiplexer itself, but also in your data sets and telephone lines.

Right now our 220 multiplexers are installed throughout the United States and Canada, operating on-line for businesses whose success depends upon reliable communications every minute of the working day. You might also like to know that our operating history is so successful that we're able to offer our customers a two-year warranty, including on-site service.

Quite a bit of a character that Timeline 220.



**Infotron Systems**

7300 North Crescent Boulevard, Pennsauken, N.J. 08110 (609) 665-3864

CIRCLE NO. 4 ON INQUIRY CARD

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FRAMINGHAM, MASS. 01701  
(617) 872-4824

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THIS ISSUE OVER 85,000 COPIES

MODERN DATA/February 1971

## Computer Automation offers high-speed, on-line control computer

### EFFICIENT MEMORY UTILIZATION AFFORDS UNSURPASSED LIMIT-CHECKING CAPABILITY.

Computer Automation, a leading minicomputer manufacturer headquartered in California, offers a high performance control computer that is designed for the real-time, on-line applications that demand top reliability as well as high speed operation. Through a well designed instruction set, geared specifically for the real-time environment, operating times are reduced by as much as one-half over other computers with comparable memory speeds.

A typical task in control systems involves limit checking of numerous parameters to ensure proper operations of a given system. Action is taken only when a parameter is out of limits, but each parameter must be constantly monitored, a task that quickly overloads most minicomputers. Computer Automation's Model 116, using the Compare With Memory instruction, can perform an upper limit and lower limit check on a 16-bit parameter in just six cycles (9.6 microseconds). Only eight words of memory are required, including the two stored limits.

Coupled with a high speed A/D converter, it is possible to make over 60,000 different limit checks per second. This would be an extreme case, but it illustrates the power of the Model 116 computer.

The computer is priced at \$5,450 (qty. 50) with a 4K, 16-bit memory, three Direct Memory Channels, Hardware Multiply/Divide, and three levels of Vectored Priority Interrupts. Delivery is stock to 60 days.



COMPUTER AUTOMATION, INC.  
895 West 16th Street • Newport Beach, California  
92660 • Phone (714) 642-9630 • TWX 910-596-1377  
CIRCLE NO. 5 ON INQUIRY CARD

# Trying to get on-line with a "low-cost" box?

If you've been looking for a small, low-cost processing box, you might be getting yourself into one.

Anybody can sell you a box of hardware, but only with Raytheon Computer's 704 do you get all the software to do the job. All for under \$10,000.

With our software library of over 600 programs, you'll never have to write a systems program again. Raytheon Computer's 704 is operational the moment you plug it in.

And every program is fully documented and fully tested. Like our exclusive executives and monitors. And our 360-compatible superset of USASI FORTRAN IV and conversational FORTRAN. And the only small computer Sort/Merge package.

And we've got the hardware too. The 704 is a 16-bit gp computer with 74 instructions, 4k of 1.0  $\mu$ s core (expandable to 32k), a real-time automatic priority interrupt system, direct I/O to the CPU and 4 registers. Options

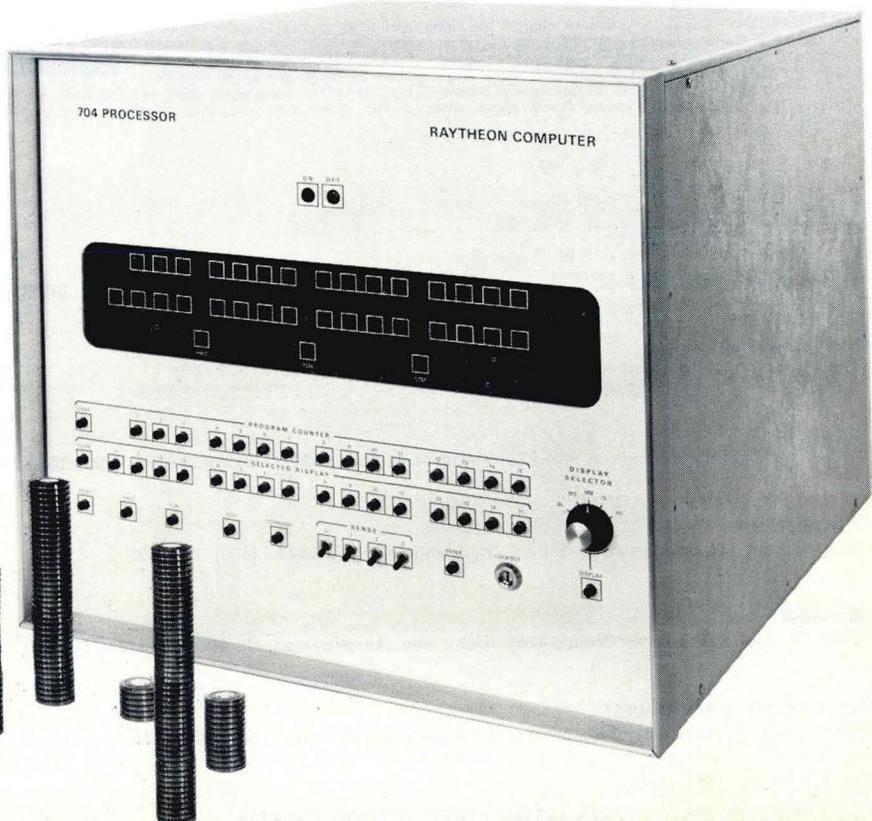
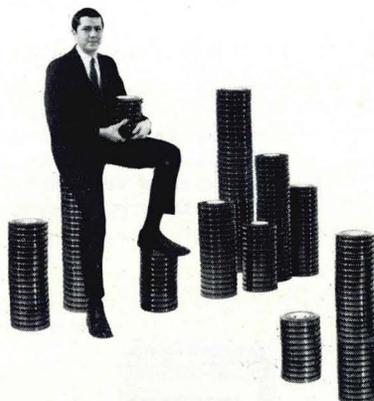
include hardware multiply/divide, bootstrap and direct memory access, and all the interface equipment you'll need.

So write today and ask for Data File C-194. We'll send you all the facts and figures you'll need to help you get on-line faster and cheaper. And that's our bag.

Raytheon Computer, 2700 S. Fairview St., Santa Ana, Calif. 92704. Phone 714/546-7160.



## With 600 programs, Raytheon Computer's 704 won't leave you holding the bag.



**Raytheon Computer.  
We give you our all.**

## NATIONWIDE SURVEY OF COMPUTER BUYERS' PREFERENCES RELEASED BY MODERN DATA

OVER 700 COMPUTER PRODUCT SUPPLIERS RECEIVED MENTIONS

The "1970 Brand Awareness Survey," covering 54 specific types of computer hardware, software, EDP supplies and accessories, has just been released by MODERN DATA's Information Products Division.

For each of the 54 products surveyed, respondents were instructed to . . . "List three manufacturers you would consider contacting if you were planning to buy (product name)."

The 72-page report is the second annual study of company recognition, awareness, and preferences conducted among a nation-wide sample of computer professionals from MODERN DATA's circulation.

The results show the total number of mentions for each product, plus the percent of total mentions received by each company. The results from the previous year's survey are compared with the current report to show the changes and trends in company awareness and recognition.

Among the major product areas, some of the more noteworthy results are:

**Computers for Business Data Processing**—IBM remained in first position with 32.2% of mentions—the same score as in 1969. Honeywell remained in second position with 14.6% of mentions but dropped in percentage points. The largest gain was made by RCA.

**Computers For Industrial Process Control**—Digital Equipment Corp. moved from 5th position to third while showing an increase of 80% from the previous year. IBM dropped by 34% but remained in first position.

**Small-Scale & Minicomputers**—Digital Equipment increased its first place lead by 53% while receiving 23.4% of the total mentions. Varian moved from 5th position to 2nd replacing Honeywell. Hewlett-Packard dropped slightly in percentage points yet moved from 4th to 3rd position. The largest gainer was Data General which moved from 10th position last year to 5th position this year—an increase of nearly 400% in percentage points.

**Digital Plotters**—Calcomp remained in first position with 41.9% of the mentions. Hewlett-Packard moved to 2nd position with 9.2% after receiving less than 1% last year.

**Key-To-Tape**—Mohawk Data and Honeywell remained in 1st and 2nd positions respectively with 31.7% and 17.9% of mentions. IBM remained in 3rd position while dropping from 13.5% mentions to 7.3%. Inforex with no mentions in 1969 received 4.8% this year for a fourth place tie with Computer Machinery. Viatron dropped from 4th to 12th position.

**Magnetic Tape Drives**—IBM remained in 1st place while Potter Instrument moved from 3rd to 2nd, exchanging positions with Ampex. The biggest gain was scored by Telex moving from 13th to 4th.

**CRT Displays**—Contrasted with 1969 this product area showed the most volatility. In 1969, only 23 companies received mentions—this year 52 companies were mentioned. IBM, in 2nd position in 1969, exchanged places with Sanders which was first last year. Computer Terminal moved from the 5th spot in 1969 to 3rd place this year. Bunker-Ramo took 4th position. Tektronix came in 5th after receiving no mentions last year.

**Continuous EDP Forms**—Moore Business Forms remained in first position with a comfortable margin over Uarco and Standard Register which were 2nd and 3rd respectively.

Items added to this year's survey are: EDP Facilities Management, Computer Site Preparation Services, Data Collection/Retrieval Systems, Fire Detection/Protection Systems for EDP Rooms, and Analog/Hybrid Computers.

Copies of the 1970 Brand Awareness Survey are available at \$12.00 each. Due to the limited supply only prepaid orders are being accepted. Write to MODERN DATA, Information Products Div., 3 Lockland Ave., Framingham, Mass. 01701.

## Raytheon Computer. We give you our all.

With the Raytheon Computer 704, you'll have the only complete, efficient software library in the 16-bit class. In all, we've got over 600 field-proven programs to choose from.

Multi-programming  
Systems

Complete Math Library

Applications Programs

Data Processing Programs

Diagnostic and Test  
Programs

FORTRAN IV

Conversational FORTRAN

Array Processing

Sort/Merge Package

Monitors and Executives

Utility Programs

System Programs

For a complete listing of our software and all the facts and figures on our entire 700-Series computers, write today. Ask for Data File C-195.

Raytheon Computer,  
2700 S. Fairview St., Santa Ana, Calif. 92704. Phone 714/546-7160.

RAYTHEON



CIRCLE NO. 6 ON INQUIRY CARD

# THE BEST THING ABOUT DATA GENERAL IS OUR LOW MAIN FRAME PRICES. OR SO PEOPLE THINK.

For too long, people have thought of us as a main frame company.

And justifiably.

After all, we have spent the last couple of years producing the Nova line of fully compatible, 16-bit mini computers.

But we're smart enough to know that main frames and low base prices aren't everything.

Proven performance is important, too. (We've installed over 850 Nova-line computers so far.)

A strong service organization is important.

Software and peripherals are important.

And finally, the ability to put main frames, software and peripherals together in configurations that meet real-world computing requirements at the lowest prices possible is the most important consideration of all.

And that's what we'd like to talk to you about.



**DISC  
OPERATING  
SYSTEM  
ONLY \$27,870**

Built around the Nova 800, Data General's DOS provides high-speed data processing capability at a remarkably low price. The system priced here includes the Nova 800, 16K of core memory, a 128K, head-per-track disc, Teletype, high-speed paper tape reader, and device-independent software.

DOS supports system software that includes relocatable assembler, editor, linking loader, and ALGOL 60 and FORTRAN IV compilers.

Substituting a 256 K disc adds only \$1,500, and a 356 lpm, 80 column, 64 character line printer costs \$12,900.



**MAG TAPE SYSTEM  
ONLY \$29,885**

The configuration priced here includes the superfast Supernova, 8K of core memory (interchangeable with 300 nanosecond monolithic memory), Teletype, 8-channel, 10-bit A/D converter, and a 24ips, IBM-compatible magnetic tape unit.

This is an inexpensive, easily expandable, on-line data acquisition system that can handle its own data processing, or can prepare data for a larger processor.



**OUR  
MAIN  
FRAMES  
STARTING  
AT \$5,450**

Everything starts with main frames.

And any one of ours can plug into any one of the systems priced above.

What's more, they are all software compatible, mechanically interchangeable, and all run the same peripherals.

□ Nova 1200: First to take advantage of LSI and MSI. It's fast (1200 nanosecond cycle time), reliable, and less expensive than anything else at its performance level.

Price: \$5,450.\*

□ Nova 800: Faster, more powerful than the 1200, Nova 800 has a fully parallel central processor and a cycle time of 800 nanoseconds.

Price: \$6,950.\*

□ Supernova SC: First to really take advantage of all-monolithic memory, making it the world's fastest mini computer (300 nanosecond add time). Price: \$11,900.\* (\$9,600\* with compatible 800 nanosecond core.)

**TIME SHARING  
BASIC ONLY  
\$17,596**

This is the least expensive way to provide a sophisticated, easily-used computing capability for as many as 16 users.

The four-user system priced here includes a Nova 1200 with 12K words of core memory, four Teletypes and interfacing. A high-speed paper tape reader adds \$2,650.

The system uses Data General's fully extended time-sharing BASIC with string and matrix manipulation capabilities.

When not time sharing, the system can use all of Data General's extensive list of software and peripherals.



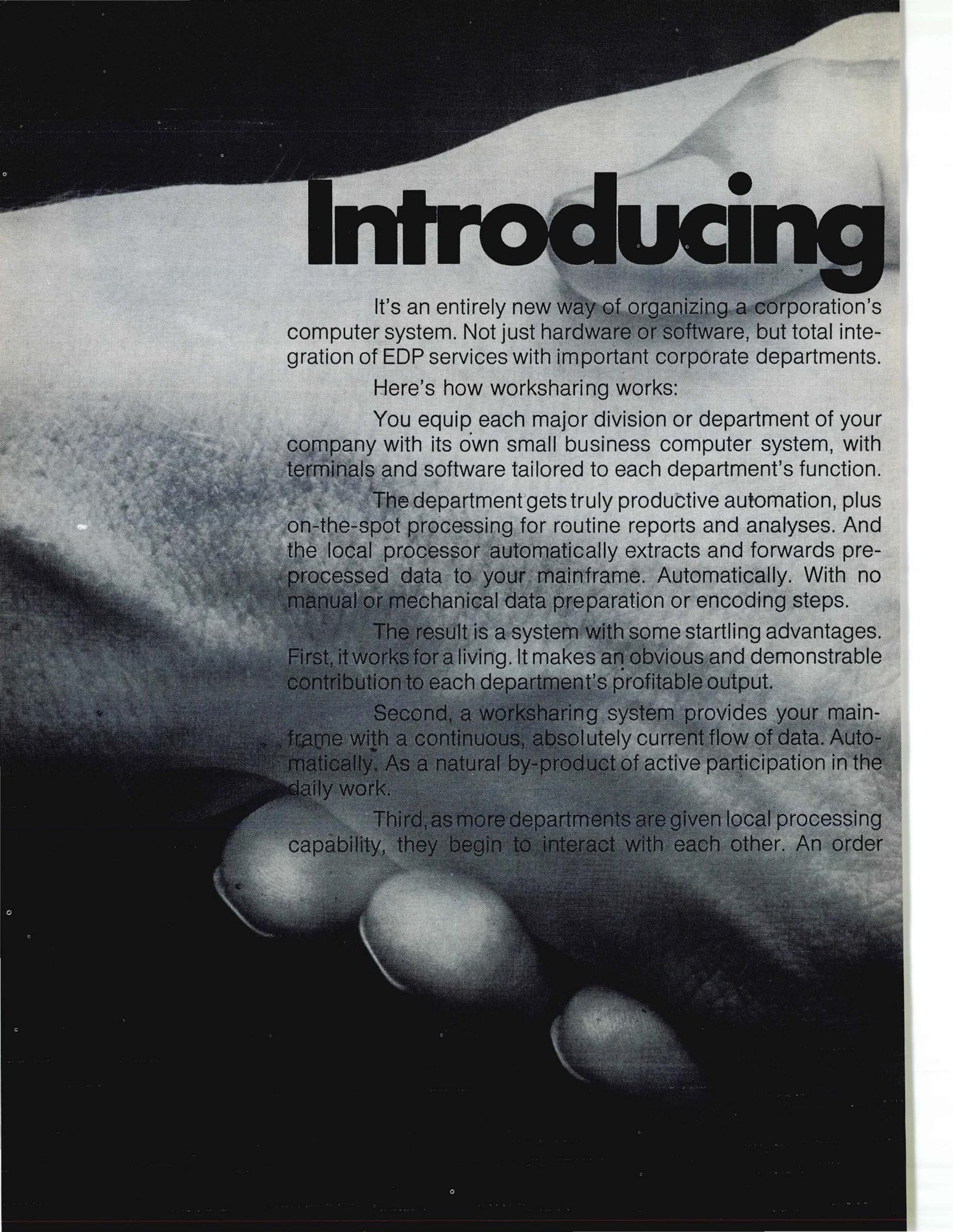
To find out how little *your* configuration will cost, call or write the nearest Data General office.

To know us is to love us.

**DATA GENERAL**

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\* Main frame prices include 4,096 16-bit words of memory, Teletype interface, and Direct Memory Access data channel.



# Introducing

It's an entirely new way of organizing a corporation's computer system. Not just hardware or software, but total integration of EDP services with important corporate departments.

Here's how worksharing works:

You equip each major division or department of your company with its own small business computer system, with terminals and software tailored to each department's function.

The department gets truly productive automation, plus on-the-spot processing for routine reports and analyses. And the local processor automatically extracts and forwards pre-processed data to your mainframe. Automatically. With no manual or mechanical data preparation or encoding steps.

The result is a system with some startling advantages. First, it works for a living. It makes an obvious and demonstrable contribution to each department's profitable output.

Second, a worksharing system provides your mainframe with a continuous, absolutely current flow of data. Automatically. As a natural by-product of active participation in the daily work.

Third, as more departments are given local processing capability, they begin to interact with each other. An order

# Worksharing.

entered at a remote sales office can automatically adjust a production schedule or a warehouse "pick sheet," print shipping papers on the loading dock, initiate billing, adjust sales totals in management analyses, alert the controller of expected income, and make the VPs smile. All within a few minutes.

Of course, all this would be Pie in the Sky except for one thing. Cost. Now, there is a small business computer flexible enough and inexpensive enough to commit to a single department. System Ten business computer by Singer.

A System Ten computer will accommodate up to twenty workstations and process all twenty jobs simultaneously. It's designed to be used easily by ordinary business people without special EDP training. It uses simple two-wire connections—easy to install. It's ready to go on-line to your mainframe. And most important, its cost is extremely realistic. On the basis of cost per function, a System Ten business computer is the most efficient system available to you today.

To find out why, and to get more information about how a worksharing system could work for your company, call your nearest Friden Office. Or write Friden Division, The Singer Company, San Leandro, California 94577.

**The computer that works for a living.**

**System Ten  
business computer  
by Singer**

# NEWS ROUNDUP

## **MINIS — A BUYER'S MARKET IN '71**

Minicomputer manufacturers, dependent on the R&D and instrumentation industries to absorb the lion's share of their products, may be in for further belt-tightening during the current year. According to the annual R&D forecast prepared by the Columbus Laboratories of Battelle Memorial Institute, continuing inflationary forces will more than offset the modest 3.6 percent growth of R&D expenditures expected in 1971, resulting in an estimated 2.3 percent reduction in the real level of R&D effort. Almost as gloomy is a prediction by James E. Myers, v.p. and gen'l. mgr. of Honeywell's Industrial Division. While "cautiously optimistic" that instrumentation business will gradually pick up in the last half of 1971, Mr. Myers cited reduced capital spending by most U.S.-based instrument users as a major factor in the generally depressed condition of today's market. For instance, during the period March to September, spending plunged almost 10 percent below estimated figures for instrument users identified with durable goods manufacturing, and almost 7 percent downward for those in the non-durables category. For minicomputer users, these predictions add up to continued reductions in manufacturers' list prices as competition increases for a larger slice of the pie remaining.

## **MAKING MEMORIES FOR MELODIES**

A new process said to identify any recorded sound by computer was revealed by Sound Signatures, Inc. of Los Angeles, and Tracor, Inc. of Austin. The first application developed and discussed in detail is related to radio monitoring and the performing rights industry, which is responsible for determining and paying the royalties to which music composers and publishers are entitled each time one of their recordings is played on the air. The Sound Signatures system starts with the radio broadcast of a recording and results in a computer-printed list that includes the recording title, composer, lyricist, publisher, recording artist, record company, radio station, time and date of the recording play, etc. The identification is made through comparison with a computer library of every recording represented by any of the performing rights organizations that subscribe to the service.

## **NEED A LEFT-HANDED PITCHER?**

Computer Sciences Corp. recently demonstrated an automated scouting report system to the National Association of Professional Baseball Leagues. Offered on CSC's INFONET T-S network, the system would enable baseball clubs to obtain quick reports on available players through terminals in the club's offices. A list of 100 available left-handed pitchers, for example, could be prepared within seconds for about \$5.00.

## **SMALL BUSINESS COMPUTER FROM NCR**

A new disk-oriented computer for small businesses which will rent for only \$1500 a month has been announced by the National Cash Register Co. The NCR Century 50 is fully compatible with all other computers in the company's Century Series and will directly compete with IBM's System 3. Features include 16K of 800 ns thin-film rod memory and an 8.4 megabyte dual disk unit. A 200 lpm printer is standard.

## **NUMBER TWO AIMS AT BIG SMALL T-S MARKET**

Honeywell Inc. has entered what it describes as "a virtually untapped segment of the time-sharing computer market" by adding a family of four small systems to its present stable of six medium (200 and 400 series) and two large (600 series) T-S computers. The 1640 series is aimed at the market segment that Honeywell predicts will grow from \$63 million in 1970 to more than \$310 million in 1975. The new "Number Two" said it expects to capture about 10 percent of that market with its Model 1642, 1644, 1646, and 1648A systems that range in monthly rent from \$2,995 for the 1642 to \$7,815 for the 1648A. Except for the 1648A, each of the new 1600 family is built around dual Model 316 minicomputers — one used as a job processor for computational functions; the other as a control processor to monitor system functions. The 1648A uses a Model 416 (for communications processing) and a pair of Model 516s.

## DEC PDP-10 FOR COMMERCIAL USERS

Digital Equipment Corp. announcements of an ANSI standard Cobol compiler, multiprogramming batch software, and a remote batch terminal for use with the DEC PDP-10 indicate that DEC is getting away from its traditional position of selling PDP-10s to only the time-sharing and scientific markets. Rod Belden, DECman in charge of marketing the PDP-10 to business users, described DEC's strategy of developing a commercial EDP image for the product as initially aimed at convincing present educational and industrial PDP-10 users of their system's new batch processing potential. Following that, DEC will go all-out to promote the system for general commercial applications.

## CDC WINS IRS CONTRACT

The much-prized Internal Revenue Service data processing equipment contract has been awarded to Control Data Corp. In a brief announcement, CDC said it received a \$29,284,674 contract from the General Services Administration to provide and install 10 medium-scale computer systems and 3,600 display terminals at IRS facilities throughout the country. The systems and terminals will be maintained for 5 years from the date of installation. While CDC and IRS have not yet announced the exact equipments and configurations accepted, industry sources say that the mainframe portion of the CDC offering consists of used hardware. The computer systems will enable IRS to interrogate directly taxpayer records stored in massive computer files in 225 field offices.

## ORDERS AND INSTALLATIONS

Interdata, Inc. has sold eight System Model 4 computers to Macro Data, Inc., of Chatsworth, Cal. Total value of the sale exceeds \$120,000.

Silja Line, a major Finnish steamship concern headquartered in Turku, has contracted with Oy Sperry Rand AB Finland for two Univac 9400 computer systems valued at \$1.2 million. The first computer will be delivered in April 1972 and the second in November 1972.

A contract for \$297,000 worth of data collection equipment has been awarded to The Standard Register Company by the Federal government's General Services Administration. The order calls for 141 source record punch data collection units which are to be installed in GSA motorpool locations across the country.

The Port of New York Authority has awarded \$372,000 to LFE Corporation for the development of a Surface Traffic Control System (STRACS) for John F. Kennedy International Airport. STRACS will be a complete, automated system incorporating advanced communication equipment to safely and efficiently move aircraft, emergency, and other vehicles over the airport between the terminal buildings and the points of aircraft landing and take-off.

Innsbruck University, Innsbruck, Austria, has ordered an \$800,000 Control Data 3300 computer system which will provide centralized computer services for the University's science, engineering, economics, philosophy, and computer science departments.

C. Itoh Electronic Computing Service Co., Tokyo, Japan, this month will install a Control Data 6600 computer system to provide expanded data center service to its customers. This CDC 6600 system will be the first installation of a CDC 6000 Series system for time-sharing use in the Far East area.

The Max Planck Institute at the University of Goettingen, West Germany, has purchased a Sperry Rand Univac 1108 computer system, valued at approximately \$3.5 million.

### SUCCESSFUL SALES ORGANIZATIONS NEEDED

BCD Computing Corporation needs sales coverage throughout the United States. With a dramatically demonstrable product — the **DIMBO-10**, you can immediately direct your organization to new profits.

If you are systems and applications oriented in your selling, you need the **DIMBO-10**.

For additional information on BC-DC, DIMBO-10, and Profits, contact: **Phillip M. Lumish, Director of Marketing, BCD Computing Corporation, 100 E. Industry Court, Deer Park, N. Y. 11729.**

# DC DATASCAN

**U.S. DOMINATION?** — During the Senate debate on funds for the supersonic transport (SST) Senator Barry Goldwater (R. Ariz.) pointed out that the U.S. "no longer leads in manufacture of computers or radios or television." Senator Charles Percy rebutted by saying "that the computer industry is dominated by the American market and every country knows it." "Senator Percy's statement is correct," Senator Goldwater replied, "if you are talking about large, fast digital computers, but it is not correct for the entire computer market." The Japanese, he added, now dominate the calculator, small desk-type computer market. The Arizona Senator seems to stretch the point by referring to the calculator as a computer. It is not hard to see his point that "Japan is determined to create a powerful computer industry and every indicator points to a growing success in this endeavor." But by the way, what's that got to do with the price of the supersonic transport?

**DE-URBANIZED SOCIETY** — Dr. Peter C. Goldmark, President of CBS Laboratories in a recent talk to the National Governor's Council on Science and Technology called for a massive national effort using computer and communications technology to create a new living pattern for a de-urbanized society. Future cities in the de-urbanized society should be small using existing communities as nuclei, he said. Two states — Conn. and Ga. — already have targeted exploratory projects using "broadband communications" links forming highways of cables rather than cars enabling people to transmit digital information talk by picturephone and send photocopies to persons they are meeting along these highways, he added. Broadband communication networks, he believes, could be laid along existing highways and link any location in a de-urbanized society for business operations, home services, educational, and cultural purposes.

**NAVY BUYS** — Control Data Corp. has been awarded two contracts by the U.S. Navy valued at \$15.2 million to install three CDC 6000 Series and six CDC 1700 computer systems at the Naval Weapons Laboratory Dahlgren, Va., and the Naval Ship Research and Development Center Carderock, Md. A Control Data 6700 computer system and four CDC 1700 computers was installed in December, 1970, at NSRDC will be used to solve engineering problems and to provide technical support to the Center's staff. The installation will be augmented by a CDC 6500 computer system at a later date. In November 1970, the Naval Weapons Laboratory installed a CDC 6700 system and two CDC 1700 Digi-graphics systems.

**COMPUTER ENHANCEMENT** — National conferences may employ computers as a matter of course if the experience of the White House Conference on Children is any guide. Recommendations from 24 forums were made to the President on the needs of America's children. To guarantee the right mix for each forum, an RCA Spectra 70/45 computer was used to sort and match sex, age, race, and other background information on the delegates. In addition, the 70/45 was used to rearrange names and addresses so as to prepare lists of delegates.

**STANDARDIZATION** — As part of a Government-wide effort to standardize methods of reporting factual material, the U.S. Department of Housing and Urban Development has awarded a \$228,000 contract to the System Development Corp. (SDC), Falls Church, Va. The purpose of the project is to design and implement an automated report management system which will help HUD to manage the reporting function more effectively. It will eliminate duplication in reporting, control the introduction of new reports, and standardize data elements and their representations.

**SAVINGS FROM LEASING** — The General Accounting Office (GAO) has completed a study of computer leasing at the Government Printing Office (GPO) and reported its results to Congress. GAO concluded that GPO should reduce rental costs by leasing its equipment from a commercial leasing firm rather than from the manufacturer.

## IN BRIEF

The National Aeronautics and Space Administration and the Federal Aviation Agency have signed an interagency agreement by which NASA will provide technical and scientific data to support FAA's technical program.

The National Academy of Science and the Army are negotiating a contract for a study of advanced ballistic missile defense DP system for the Safeguard System.

ANSI Standards Committee X3 has initiated work leading to standards for recording digital information on magnetic tape cassettes.

U. S. Patent No. 3,528,177 was assigned to General Research, Inc., Greenwich, Conn. for an inventory system.

The U. S. Army Signal Center and School, Fort Monmouth, N. J. has hosted a regional conference on the application of computers to training.

# It had to happen ...and it did.



By design—and to your benefit. Ampex was sure to offer direct-access memory in the form of Disk-Drive and Controller. Your gain is the new Ampex DM-312 Disk Drive and DC-314 Controller, plug-interchangeable with the IBM 2314 Disk Files for 360 and 370 Systems. First in a family of Direct Access Memories from the *one* company that deals helpfully with computer peripherals and comes up with the better answer.

**IT'S FAST ACCESS.** Reliable voice coil head positioning, as opposed to hydraulic. Optical position sensing, combined with a closed-loop servo, further increases reliability and decreases access time. Average of 32 msec access. Minimum access is 8 msec, maximum is 58 msec. This means less waiting for data on the 20 recording surfaces... faster throughput and greater time and dollar savings.

**IT'S PLUG-INTERCHANGEABLE.** Direct replacement for the IBM 2312 Drive and 2314 Controller combination, identical in format density, ... and program compatible. One DC-314 controls up to 8 DM-312 Drives, with an optional 9th service module. All solid state for maximum reliability.

**IT'S PRICED RIGHT—AND SERVICED.** If you could benefit from a faster access replacement for your IBM disk drives, you'll save money with the Ampex DM-312 and DC-314, with worldwide site installation and maintenance service. Typically helpful and economic Ampex attention to OEM requirements, the familiar Ampex approach to helping the customer get the most out of a product.

**AND IT'S ONLY THE BEGINNING.** The pioneer company dedicated to providing a complete line of computer peripherals *has* to offer something better in direct-access memory. Our brochure spells out just how much better. Yours for the asking. Call or write Ampex Corporation, Computer Products Division, 9937 West Jefferson Blvd., Culver City, Calif. 90230, (213) 836-5000.

Your computer counts on us.

**AMPEX**

# INTERNATIONAL NEWS

**POWER SHORTAGE** — England's electric power stoppage caused considerable difficulties for computer users. A survey by the National Computing Centre in Manchester of approximately 50 large computer installations found 70% of the installations had some stoppage and only 20% had alternate power supplies. Also, London newspapers reported worker dissatisfaction because of payroll delays.

**HELP FOR GERMAN PRODUCERS** — The German Ministry for Education and Science plans to participate in a special finance company for EDP equipment. This venture is designed to strengthen the competitive position of German computer producers by raising funds on the capital market with Government guarantees and subsidies. It is expected to help Siemens-Zuse and AEG Telefunken which now have about 17% of the market compared to IBM's 62%.

**GOOD SHOW** — The U. S. Dept. of Commerce has sponsored COMPUTER '70 — a Tokyo Trade Show. It was a great success according to Commerce. The 54 participants are projecting more than \$41.5 million sales will result over the next 12 months and they are estimating 24-month sales over \$53 million. Several American firms were successful in seeking overseas representation.

**COMPUTERS VULNERABLE** — The American Chamber of Commerce in Germany warns that the U. S. will suffer sharp retaliation if import curbs are enacted by the U. S. Congress. Vulnerable areas are computers and electronic components. American companies have approximately 80% of the German computer market and "any restrictive measures taken in this field would be disastrous to one of our most lucrative and profitable businesses" in Germany, the Chamber also reports.

**MEXICAN OPPORTUNITY** — The U. S. Department of Commerce recently sponsored a Mexican exposition of electronic data processing equipment. According to the **Journal of Commerce**, there are approximately 500 computers in that country. These represent a quarter of the potential market. The primary obstacles to the development of that market are a shortage of qualified personnel and a complicated customs structure. Opportunities for a time-sharing service appear particularly interesting. RCA plans to open a batch service bureau next year.

**WORLD WEATHER REPORTING** — A high-speed, 24-hour "hot" line between Tokyo, Japan, and Washington, D.C., has been initiated by the U. S. National Weather Service. It is one element of a vast new system of global telecommunications for the exchange of weather data.

**OLE! CHECKMATE** — The **Baltimore Post** recently reported upon a Madrid exhibition of Spanish inventions through the ages. Of particular interest, was a 50-year-old computer developed by the Spanish designer Leonardo Torres Quevedo. It plays three-piece chess and wins every time, shouting Checkmate in Spanish. If an opponent tries to cheat, the machine flashes a warning light.

**BLOOD BANK, DATA BANK** — The Netherlands Red Cross Blood Research Center, which stores and distributes rare blood throughout Europe, is planning to merge its business and scientific work on a single compatible computer system, thereby giving the laboratory immediate access to more than 200,000 patient files. A Honeywell 316 minicomputer will analyze blood samples and set up files after performing on-line conversions of signal inputs from test instrumentation equipment, such as auto-analyzers. The 316 will communicate via magnetic tape with a Honeywell Model 125 computer, on which a historical file of patient data will be maintained. The computers will contribute to the Center's work in research and development of transfusion equipment and in identifying blood samples, particularly relating to their genetic, biochemical, immunologic, and organ transplant properties.

## QUICKLY AROUND THE WORLD

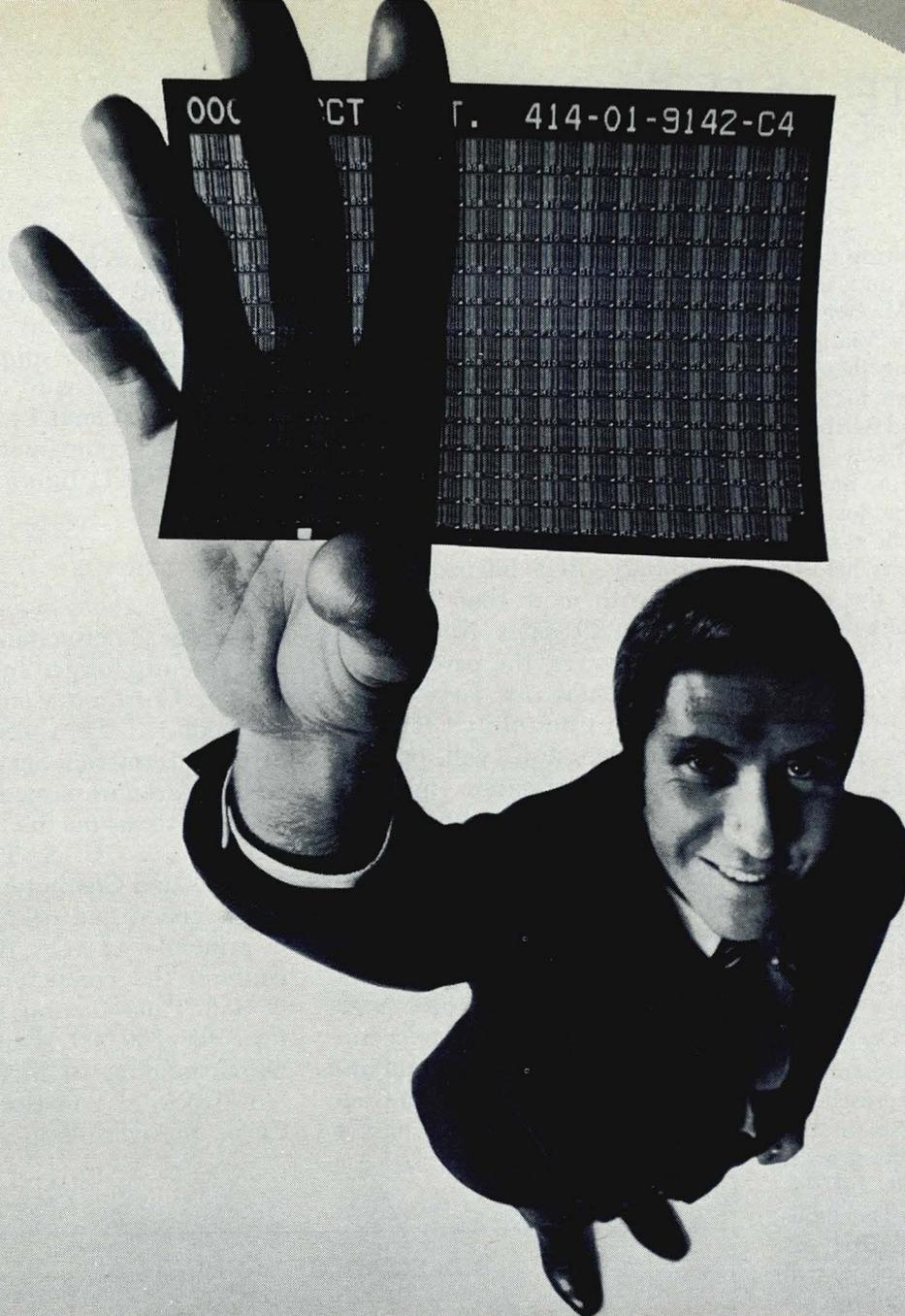
A computer control system for preventing air pollution was discussed at the Second International Clean Air Congress in Washington.

U. S. exports of computers and parts totaled \$777 million for the first three quarters of 1970 — up 55% from the same period in 1969.

British European Airlines is extending its Beacon instant seat reservation system to 22 cities in 9 countries in Europe.

A Honeywell 316 minicomputer is providing the "brains" for a propulsion system trainer being developed by Rolls Royce.

Kodak



## Good news! Kodak KOM microfilmers now give you microfiche.

The microfiche you see above holds 208 pages, plus title, that were recorded from magnetic tape by the Kodak KOM-90 microfilmer in less than thirty seconds. And with remarkable clarity, thanks to the new Kodak Versaform camera.

It lets you convert tape data to 16mm, 35mm, 82.5mm, and 105mm film at 24X and 42X reduction ratios. The camera is retrofittable to KOM-90 microfilmers already installed.

Whether your application requirements call for roll, strip, fiche, or tab-card-size formats, all are possible using the Versaform camera. Couple this with one of several available computer-generated indexing systems, and you have one more reason to select Kodak for all your COM needs.

Find out more about Kodak's total COM systems responsibility. Ask your Kodak systems expert for details or write Eastman Kodak Company, Business Systems Markets Division, Dept. DP534, Rochester, N.Y. 14650.

# Kodak Microfilm Systems

CIRCLE NO. 10 ON INQUIRY CARD

# CORPORATE AND FINANCIAL NEWS

Less than a year ago Viatron Computer Systems' founder and then-president Dr. Edward M. Bennett responded to queries on Viatron's financial health by stating that the company had \$10 million in cash, was paying its bills, had virtually no bank debt at all, and was shipping about 700 units a month. Recently Dr. Bennett was just another "interested party" at a meeting of Viatron bondholders held in Boston two weeks after the company failed to pay interest due on some \$14.8 million worth of convertible debentures.

Total 1971 expenditures for research and development in the United States are expected to reach \$28.5 billion, according to the annual R&D forecast prepared by the Columbus Laboratories of Battelle Memorial Institute. The 1971 forecast represents a rise of 3.6 percent over now estimated 1970 expenditures of \$27.5 billion. The increase follows closely the growth rate in expenditures of the past several years, but represents a distinctly slower rate than in the mid-1960s and earlier. The growth rate from 1965 to 1966, for example, was 9.0 percent. The modest increase in estimated 1971 expenditures, as Battelle sees it, will result entirely from additional funds provided by industry and by colleges, universities, and other not-for-profit institutions. Federal support of R&D in 1971 is expected to decline about 1.2 percent.

General Telephone & Electronics Corp. has filed a proposal for a \$27 million satellite communications system with the FCC. The proposed system would consist of four earth stations interconnected to a satellite 22,300 miles over the equator, and provide capacity equivalent to 10,560 voice-grade channels. GT&E has already concluded an agreement with Hughes Aircraft Co. to lease the required channels from one of two communications satellites that Hughes is proposing for domestic use.

**RECENT ENTRIES IN THE COMPUTER FIELD:** **Applied Computer Graphics Corp.** of Silver Spring, Md. will provide a wide range of graphic systems design and programming support services . . . **Boeing Computer Services**, a division of the Boeing Co. since May of last year, has been incorporated as a full-service subsidiary. BCS begins its new status with more than 250 customers in 29 states. Not surprisingly, however, the parent company remains its largest customer . . . **Control-By CRT, Inc.** of Torrance, Cal. will provide real-time information management services to small and medium-sized businesses . . . **Thorn Electrical Industries Ltd.** of London and **GTE International Inc.**, a subsidiary of General Telephone and Electronics Corp., have formed three new companies to provide telecommunications equipment and information systems. **Thorn-General Telephone Ltd.** will market

GTE products manufactured in Europe and N. America; **GTE Information Systems Ltd.** will provide products, support functions, and services to users; and **GTE International Ltd.** will act as a holding company for the interests of GTE International in the U. K.

**MERGERS AND ACQUISITIONS:** **Brokerage Transaction Services Inc.** recently formed by Ultronic Systems Corp. and Control Data, has acquired the assets of **Wall Street Information Services Inc.**, a New York firm providing automated systems for the brokerage industry . . . **U. S. Time-Sharing, Inc.** and **Computer Network Corp.** announced an agreement in principle whereby COMNET acquires the computer business of U. S. Time-Sharing, Inc. in return for 600,000 shares (60%) of outstanding COMNET common stock . . . **Leasco Systems Corp.**, the consulting subsidiary

## BOX SCORE OF EARNINGS

Company	Period	Revenues	Net Earnings (Loss)	Earnings (Loss) per Share
<b>Adv. Computer Techniques</b>	6 mos. 9/30/70	1,539,213	(23,302)	(.03)
	6 mos. 9/30/69	1,683,160	30,799	.04
<b>Beta Instrument</b>	9 mos. 9/30/70	1,799,518	16,184	.01
	9 mos. 9/30/69	616,465	(322,310)	(.31)
<b>Compress</b>	9 mos. 9/30/70	3,594,000	(246,000)	(—)
	9 mos. 9/30/69	3,661,000	392,000	—
<b>EDP Technology</b>	12 mos. 6/30/70	5,135,183	(2,481,773)	(—)
	12 mos. 6/30/69	3,740,094	(1,298,008)	(—)
<b>General Automation</b>	12 mos. 7/31/70	7,454,230	(1,691,516)	(1.04)
	12 mos. 7/31/69	2,008,132	(798,909)	(.63)
<b>Inf. Interscience</b>	12 mos. 6/30/70	1,402,760	(555,577)	(.34)
	12 mos. 6/30/69	1,256,936	(692,460)	(.47)
<b>Mohawk Data Sciences</b>	3 mos. 10/31/70	21,780,000	1,265,000	.23
	3 mos. 10/31/69	24,955,000	2,025,000	.37
<b>Nat. Computer Sys.</b>	9 mos. 10/31/70	2,904,374	(122,540)	(.23)
	9 mos. 10/31/69	2,047,760	37,462	.08
<b>Terminal Data</b>	12 mos. 9/30/70	623,528	(268,837)	(.61)
	12 mos. 9/30/69	40,105	(254,100)	(.76)
<b>Tracor</b>	9 mos. 9/30/70	53,327,000	(142,000)	(.06)
	9 mos. 9/30/69	63,621,000	2,086,000	.97
<b>Wyle Laboratories</b>	9 mos. 10/31/70	71,020,299	(249,547)	(.07)
	9 mos. 10/31/69	77,196,554	1,166,902	.33

of Leasco Data Processing Equipment Corp., has sold its Education Division to **DeltaK Inc.** Purchase price was set at \$200,000 . . . **EDP Technology, Inc.** and **KMS Industries, Inc.** jointly announced approval of an agreement for EDP Technology to acquire the Electronic Futures Division and certain other assets of KMS Industries in exchange for approximately eighty percent of the stock of EDP Technology . . . The acquisition of **Tempo Computers, Inc.** of Fullerton, Cal. has been announced by **General Telephone & Electronics Corp.** Tempo manufactures a series of small computers especially designed for data communications. Terms of the transaction were not disclosed . . . **Hathaway Instruments, Inc.**, Denver, Col., has acquired the **Century Electronics and Instruments Div. of Century Geophysical Corp.**, Tulsa, Okla. . . . **Leasepac Corp.** of Cleveland, Ohio has reached an agreement in principle to acquire the computer disk pack division of **Datapax Computer Systems Corp.** of New York . . . **Planning Research Corp.** has acquired **Realtronics of Denver, Inc.**, a Colorado-based company that provides computerized services to the real estate industry . . . **Sierra Research Corp.** has acquired **BCD Computing Corp.** of Deer Park, N.Y. BCD's president is Dan Bowers, former editor-in-chief of **MODERN DATA** and the designer of the DIMBO-10 Information Retrieval System, BCD's principal product . . . **TBS Computer Centers Corp.**, a national data processing services company, has agreed in principle to acquire **Computech, Inc.**, a subsidiary of International Systems Associates, Ltd. . . . **Telefile Computer Corp.** of Newton, Mass. has acquired **Interactive Data Systems** of Irvine, Cal., for cash and Telefile common stock. IDS' name has been changed to Telefile Computer Products, Inc.

# DEBUG

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The Universal Monitor is simple to install and is as easy for programmers to use as it is for engineers. It connects to the business machine interface of any standard modem, and automatically synchronizes with the data stream to provide a record of every character on the line—not only the usual printable characters, but all control characters as well. The system monitors any code and speed up to 7200 bps, accommodates all line coordination systems, and works with synchronous or start-stop transmissions.

There are two basic components of the Universal Monitor system. These are a Monitor Control Unit which provides synchronization and control, and decodes the monitored data for printing; and the Monitor Printing Unit which is a high-speed non-impact printer. Other components are available which allow switch-selection of lines to be monitored in a multi-line system. For more information or a demonstration, fill in and return the coupon below. Or call (609) 667-5700.

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CORPORATION

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Please send technical bulletin on Universal Monitor System.

Please arrange Universal Monitor System demonstration at my convenience.

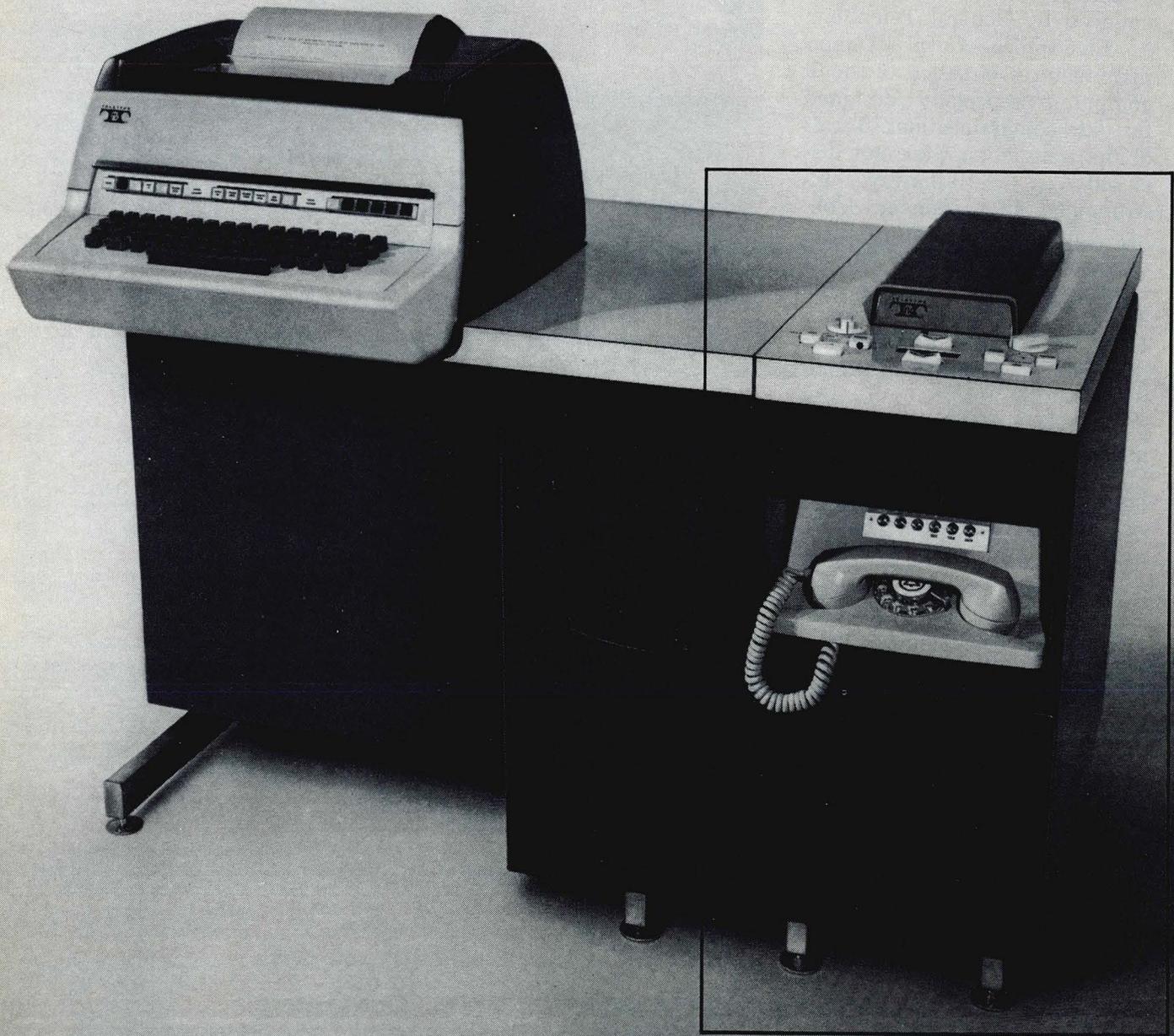
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Our Dataspeed<sup>®</sup> Magnetic Tape Terminal.

It bridges the gap between low-speed keyboard preparation and high-speed on-line data transmission.

At the same time it reduces the cost of data transmission over regular telephone lines.

The data that is sent and received is recorded on a compact cartridge that has a capacity for 150,000 characters. And the tape is reusable once the information on it is no longer needed.

Besides communicating at high speeds, the terminal has a Forward/Reverse mechanism that can search for specific data on the tape at a rate of 4,000 characters per second.

And time-consuming correction procedures are cut to a minimum since individual lines or characters can be easily located and corrected within a message.

The terminal can be adjusted to answer calls automatically, too. Transmission can be sent and received over regular telephone lines (Data-Phone<sup>®</sup> service) or private line service.

Often at low-cost after-hour rates.

Call your local Bell Company Communications Consultant for information on how our Magnetic Tape Terminal can be implemented within your existing system without major redesign.

The American Telephone and Telegraph Company and your local Bell Company keep working to improve telephone communications.

This time by helping you communicate at speeds up to 1200 words per minute.





# COMPUTER STOCK TRENDS

MONTH ENDED JANUARY 8, 1971

EXCH	COMPANY	PRICE					VOLUME (IN 100'S)			EARNINGS	
		1970/71 RANGE (1)	1 YEAR AGO	CLOSE JAN. 8, 1971	MONTH NET CHG.	MONTH % CHG.	THIS MONTH (3)	LAST MONTH	AVG. VOL-UME (2)	PER SHARE LATEST 12 MONTHS	PRICE-EARNINGS RATIO
COMPUTERS	N BECKMAN	19- 52	49 1/2	27 3/8	+1 3/8	+5.2	1442	1163	1669	1.43	19
	N BURROUGHS	80-173	164 1/4	108 3/8	-2 1/2	-2.2	7487	9718	9099	3.63	30
	N CONTROL DATA	30-123	116	49	-1 1/2	-2.9	4249	6255	8070	1.28	38
	O DATA GENERAL	16- 36	N/A	20 3/8	-7 3/8	-26.5	(3)	-	-	0.28	73
	O DATACRAFT	3- 20	N/A	6 1/8	+1 3/8	+28.9	(3)	-	-	-	-
	N DIGITAL EQUIPMENT	50-124	104 3/8	53	-10 1/8	-16.0	3465	2894	5606	1.49	36
	N ELECTRONIC ASSOC	4- 12	10 5/8	5 5/8	+1 1/2	+36.3	1607	836	885	-2.63	-
	O GENERAL AUTOMATION	9- 42	N/A	11 3/4	-2 1/4	-16.0	(3)	-	-	-0.88	-
	N GENERAL ELECTRIC	60- 94	75	93 5/8	+2 5/8	+2.8	6065	7999	7959	1.99	47
	N HEWLETT-PACKARD	19- 46	52 3/4	30 7/8	+ 5/8	+2.0	3242	6432	3918	0.89	35
	N HONEYWELL	66-152	143 1/4	82 1/2	-1 3/8	-1.6	3629	6890	4919	4.07	20
	O INTERDATA	3- 22	N/A	5 3/4	-1 1/2	-20.6	(3)	-	-	-	-
	N IBM	223-387	369 1/2	314 1/2	-2 1/2	-0.7	5487	7481	9041	8.68	36
	N LITTON INDUSTRIES	15- 38	32	21 1/2	+1 3/8	+6.8	7983	9551	11504	1.65	13
	N NCR	30- 61	81	38 7/8	+2 5/8	+7.2	7017	7898	8014	2.08	19
	N RCA	18- 35	33 1/4	26 7/8	+ 1/4	+0.9	8758	9577	8397	1.48	18
	N RAYTHEON	16- 34	31 5/8	28 3/8	+3 7/8	+15.8	2836	2738	3084	2.35	12
	O REDCOR	4- 34	33 3/4	6 1/8	+ 7/8	+16.6	(3)	-	-	-2.81	-
	O SCIENTIFIC CONTROL	1- 9	6	1 1/4	- 1/2	-28.5	(3)	-	-	-2.44	-
	N SPERRY RAND	19- 40	38 3/4	27 1/4	+2 3/8	+9.5	21540	7450	11062	2.36	12
	A SYSTEMS ENGRG LABS	11- 49	46 3/8	14 1/2	-1 1/2	-9.3	1902	4138	5302	0.78	19
	N SYSTRON DONNER	8- 29	26	10 7/8	+1 1/8	+11.5	759	508	699	0.71	15
	N VARIAN ASSOCIATES	10- 29	27 7/8	13 1/2	+ 3/4	+5.8	2431	1906	3899	0.68	20
	O VIATRON	1- 51	34 3/4	1 1/2	- 5/8	-29.4	(3)	-	-	-3.38	-
	N WANG LABS	19- 52	47	29 3/8	-3 1/8	-9.6	633	909	1802	0.81	36
	A WYLE LABS	3- 10	8 5/8	4 1/8	+ 5/8	+17.8	647	517	808	-0.04	-
	N XEROX	66-116	106	86 5/8	+ 1/8	+0.1	9320	11251	15069	2.33	37
	O ADVANCED MEMORY SYS	10- 38	N/A	22 1/2	0	0.0	(3)	-	-	-	-
	N AMP	41- 59	51 1/2	56	+1 3/4	+3.2	1473	1311	2284	2.01	28
	N AMPEX	13- 49	45 5/8	17 3/8	- 1/8	-0.7	3891	4388	5414	0.78	22
	O APPLIED MAGNETICS	9- 26	21 1/4	16 1/4	+ 1/4	+1.5	(3)	-	-	0.54	30
	O ASTRODATA	1- 35	N/A	1 1/2	+ 1/8	+33.3	(3)	-	-	-	-
	O ASTROSYSTEMS	2- 9	8 3/4	5 3/4	- 1/8	-2.1	(3)	-	-	-	-
	N BUNKER RAMO	6- 15	14	10 1/4	+ 1/8	+1.2	2804	3164	3783	0.49	21
	A CALCOMP	11- 36	26 1/2	24 1/4	-10 5/8	-30.4	7343	6211	4942	0.49	49
	O CHALCO INDUSTRIES	1- 5	N/A	2	+ 3/8	+23.0	(3)	-	-	-	-
	O CODEX	3- 38	N/A	6 1/4	+ 1/2	+8.6	(3)	-	-	-	-
	O COGAR	37- 94	72	65	+14	+27.4	(3)	-	-	-	-
	O COGNITRONICS	3- 14	13 3/4	6 1/4	- 5/8	-9.0	(3)	-	-	-0.30	-
	N COLLINS RADIO	10- 37	35 7/8	14	- 3/4	-5.0	1509	1355	1931	-0.37	-
O COMCET	4- 50	47	7 1/4	+2 3/8	+48.7	(3)	-	-	-	-	
O COMPUTER COMM	5- 36	35	7	- 1/4	-3.4	(3)	-	-	-0.41	-	
O COMPUTER CONSOLES	6- 22	20 1/2	6 3/4	- 5/8	-8.4	(3)	-	-	-	-	
A COMPUTEST	12- 28	25 1/2	14 1/8	+1	+7.6	446	567	517	0.98	14	
N CONRAC	11- 32	31	16 3/8	+1 5/8	+11.0	440	538	438	1.00	16	
O DATA 100	5- 17	16 1/2	10 3/4	+3 1/2	+48.2	(3)	-	-	-	-	
A DATA PRODUCTS	5- 26	23 5/8	6 1/4	0	0.0	(3)	-	-	0.25	25	
O DATARAM	2- 16	N/A	3	+ 1/2	+20.0	(3)	-	-	-	-	
O DATA RECOGNITION	1- 10	N/A	4	- 1/2	-11.1	(3)	-	-	-	-	
O DATASCAN	4- 27	23	6 1/2	+2	+44.4	(3)	-	-	-	-	
O DIGITRONICS	3- 14	13 1/4	4 3/4	+1 3/8	+40.7	(3)	-	-	-0.18	-	
A ELEC ENG OF CAL	4- 15	14 1/4	5 1/4	+1 1/8	+27.2	253	88	175	-0.20	-	
N ELEC MEMORIES + MAG	7- 40	36	8 5/8	+ 3/8	+4.5	4806	5293	6351	0.20	43	
N EXCELLO	17- 28	24 3/4	23 3/8	+3 3/8	+16.8	1705	1628	1030	2.22	11	
O FABRI-TEK	2- 8	6 3/8	2 1/4	- 1/2	-18.1	(3)	-	-	-0.09	-	
O FARRINGTON MFG	1- 17	17	1 3/4	- 1/8	-6.6	(3)	-	-	-2.14	-	
A GERBER SCIENTIFIC	9- 39	25	11 7/8	- 3/8	-3.0	384	179	380	0.65	18	
O GRAPHIC SCIENCES	8- 42	39 1/4	16 1/2	+1 5/8	+10.9	(3)	-	-	-1.56	-	
A HI-G	5- 17	11 5/8	5 1/4	- 1/8	-2.3	(3)	-	-	-0.07	-	
O INFORMATION DISPLAYS	4- 20	20	6 1/4	- 1/4	-3.8	(3)	-	-	-	-	
A ITEL	6- 26	22	14 7/8	-1 1/8	-7.0	(3)	-	-	0.90	17	
O LOGIC	4- 14	13 1/2	4 3/4	+ 3/4	+18.7	(3)	-	-	-	-	
A MILGO	15- 41	35 3/4	23	-5	-17.8	5170	5749	10849	1.11	21	
N MOHAWK DATA SCIENCES	19- 87	78 3/8	23 1/4	-3 1/4	-12.2	2471	4668	6045	1.43	16	
O NORTH ATLANTIC IND	2- 8	6 3/4	2 1/2	+ 1/4	+11.1	(3)	-	-	0.70	4	
O OPTICAL SCANNING	11- 52	51	13 1/2	0	0.0	(3)	-	-	-0.54	-	
A POTTER INSTRUMENTS	15- 43	37 1/2	18	- 5/8	-3.3	2838	891	3035	0.90	20	
O RECOGNITION EQUIP	12- 84	74	16	+1 7/8	+13.2	(3)	-	-	-2.15	-	
N SANDERS ASSOCIATES	7- 30	27 5/8	13 1/2	+1 3/4	+14.8	1678	1272	1525	0.19	71	
N SANGAMO	9- 29	24 1/8	14 5/8	+ 1/8	+0.8	1013	844	1156	0.46	32	
O SCAN-DATA	5- 53	48	8 1/2	+2 1/4	+36.0	(3)	-	-	-	-	
A SEAELECTRO	4- 13	11	4 7/8	+ 3/4	+18.1	187	144	224	0.07	70	
O SYKES DATATRONICS	2- 9	N/A	3	+ 1/8	+4.3	(3)	-	-	-	-	
O TALLY	10- 23	19	11 3/4	- 1/4	-2.0	(3)	-	-	0.21	56	
N TELEX	10- 26	20 1/4	15 5/8	-4 3/4	-23.3	27228	20972	30777	0.99	16	
N TEXAS INSTRUMENTS	62-135	132	79 3/4	-1	-1.2	2067	3703	3816	3.08	26	
O VARIFAB	1- 5	4 3/4	2 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;

EXCH	COMPANY	PRICE					VOLUME (IN 100'S)			EARNINGS	
		1970/71 RANGE (1)	1 YEAR AGO	CLOSE JAN. 8, 1971	MONTH NET CHG.	MONTH % CHG.	THIS MONTH (3)	LAST MONTH	AVG. VOLUME (2)	PER SHARE LATEST 12 MONTHS	PRICE-EARNINGS RATIO
A	APPLIED DATA RESCH	4-24	23	5 1/8	+ 1/2	+10.8	333	350	773	-0.31	-
O	APPLIED LOGIC	1-18	N/A	1 1/2	+ 1/2	+50.0	(3)	-	-	-	-
O	ARIES	1-8	7	1 3/8	- 1/4	-15.3	(3)	-	-	-	-
N	AUTOMATIC DATA PROC	22-48	42 7/8	45 3/4	-1 1/2	-3.1	1383	2052	3378	0.70	65
A	BOLT, BERANEK, NEWMA	5-11	10 1/2	6 1/8	+ 1/8	+2.0	(3)	-	-	0.26	24
O	BOOTHER COMPUTER	8-26	23 1/2	14 1/4	+1 1/2	+11.7	(3)	-	-	1.57	9
O	BRANDON APPLIED SYS	1-10	N/A	1	- 1/8	-11.1	(3)	-	-	-	-
O	COMP ENVIRONMENTS	1-14	N/A	1	- 1/4	-20.0	(3)	-	-	-	-
O	COMPUTER EXCHANGE	3-8	6 1/2	3 3/4	- 1/4	-6.2	(3)	-	-	-	-
A	COMPUTER INVESTORS	4-12	11 1/4	8 3/4	+1 5/8	+22.8	363	165	281	0.57	15
O	COMPUTER METHODS	1-3	2 1/2	1/2	- 1/8	-20.0	(3)	-	-	-	0
O	COMPUTER PROPERTY	4-15	N/A	5 3/4	+ 3/4	+15.0	(3)	-	-	-	-
N	COMPUTER SCIENCES	6-34	32 1/4	9 3/8	- 3/4	-7.4	4157	4175	9744	0.16	59
O	COMPUTER TECHNOLOGY	2-13	N/A	5 5/8	+1	+21.6	(3)	-	-	-	-
O	CTC COMPUTER	1-19	18 1/2	2 7/8	+ 3/4	+35.2	(3)	-	-	-	-
O	COMPUTER USAGE	2-9	8	5 1/4	+ 1/4	+5.0	(3)	-	-	-2.05	-
A	COMPUTING + SOFTWARE	18-76	66	29 7/8	-1 1/4	-4.0	734	1167	1874	1.32	23
O	COM-SHARE	3-15	N/A	5 1/2	+1 1/4	+29.4	(3)	-	-	-	-
O	CYBERMATICS	5-14	11 1/4	8 1/4	- 3/4	-8.3	(3)	-	-	-	-
O	DATA AUTOMATION	1-24	N/A	1 7/8	+ 5/8	+50.0	(3)	-	-	-	0
O	DATA DYNAMICS	1-4	N/A	1	+ 1/4	+33.3	(3)	-	-	-	-
N	DATA PROC FIN + GEN	7-32	31 3/8	11 7/8	+ 5/8	+5.5	3262	4116	3489	0.36	33
O	DATA SYSTEMS ANALYST	2-6	N/A	2 1/2	+ 1/4	+11.1	(3)	-	-	-	-
O	DATRONIC RENTAL	2-8	5 1/2	2	- 1/2	-20.0	(3)	-	-	-	-
A	DEARBORN COMPUTER	10-25	22 7/8	25	+5	+25.0	713	349	589	1.96	13
O	DECISION SYSTEMS	1-5	N/A	1/2	- 3/4	-60.0	(3)	-	-	-	-
O	DIGITAL APPLICATIONS	2-7	5 1/2	1 1/2	- 7/8	-36.8	(3)	-	-	-	-
O	DIGITEK	1-5	N/A	1 1/4	0	0.0	(3)	-	-	-	-
A	DPA, INC	3-10	10	5	+1	+25.0	819	556	673	0.69	7
O	EFFICIENT LEASING	1-5	4	7/8	- 3/8	-30.0	(3)	-	-	-	-
A	ELEC COMP PROG INST	3-12	10 3/4	3 5/8	+ 1/8	+3.5	175	217	347	0.01	363
O	ELEC DATA SYSTEMS	31-161	153	64 3/4	+6 1/4	+10.6	(3)	-	-	0.67	97
A	GREYHOUND COMPUTER	5-14	13 1/2	7 5/8	+1 1/4	+19.6	529	243	349	0.76	10
O	INFORMATICS	4-21	19 3/4	7 3/4	+1 3/4	+29.1	(3)	-	-	0.04	194
O	INTL COMPUTER	1-8	6	2 1/4	+ 1/4	+12.5	(3)	-	-	-	-
N	INTL COMPUTER SCI	1-3	N/A	1	+ 1/8	+14.2	(3)	-	-	-	-
L	LEASCO	7-31	27 1/2	17 1/8	+2 7/8	+20.1	15689	9991	8359	-	-
O	LEVIN-TOWNSEND	3-19	18 1/4	5 1/8	+ 1/8	+2.5	(3)	-	-	-1.20	-
O	LMC DATA	1-4	2 1/4	5/8	0	0.0	(3)	-	-	-	0
O	MGMT ASSISTANCE	1-4	N/A	7/8	+ 1/4	+40.0	(3)	-	-	-	-
A	MANAGEMENT DATA	7-26	20 3/4	8 3/8	+ 5/8	+8.0	288	111	231	0.69	12
O	NATIONAL COMP ANAL	1-9	7 1/2	1 1/2	- 7/8	-36.8	(3)	-	-	-	-
N	PLANNING RESEARCH	14-53	50	16 3/4	-1 1/2	-8.2	2229	2302	2857	0.72	23
O	PROGRAMMING METHODS	9-27	20 1/2	17 1/2	+2	+12.9	(3)	-	-	-	-
L	PROGRAMMING SCIENCES	1-17	N/A	1	+ 1/4	+33.3	(3)	-	-	-	-
O	PROGRAMMING SYSTEMS	2-6	4	2 1/8	+ 1/8	+6.2	(3)	-	-	0.14	15
O	SCIENTIFIC COMPUTER	1-4	3	1 7/8	+ 1/8	+7.1	(3)	-	-	0.09	21
N	SCIENTIFIC RESOURCES	2-15	13 7/8	3 7/8	+ 3/8	+10.7	2785	2178	3709	-0.98	-
O	SYSTEMS CAPITOL	1-8	6 1/2	4 1/8	+1 7/8	+83.3	(3)	-	-	-	-
O	TIME SHARE	1-9	N/A	1 3/8	+ 3/4	+120.0	(3)	-	-	-	-
O	TRACOR COMPUTING	2-8	7 1/4	2 1/8	0	0.0	(3)	-	-	-0.89	-
A	URS SYSTEMS	5-21	26 1/4	7 1/2	+ 3/4	+11.1	(3)	-	-	0.41	18
O	UNITED DATA CENTERS	1-5	3 1/2	2 1/2	+ 1/2	+25.0	(3)	-	-	-	-
N	UNIVERSITY COMPUTING	14-99	95 3/8	20 7/8	- 5/8	-2.9	3979	6662	13291	0.97	22
O	US TIME SHARING	2-14	N/A	1 3/4	- 1/4	-12.5	(3)	-	-	-	-
N	ADAMS MILLIS	8-15	13 3/4	14 7/8	+3 1/4	+27.9	904	438	476	1.19	13
O	BALTIMORE BUS FORMS	6-21	N/A	6 1/4	-1	-13.7	(3)	-	-	-	-
A	BARRY WRIGHT	6-25	23 3/8	8 3/8	- 7/8	-9.4	565	509	578	0.62	14
A	CAPITOL INDUSTRIES	12-54	52 1/4	18 1/4	+2	+12.3	1190	1328	1519	1.44	13
A	DATA DOCUMENTS	15-36	33	21	+3 3/8	+19.1	161	92	118	1.68	13
O	DATA PACKAGING	5-29	28 1/2	7 3/8	+1 5/8	+28.2	(3)	-	-	0.51	14
N	DENNISON MFG	11-25	22 7/8	22 5/8	+1 3/4	+8.3	2067	832	1345	1.54	15
N	DUPONT	93-135	104 5/8	134 3/4	+5 3/4	+4.4	3245	3551	3820	7.02	19
N	ENNIS BUSINESS FORMS	9-19	18 7/8	11 3/4	+1 1/4	+11.9	810	493	359	0.85	14
O	GENERAL BINDING	14-31	30 1/2	25 1/2	+ 1/2	+2.0	(3)	-	-	0.84	30
O	GRAPHIC CONTROLS	5-17	17 1/4	6 1/2	- 1/8	-1.8	(3)	-	-	0.27	24
O	LEWIS BUSINESS FORMS	10-20	19 1/2	10 1/4	- 1/4	-2.3	(3)	-	-	0.85	12
N	MEMOREX	46-167	153 1/2	53 7/8	-26 5/8	-33.0	14686	9010	12717	1.53	35
N	3M	72-115	113 1/2	96 7/8	- 1/8	-0.1	2406	5401	5333	3.31	29
O	MOORE CORP LTD	27-39	N/A	37 1/4	+1 1/4	+3.4	(3)	-	-	-	-
O	REYNOLDS + REYNOLDS	25-49	46 1/2	36 3/4	- 3/4	-2.0	(3)	-	-	1.49	25
A	SAFEGUARD INDUSTRIES	7-16	14 3/4	10 5/8	+ 7/8	+8.9	749	746	542	0.81	13
O	STANDARD REGISTER	17-31	29 1/4	20 3/4	+2 3/4	+15.2	(3)	-	-	1.98	10
N	UARCO	22-39	35 3/4	26 1/4	+ 1/2	+1.9	106	109	180	2.16	12
O	WALLACE BUS FORMS	9-21	19 7/8	17 7/8	- 1/8	-0.6	(3)	-	-	1.17	15
<b>AVERAGES</b>		<b>COMPUTER STOCKS</b>	<b>12-36</b>	<b>37.34</b>	<b>18.49</b>	<b>+0.13</b>	<b>+0.7</b>			<b>0.74</b>	<b>25.0</b>
		<b>DOW JONES INDUSTRIALS</b>	<b>631-838</b>	<b>800.36</b>	<b>837.01</b>	<b>+11.09</b>	<b>+1.3</b>			<b>3.19</b>	<b>16.0</b>

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# CORPORATE PROFILE

Featured this Month:

## **REPCO INCORPORATED** (wholly-owned subsidiary of Scope, Inc., Reston, Va.)

1940 Lockwood Way  
Orlando, Fla. 32804

**OFFICERS:** Paul K. McKenney, Jr., President; Howard H. Howland, Vice-Pres.-Marketing; John P. Daly, Vice-Pres.-Engineering; George W. Madison, Jr., Secy.-Treasurer.

**BACKGROUND:** Incorporated in November 1961, the company began operations in early 1962, primarily on special electronic items and sub-assemblies on government contracts. The primary products were highly sophisticated VHF-FM portable transceivers. Since then, government contract work has been phased out and the company has oriented itself toward commercial markets.

In late 1968 Repco was acquired by Scope Inc., of Reston, Va. The latter company designs, develops, and manufactures specialized electronic equipment on government contracts. These include electronic warfare items, information acquisition and analysis equipment, and specialized classified products. In addition, Scope has developed a number of items for future commercial use, including an impactless printer transferred to Repco for finalization of design, marketing, and manufacturing.

**FACILITIES:** Repco Inc., occupies a 36,000 square foot facility located in Orlando, Fla. Additional research and development work is carried on at the headquarters of the parent company which occupies a building of 80,000 square feet in Reston, Va. Repco employs approximately 275 people.

**PRODUCTS:** Repco manufactures and markets products in three groups: 1. **EDP Products:** Initial product in this category is an inexpensive, high-speed, electrostatic, impactless printer originally developed at Scope Inc. and more recently transferred to Repco for finalization of design, manufacturing, and marketing. The unit is designed for use as a hard copy device with CRT's or as a printer for minicomputers. It can be interfaced

with a variety of equipment now on the market and adjusted to print at variable speeds from 1 cps to 120 cps. A printer with keyboard will be available shortly. 2. **Mobile Communications Products:** Repco's VHF-FM portable transceivers have captured wide reception in domestic and foreign markets. 3. **Special Products:** For the fast growing market in data acquisition and transmission equipment, particularly for use in environmental monitoring, remote alarm, and reporting, Repco has developed a wide range of telemetry transmitters and receivers. This equipment is used to enter data into the large computer systems of research centers.

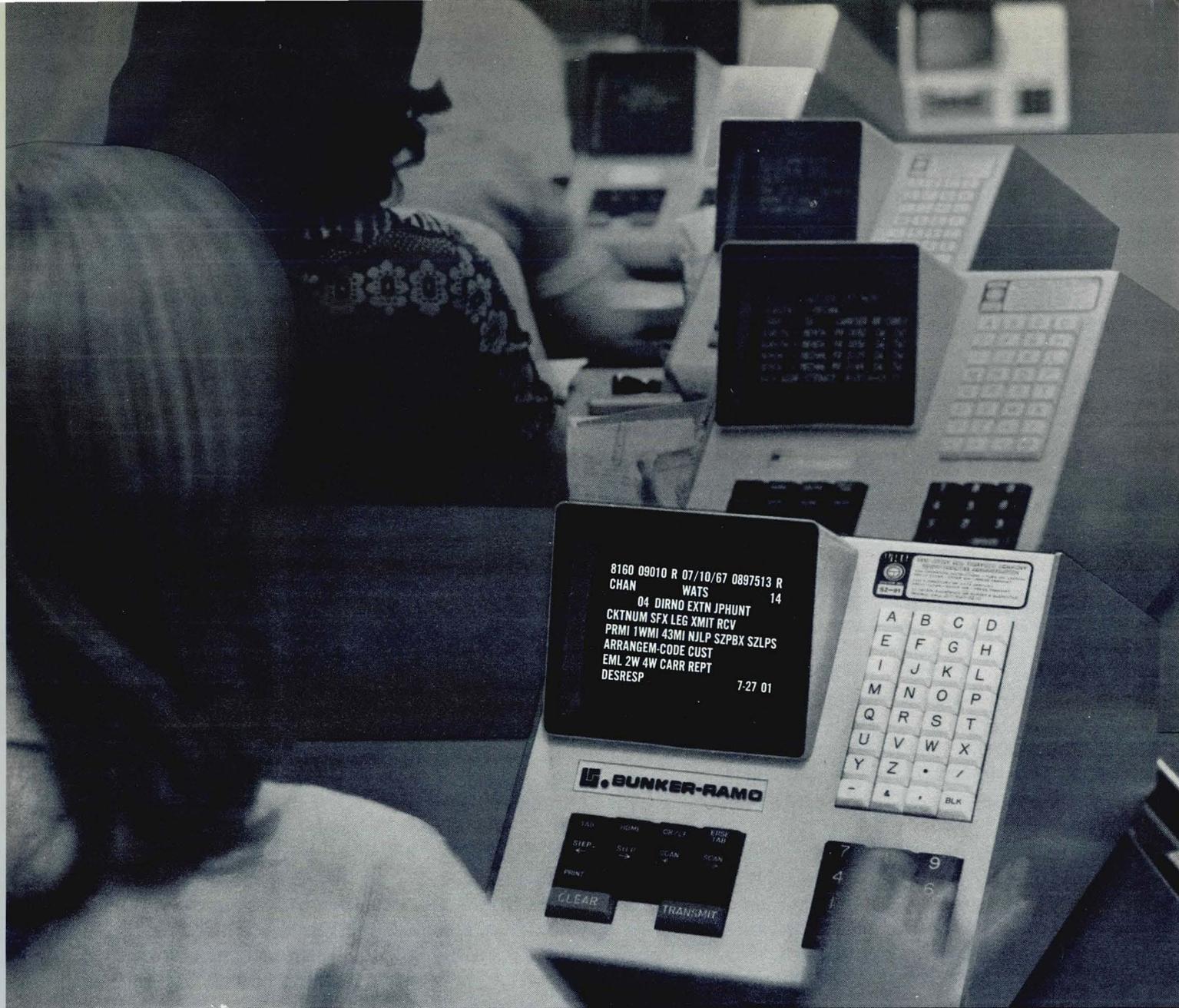
**CURRENT POSITION:** The financial results of Repco Inc. are understandably confidential. However, the consolidated statement of the parent company, Scope Inc. is reported here.

The company is in a strong financial position with a current ratio of approximately 8 to 1. Its cash position is more than adequate to fund product development and marketing efforts to expand its current product line and enter new markets.

**OUTLOOK:** Repco each year has shown steady growth and profits even during the current recession. Through investment in research and development of new products, expansion of marketing facilities, and sales outlets, Repco expects that its 1971 growth rates will exceed those of the markets in which it participates.

### **SCOPE INC.** YEAR ENDED DECEMBER 31

	Sales	Net Income	Earnings Per Share
Six months (ended 7/3/70)	\$ 6,188,946	\$ 292,793	\$.26
1969	15,658,798	583,528	.52
1968	16,461,088	1,060,061	.93
1967	10,027,789	232,255	.22



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CIRCLE NO. 12 ON INQUIRY CARD

# DATA NETWORK CONTROL

JOSEPH T. REUSS, Corporate Tele-Communications Dept. • The Singer Co., New York, N.Y.

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

The problems encountered in implementing, operating, and maintaining data communications services can be extremely frustrating. In such systems, a major problem has always been determining where the vendor's responsibility stops in relation to trouble isolation. Of course, this responsibility has always stopped with that particular vendor's equipment, but recently a new entity has been introduced which complicates the implementation, trouble-shooting, and maintenance problems more than ever before. This new entity is yet another vendor, who provides what is known as the non-Bell modem. Thus, for the user of non-Bell modems, there is now a third vendor who must be considered when the teleprocessing system becomes inoperable. This and other problems, such as poor service quality and excessive dispatch times, have created for the user a need to take a more active part in the isolation of service problems.

The first thing that comes to mind at this point is, then, why use a non-Bell modem if the user must now face new problems? The answer to this question is that there can be many benefits in cost, speed, and physical size to be gained by using non-Bell modems. One must also consider the factors of availability and flexibility. Availability means that such devices can be obtained within reasonably short periods of time, thus cutting down on long installation intervals. Flexibility means that changes in transmission speed and

equipment locations can be accomplished (with the proper circuit design) by merely repatching between data sets.

The long existing problems of operating and maintaining a teleprocessing system — compounded by the introduction of a third vendor — require that the system have an overall directing force or controlling factor. What better entity is there for this than the user himself? The user is the one who has the most to lose if the job is not completed on time, or is not configured correctly, or is a completely inflexible system that cannot be maintained easily and properly.

There are many tactical approaches a user can take in effecting network or system control, but not all include, as they should, the ability to monitor and test in implementation stages, and during everyday operation. The special hardware necessary for such monitoring and testing can be rationalized when one considers that an effective network control system requires not only people who can observe and react to problems, but also hardware which can provide the interface and testing capability to enable fast, accurate, and thorough observations.

In a recent consulting assignment, we were privileged to inspect the Data Network Control Center built and installed by the Singer Company at their Wayne, New Jersey Data Center. The system so impressed us that we invited one of the designers, Joseph Reuss of Singer, to do a guest Clinic on the subject. The center is very unusual in our experience, but represents, perhaps, what is needed by users to cope with the service problems of on-line systems. It is certainly a Cadillac approach. As a followup to this, however, we hope to do a future clinic on some "Volkswagens" — individual pieces of data communication equipment on the market and their application to user problems.—**Berglund Associates, Inc.**

As a case in point, the Singer Company has installed a data network control system which was designed and manufactured by the company at its Tele-Signal Division in Woodbury, Long Island. Emphasis in developing the hardware was given to simplicity of use, modularity, and total interconnection with both private line and dial-up data communication services. Connections to the system are to patch panels, permitting interconnections on an as-required basis. The system interfaces both the analog and digital sides of equipment on private line circuits using non-Bell modems or multiplexers. Interface access to Bell modems is confined to the digital side only. Those services using data access arrangements and non-Bell modems with dial-up capability have interface access on the analog and digital sides of the device; dial-up services using Bell modems have interface access on the digital side only. Monitoring and testing is accomplished by the use of a specially designed key panel and by patches which connect the available test devices to any individual data circuit. The test devices are usable for both electronic and control logic evaluation of the data link. These devices include an oscilloscope, bit transmission test set, transmission level measuring meter, and an EIA lead status display.

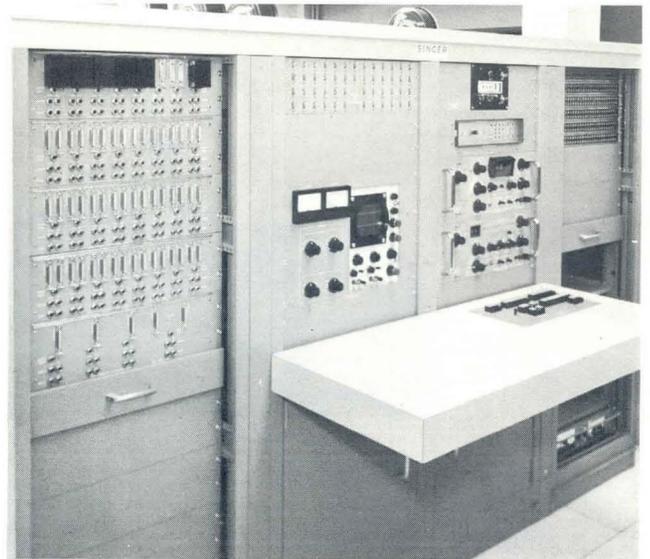
As the backbone of our data network control, we use this system on a daily basis. All inoperative and new data communication lines are tested through the system before they are considered to be ready for normal operation. Scheduled tests are made of each individual working data line to insure that they are operating within performance standards. The total data network control operation depends heavily on the information obtained through the use of the control center equipment.

Past experience had indicated that when the responsibility for a data line problem was in question, the user had to look forward to a very lengthy inoperative period before service was restored. The ability to test inoperative data lines ourselves has shortened our down-time considerably. The trouble call can now be immediately placed to the responsible vendor, and the problem explained clearly and accurately. The vendor can react faster, and with a much higher degree of certainty that the problem is his to solve.

The testing capability of new data services is an

important feature of the control center. It has enabled us to shorten our implementation time and provide workable data services to our users with the minimum amount of delay. And our users are also assured that their data links with the host computer are of appropriate quality and readily serviceable should problems develop.

The scheduled testing of working data lines is conducted as a preventive measure by catching service outages before they happen. Transmission



The Data Network Control Systems at Singer Corp.'s Wayne, N. J. Data Center

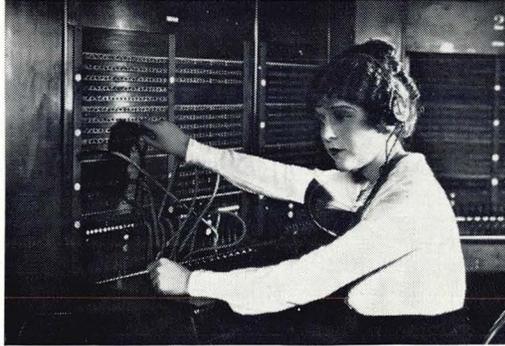
levels are checked and error counts taken on each data line on a periodic basis. This information is then logged and evaluated for indications that a service outage is impending.

The advantages in having this type of testing and evaluation capability are all related to the most important aspect of data communications — service. With the information obtained from the system, the data user can now deal effectively with his vendors in regard to operational problems. The user can also plan more effectively because he can anticipate where a problem may occur which could delay the installation of a new data line or put an existing line out of service. The level of sophistication to which this system has brought us has enabled us to advance teleprocessing within our company at an accelerated pace. ▲

what!



really!



yes, mag  
tape  
terminals



TELETYPE?

It's true.

After helping a jillion feet of paper tape wind and unwind its way through communications systems everywhere, Teletype announces the addition of magnetic tape data terminals.

There are some basic advantages in both mediums. But as you are well aware, the medium that's right for a system depends a lot on the application criteria.

The new magnetic tape data terminals have many operational features that make life less complicated for the operator.



*New, modular line of Teletype® 4210 magnetic tape data terminals.*

For example, take a look at the tape cartridge, which was specifically designed for reliability required for data transmission.

Its vital statistics are: 3" x 3" x 1".

It contains 100 feet of 1/2" precision magnetic tape.

It will hold 150,000 characters of data, recorded at a density of 125 characters per inch. The equivalent of a 1000 foot roll of paper tape.

This means that your data is easier to store, easier to handle, easier to work with than ever before. And it's reusable.

# DATA COMMUNICATIONS

equipment for on-line, real-time processing

The units have a "fast access" switch which will move tape forward or reverse at a speed of 33 inches per second. A digit counter provides a reference point to help locate various areas of the tape.

Four ASCII control code characters can be recorded in the data format to aid character search operations. When the terminal's "search" button is pressed, tape moves at the rate of 400 characters per second

Also magnetic tape adds high speed on-line capability to low speed data terminals.

You can zip data along the line at up to 2400 words per minute. For example: Take a standard speed Teletype keyboard send-receive set, and a typical typist. Add a new magnetic tape unit to this combination and the on-line time savings can pay for the magnetic tape terminal in short order.



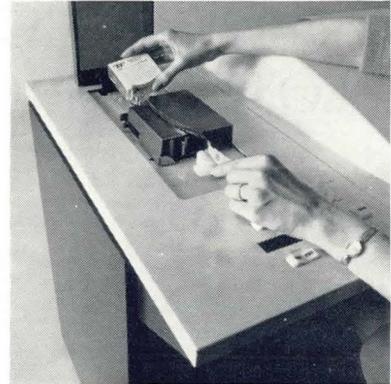
until the control code selected is detected. Then the terminal stops the tape automatically.

A "single step" switch is also provided which enables you to move the tape forward or backward one character at a time. In editing or correcting tape, you can send a single character using this feature.

You can take better advantage of voice grade line speed capabilities.

An operator can prepare data for magnetic tape transmission using the keyboard terminal in local mode. Then send it on-line via the magnetic tape terminal up to 2400 words per minute.

These new modular magnetic tape data terminals offered by Teletype are perfectly compatible with model 33, model 35, model 37 and Inktronic® keyboard send-receive equipment.



*Straight-through threading makes tape loading and unloading exceptionally easy.*

They can send or receive at high or low speed. Or can be used independently as stand-alone terminals on-line.

If you would like to know more about this new line of Teletype magnetic tape data terminals, please write Teletype Corporation, Dept 40-15, 5555 Touhy Avenue, Skokie, Illinois 60076.



*Teletype 4210 magnetic tape data terminal with 37 keyboard send-receive set.*

**machines that make data move**

## THE LOW-COST OCR

LAWRENCE A. FEIDELMAN, Vice Pres. • Information Spectrum Inc., Cherry Hill, N.J.

### THE LOW-COST OCR

The field of optical character recognition has been noted for both its inventiveness and its expensive equipment. The obvious advantage to the data processing manager of having a machine "read" is offset by the \$3,000 a month or more rental he must pay for it. Therefore, only those data processing managers who have seen their data input costs skyrocket have been willing to give OCR a chance. A basic rule of thumb has been that OCR can be economically sound for installations having 8 or more keypunch operators processing about a half-million characters daily.

Potential users having a lower volume could not consider OCR, and borderline volume installations often stayed away from OCR because of a general mistrust of OCR capabilities. Of course, the OCR companies have seen heavy competition from keyboard to tape manufacturers who can sell their equipment to low-volume users and provide low-cost expansion.

Now all that is about to change. The advent of the low-cost OCR machine (under \$20,000) is here. Although such machines are now being manufactured predominantly by smaller companies, they should provide the incentive for additional competition from large manufacturers. The void of low-cost OCR machines has been noted for many years, but marketing, rather than technical capability prevented their appearance.

Interestingly, the manufacturer movement to a lower-cost optical character reader was indirect and due mainly to the remote optical character reader (ROCR), an OCR scanner for transmitting data over telephone lines. These units have the characteristics of being slow, usually hand-fed, and inexpensive. Some manufacturers separated



Fig. 1 Cognitronics' System 70 Optical Character Reader

the scanner and recognition units at opposite ends of the telephone line, but others devised small OCR terminal units which transmit recognized characters instead of scanner data. These reduced data transmission costs since only the character code is transmitted.

With the manufacturing of the OCR data terminal, slight design changes were needed to sell it separately as an OCR reader for under \$50,000. Cognitronics announced its System 70 (Fig. 1), an under-\$35,000 unit having the same capability of reading multi-font and numeric handprint as the ROCR terminal. Infoton, which had a single-font remote optical scanner, similarly announced a self-contained OCR machine. Univac did not produce a terminal, but did announce an under-\$50,000 document reader.

The low-cost OCR breakthrough, however, came with the announcement by Allied Computer Systems, Inc. of a less than \$20,000 numeric single-font document reader. Their ReaDoc System is sold as either a self-contained unit or as part

Mr. Feidelman is a regular contributor to Source Data Automation.



Fig. 2 Sample of coded font scanned by Datatype Corp.'s Dataflow Optical Reading System

of a multi-scanner system with its own computer. ReaDoc is presently being used in such applications as reading turnaround documents for the banking industry. With customer statements, for example, the customer account number is read off the statement and the amount of the accompanying check is entered via an associated keyboard. Also, a small electronics firm, Information Technology, Inc. of Pennsauken, N.J., announced it was manufacturing and selling a similar numeric OCR reader capable of reading four different fonts. Their 3600 model has a display and keyboard for data insertion and error correction; is priced to the OEM market at \$6,000 in orders of 100.

Datatype Corp. of Miami, Fla. decided to take a different approach to OCR and produced an optical page reader which reads a miniature digital code printed under the character (Fig. 2). Their "Dataflow" system, which sells for \$10,000, is certainly a low-cost alternative to keypunching. The data can be typed or printed on the page and can be both read by humans and the machine alike. Although not classified as an optical character reader by purists, it serves the same function and at a lower cost.

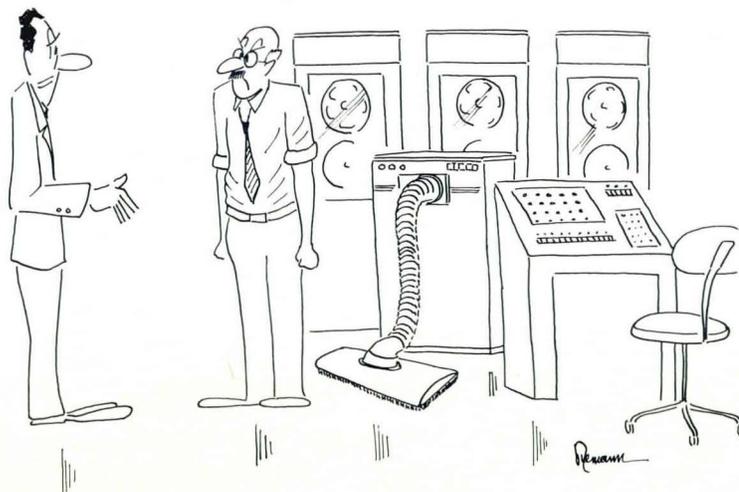
Viatron at one time announced plans to manufacture and market a \$7,000 OCR machine which

would read a specially-designed character font ("Viafont"), but has since stopped production on the unit. Identimation, a subsidiary of Sibany Corp., claims to have developed a handprint reader for under \$4,000 to the OEM markets. An announcement by CDC of a new line of lower-cost optical character readers is expected soon. One would also expect IBM to produce such equipment after its popularity is attained.

The existence of low-cost OCR machines holds great promise for both potential users and the industry. Although these machines can be expected to have limitations in font and document length, a cost breakthrough has occurred and more sophisticated low-cost OCR machines can be expected in the next few years.

Their basic applications at present are for turnaround documents and as keypunch replacements. The user cannot expect either the format flexibility or the multi-font capability of the more expensive machines, but he will have a system that can show definite economic advantages over keypunching. With growing confidence in the capability of OCR at a nominal cost, the marketing of the higher-priced models will be easier.

The advent of the low-cost reader has not come too soon. ▲



*"The chief likes it fine, Smythe, but, he thinks you could clean up your input a bit more"*

# WHAT HATH BABBAGE WROUGHT Dept.

## BRANCH AND GIGGLE

The following item appeared in *The University of Michigan Daily* after a recent Student Government Council election:

"Congratulations to Kirby Dilworth, voter No. 3688. You were the only student in the University of Michigan to vote both "Yes" and "No" on the bookstore referendum in the recent SGC election, and to put your ID number on your ballot. You could have been the 821st person to vote "Yes" or the 834th person to vote "No" or the 258th person to abstain. Instead, you have chosen this unique alternative. Never in all my years of reading ballots and spewing out results have my triodes been so titillated.

(signed) IBM 360/67

Submitted by:  
David K. Polacsek  
Park Forest South, Ill.

## EVERYTHING CLEAR NOW?

The following memorandum was issued by the Department of Computer Science, University of Illinois:

TO: Recipients of 48-Hour Notices  
RE: 48-Hour Notices

From time to time a copy of a 48-Hour Notice that is no longer relevant is included in our mailings. These notices generally refer to those times a piece of equipment or the entire system will not be available for regularly scheduled production. Since 48-Hour Notices are numbered sequentially, these irrelevant notices are included so that recipients of notices can, if they desire, be assured that a more pertinent notice has not been inadvertently omitted.

Submitted by:  
M. J. Foster  
Dept. of Computer Science  
University of Illinois  
at Urbana-Champaign

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

## WE WISH THIS STORY GOT LOST!

An old science fiction story was built around the concept that all of the world's knowledge was stored in digital form in a massive computer memory. With ultrasophisticated micro-miniaturization techniques, this data memory was reduced in size from a cubic mile to the dimensions of a card-file drawer.

Now, with all the world's knowledge thus compactly stored, the problem of access reared its ugly head. First an index file had to be built to reference the data. Then cross-reference files to allow referencing the data in numerous ways. Then cross-reference index files, all in file drawer-size memory banks. Soon the number of index file drawers far exceeded the original data. Then a boo-boo occurred. With thousands of index file drawers, each referencing each other, the original data file was mis-labeled and somehow got lost!

Submitted by:  
George A. Mayerchak  
Minneapolis, Minn.

## PLANNED OBSOLESCENCE

An IBM 7080 computer is still a part of our installation. Recently a programmer submitted an assembly to be run on the 7080. The assembly was terminated with an error message indicating an invalid data control card. After puzzling over this message for a while, the programmer decided to check the 7080 Processor SKL. The manual stated the following for the year portion of the date control card: "specifies the year as 62-70." This was verified by checking the source code for the assembler. Would you believe no assemblies can be run which specify a date greater than 12-31-70?

I'd call this "planned obsolescence" — and now I'm wondering if there's a comparable date set for the 360.

Submitted by:  
Jeffrey S. Dunn  
Northwestern Mutual Life Insurance Co.  
Milwaukee, Wis.

all submissions to:

WHBW DEPT.  
MODERN DATA

3 Lockland Ave., Framingham, Mass. 01701  
All entries become the property of MODERN DATA.

### Concept and design



Gilbert F. Curtis

An honors graduate of Princeton, Gil Curtis is perhaps the industry's most skilled designer of generalized business software systems. Certainly Curtis-designed systems are operating very successfully in literally hundreds of major corporations throughout the U. S.

From this experience evolved the obvious need for a powerful report generator. One that would be easy to use, yet so powerful and fast it could be used as a report utility as well as for on-demand reports. In other words . . . CULPRIT.

### Design and implementation

Anna Marie was literally a co-designer of CULPRIT and the major implementor. A skilled programmer, Anna Marie was able to perform basic CULPRIT functions in virtually I/O time, thus making CULPRIT unbelievably fast.

Anna Marie was at one time a member of the staff of Arthur D. Little, Inc., engaged in product development. Later, she spent a number of years in software design and development. Mrs. Thron holds a B.A. degree in chemistry from Beaver College, Pa.

Anna Marie Thron



### Interface with data base language



James J. Baker

Jim Baker is an M.I.T. graduate (math major and honor society member) who has completed requirements for his Phd at Harvard.

Prior to joining Cullinane Corporation, Jim spent 5 years in advanced software system development at I.B.M. Therefore, Jim was the logical choice to develop the IMS/data language 1 interface module . . . which allowed CULPRIT to enhance the report generator capability of DL 1.

Jim was also a major contributor to the OS version of CULPRIT.

### Documentation

An engineer with a B.S. in E.E. from Michigan State, Ken spent many years in electronics research and software review and evaluation before joining Cullinane Corporation.

He authors a monthly column on software for Modern Data magazine and knows exactly what the user looks for in terms of really effective documentation.

So when Ken wrote the user's manual for CULPRIT he put himself entirely in the user's position. Example: he devoted a major effort to a self-teaching section for junior level personnel . . . but at the same time included substantial material for the advanced CULPRIT user.

Kenneth Falor



# Meet the people behind the most important software package of 1970: new CULPRIT.

Before many months are out the chances are you'll be using CULPRIT. Wherever it has been shown it has generated intense interest. The list of sales is growing quite rapidly. And it is the type of package literally everyone needs.

So we thought you'd like to meet a few of the more important people behind it. There are others. Perhaps a dozen Cullinane staff members had some part in CULPRIT. But these are the four who deserve the credit.

CULPRIT brought us a few surprises. Particularly in speed. While we designed it for flexibility and ease in use CULPRIT turned out to be much faster than our most optimistic estimates. Otherwise it performs exactly as planned.

And what we planned was an easy-to-use report generator and information retrieval system that would allow you to respond to on-demand report requests regardless of report complexity. One that was so efficient it could be used as the report utility in production systems.

#### How CULPRIT differs

Many report generators can produce only one report from one pass of the data file. Others produce a Cobol program which must be com-

plied, link edited and run before they produce a report. Some even have both problems. That's Model T designing!

CULPRIT is a parameter-driven program. No compiling needed. The program is kept on the core image library like a utility and produces a report as directed by the parameter coding. Highly efficient, it produces many reports (up to 99) with a single pass and can extract from multiple input files.

CULPRIT requires from 1/10 to 1/40 the normal coding time. This means that the most junior-level programmer can request and get a simple one-time report in minutes. Or many complex reports in one pass . . . with just a few hours of coding. Not weeks. Hours! But fast reports are not all that CULPRIT can do for you.

#### New Systems

When you design a new system, how much of it is made up of report editing programs? Half? A third? Then you can put your new system on the air nearly one-third to one-half sooner by simply plugging new CULPRIT into the system to handle the reporting requirements. You not only save programming time, but the machine time usually needed for debugging this part of the system.

Processing speeds are close to those for well-designed and laboriously hand-coded programs. Remember . . . this isn't an ordinary report generator. You just load and go.

#### Features

CULPRIT has multi-line output for address labels, notices, etc. Other options include header variables; multiple-lines in headers, detail and totals; separately specifiable total lines; calculation ability on both detail and total levels; use of mnemonics for working fields; and many others. Output may be printer, punched cards, tape or disk . . . permitting program and test file creation and conversion.

#### Find out for yourself!

Send for a complete 15 page technical report. Or, if you'd rather discuss CULPRIT directly with one of the above people (or equally well-qualified Cullinane staff members), pick up your phone and dial (617) 742-8656. You really ought to know about CULPRIT. Don't pass up the chance!



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



# Cullinane Corporation

60 State St., Boston, Mass. 02109 Phone: (617) 742-8656. Other offices in New York, St. Louis, and London.

## SORTING THE PROS FROM THE CONS

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

Many company recruitment officials pride themselves on the large number of applicants they interview before the one applicant who is just right for the job is selected. With such high standards of selectivity, one would assume that their companies would have tremendous productivity and few people-problems, right? Wrong.

A casual glance at the budget projections and the actual expenses of most EDP departments would turn a maggot's stomach. Even the most pre-occupied executives are beginning to worry that something is wrong with the personnel selection criteria. We do such a miserable job of getting the right pegs into the right holes that perhaps some re-thinking of the basic problem is in order.

### ECONOMIC PURITY

The classic personnel procurement philosophy operates on three basic principles: (1) Offer only what it takes to hire people; (2) Pay only what it takes to keep them; (3) Always deny that principles #1 or #2 are significant considerations. That's fairness in the purest sense because the applicant will take as much as he can get and will stay only as long as he can do no better.

Although these principles are empirically derived, it's sufficient to acknowledge that there are not enough exceptions to require further proofs. We must conclude that the economic factors commonly involved in personnel placement are reasonable, systematic, and just. The difficulty of getting the right people in the right jobs lies elsewhere.

### PEOPLE-PROBLEM PROCUREMENT

We shall begin our analysis with two necessary managerial assumptions: (1) That we know what job we want done; (2) That we can generate enough cash to pay for it. The extent to which either of these assumptions is in doubt is attributed to normal managerial risk taking.

This brings us to the recruitment process of Search, Appraisal, and Decision. (If I ever automated such a system, I'd call it SAD) It's sad that most executives are **behind** the power curve and that their companies are hiring people-problems faster than solving their existing ones. The reason for the dilemma is that **most executives have delegated responsibility for recruitment without retaining any means for qualitative control.**

It's well recognized by the top management of most companies that the success or failure of their enterprise largely depends upon the people who do the day-to-day work. This is why top management wants decent help and spends a significant portion of the company's income to get it. The top manager knows that he must get his job done **through people** and he spends a large part of his time working out **people-problems**. It's sad that he has all but lost control over the source point of people-problem production. We don't just **have** people-problems, we **recruit** them!

### QUALITY IS IN THE EYE OF THE BEHOLDER

Your EDP Manager goes through a three-step exercise when he recruits talent: (1) He searches for the most likely applicants; (2) He appraises their qualifications; and (3) He then decides upon whom he will hire. This is a time-honored process; we do the same thing when we select a mate and it's obvious that selection criteria vary widely. In any case, mistakes can be very expensive.

Let's be affirmative about whom your manager will put on your payroll. He will select people with whom he can get along — people who speak his language and who tend to view problems the same way he does. Don't look for a hard-driving, pragmatic man to hire scholars or philosophers unless they're really sharp and able to con him. If he's a technician, don't expect him to hire generalists because they don't dig the environment. If he's mainly oriented toward quick response and short-term projects, don't expect him to hire

people who understand data base integration and maintenance because they all seem to be too academic. There are frightening implications in such a situation. If your EDP manager is primarily a trombone player, you may wind up with seventy-six trombones in your band. Worse yet, there is even a possibility that the seventy-five he hires won't be any better than he is!

This brings us to another affirmative conclusion. An EDP manager who acknowledges himself to be primarily a technician really isn't looking for a replacement so that he can be advanced into a higher management role. Inwardly, he fears such a situation. He will instead make sure that he does **not** hire anyone who might threaten to replace him and leave him with no other place to go. Beware of the absence of upward momentum.

### WHAT'S IT TO YA'?

Whether you're working your way up through it, or are on top of it and wondering why nothing ever goes right, there are several aspects of the recruitment game that you might productively ponder.

Are the guys who approve the recruitment decisions capable of judging talent? The right kind of talent for the job at hand? The kind of people who will be promotable to higher-level management jobs?

If the responsible executive doesn't know, maybe he should find out. If you know the responsible executive doesn't know, maybe you should move to a better-managed outfit.

In years to come we'll find successful companies more dependent upon computer technology and in better control of that technology. Control will be achieved through the classic methods of management and that means working with people, not equipment. When control is achieved, we will see the professionals separated from the con men. The sorting technique, like anything else that really works, will be quite simple. Qualified technicians will do the technical evaluation and a recognized manager will evaluate the applicant's managerial qualifications. It will be amazing to see how many technical problems evaporate under sound management techniques!

### SO WHO'S LOOKING?

It's been suggested here that the people who make the recruitment decisions for your EDP group might not recognize a manager even if he wore a neon sign. And if they did recognize him, they might not be motivated to hire him. After all, they would have so little in common. . . . ▲

## We'll tell you why the world needs another data modem.



For years we've made the test equipment that all the phone companies use to measure the quality of transmission lines. So when it comes to compatible equipment we really know what we're talking about. We'll be happy to tell you what we know. Call or write. We'll talk.



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- I would like to talk about your capabilities.

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Address \_\_\_\_\_  
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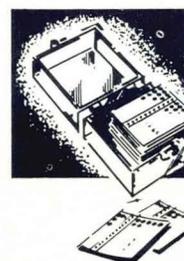
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A precision method of butt splicing, joining or mending of perforated Communications, Numerical Control and Data Processing tapes. . . it's economical and easy to do with the IDEAL Tape Splicer



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# FREE-FORM vs. FORMS-ORIENTED CODING

KEN FALOR, Dir. Mktg. Services • Cullinane Corp., Boston, Mass.

Software people started programming in zeros and ones, then went to Assembly, then Cobol, and Fortran. Now a higher-level means of communicating with the computer is evolving, and recent developments in this area suggest it will have a significant impact on programming in the future. It is the parameter coding of the new generation of report generators, file management systems, output processors, and the like. (See **MODERN DATA**, August, 1970, for a survey of over 100 such systems.)

While there is talk of standardization, most feel it is too early for that, since some new developments are considerably more flexible and capable than those which came along only two or three years ago. In other words, things are still improving too fast.

The biggest problem to any standardization is the question of forms-oriented coding vs. free-form language-like coding. This can be an important

factor in the evaluation for purchase of such packages. Fig. 1 shows several examples of both types.

Although arguments for one or the other are rarely decisive, a few points stand out. The Table 1 notes a few of these. A critical factor seems to be the degree of familiarity with free-form by those who will be the principal users of the system.

There is no clear tendency in the field to go in either direction. Major systems coming from independent software companies tend to be forms-oriented, while IBM seems to favor free-form (as in its JCL).

Our feeling is that free-form coding is best if a person is assigned to a system and uses it enough to develop maximum proficiency. Forms-oriented coding, on the other hand, is better suited to the occasional user. Perhaps this is best illustrated by the well-known problems associated with OS JCL, a powerful free-form language, but one which is extremely difficult for some of the complex operations specified by the average programmer.

We would be interested in your comments. ▲

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

	Free-Form	Forms-Oriented
ADVANTAGES	<ul style="list-style-type: none"> <li>• Easily "collapsed" to simple format for simple requests and use by laymen such as clerks.</li> <li>• Quite flexible when used by programmers proficient in free-form coding such as JCL (especially for OS).</li> </ul>	<ul style="list-style-type: none"> <li>• Fewer mistakes in coding since forms are a memory-jogger.</li> <li>• More easily learned and used by most programmers and professional laymen who must perform complex operations.</li> <li>• Forms often completely self-explanatory.</li> <li>• More quickly learned.</li> </ul>
DISADVANTAGES	<ul style="list-style-type: none"> <li>• More reliance on memory.</li> <li>• More likelihood of mistakes in code.</li> <li>• More frequent reference to manuals necessary for unfamiliar requests.</li> <li>• More difficult to achieve proficiency.</li> </ul>	<ul style="list-style-type: none"> <li>• Less "collapsible" for simple use.</li> <li>• Forms must always be at hand.</li> <li>• Forms can sometimes seem complex and discourage beginner.</li> <li>• Forms can proliferate for complex tasks.</li> </ul>

Table 1 — Free-Form vs. Forms-Oriented Coding



# PRINTERS—Part I:

## Medium- & High-Speed Printers

MALCOLM L. STIEFEL, President • M. L. Stiefel Co.

### INTRODUCTION

This Profile series places the spotlight on printers for the first time since 1968.<sup>1</sup> Long past their barely legible, wavy-lined infancy, but far from reaching their dotage, printers are changing dramatically—they're getting faster, cheaper, and quieter; they're being used in new varieties of system configurations; and the outputs are starting to provide quality copies.

Part I of this series will deal with medium- and high-speed line printers (or page printers). A **line printer** is arbitrarily **defined** to be one **without keyboard** that is driven by an external digital source (computer, communications line, magnetic tape, etc.) to print rows (lines) of alphanumeric data on paper, at no less than 80 columns per line and at a **maximum speed** of not less than 100 lines per minute. This maximum rate excludes anything that trudges along at less than 120 characters per second and omits virtually all of the one-character-at-a-time printers, which will be treated in Part II of this series next month. Interactive printers with keyboards, called telewriters or teleprinters, will be treated in another Technology Profile.

### TYPES OF PRINTERS

Quickly now, without peeking, picture a high-speed line printer in your mind. It looks like the one in Fig. 1, right? 1200 lines a minute; pin-fed, fan-folded paper with green and white horizontal stripes and little holes running up and down the sides. Well, that's called an **impact printer**, and it prints much like a conventional typewriter. An im-

pression is transferred from a type slug on a drum, chain, or wheel to the paper. Ink is provided by a ribbon or a roller, or is incorporated in the paper itself. Multiple copies may be obtained since the character impact — as in a typewriter — can be transmitted through the first or original copy to other sheets in a multi-part form. Another class of impact printers uses a solenoid-driven matrix of points to form a dot matrix character on the paper; they also have multi-copy capabilities.

Then there are the **non-impact** varieties of printers. These include the *shpritzer* types — printers that spray controlled jets of ink onto the page to form the characters. There are also the electrostatic or electrographic non-impact types — printers that use electrodes or other image matrix mechanisms to construct characters on sensitized paper. Another type of non-impact printer utilizes electro-optics to flash an optical image on photographic paper or film to form the character. All of these types are silent — as opposed to the clattering impact varieties — but they can only provide one copy per print run.

### OPTIONS UNLIMITED

Today users are almost overwhelmed by printer options. Speeds can vary from 100 to 5000 lines per minute. Some units have a 50 character font; others carry up to 432 symbols at a time. Some may print at fixed densities of 10 characters per inch horizontally, while others vary horizontal density. Most print at operator-selectable vertical line densities of 6 or 8 lines to the inch, with vertical formatting either done with software and a carriage control tape, or by software alone.

In one common approach, vertical positioning commands on the input line are limited to "Skip One Line" and "Skip To Top Of Next Page." Another option offers "Skip n Lines" and "Skip To

<sup>1</sup>J. H. Levine, "High-Speed Line Printers," MODERN DATA, May, 1968

Next Vertical Tab Stop." The option selected can make a considerable difference in printing time for many types of forms; a "Skip To Top Of Next Page" or "Next Tab Stop" is generally accomplished much faster than a "Skip One Line" or "Skip n Lines" at a time. In one specific case there isn't any vertical control. The printer just runs at a constant speed. The user is responsible for feeding it data; otherwise it degenerates into a large-volume paper towel dispenser.

There are more choices of symbol fonts than you can shake a stick at. Some printers require major surgery to change a font; some can't be changed at all; on others, it's a matter of plugging in a cartridge. In the case of the phototypesetting models, several fonts are available on-line. Moreover, some may be printer/plotters, offering both graphic capability and line printing.

The choices go on and on: 80 to 160 columns of print; page sizes up to 2 feet wide and 2 feet long; fan-folded paper or paper in rolls, perforated or non-perforated; specially treated paper — heat sensitive, light sensitive, pressure sensitive; carbon copies and carbonless copies; and some printers with no duplicate copies at all.

A user with a large computer and a high print-out volume could turn to the **satellite configuration** concept. A print image is recorded on magnetic tape or disk packs on-line, at fairly high speeds. Then the tape or disk pack is physically removed and placed on another device in a separate, cheaper, completely compatible off-line printing system. This technique, termed **off-line printing** or **satellite printing** is likely to spread in the future. It will mature into a complete class of systems which involve all kinds of computer peripherals connected together to transfer and transform information without substantially altering its sequence and content. By strictly limiting processing to parity checking and some elementary logical operations, programming is minimized or avoided entirely, equipment is made simple and reliable, and a few bucks can be saved in overall system operation.

## PICKING A PRINTER

This bewildering array of options becomes more manageable to a user who is trying to pick a printer for his own needs. For instance, if the printer is to be used in a medium-scale data processing operation, the user is likely to turn to the mainframe manufacturer or to someone else who offers a direct replacement for the manufacturer's printer. For this situation the analysis has been done beforehand; the user is sure to wind up with a printer that is well matched in price, speed, and flexibility to the remainder of his data processing system.

For other users, the picture is quite different. The appearance, legibility, and print density become important if the output is to be published and widely disseminated. This leads to an examination of phototypesetting machines, or to a printer that uses an attractive type font with upper and lower case letters.

Virtually any printer maker can supply custom-tailored fonts for customers, at an extra cost. The limitation is in the number of characters in the symbol set, and in the effect of a given font on speed — since printer speed varies inversely (in a non-linear manner) with the size of the font used. Printer speed is also affected (in impact printers) by the relationship between the layout of the symbols around the drum or chain and the frequency of occurrence of each character in the set of sym-



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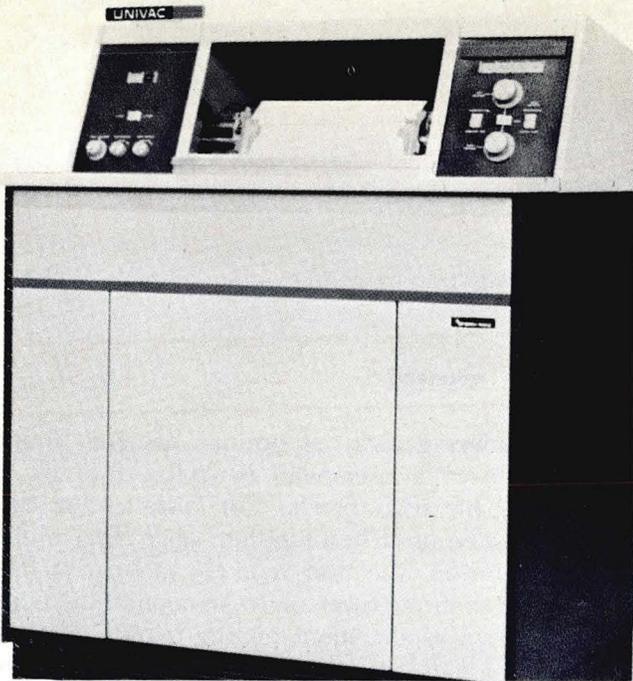


Fig. 1—The Univac 0758-00, a high-speed line printer capable of 1200 LPM with a 63-character drum.

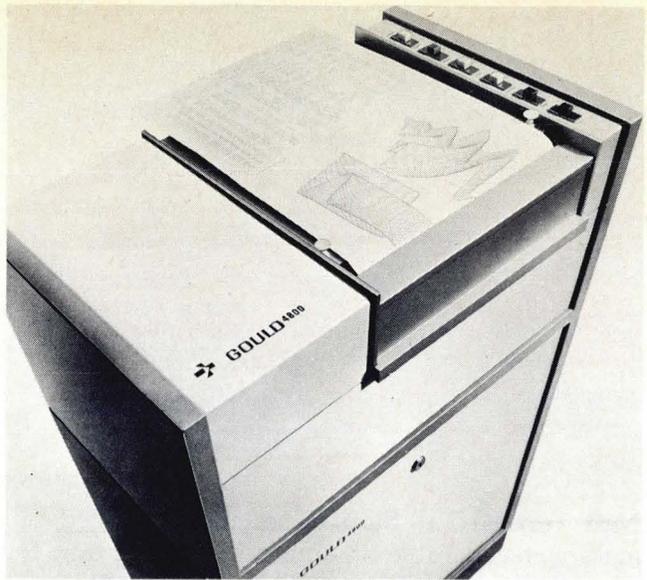


Fig. 4—The Gould 4800 high-speed electrostatic printer/plotter used in on- and off-line printing systems.

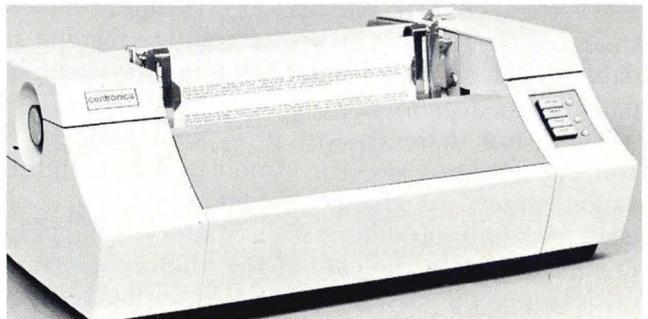


Fig. 5—The Centronics 101 impact matrix medium-speed printer, capable of up to 150 LPM rates.

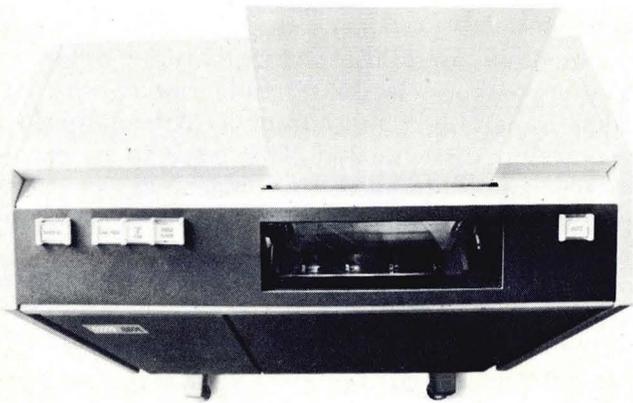


Fig. 2—The Vogue Instrument, Shepard Division's Model 880E medium-speed line printer capable of 400 LPM using a drum of 64 characters.

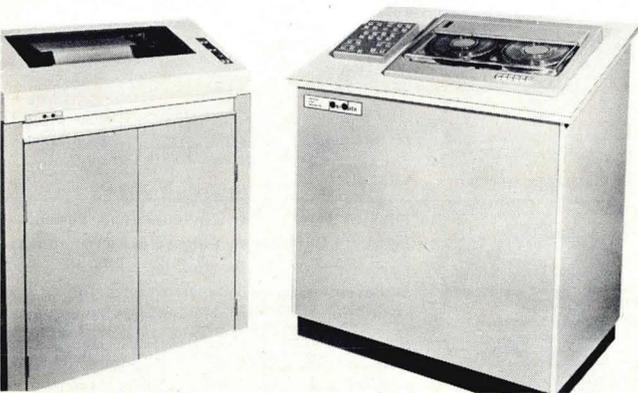


Fig. 3—The MP Series off-line magnetic-tape-to-print system of Per Data, featuring a 600 LPM printer and a 7/9 track tape drive.

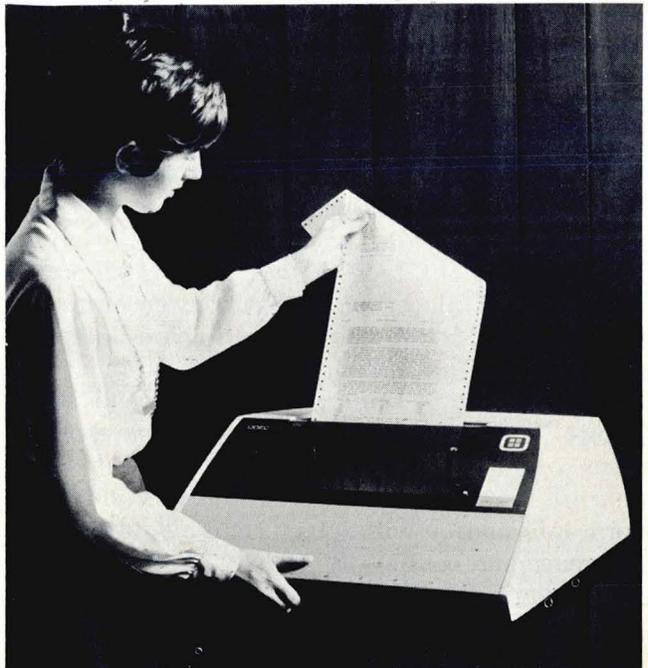


Fig. 6—Odec Computer System Model 801, a 150 LPM, 80-column chain printer with RS 232 interface.

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**TABLE 1 • MEDIUM-SPEED PRINTERS**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	Bright Industries	Centronics Data Computer	Custom Computer Systems	Daconics
MODEL	BI 1215	101	120	2909
PRINTING MECHANISM	Bar	Impact Matrix <sup>1</sup>	Chain	Chain
CHARACTER SET (min/std/max)	64/96/128 Upper & Lower Case	63 Upper Case	64 Upper Case	45/64/96 Upper & Lower Case
DENSITY				
Characters/Inch	10	10	10	10
Lines/Inch	—	6	6 or 8	8
COLUMNS PER PAGE (min/std/max)	132	132	80	20/132
PRINT RATE				
Characters/Sec.	330/500/660	165	—	—
Lines Inch	150/230/300	60/150	120	125/200/300
NO. FORMS (copies)	6	5	6	6
OPERATION	—	—	• Communications Interface • 202 Dataset	• DEC PDP-8/9 • HP-2114/15/16 • HON DDP 116, 316, 516
MAINTENANCE	Std-Serv Co Local Basis	Std-Mfr	Opt-Serv Co Local Basis	Opt \$95/mo
PRICE				
Lease	—	—	\$400/mo	—
Purchase	\$9,000	\$2,400	\$11,500	\$11,900
OTHER FEATURES & COMMENTS	—	<sup>1</sup> 5x7 Dot Matrix	—	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.

bolds. That is, if a printer is typing one fixed letter in each column all the time, a certain speed will be attained; if the symbol in each column is selected somewhat at random, the speed will be lower. Therefore, in reading the specifications, the user must ask, "Under what conditions is this speed obtained?" A printer rated at 1200 lines a minute maximum?" say, might only run at 600 lines under the circumstances that are of interest to a user.

The user with a publishing problem must also take printer speed into account as a separate factor, since print quality is usually lower at higher speeds. Moreover, some of the dot matrix printers may not produce sufficiently legible output for all occasions. A given print output may be perfectly legible if it is viewed directly, but may be unacceptable if it is reduced by an offset technique for reproduction.

The user with a limited budget who almost never needs more than one copy of his printouts, but still needs a high throughput, will want to give the dot matrix printers serious consideration. By the same token, a user like a hospital will only want to consider the silent variety of printers in

their patient care areas; a school or college may only want to consider silent printers that might be in or near classrooms. A user with a fair volume of graphical output may want to consider a slightly more expensive printer/plotter instead of a pure printer.

Users will always want to fit their printers into the existing environment, unless the whole operation is being changed. Therefore, the choice is among printers which can be interfaced with a previously installed computer.

The user who is choosing a complete computer system will see what the manufacturers offer as original equipment before going out to shop for bargain-priced peripherals separately. There might be an advantage to be gained from having one service organization to deal with, since this situation automatically establishes responsibility for all repairs and simplifies communication between the user and the service organization. The issue of multiple service groups must be faced when a user orders from more than one source.

CONTINUED ON PAGE 51 .....

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## LINE PRINTERS—A RAPIDLY GROWING MARKET

One of the fastest growing markets in the EDP industry, the line printer market, is on the verge of an enormous expansion. Contributing to this growth are the technological advances made by printer manufacturers, old and new, and the burgeoning minicomputer and data terminal industries.

### HISTORY

High-speed line printer development began over 20 years ago, and centered around sophisticated printer systems provided for the military, government, and university communities. Early high-speed printers were designed and built for the Aberdeen Proving Grounds in 1950, and have subsequently appeared in military programs such as the Mobile Digital Computer (Mobic), and the Polaris Fleet, White Sands Missile Range, and Minute-man projects. These applications still constitute a large segment of the overall printer market, but they have been rapidly overtaken by the commercial uses for printers that has been stimulated by new pricing of under \$10,000.

### MINICOMPUTER MARKETS

The minicomputer industry is the fastest growing segment of the computer world. Its success comes

from low cost and size which has enabled the penetration of markets that larger computers could not touch. The U. S. Computer Census of June 30, 1970 estimates the cumulative installations of small-size computers at 42,551, with the computers being built by over 20 different companies. Other industry reports show more than 15,000 minicomputers in the field today, with an additional 25,000 in use by the end of 1972.

Now why all this attention to the minicomputer industry? In most cases, the present output device employed with minicomputers is the teletypewriter. The teletypewriter, a work horse for so many years, operates at a speed of 10 cps. The minicomputer user has begun to recognize that his computer system is tied up waiting for information to come over such devices, and is looking for alternate means of printed output. There are low-cost line printers on the market today that are TTL compatible, and can operate at speeds 50 times that of the teletypewriter. The savings in computer and manpower time offsets the difference in price over a very short time period.

### DATA TERMINAL MARKETS

The data terminal market is growing rapidly; the 180,-

000 plus terminals in use this year will probably triple by the end of 1975. The value of existing terminals, about 1.7 billion dollars, will rise to above 5.9 billion dollars within the same period, and forecasts on shipments show increases from the current 500 million dollars to about one billion in 1975.

A recent study for Datran, Inc., conducted by Booz, Allen and Hamilton, indicates that the data communications growth rate will be startling during the first half of the 70's. The study predicts an annual growth rate for all data terminals of 45% in the next five years, bringing the number of terminals in use to 800,000 in 1975 and 2.5 million terminals by 1980.

Very few of the 73,000 large and small computer installations, reported by the U. S. Computer Census, have data transmission capabilities. However, half of the computers manufactured today place a greater emphasis on this capability because the computer, even with the present limitation of a 2,400 baud rate over voice grade telephone lines, can send and receive 100 invoices in less than one minute. The use of a line printer, instead of the slower character printer, permits a significant throughput advantage. Line printer technology is effectively coasting at

transmission rates of 2,400 to 4,800 bps; impact character printing technology cannot presently exceed 300 bps without severe maintenance constraints, and non-impact character printers do not operate reliably above 1200 bps, nor will they produce multiple copies.

Businesses, such as the securities industry, recognize the need for high-speed data transmission, having encountered paper work log jams that demand automation. Even during a small volume day, peak backlogs will develop during the market open and close. A special high-speed printer has been developed for the American Stock Exchange which can replace more than ten ASR 28's, and assures the broker and his clients swift reports on market prices.

Another data transmission area involves the embryonic postal transmission system which companies like Western Union are researching. The concept employs high-speed communication printers which will buoy our archaic postal system by speeding letters to their locations over a closed data communications network. The necessity for this type of automation will become apparent to medium and large organizations as labor and operating costs continue to spiral upward in

the years ahead.

The communications printer also solicits interest from national warehousing organizations, airlines reservations systems, financial institutions, retail credit bureaus, and news media like UPI and AP.

The demand for data transmission facilities will be great enough by 1980 to support outside competition and to justify a separate network dedicated to data transmission. The new Bell System 203 modem allows speeds of 3600 bps and 4800 bps; this translates to print rates of approximately 350 lpm and 450 lpm respectively. The purchaser of a printer must consider these facts if he is to compete effectively in the overall data market. As the processing power of the computer increases, demand will also increase for more effective transmission of data. Computer systems are going to be more widely dispersed due to the advent of the minicomputer, with a network of transmission line connections between remotely-located terminals and the central computer. The cost of long distance data transmission will be considerably reduced as a result of sending data via high-speed lines.

#### **EXPORT MARKETS**

The export market for printers will also be active

over the next three years, particularly in England, Germany, and Japan. An increase of 175% in the sale of minicomputers to the Japanese recently resulted in Japanese companies scrambling to represent American printer firms in their home markets. The *per capita* growth in Europe and Japan for minicomputers will be dramatic in the coming months. Marketing efforts by the minicomputer manufacturer in these foreign markets have created significant sales for printers and other peripherals.

#### **MANUFACTURER CAPABILITIES**

In the printer industry, like most other industries, the most critical ingredient in the corporate capability is its marketing strength. A rising market may be expected to create competition — as evidenced by the offerings today of more than 30 printer manufacturers. While product innovation in today's printer market is rapid, changes may only result in some marginal improvement in performance, and usually are more a matter of technology allowing lower manufacturing costs. Several of the newer manufacturers have already run into difficulties in the building of a low cost, reliable printer, a

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task that at first seemed simpler to achieve than was finally possible.

Keeping the above in mind, a printer manufacturer's marketing capability (and the buyer's evaluation of that capability) may be measured by the following:

■ **Availability of production versions of a well-built, reliable, easy to maintain printer** — You must expect some failure from your printer, and the simpler its design, the more rapidly it can be put back on line. High reliability ultimately reduces the need for excessive field support.

■ **A complete understanding of the applications and objectives of the potential customers** — Many customers don't have the foresight to predict their ultimate needs accurately. Factors to be considered are multi-copy output, print-rates, sound levels, forms, and the price/performance ratio.

■ **A solid sales organization** — The sales staff must be adaptable to the changes in the industry, and be able to counsel and guide its customers in the purchase decisions. Today's printer salesman is oriented either toward OEM sales or end-user sales. He must understand both.

■ **A strong technical support group** — A "total response" to a customer's application involves integrated packages of hardware and software, and the capability to make them plug-to-plug compatible.

■ **A solid service organization** — Post-sales service to customers on a broad geographic base is essential if a company is to sell on a national basis. Many printer manufacturers employ their own service divisions; where national service organizations supplement those of the manufacturer, be certain that such servicing firms fully understand the printer and the interface.

## SUMMARY

These basic elements of marketing will be critical to the success of the printer manufacturer. For the next few years at least, most of the companies in the business will continue to function because the expanding market will allow even marginal producers to survive. The trend toward lower prices will test the marketing and manufacturing efficiencies of the industry, and the success of the printer manufacturer will be characterized by his ability to handle both. ▲

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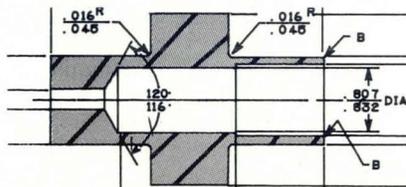
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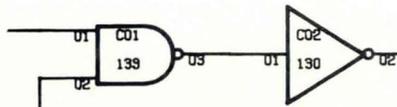
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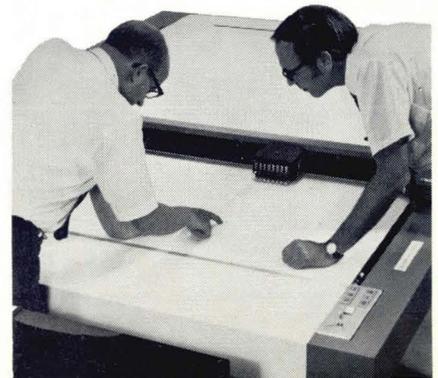


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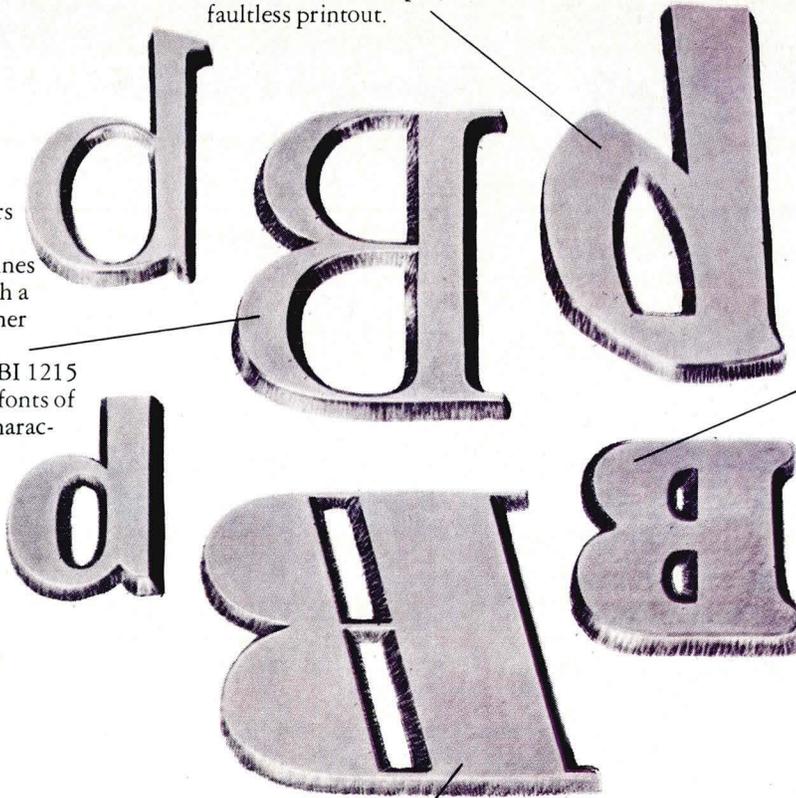
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These characters print crisply, cleanly at 300 lines per minute, with a precision no other line printer can approach. The BI 1215 accommodates fonts of 64, 96 or 128 characters, up to one-quarter inch high; fonts can be changed in the field in minutes.



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**TABLE 1 • MEDIUM-SPEED PRINTERS ..... Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	Data Computing			Data Printer	
	I & IA	II & IIA	III & IV	F-80-C	F-132-C
MODEL					
PRINTING MECHANISM	Impact Matrix <sup>1</sup>	Impact Matrix <sup>1</sup>	Impact Matrix <sup>1</sup>	Drum	Drum
CHARACTER SET (min/std/max)	64 Upper Case	64 Upper Case	96 Upper & Lower Case	64 Upper Case	64 Upper Case
DENSITY					
Characters/Inch	10	10	10	10	10
Lines/Inch	6	6	6	6	6
COLUMNS PER PAGE (min/std/max)	80	132	80(III)/132(IV)	80	132
PRINT RATE					
Characters/Sec.	—	—	—	—	—
Lines/Min.	100	100	100	600	600
NO. FORMS (copies)	6	6	6	6	6
OPERATION	• RS232(I)	• RS232(II)	• RS232	• DEC PDP-8	• DEC PDP 8
MAINTENANCE	Std-Mfr 35 Offices	Std-Mfr 35 Offices	Std-Mfr 35 Offices	Opt-Serv Co	Opt-Serv Co
PRICE					
Lease	\$245/mo(I) —	\$285/mo(II) —	\$270/mo(III) \$315/mo(IV)	—	—
Purchase	\$8,250(I) \$7,425(IA)	\$9,600(II) \$8,640(IIA)	\$ 8,925(III) \$10,600(IV)	\$7,665(OEM)	\$8,690(OEM)
OTHER FEATURES & COMMENTS	<sup>1</sup> 7x8 Dot Matrix	<sup>1</sup> 7x8 Dot Matrix	<sup>1</sup> 7x8 Dot Matrix	—	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.

**SERVICE BUREAU OPTIONS**

The user with an occasional non-standard printing problem might find it hard to uncover a service bureau to suit his needs. General-purpose batch houses will usually employ the computer manufacturer's standard impact printer. Industry-specific service bureaus, especially those in some aspect of the publishing business (subscription fulfillment, book composition, direct mail, etc.) are more likely to carry the more specialized printers. Beyond that, a user in a given industry may know of other companies in the same industry who have the proper equipment.

**MAINTENANCE & ANCILLARY EQUIPMENT**

Maintenance of printers must be studied carefully. For one thing, high-speed printers have an insatiable appetite for paper. Sometimes, if the paper is specially treated, it may be expensive to buy and may only be available from the manufacturer.

Electrostatic printers must periodically drink certain chemicals, like toner or developer, in order to keep their vigor and vitality. Again, the user may not find many suppliers for these materials.

Treated paper usually requires special storage before it's used. It may be kept in an oven or in a refrigerator; in the light, in the dark, or in the shade; in a dry, damp, or wet room — all depending on the nature of the beast. Then it must be handled carefully to avoid smudging.

A burster may be needed if the printer uses fan-folded paper, although printouts are being bound and used unburst more frequently. If the paper comes in a roll, take-up reel is needed, along with a guillotine for cutting the paper to size; however, most roll-input printers have built-in guillotines.

With few exceptions, high-speed printers require some sort of periodic maintenance. In impact printers adjustments must be made, typically every 200 hours of operation, to make sure the printline remains straight. Ribbons must be replaced, or rollers must be inked. Sometimes field

**TABLE 1 • MEDIUM-SPEED PRINTERS ..... Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	A.B. Dick	Digital Equipment		Eclectic
MODEL	9600	LP08	LP11	740
PRINTING MECHANISM	Ink Jet <sup>1</sup>	Drum	Drum	Ink Jet
CHARACTER SET (min/std/max)	64 Upper & Lower Case	64/96 Upper Case	64/96 Upper Case	64/96 Upper & Lower Case
DENSITY				
Characters/Inch	5 to 15	10	10	5 to 15
Lines/Inch	6	6	6	6
COLUMNS PER PAGE (min/std/max)	132	80	80/132	132
PRINT RATE				
Characters/Sec.	250	—	—	250
Lines/Min.	160	356	356	—
NO. FORMS (copies)	1	—	—	1
OPERATION	<ul style="list-style-type: none"> <li>• IBM 360</li> <li>• DECPDP-8</li> <li>• HP 2114/15/16</li> <li>• Data Gen Nova</li> <li>• HON DP 516</li> <li>• Varian 620 i</li> <li>• 201/202 Dataset</li> </ul>	• DEC PDP-8	• DEC PDP-11	• DEC PDP-8, -11 & -12
MAINTENANCE	Opt-Mfr \$65/mo	—	—	Opt Mfr \$75/mo 2 Offices
PRICE				
Lease	—	—	—	\$375/mo
Purchase	\$6,250 <sup>2</sup>	—	—	\$7,500
OTHER FEATURES & COMMENTS	<sup>1</sup> 9 x 11 Dot Matrix <sup>2</sup> Plus Interface	—	—	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.

service personnel are needed to make the adjustments. All of this costs the user some downtime, and some money, but it's inescapable. About all a user can do to minimize maintenance problems is to check on the performance record of the printer and its service company. The printers with fewer moving parts can be expected to poop-out less often than the more complex types, but the state-of-the-art has advanced far enough so that printers are fairly reliable instruments across the board. The user's success in keeping unscheduled maintenance to a minimum will depend, again, on the skill of the service organization.

**THE TABLES**

The Tables are organized to give the potential user a starting point for selecting a printer. They furnish an overview of some of the significant evaluation parameters for medium-speed and high-

speed line printers, and for off-line/satellite printing systems.

Table 1 lists printers having speeds of from 100 to less than 1000 lines per minute, designated as **Medium-Speed Printers**.

Table 2 lists **High-Speed Printers**, printers having speeds in excess of 1000 lines per minute.

**Off-Line or Satellite Printing Systems** are listed in Table 3; printers may be of the medium- or high-speed varieties.

Pricing information for each printer should be interpreted with care. Some manufacturers may cite only the printer price — not including the print controller or interface; others may cite the OEM quantity price — purchases involving from 5 to 500 printers.

Additional information on the printers listed in Tables 1, 2, and 3 may be obtained from the manufacturers by consulting Tables 4, 5, and 6 and keying the appropriate number on the Reader Service Card.

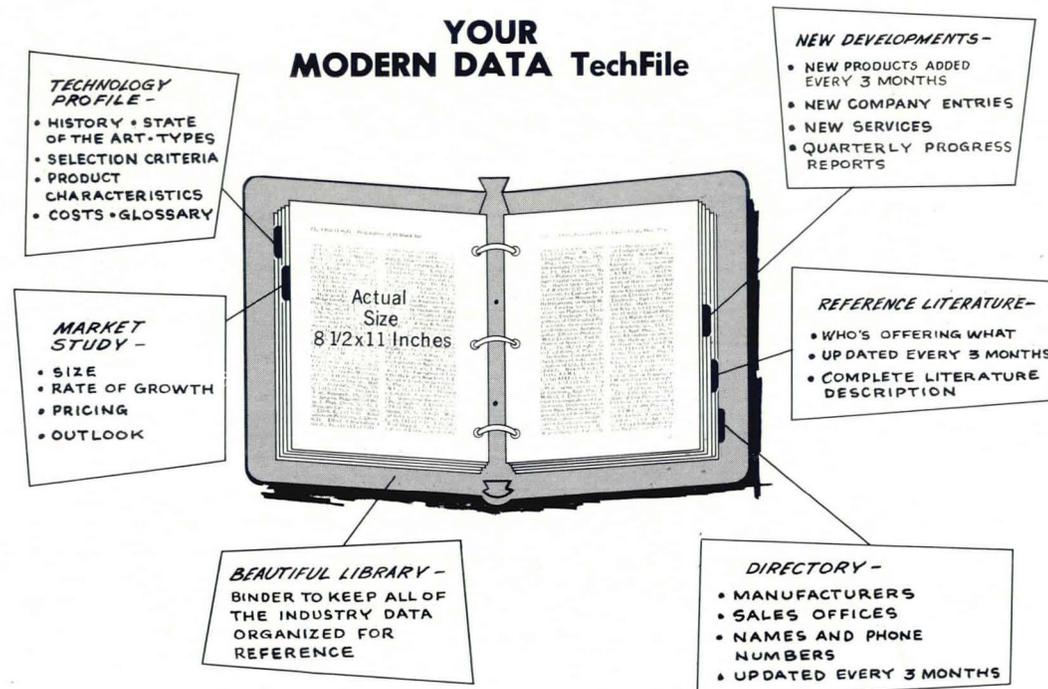
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**TABLE 1 • MEDIUM-SPEED PRINTERS . . . . . Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	Honeywell			
MODEL	112 & 222-7 <sup>1</sup>	122-3 & 222-3 <sup>1</sup>	122-4 & 222-4 <sup>1</sup>	I-543
PRINTING MECHANISM	Drum	Drum	Drum	Drum
CHARACTER SET (min/std/max)	56/63 Upper Case	51/63 Upper Case	46/63 Upper Case	64 Upper Case
DENSITY				
Characters/Inch	10	10	10	10
Lines/Inch	6 or 8	6 or 8	6 or 8	6 or 8
COLUMNS PER PAGE (min/std/max)	120/132	120/132	120/132	128/132
PRINT RATE				
Characters/Sec.	—	—	—	—
Lines/Min.	262/300	550/650	750/950	200
NO. FORMS (copies)	6	8	8	6
OPERATION	• HON Series 200-Models: 110, 115, 120 & 125 (112); Models: 115, 200, 1200, 1250, 2200, 3200, 4200 & 8200 (222-7)	• HON Series 200-Models: 115, 120 & 125 (122-3); Models: 115, 120, 125, 200, 1200, 1250, 2200, 3200, 4200 & 8200 (222-3)	• HON Series 200-Models: 110, 115, 120 & 125 (122-4); Models: 115, 120, 125, 200, 1200, 1250, 2200, 3200, 4200 & 8200 (222-4)	—
MAINTENANCE	Std-Mfr 80 Offices	Std-Mfr 80 Offices	Std-Mfr 80 Offices	Opt-Mfr 80 Offices
PRICE				
Lease	\$424/mo (112) \$560/mo (222-7)	\$784/mo (122-3) \$871/mo (222-3)	\$1,032/mo (122-4) \$1,233/mo (222-4)	—
Purchase	\$20,250 (112) \$25,410 (222-7)	\$35,070 (122-3) \$40,500 (222-3)	\$46,200 (122-4) \$57,375 (222-4)	\$6,730 (OEM)
OTHER FEATURES & COMMENTS	<sup>1</sup> 222-7 Includes Control	<sup>1</sup> 222-3 Includes Control	<sup>1</sup> 222-4 Includes Control	—

**TABLE 1 • MEDIUM SPEED PRINTERS . . . . . Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	IBM			
MODEL	1403-1,2,4,5 & 6	1443	1445	5203
PRINTING MECHANISM	Chain	Chain	Chain	Chain
CHARACTER SET (min/std/max)	48/120 Upper & Lower Case	13/39/63 Upper Case	14/42/56 Upper Case	48/120 Upper & Lower Case
DENSITY				
Characters/Inch	10	10	10	10
Lines/Inch	6 or 8	6 or 8	8	6
COLUMNS PER PAGE (min/std/max)	1	120	113	120/132
PRINT RATE				
Characters/Sec.	—	—	—	—
Lines/Min.	<sup>2</sup>	200/300/600	190/240/525	100/200
NO. FORMS (copies)	—	—	—	—
OPERATION	• IBM 1401, 1460, 1130 & S/360	• IBM S/360 Models 25+	• IBM S/360 Models 25 & 30	• IBM S/3
MAINTENANCE	Opt-Mfr Local Basis	Opt-Mfr Local Basis	Opt-Mfr Local Basis	Opt-Mfr Local Basis
PRICE				
Lease	—	—	—	—
Purchase	—	—	—	—
OTHER FEATURES & COMMENTS	<sup>1</sup> 100-1 & 4 120-6 & 7 132-2 & 5 <sup>2</sup> 340-6 465-4 & 5 600-1, 2 & 7	—	—	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.

**TABLE 1 • MEDIUM-SPEED PRINTERS ..... Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	ICL			Intercomp	Leigh Instruments
MODEL	667	2401	2402	143	1100
PRINTING MECHANISM	Drum	Drum	Drum	Chain	Electrostatic <sup>1</sup>
CHARACTER SET (min/std/max)	64 Upper Case	64 Upper Case	48/64 Upper Case	48/96 Upper & Lower Case	64 Upper Case
DENSITY					
Characters/Inch	10	10	10	10	11
Lines/Inch	6 or 8	6	6	6 or 8	7
COLUMNS PER PAGE (min/std/max)	80/136	96/120	96/120	120/136	80/128
PRINT RATE					
Characters/Sec.	—	—	—	—	—
Lines/Min.	775/880	300	600/750	400/450	180
NO. FORMS (copies)	6	6	6	6	1
OPERATION	—	• ICL 1900 Series	• ICL 1900 Series	• IBM 1130	• Dec PDP-8/L
MAINTENANCE				Std-Serv Co Local Basis	
PRICE					
Lease				\$795/mo	
Purchase				\$24,800	\$6,000
OTHER FEATURES & COMMENTS					• Also Has Plotting Capability <sup>1</sup> 5x7 Dot Matrix

**TABLE 1 • MEDIUM-SPEED PRINTERS ..... Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	Mohawk Data Sciences		Motorola Information Systems	Nortec Computer Devices	
MODEL	4320C	4330	7 MTP	B64	B96
PRINTING MECHANISM	Drum	Chain	Electrostatic <sup>1</sup>	Chain	Chain
CHARACTER SET (min/std/max)	16/64/128 Upper & Lower Case	16/64/128 Upper & Lower Case	64 Upper Case	64 Upper Case	96 Upper & Lower Case
DENSITY					
Characters/Inch	10	10	10	10	10
Lines/Inch	6 or 8	6 or 8	6	6 or 8	6 or 8
COLUMNS PER PAGE (min/std/max)	120/132/160	80/120/136	80	132	132
PRINT RATE					
Characters/Sec.	—	—	300/400	400	330
Lines/Min.	160/300/375	162/300/450	266	200	150
NO. FORMS (copies)	6	6	1	6	6
OPERATION	—	—	—	—	—
MAINTENANCE	Opt-Mfr 100 Offices	Opt-Mfr 100 Offices		Not Available	Not Available
PRICE					
Lease	—	—	—	—	—
Purchase	\$4,700 (OEM)	\$8,780	\$3,850	\$6,000 (OEM)	—
OTHER FEATURES & COMMENTS	—	—	<sup>1</sup> 5x7 Dot Matrix	—	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.

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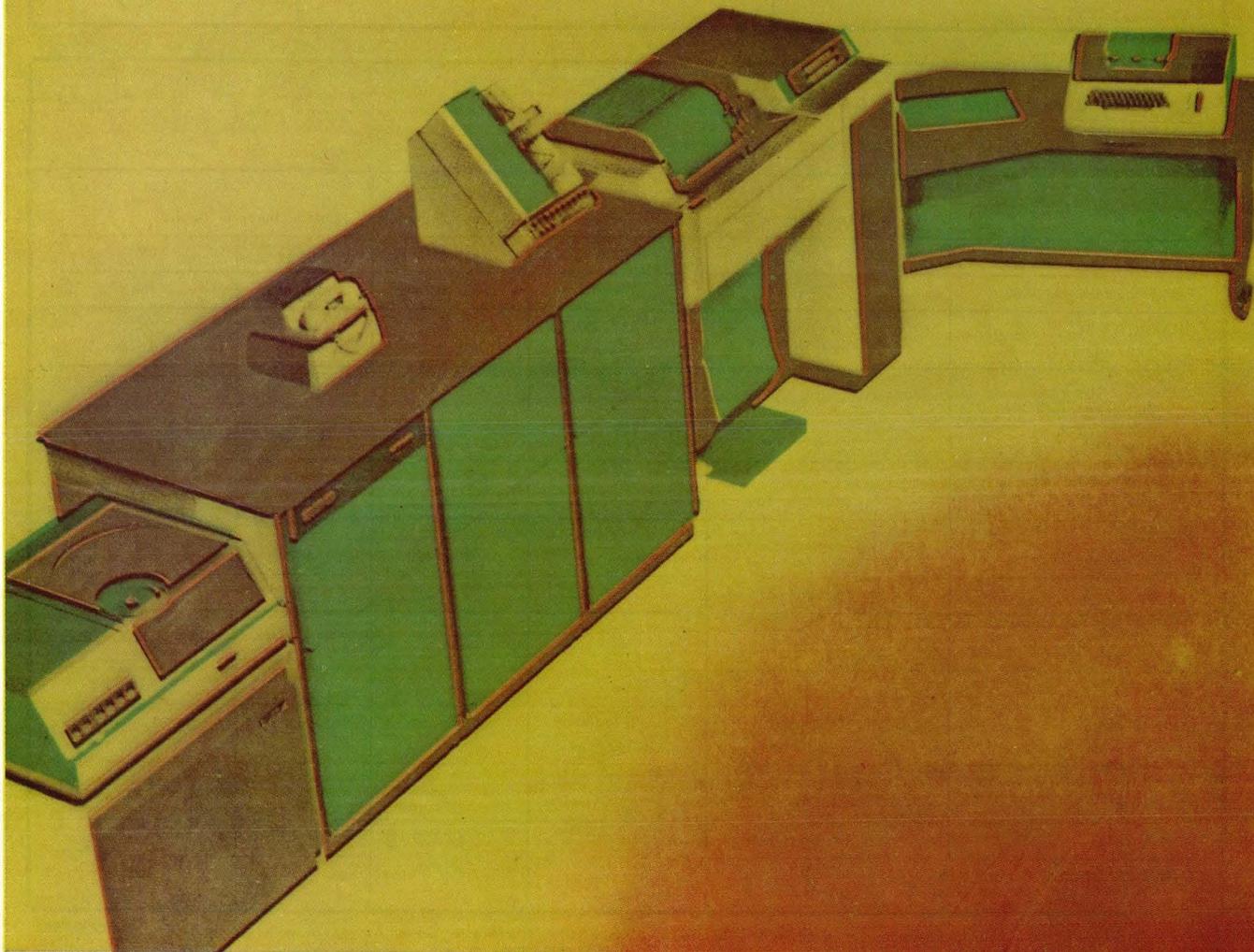
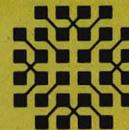
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**TABLE 1 • MEDIUM-SPEED PRINTERS ..... Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	Odec Computer Systems			Per Data	Peripheral Dynamics
MODEL	200	801	1321	LP Series	L100
PRINTING MECHANISM	Chain	Chain	Chain	Drum	8-Col. Wheel
CHARACTER SET (min/std/max)	64 Upper Case	64 Upper Case	48/96 Upper & Lower Case	64 Upper & Lower Case	64 Upper Case
DENSITY					
Characters/Inch	10	10	10	10	10
Lines/Inch	6 or 8	6 or 8	6 or 8	6	6
COLUMNS PER PAGE (min/std/max)	80	80	132	80/132	80/132
PRINT RATE					
Characters/Sec.	—	—	—	—	—
Lines/Min.	205	150	110/210	600	100
NO. FORMS (copies)	6	6	6	7	6
OPERATION	—	• RS 232	• DEC PDP-8, -11 & -15 • Data Gen Nova • HP 2114/15/16 • HON 316 & 516 • Varian 620 i	• HON 316, 516 • Data Gen Nova & Super Nova • Varian 620 i & 520 i • DEC PDP-8, -11 • HP 2114/15A/16B • IBM 1130	—
MAINTENANCE	Opt-Serv Co 17 Offices	Opt-Serv Co \$90/mo 17 Offices	Opt-Serv Co \$100/mo 17 Offices	Std-Mfr/Serv Co Local Basis	Opt-Serv Co 20 Offices
PRICE					
Lease	—	\$145/mo	\$176/mo	—	—
Purchase	—	\$6,500	\$7,900	\$11,000	\$3,000 (OEM)
OTHER FEATURES & COMMENTS	—	—	—	—	—

**TABLE 1 • MEDIUM-SPEED PRINTERS ..... Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	Potter Instrument	Qantel	Repco	Syner-Data	
MODEL	LP 3000	HSP 3502 A	M2-2001	120	Alpha
PRINTING MECHANISM	Impact <sup>1</sup> Scanner	Chain	Drum	Electrostatic <sup>1</sup>	Drum
CHARACTER SET (min/std/max)	64 Upper Case	32/64/192 Upper & Lower Case	64 Upper Case	64 Upper Case	64 Upper Case
DENSITY					
Characters/Inch	10	10	10	10	10
Lines/Inch	6	6 or 8	6 or 8	6	6
COLUMNS PER PAGE (min/std/max)	88/132	80/132	136	80	80/132
PRINT RATE					
Characters/Sec.	300	—	—	120	—
Lines/Min.	135	78/215/360	200	100	300
NO. FORMS (copies)	3	6	10	1	6
OPERATION	—	• DEC PDP-8 • XDS Sigma 2, 5 & 7 • IBM 1130	—	• RS 232B	• DEC PDP-8 • HON 316 • Data Gen Nova & Supernova
MAINTENANCE	—	Opt-Mfr	Opt-Mfr \$75/mo 5 Offices	Opt-Serv Co	Opt-Mfr 4 Offices
PRICE					
Lease	—	—	\$280/mo	—	—
Purchase	\$3,385 (OEM)	\$9,000 (OEM)	\$11,500	\$995 (OEM)	\$6,660
OTHER FEATURES & COMMENTS	<sup>1</sup> 5x7 Dot Matrix	—	—	<sup>1</sup> 5x7 Dot Matrix	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.

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**TABLE 1 • MEDIUM-SPEED PRINTERS . . . . . Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	Teletype	Univac	Versatec	
MODEL	Inktronic RO	0762	Matrix 300	Matrix 600
PRINTING MECHANISM	Ink Jet <sup>1</sup>	Bar	Electrostatic <sup>1</sup>	Electrostatic <sup>1</sup>
CHARACTER SET (min/std/max)	64 Upper Case	14/63 Upper Case	64 Upper Case	64 Upper Case
DENSITY				
Characters/Inch	10	10	10	10
Lines/Inch	6	6 or 8	6	6
COLUMNS PER PAGE (min/std/max)	80	80/132	80	80
PRINT RATE				
Characters/Sec.	120	25/1200	400	800
Lines/Min.	100	300/600	300	600
NO. FORMS (copies)	1	6	1	1
OPERATION	—	• Univac DCT 2000, 9200, & 9300	• HP 2114/16 • HON 316, 416 • Varian 620i • DEC PDP-8, -12 • Data Gen Nova • GRI-909	• HP 2114/16 • HON 316, 416 • Varian 620i • DEC PDP-8, -12 • Data Gen Nova • GRI-909
MAINTENANCE	—	Std-Mfr 250 Offices	Opt-Serv Co \$23/mo 32 Offices	Opt-Serv Co \$26/mo 32 Offices
PRICE				
Lease	—	—	\$126/mo	\$154/mo
Purchase	—	—	\$5,500	\$6,700
OTHER FEATURES & COMMENTS	<sup>1</sup> 8x14 Dot Matrix	—	<sup>1</sup> 5x7 Dot Matrix	<sup>1</sup> 5x7 Dot Matrix

**TABLE 1 • MEDIUM-SPEED PRINTERS . . . . . Cont'd**

(100 LPM ≤ Rate < 1000 LPM)

COMPANY	Versatec (cont'd)		Vogue Instrument Shepard Div.		Xerox Data Systems
MODEL	Matrix 100A	Matrix 200A	880C	880D & E	7440
PRINTING MECHANISM	Electrostatic <sup>1</sup>	Electrostatic <sup>1</sup>	Drum	Drum	Drum
CHARACTER SET (min/std/max)	64 Upper Case	64 Upper Case	64 Upper & Lower Case	16/64/96 Upper Case	56 Upper Case
DENSITY					
Characters/Inch	10	10	10	10	—
Lines/Inch	6	6	6	6	6
COLUMNS PER PAGE (min/std/max)	80	80	80	80	132
PRINT RATE					
Characters/Sec.	400	800	—	—	—
Lines/Min.	300	600	400	250/400/1000	700
NO. FORMS (copies)	1	1	6	6	6
OPERATION	—	—	• RS 232B • 201/202 Dataset • IBM 2703	• DEC PDP-8 • HP 2114/15/16 • Varian 620i • HON 316, 516	—
MAINTENANCE	Opt-Serv Co 32 Offices	Opt-Serv Co 32 Offices	Opt-Serv Co \$84/mo 17 Offices	Opt-Serv Co \$84/mo 17 Offices	—
PRICE					
Lease	—	—	\$407/mo	\$288/mo	—
Purchase	\$7,300	\$7,900	\$11,000	\$7,800	—
OTHER FEATURES & COMMENTS	• Also Has Plotting Capability <sup>1</sup> 5x7 Dot Matrix	• Also Has Plotting Capability <sup>1</sup> 5x7 Dot Matrix	—	—	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.

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**TABLE 2 • HIGH-SPEED PRINTERS**

(Rate ≥ 1000 LPM)

COMPANY	Control Data	Data Products	Gould Graphics Div.	Honeywell	IBM
MODEL	512	4000	4800	122-6 & 222-6 <sup>1</sup>	1403-3 & -N1
PRINTING MECHANISM	Train	Drum	Electrostatic <sup>1</sup>	Drum	Train
CHARACTER SET (min/std/max)	18/64/288 Upper & Lower Case	14/64/128 Upper & Lower Case	64/128 Upper & Lower Case	42/63 Upper Case	48/120 Upper & Lower Case
DENSITY Characters/Inch	10	10	—	10	10
Lines/Inch	6 or 8	6 or 8	—	6 or 8	6 or 8
COLUMNS PER PAGE (min/std/max)	136	132/136	100/132	120/132	132
PRINT RATE Lines/Min.	225/1200/1500	500/1000/2000	4800	825/1100	1100
NO. FORMS (copies)	6	6	1	8	—
OPERATION	• CDC 3000, 6000 & 7000 Computers	• IBM 360/30 + • HON 200 & 1200 • XDS Sigma 2, -- 5 & 7	• IBM 360/370 • DEC PDP-8, -12 & -15 • Interdata • Burroughs • Univac	• HON Series 200-Models: 115, 120 & 125 (122-6) Models: 115, 120, 125, 200, 1200, 1250, 2200, 3200, 4200 & 8200 (222-6)	• IBM 1401, 1460, 1130 & S/360 & 370
MAINTENANCE	Opt-Mfr \$243/mo Local Basis	Std-Mfr Local Basis	Std-Mfr	Std-Mfr 80 Offices	Opt-Mfr Local Basis
PRICE Lease	\$780/mo	\$1,200/mo	—	\$1,153/mo (122-6) \$1,308/mo (222-6)	—
Purchase	\$47,700	\$44,000	\$8,900	\$51,660 (122-6) \$60,975 (222-6)	—
OTHER FEATURES & COMMENTS	—	—	• Also Has Plotting Capability 1 5 x 7 Dot Matrix @ 132 Col. & 7 x 10 Dot Matrix @ 100 Col.	<sup>1</sup> 222-6 Includes Control	—

**TABLE 2 • HIGH-SPEED PRINTERS . . . . . Cont'd**

(Rate ≥ 1000 LPM)

COMPANY	IBM (cont'd)	ICL	Mohawk Data Sciences		Path Computer Equipment
MODEL	3211	1933	3160	5320	1200
PRINTING MECHANISM	Train	Drum	Drum	Drum	Electrographic <sup>1</sup>
CHARACTER SET (min/std/max)	27/48/432 Upper & Lower Case	48/64 Upper Case	56/64/112 Upper & Lower Case	56/64/112 Upper & Lower Case	96 Upper & Lower Case
DENSITY Characters/Inch	10	10	10	10	10
Lines/Inch	6 or 8	6 or 8	6 or 8	6 or 8	6
COLUMNS PER PAGE (min/std/max)	132/150	96/120/160	132/160	120/132/160	80/132
PRINT RATE Lines/Min.	300/2000/2500	1100/1350	625/1000/1250	625/1000/1250	1200
NO. FORMS (copies)	4 <sup>1</sup>	6	6	6	1
OPERATION	• IBM S/360 Models 30 + & S/370	• ICL 1900 Series	• IBM 1401, S/360	—	• RS 232
MAINTENANCE	Opt-Mfr Local Basis	—	Opt-Mfr \$250/mo 100 Offices	Opt-Mfr 100 Offices	—
PRICE Lease	\$2,800/mo	—	\$1,050/mo	—	—
Purchase	\$129,150	—	\$52,000	\$9,200 (OEM)	\$7,000 (OEM)
OTHER FEATURES & COMMENTS	<sup>1</sup> Higher No. Multi-Parts Should Be Tested	—	—	—	<sup>1</sup> Dry Ink Process

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.



# MAC AND THE HASTY HEARTBEAT REPORTER

or  
Taking the Pulse  
of an ECG.

But now we must leave our friends in their perilously crippled electric airship, and take the reader, for a while, to the gleaming laboratories of the 3M Company.

The 3M engineers, having never lost heart in their search for the perfect control computer to complete their 1260 ECG Recording System, discovered MAC 16 readily at hand!

The 1260 ECG Recording System, as you will remember from the previous chapter, produces electrocardiograms on microfilm in less than two minutes. A boon, indeed, for the healing arts!

Furthermore, with the incorporation of the indomitable MAC 16 into the system, the 1260 provides on-line computer aided analysis. Immediate diagnosis of transmitted ECGs becomes commonplace!

What nobler use for MAC 16, with its 1-microsecond cycle time and 4K core, readily expandable to 64K. And other points of excellence, with which the reader is by now thoroughly acquainted.

Yet, a myriad of applications still await MAC 16. Quite possibly, one that will benefit you. For an exhaustive elaboration, telephone (213) 722-6810. Collect, as a mark of our respect.

## Lockheed Electronics

Data Products Division / Los Angeles (213) 722-6810  
A Subsidiary of Lockheed Aircraft Corporation

**TABLE 2 • HIGH-SPEED PRINTERS . . . . . Cont'd**

(Rate ≥ 1000 LPM)

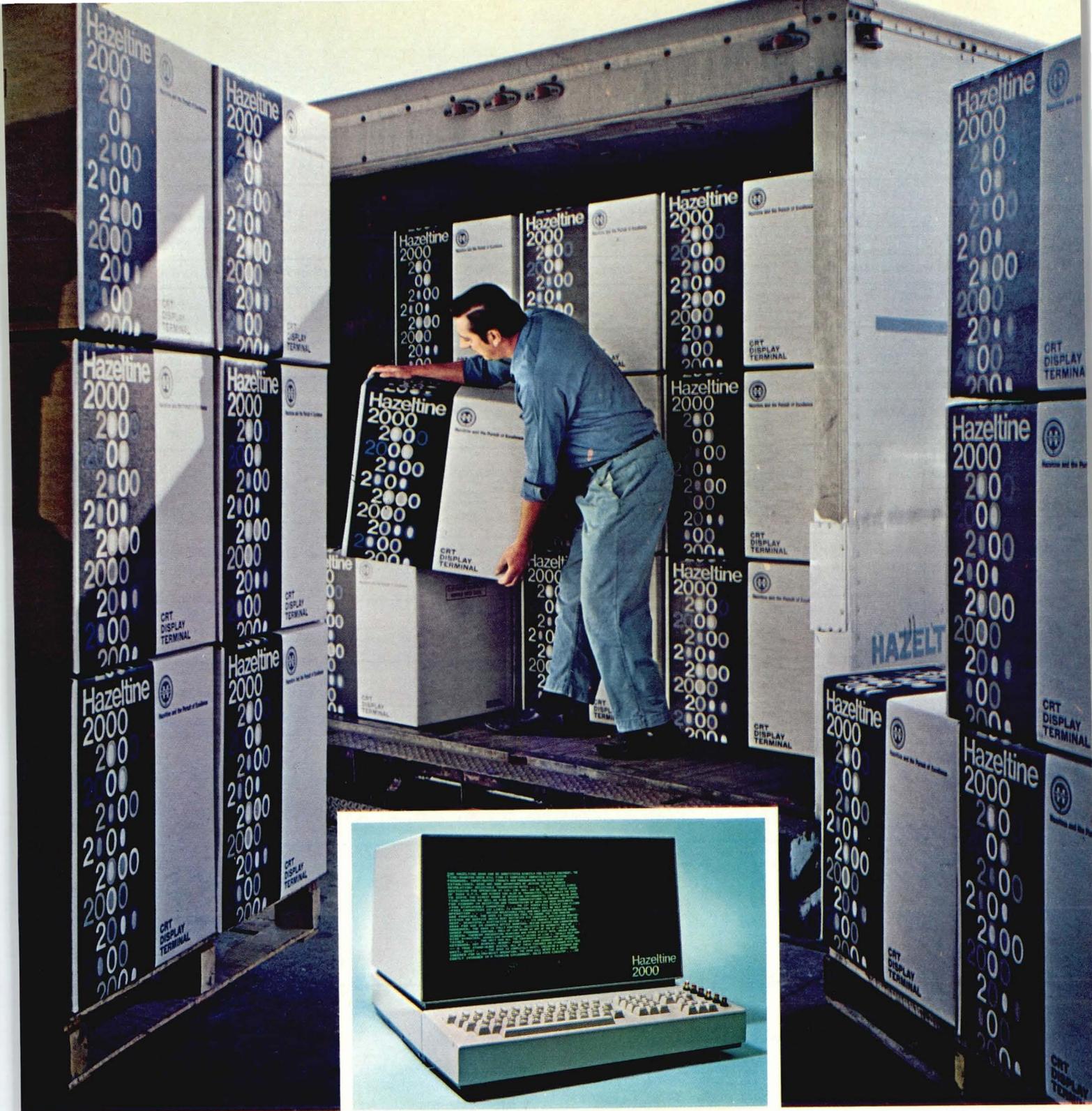
COMPANY	RCA		Telex Computer Products	Univac	
MODEL	8244-100	8244-200	5803	0758-00	0768-00
PRINTING MECHANISM	Chain	Chain	Chain	Drum	Drum
CHARACTER SET (min/std/max)	16/48/120 Upper & Lower Case	16/48/120 Upper & Lower Case	16/48/253 Upper & Lower Case	43/63 Upper Case	49/63 Upper Case
DENSITY					
Characters/Inch	10	10	10	10	10
Lines/Inch	6 or 8	6 or 8	6 or 8	6 or 8	6 or 8
COLUMNS PER PAGE (min/std/max)	132	132	132	132	132
PRINT RATE Lines/Min.	400/750/1200	400/1200/1500	—/1200/2500	1200/1600	900/1100
NO. FORMS (copies)	6	6	6	6	6
OPERATION	• RCA Spectra 70; RCA 2, 3, 6 & 7	• RCA Spectra 70; RCA 2, 3, 6 & 7	• IBM S/360-25, 85 & 195 • IBM S/370-155 & 165	• Univac 494, 1106, 1108 & 1110 Systems	• Univac 9200, 9300, 9400 & 1110 Systems
MAINTENANCE	Opt-Mfr Local Basis	Opt-Mfr Local Basis	Std-Mfr Local Basis	Std/Opt-Mfr 250 Offices	Std/Opt-Mfr 250 Offices
PRICE					
Lease	—	—	\$805/mo	\$1,250/mo	\$1,250/mo
Purchase	—	—	\$26,400	\$43,500	\$40,675
OTHER FEATURES & COMMENTS	—	—	—	—	—

**TABLE 2 • HIGH-SPEED PRINTERS . . . . . Cont'd**

(Rate ≥ 1000 LPM)

COMPANY	Univac (cont'd)		Varian Graphics & Data Systems	Xerox Data Systems	
MODEL	0768-02	0768-99	Statos 21	7441	7446
PRINTING MECHANISM	Drum	Drum	Electrostatic	Drum	Drum
CHARACTER SET (min/std/max)	14/87/94 Upper & Lower Case	43/63 Upper Case	64 Upper Case	42/64/96 Upper & Lower Case	47/64
DENSITY					
Characters/Inch	10	10	10	—	—
Lines/Inch	6 or 8	6 or 8	8	6 or 8	6 or 8
COLUMNS PER PAGE (min/std/max)	132	132	80	132	132
PRINT RATE Lines/Min.	840/1000/2000	1200/1600	5000	550/800/1100	1200/1500
NO. FORMS (copies)	6	6	1	6	6
OPERATION	• Univac 1110	• Univac 9200, 9300, 9400 & 1110 Systems	• Varian 620 i • IBM S/360	—	—
MAINTENANCE	Std/Opt-Mfr 250 Offices	Std/Opt-Mfr 250 Offices	Opt-Mfr 9 Offices	—	—
PRICE					
Lease	\$1,425/mo	\$1,550/mo	—	—	—
Purchase	\$46,545	\$50,465	\$12,950	—	—
OTHER FEATURES & COMMENTS	—	—	• Also Has Plotting Capability	—	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.



## We're not promising... We're Delivering!

Delivering Performance—the best Video Display Terminal on the market. Delivering Price—only \$88 per month (12-month rental) plus \$20 maintenance. Delivering now! Ask for a demonstration. Then insist on Immediate Delivery! You won't be disappointed.

# Hazeltine 2000

Hazeltine Corporation  
Greenlawn, N.Y. 11740 Phone (516) 261-7000

CIRCLE NO. 27 ON INQUIRY CARD

**TABLE 3 • OFF-LINE OR SATELLITE PRINTING SYSTEMS**

COMPANY	Computer Machinery	Data Products	Dylaflo Business Machines	Gould Graphics Div	Mohawk Data Sciences
MODEL	CMC 36 <sup>1</sup>	4000	Dylaflo-1 <sup>1</sup>	4800	1320
PRINTING MECHANISM	Train	Drum	Train	Electrostatic <sup>1</sup>	Drum
CHARACTER SET (min/std/max)	48/120 Upper & Lower Case	14/64/128 Upper & Lower Case	48/120 Upper & Lower Case	64/128 Upper & Lower Case	64 Upper Case
DENSITY					
Characters/Inch	10	10	10	—	10
Lines/Inch	4 or 8	6 or 8	6 or 8	—	6 or 8
COLUMNS PER PAGE (min/std/max)	132	132/136	132	100/132	132
PRINT RATE					
Lines/Min.	600/1100	500/1000/2000	600/1100	4800	300
NO. FORMS (copies)	—	6	—	1	6
OPERATION	• 7/9 Track Mag Tape @ 200/556/800/1600 bpi • 2311/2314 Disk Drives	• 7/9 Track Mag Tape @ 200/556/800/1600 bpi	• 7/9 Track Mag Tape @ 800/1600 bpi	• 9 Track Mag Tape	• 7/9 Track Mag Tape @ 200/800 bpi
MAINTENANCE	Std-Mfr 15 Offices	Std-Mfr Local Basis	—	Std-Mfr	Opt-Mfr \$80/mo 100 Offices
PRICE					
Lease	\$1,175/mo <sup>2</sup>	\$1,500/mo	—	—	\$420/mo
Purchase	\$47,000	\$57,000	—	\$25,000	\$21,000
OTHER FEATURES & COMMENTS	<sup>1</sup> Uses IBM 1403 Printer, Models 2, 3, 7 or N1 <sup>2</sup> Plus 1403 Lease	—	<sup>1</sup> Uses IBM 1403 Printer	• Also Has Plotting Capability <sup>1</sup> 5x7 Dot Matrix@ 132 Col. & 7x10 Dot Matrix @ 100 Col.	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.

**TABLE 4 • REFERENCE LITERATURE**

*For additional information on Medium-Speed Printers, listed in Table 1, circle on the Reader Service Card the appropriate number listed below.*

Company	Reader Service Card Number
Bright Industries, San Francisco, Cal. . . . .	200
Centronics Data Computer, Hudson, N.H. . . . .	201
Custom Computer Systems, Plainview, N.Y. . . . .	202
Daconics, Sunnyvale, Cal. . . . .	203
Data Computing, Phoenix, Ariz. . . . .	204
Data Printer, Cambridge, Mass. . . . .	205
A. B. Dick, Chicago, Ill. . . . .	206
Digital Equipment, Maynard, Mass. . . . .	207
Eclectic, Dallas, Texas . . . . .	208
Honeywell, Needham, Mass. . . . .	209

IBM, White Plains, N.Y. . . . .	210
ICL, New York, N.Y. . . . .	211
Intercomp, Cambridge, Mass. . . . .	212
Leigh Instruments, Ottawa, Canada . . . . .	213
Mohawk Data Sciences, East Herkimer, N.Y. . . . .	214
Motorola Information Systems, Phoenix, Ariz. . . . .	215
Nortec Computer Devices, Ashland, Mass. . . . .	216
Odec Computer Systems, East Providence, R.I. . . . .	217
Per Data, Hicksville, N.Y. . . . .	218
Peripheral Dynamics, Norristown, Pa. . . . .	219
Potter Instrument, Plainview, N.Y. . . . .	220
Qantel, Hayward, Cal. . . . .	221
Repco, Orlando, Fla. . . . .	222
Syner-Data, Beverly, Mass. . . . .	223
Teletype, Skokie, Ill. . . . .	224
Univac, Blue Bell, Pa. . . . .	225
Versatec, Cupertino, Cal. . . . .	226
Vogue Instrument, Richmond Hill, N.Y. . . . .	227
Xerox Data Systems, El Segundo, Cal. . . . .	228

**TABLE 3 • OFF-LINE OR SATELLITE PRINTING SYSTEMS .....Cont'd**

COMPANY	Mohawk Data Sciences (cont'd)		Per Data	Photon-Computer Graphics Div.	Telex Computer Products
MODEL	2501	7160 & 9160	MP Series	7700	5803
PRINTING MECHANISM	Drum	Drum	Drum	Photographic <sup>1</sup>	Chain
CHARACTER SET (min/std/max)	56/64/112 Upper & Lower Case	56/64/112 Upper & Lower Case	64 Upper & Lower Case	4 Fonts of 2 Sizes	16/48/253 Upper & Lower Case
DENSITY					
Characters/Inch	10	10	10	Adjustable	10
Lines/Inch	6 or 8	6 or 8	6	Adjustable	6 or 8
COLUMNS PER PAGE (min/std/max)	132/160	132/160	132	Adjustable	132
PRINT RATE Lines/Min.	625/1000/1250	625/1000/1250	600	300	—/1200/2500
NO. FORMS (copies)	6	6	7	1	6
OPERATION	• 7/9 Track Mag Tape @ 200/556/800/1600 bpi	• 7 Track Mag Tape @ 200/556/800 bpi (7160) • 9 Track Mag Tape @ 800/1600 bpi (9160)	• 7/9 Track Mag Tape @ 200/556/800/1600 bpi	• 7/9 Track Mag Tape @ 200/556/800 bpi	• 7/9 Track Mag Tape @ Up To 1600 bpi
MAINTENANCE	Opt-Mfr \$275/mo 100 Offices	Opt-Mfr \$250/mo 100 Offices	Std-Mfr/Serv Co  Local Basis	—	Std-Mfr  Local Basis
PRICE					
Lease	\$1,140/mo	\$1,000/mo (7160) \$1,090/mo (9160)	\$1,185/mo	—	\$910/mo
Purchase	\$57,000	\$50,000 (7160) \$54,000 (9160)	\$40,000	—	\$37,100
OTHER FEATURES & COMMENTS	—	—	—	<sup>1</sup> Paper, Film or Offset Master Output	—

NOTE: Relationships of Print Rate to Character Set in tables are denoted by slashes "/". A character set of 64/96/128 with a print rate of 150/230/300 LPM reads: 300 LPM @ 64 characters; 230 LPM @ 96 characters; and 150 LPM @ 128 characters.

**TABLE 5 • REFERENCE LITERATURE**

*For additional information on High-Speed Printers, listed in Table 2, circle on the Reader Service Card the appropriate number listed below.*

Company	Reader Service Card Number
Control Data, Minneapolis, Minn. ....	229
Data Products, Woodland Hills, Cal. ....	230
Gould, Cleveland, Ohio .....	231
Honeywell, Needham, Mass. ....	232
IBM, White Plains, N.Y. ....	233
ICL, New York, N.Y. ....	234
Mohawk Data Sciences, East Herkimer, N.Y. ....	235
Path Computer Equipment, Stamford, Conn. ....	236
RCA, Camden, N.J. ....	237
Telex Computer Products, Tulsa, Okla. ....	238

Univac, Blue Bell, Pa. ....	239
Varian, Palo Alto, Cal. ....	240
Xerox Data Systems, El Segundo, Cal. ....	241

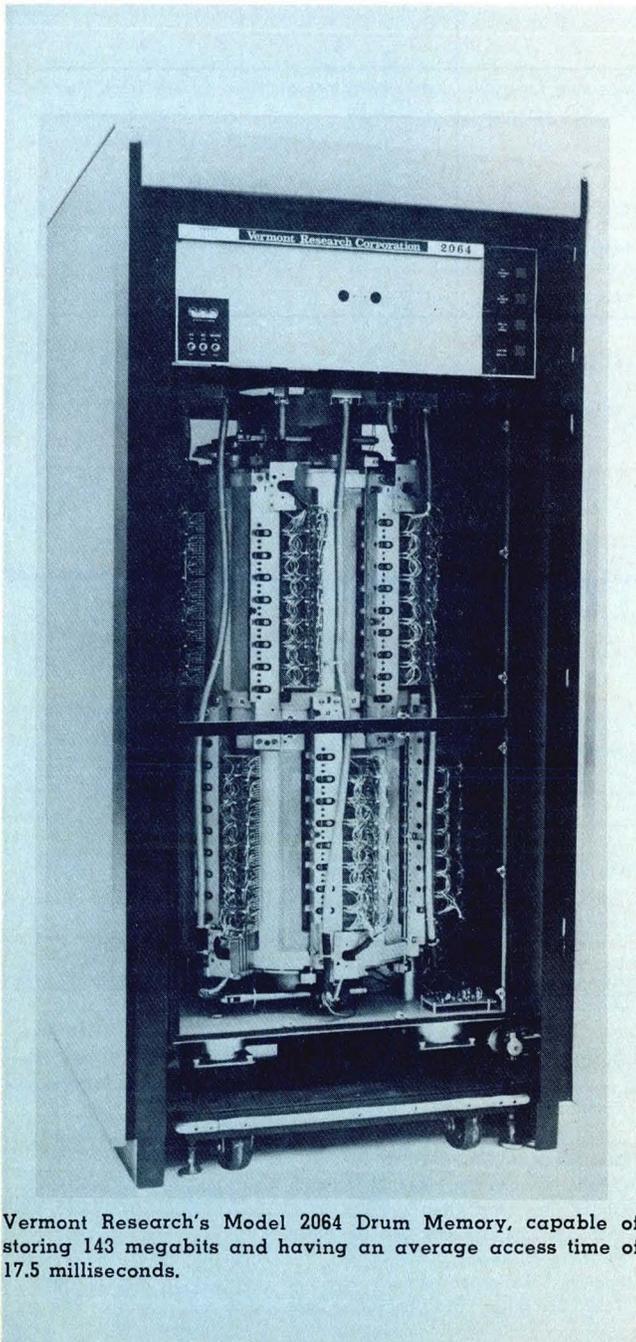
**TABLE 6 • REFERENCE LITERATURE**

*For additional information on Off-Line or Satellite Printing Systems, listed in Table 3, circle on the Reader Service Card the appropriate number listed below.*

Company	Reader Service Card Number
Computer Machinery, Los Angeles, Cal. ....	242
Data Products, Woodland Hills, Cal. ....	243
Dylaflo Business Machines, El Segundo, Cal. ....	244
Gould, Cleveland, Ohio .....	245
Mohawk Data Sciences, East Herkimer, N.Y. ....	246
Per Data, Hicksville, N.Y. ....	247
Photon, Wilmington, Mass. ....	248
Telex Computer Products, Tulsa, Okla. ....	249

## DISK & DRUM DRIVES Part 2 — Large-Scale Drives

FRANKLIN L. TABEL, Project Manager • BCD Computing, Subsidiary of Sierra Research, Buffalo, N.Y.



Vermont Research's Model 2064 Drum Memory, capable of storing 143 megabits and having an average access time of 17.5 milliseconds.

**EDITOR'S NOTE:** This Profile of large capacity greater than 50 million bits (50 megabits) disk and drum memories is the second of a three-part series on disk and drum memories. The first part, published last month, covered IBM 2311 and 2314 plug-to-plug compatible disk-pack drives; the third will cover drives that have a storage capacity of under 50 Mbits.

### INTRODUCTION

Disk and drum storage systems are rotating magnetic memories which permit physical records to be written at, and retrieved from, a discrete location having a unique address. The ability to store large amounts of data (up to billions of bits) at a competitive cost, and to access directly such a mass storage system, make the disk or drum system a desirable choice when considering new or expanded processor storage configurations.

Innovations in technology have effected larger storage capacities, higher recording densities, shorter access times, and improved reliability. Greater utility has been gained by the increase in availability of interfaces for various host computers; separate and integrally packaged drive controllers and complete interface hardware can be purchased from independent manufacturers for many popular computers.<sup>1,2</sup> Many of the independents may also supply software to support their drives.

This Profile addresses itself to describing the operation of a disk or drum storage system; outlining factors that should be considered when selecting a rotating mass memory; and tabulating the features of disk-pack, fixed-disk, and drum devices having a storage capacity of over 50 megabits per drive unit; it also serves to update a previous survey<sup>3</sup> on large capacity drives that was published in **MODERN DATA**.

## OPERATION

This section outlines the operation of a disk or drum memory with the central computer. Topics considered are: the communications channels linking the computer with the drive(s); the drive control, the storage device (drive); recording techniques; transfer rate; and access mechanisms.

### Communications Channels

The typical interface between the computer mainframe and a high-speed File Control Unit (FCU) occurs at a generalized point between a selector channel and the FCU. A number of different FCU models may be attached, but a common, standardized set of data and control lines are maintained.

The selector channel operates in a burst mode — only the selected device can be serviced when a command to transfer a block of data is executed. Until the operation is completed, other devices using the same channel must await availability.

The channel concept relieves the CPU of unnecessary tasks involving I/O operations. It also reduces the number of program instructions needed to manage I/O operations. The main CPU program need maintain only a few basic instructions — start I/O, test I/O, and halt I/O.

Each CPU instruction word identifies the specific channel and device to be used in the operation. If the channel accepts the instruction (e.g., not busy) the main program can continue normal processing while the channel assumes independent control for the remainder of the I/O operation.

### Channel Operation

The channel accomplishes its job through one or more stored Channel Command Words (CCW). These commands specify what I/O actions are to

be taken, where data is to be found or stored, and what is to be done at the end of the operation. The area of a selector channel used for addressing, counting data, and holding status information is called its subchannel. The condition of status of a given I/O system at any instant is that of each component: channel, subchannel, controller, and one or more devices. The CPU main program is interrupted when conditions in the channel or in the attached components warrant it. When an I/O interrupt occurs, the channel stores a Channel Status Word (CSW) in CPU main memory. The CSW is detailed up-to-date, information about the channel, the controller the drive unit, and the results of a completed operation. When the CPU program is interrupted due to an unusual I/O event, control is transferred to a supporting program routine which can take appropriate action. For example, if an original memory track cannot be written, a new I/O routine can be initiated to provide for the steering of all subsequent write data to an alternate, or spare track.

A CPU start I/O instruction is always executed to begin any I/O device operation and results in an updated CSW; the CSW may also be updated



**Franklin L. Tabel's** technical experience ranges from radio and radar systems to computer peripherals, mainframes, and programming. At BCD Computing, Mr. Tabel has been engaged in the development of a new type of computer input typewriter and in the design of the DIMBO-10 an information retrieval system for accounting and inventory management applications. He holds a BSEE from CCNY and Hofstra Univ.

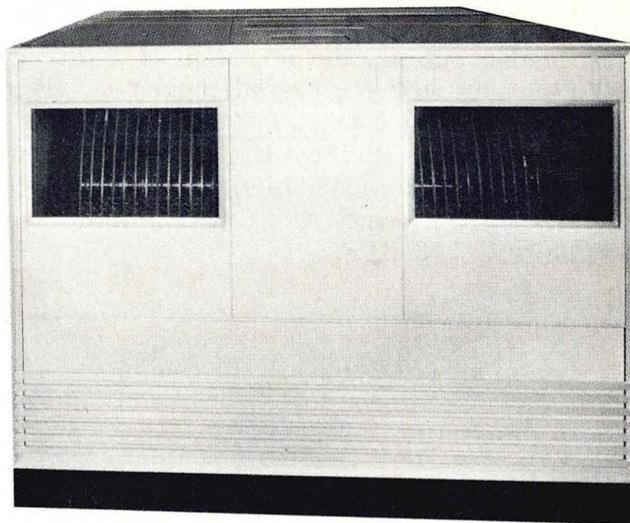
without starting an I/O device by the execution of a test I/O instruction. The halt I/O instruction execution causes the addressed channel and I/O device to be terminated. The actual effect of each CPU I/O instruction, however, is not simple. Whether an operation will begin immediately (or at all) in the addressed channel, controller, or device varies with the current condition of each component.

A channel program (i.e., a sequence of channel command words) independently controls I/O operations. The command type which causes data to be transferred from CPU main storage to the I/O device is a **WRITE** command. For transfer of data from the I/O device to CPU main storage the appropriate **READ** command is required. A third type of command, **CONTROL**, is decoded by the channel into orders which direct actions to be taken which do not involve the transfer of data. For a direct access storage device, such as the positionable-head disk drive, a seek command is of this type. It causes the addressed drive to position the read/write head at a specified address. For mass storage I/O devices, a unique fourth category of channel commands, **SEARCH**, allows areas of the memory to be sequentially compared until a field of data, such as an identification number, relates in some manner (equal, greater than, etc.) to the chosen parameters. In all, the number of specific channel commands may be as high as 40 in number. This repertory absolutely defines the capability of the system for a device type.

### The Controller

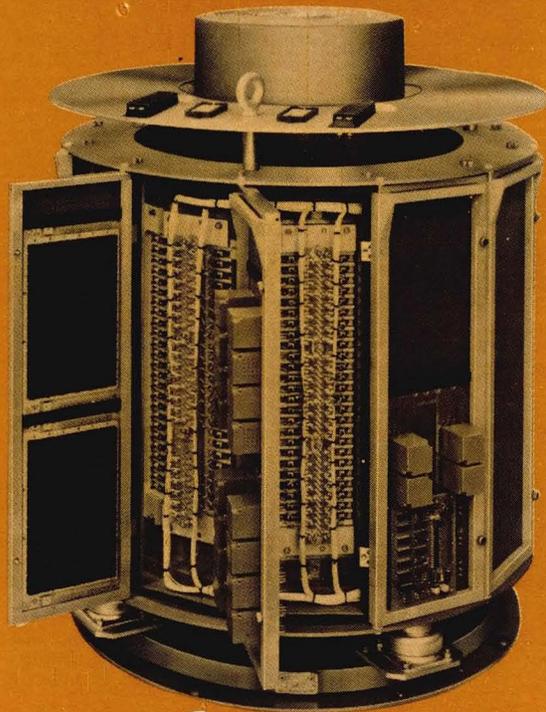
The I/O device controller has been a specialized unit peculiar to the peripheral device(s) which it is intended to regulate. The timing characteristics of electro-mechanical drive units are foreign to the normalized interface characteristics of a selector channel. In fact, a selector channel may be physically attached to several different controller types such as disk, drum, or magnetic tape. In the burst mode operation, only one of these controllers is logically connected to the channel. The primary purpose of any controller is to accept control signals from the channel (decoded orders), to control timing of all data transfers to and from the channel over the I/O interface, and to provide information to the channel as to the condition, or status, of the controller itself or any of the devices attached to it. The concept of the daisy chain I/O bus allows multiple controllers to operate in this fashion on a single channel.

It is difficult to generalize about controller capabilities, even for a specific device such as a drum memory, no less than for a range of electro-mechanical devices. In the past, the expansion of system configurations to include desirable peripheral units has been hampered by the necessity of tailoring a controller to a customized function. Only a few major computer manufacturers have succeeded in developing controller product lines but at very high cost! The price of a disk storage drive controller is approximately \$50,000 to \$75,000. Recently, disk drive memory controllers have appeared on the market with reduced capabilities, usually at the expense of CPU overhead, for as low as \$25,000, including software. Others, limited to fixed-length data format and relatively simple features, sell for even less.



The Bryant 4000 Disk File-C2A, a three-module file containing a maximum of 26 disks and capable of storing 4300 megabits.

Disk storage devices and drum memories have in common the steady-state rotating magnetic storage member (the disk or drum surfaces). An important function of all device controllers is to make this characteristic transparent as far as the channel is concerned. For fixed-length data formats, sector clock pulses are generated in the drive device 10 times per revolution. These pulses simplify the process of writing and reading fixed-length identifying and data fields. For variable-length data formats, however, the occurrence of these fields may be completely random in orientation with respect to a master index pulse which occurs only once per revolution. Some controllers solve this aspect of memory synchronization by interspersing gaps and address markers between the fields of data which originate in the CPU. The critical requirement of any storage system is to be able to recover all the data that was recorded. The addition of the gaps and address markers (serial synchronizing pulses) between other data fields permits the timing circuits

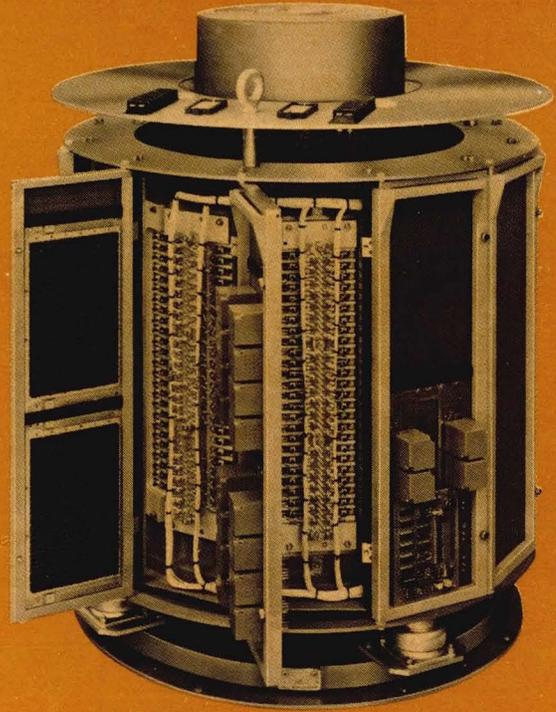


fast.

### SA 7000 DRUM MEMORIES

Our SA 7000 drum memories are fast, with average access rates of 8.7 ms. Single-drum capacities range from 10 million to 150 million bits, with 256, 512, 1024 or 1536 tracks — each with its own read/write flying head. SA 7000's are reliable, too. You can expect less than one error in  $10^{11}$  bits under normal operating conditions. Nor did we forget the human factor. Our drums feature stand-alone design, turntable mounted to give full 360° access to all circuits and checkpoints from the front. And data electronics are part of the package, including a bit serial interface that matches the drum to your controller. Optionally, controller logic can be provided to interface with a central processor.

These are just some of the features. They add up to low bit cost and high throughput. Which is what drum memories are all about. At least ours.



faster.

### SA 8000 DRUM MEMORIES

**ditto**  
**except the SA 8000**  
**is twice as fast!**  
**Average access:**  
**4.4 milliseconds!!**

*For more information on the SA 8000 Drum Memory or the SA 7000 Series, just write or call.*

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(213) 679-3377, TWX 910-325-6203.



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**TABLE 1 • REMOVABLE DISK-PACK DRIVES**  
(Capacity > 50 Megabits)

Company	Model	Storage Media	Capacity	Organization (cylinders & tracks per cylinder)	Avg Access Time (positioning & latency times)	Data Transfer Rate & Format	Controller & No. Drives Controlled	Interface	Price (D) - Drive (C) - Controller
Burroughs	B9484/85/86-3	40 Surfaces of 2 B9974-1 11-Disk Packs	968 Mbits 121 Mbytes 20.2 Mwords	406 cyl 20 trks/cyl	30 msec 12.5 msec	2.5 Mbps Bit-Ser	B6380/7380 8 Drives	—	\$700/mo- \$33,600 (D) \$1,800/mo (C)
	B9484/85/86-5	38 Surfaces of 2 B9974-2 12-Disk Packs	1600 Mbits 200 Mbytes 33.3 Mwords	406 cyl 19 trks/cyl	30 msec 8.4 msec	6.45 Mbps Bit-Ser	B6382/7382 8 Drives	—	\$1,350/mo- \$64,800 (D) \$950/mo (C)
Control Data	9740/9741	19 Surfaces of 1 CDC 873 11-Disk Pack	475 Mbits	406 cyl 20 trks/cyl	35 msec —	2.5 Mbps	—	—	—
	9750/9751	19 Surfaces of 1 CDC 872 11-Disk Pack	870 Mbits	406 cyl 16 trks/cyl	30 msec —	6.8 Mbps	—	—	—
	841/3553-1 <sup>1</sup>	20 Surfaces of 1 CDC 871 11-Disk Pack	216 Mbits	200 cyl 20 trks/cyl	75 msec —	2.2 Mbps	3553-1 8 Drives	—	—
Digital Equipment	RP 02	20 Surfaces of 1 RP02P 11-Disk Pack	186 Mbits 5.17 Mwords	203 cyl 20 trks/cyl	50 msec 12.5 msec	—	RP-10 8 Drives	• DEC PDP-10	\$650/mo- \$26,000 (D) \$25,000 (C)
EDP Technology	2311	10 Surfaces of 1 1316 6-Disk Pack	58 Mbits 7.25 Mbytes	203 cyl 10 trks/cyl	75 msec 12.5 msec	1.25 Mbps Bit-Ser	2311 8 Drives	• Data Gen Nova • DEC PDP-8	\$22,500 (D)
Honeywell	172	10 Surfaces of 1 M4005 6-Disk Pack	55.2 Mbits 9.2 Mbytes	200 cyl 10 trks/cyl	20 msec 12.5 msec	1.25 Mbps Bit-Ser	CPU 4 Drives	• HON 200 Model 115	\$409/mo- \$21,400 (D)
	259/259 B	10 Surfaces of 1 M4005 6-Disk Pack	55.2 Mbits 9.2 Mbytes	200 cyl 10 trks/cyl	30 msec 12.5 msec	1.25/.885 Mbps Bit-Ser	257/257-1/260 8 Drives	• HON 200 Models 120 to 8200	\$521/mo- \$24,000 (D) \$25,000 (C)
	273 <sup>2</sup>	20 Surfaces of 1 M4007 11-Disk Pack	110 Mbits 18.4 Mbytes	200 cyl 20 trks/cyl	20 msec 12.5 msec	1.25 Mbps Bit-Ser	257/257-1/260 8 Drives	• HON 200 Models 125 to 8200	\$767/mo- \$34,650 (D) \$25,000 (C)
	278	160 Surfaces of 8 M4008 11-Disk Packs	1600 Mbits 280 Mbytes	1600 cyl 20 trks/cyl	20 msec 12.5 msec	2.5 Mbps Bit-Ser	257-3 1 Drive	• HON 200 Models 1200 to 8200	\$2,170/mo- \$98,500 (D) \$61,000 (C)
IBM	2311 <sup>3</sup>	10 Surfaces of 1 1316 6-Disk Pack	58 Mbits 7.25 Mbytes	203 cyl 10 trks/cyl	75 msec 12.5 msec	1.25 Mbps Bit-Ser	2841 <sup>3</sup> 8 Drives	• IBM S/360 Models 20 & up	\$570/mo- \$24,700 (D)
	2312 <sup>2</sup>	19 Surfaces of 1 2316 11-Disk Pack	233 Mbits 29.2 Mbytes	203 cyl 19 trks/cyl	60 msec 12.5 msec	2.5 Mbps Bit-Ser	2314 <sup>3</sup> 8 Drives	• IBM S/360 Models 30 & up & S/370	\$535/mo- \$24,100 (D) \$1,480/mo- \$66,800 (C)
	3330 <sup>4</sup>	19 Surfaces of 1 3336 12-Disk-Pack	800 Mbits 100 Mbytes	404 cyl 19 trks/cyl	30 msec 8.4 msec	6.45 Mbps Bit-Ser	3830 8 Drives	• IBM S/360 Models 185 & 195 & S/370	\$7,600/mo- \$357,200 (D & C) <sup>5</sup>
ICL	4420 <sup>6</sup>	20 Surfaces of 1 20-Disk Pack	184 Mbits 30.7 Mbytes	203 cyl 20 trks/cyl	87.5 msec 12.5 msec	2.5 Mbps Bit-Ser	2812/1 9 Drives	• ICL 1900 Series	—

<sup>1</sup>Available in 3- to 8-Drive Configuration Models<sup>2</sup>Available as Model 274 in 8-Drive Configuration<sup>3</sup>See the January, 1971 Issue of MODERN DATA for Profile on IBM 2311 & 2314 Plug-to-Plug Compatible Disk Pack Drives<sup>4</sup>Available in 2-, 4-, 6- or 8-Drive Configuration Models<sup>5</sup>8-Drive Model with Controller<sup>6</sup>Available in 3-, 5-, 7- or 9-Drive Configuration Models

in the controller to get in step with the data during read operations. The controller does not send gap data to the channel; these bits are stripped and only the commanded read data is converted to byte information for input to the channel.

### The Storage Device

The majority of rotating storage devices employed today are disk and drum drives, although other

forms are available (magnetic card strip, tape loop, etc.). The memory element of a magnetic drum is a metal cylinder, magnetically coated over its curved surface and rotating about its central axis. The heads are fixed in the drum housing, sometimes in staggered groupings around the circumference; each head always sweeping the same circular track. Movable-head versions of drum memories are almost nonexistent today. An important limitation of the drum memory is the fixed medium which prevents off-line storage of records.

**TABLE 1 • REMOVABLE DISK-PACK DRIVES ..... Cont'd**

**(Capacity > 50 Megabits)**

Company	Model	Storage Media	Capacity	Organization (cylinders & tracks per cylinder)	Avg Access Time (position- ing & latency times)	Data Transfer Rate & Format	Controller & No. Drives Controlled	Interface	Price (D) - Drive (C) - Controller
Information Storage Systems	724	20 Surfaces of 1 2316 11-Disk Pack	188 Mbits 25.5 Mbytes 11.8 Mwords	203 cyl 20 trks/cyl	30 msec 12.5 msec	2.5 Mbps Bit-Par	Integral 2 Drives	—	\$25,000 (D & C)
NCR	EM-J	12 Surfaces of 2 EM-J 3-Disk Packs	93.3 Mbits 10.4 Mbytes	192 cyl 72 trks/cyl	45 msec 21/12 msec	108/180 Kbps	—	—	—
	657 <sup>†</sup>	20 Surfaces of 1 Disk Pack	240/384 Mbits 30/48 Mbytes	200 cyl 20 trks/cyl	60 msec 12.5 msec	315/500 Kbps	625-201 8 Drives	• NCR 200 & 300 Systems	\$575/mo- \$26,500 (D)
RCA	8564	10 Surfaces of 1 RCA 506 6-Disk Pack	58 Mbits 7.25 Mbytes	203 cyl 10 trks/cyl	75 msec 12.5 msec	1.25 Mbps Byte-Par	8551 8 Drives	• RCA 2, 3, 6, 7 Systems	\$535/mo- \$25,500 (D) \$497/mo (C)
	8590	20 Surfaces of 1 RCA 511 11-Disk Pack	233 Mbits 29.2 Mbytes	203 cyl 20 trks/cyl	60 msec 12.5 msec	2.5 Mbps Byte-Par	Integral 16 Drives	• RCA 2, 3, 6 & 7 Systems	\$1,950/mo- \$95,300 (D & C)
Univac	8411	10 Surfaces of 1 6-Disk Pack	58 Mbits 7.25 Mbytes	203 cyl 10 trks/cyl	75 msec 12.5 msec	1.25 Mbps	8411 8 Drives	—	—
	8414	20 Surfaces of 1 2316 11-Disk Pack	233 Mbits 29.2 Mbytes 3.5 Mwords	200 cyl 20 trks/cyl	60 msec 12.5 msec	2.5 Mbps	8414 8 Drives	• Univac 1100 & 9000 Series	\$1,990/mo- \$74,000 (D & C)
	8440	19 Surfaces of 1 11-Disk Pack	900 Mbits 24.8 Mwords	406 cyl 19 trks/cyl	35 msec 12.5 msec	5 Mbps	8440 8 Drives	• Univac 1100 Series	\$580/mo- \$27,800 (D) \$1,800/mo- \$86,400 (C)

<sup>†</sup>Available as Model 657-101 in 1-Drive Configuration, and as Model 657-102 in 2-Drive Configuration

Thus, drums are more likely to be found in dedicated applications (such as ground check-out systems) that require permanent diagnostic programs. One advantage of the drum is the ability to seal and pressurize the unit with an inert gas. They can therefore be used in systems which are installed near hazardous atmospheres. Otherwise, the operation and design characteristics of drum memories are the same as for disk storage devices.

Capacity, cost, and access time are the major identifying features of disks, but the awareness of certain other technical characteristics is important to proper selection. The memory element consists of one or more metal disks magnetically coated on both flat sides; the substrate may be aluminum, with diameters typically from 14 to 20 inches and the storage area usually only a few inches in diameter. One or more disks are mounted on an axis (the spindle) about which they rotate. Disk drives are available in combinations of single/multiple and permanent/removable media; some drives have more than one spindle. A disk-car-

tridge is a removable single disk; a disk-pack is a removable multiple-disk assembly. The design of these removable disk units stresses freedom from contamination of the disk surface(s), and mechanical stability from operator handling.

Many read/write head arrangements are possible. These include fixed head-per-track, single and multiple positionable heads (single actuator), multiple positionable heads (more than one actuator), and various combinations. The single positionable-head design results in the longest average access time and requires an elaborate positioner and various safety features, but the data electronics is kept at a minimum, requiring only a read and a write amplifier. At the other extreme is the head-per-track design (no positioner) which results in the minimum average access time; this is the time for a half-revolution of the disk, or the average latency. In order to implement serial-bit read and write data interface lines for the drive unit, multiple head designs require more elaborate read/write head electronics.

**TABLE 2 • NON-REMOVABLE DISK DRIVES**

**(Capacity > 50 Megabits)**

Company	Model	Storage Media	Capacity	Organization (cylinders & tracks per cylinder)	Avg Access Time (position- ing & latency times)	Data Transfer Rate & Format	Controller & No. Drives Controlled	Interface	Price (D) - Drive (C) - Controller
Bryant Computer Products	4000 A2A	24 Surfaces of 13 Disks	2100 Mbits	256 cyl 144 trks/cyl	170 msec 25 msec	1.14 Mbps Bit-Ser	Series 720 8 Drives	• Interdata Mod 1 to 5 • DEC PDP-8 • MAC-16 • SEL 810	—
	4000 C2A	50 Surfaces of 26 Disks	4300 Mbits	256 cyl 300 trks/cyl	170 msec 25 msec	1.14 Mbps Bit-Ser	Series 720 8 Drives	• Interdata Mod 1 to 5 • DEC PDP-8 • MAC-16 • SEL 810	—
Burroughs	B 475	8 Surfaces of 4 Disks	57.6 Mbits 9.6 Mbytes 1.2 Mwords	1 cyl 400 trks/cyl	— 20 msec	600 Kbps Bit-Ser/Par	B247/5470 50 Drives	—	\$1,040/mo- \$44,500 (D) \$590/mo (C)
	B 9372/74-1 B 9372-6	8 Surfaces of 4 Disks	80 Mbits 10 Mbytes 5 Mwords	1 cyl 400 trks/cyl	— 20 msec	1.66 Mbps Bit-Ser	B2373/3373/ 4373 100 Drives	—	\$675/mo- \$35,000 (D) \$200/mo (C)
	B 9372-11	8 Surfaces of 4 Disks	87 Mbits 10.9 Mbytes 1.8 Mwords	1 cyl 400 trks/cyl	— 20 msec	1.89 Mbps Bit-Ser	B6373 100 Drives	—	\$850/mo- \$44,000 (D) \$400/mo (C)
	B 9376-12 <sup>1</sup>	8 Surfaces of 4 Disks	160 Mbits 20 Mbytes 3.33 Mwords	1 cyl 400 trks/cyl	— 40 msec	1.82 Mbps Bit-Ser	B6373 100 Drives	—	\$700/mo- \$44,800 (D) \$400/mo (C)
	B 477/78-2 <sup>2</sup> B 9375/76-9	8 Surfaces of 4 Disks	115.2 Mbits 19.2 Mbytes 2.4 Mwords	1 cyl 400 trks/cyl	— 40 msec	600 Kbps Bit-Ser	B5470-1/ B0374-2 100/50 Drives	—	\$700/mo- \$45,600 (D) \$590/mo (C)
	B 9372/74-8 <sup>3</sup> B 9376-2	8 Surfaces of 4 Disks	160 Mbits 20 Mbytes 10 Mwords	1 cyl 400 trks/cyl	— 40 msec	1.82 Mbps Bit-Ser	B2373/3373/ 4373 100 Drives	—	\$700/mo- \$38,500 (D) \$200/mo (C)
	B 9376-10 <sup>4</sup>	8 Surfaces of 4 Disks	160 Mbits 20 Mbytes 3.33 Mwords	1 cyl 400 trks/cyl	— 23 msec	2.83 Mbps Bit-Ser	B6373 100 Drives	—	\$900/mo- \$45,600 (D) \$400/mo (C)
	B 9372/74-7 <sup>5</sup> B 9376-0	8 Surfaces of 4 Disks	160 Mbits 20 Mbytes 10 Mwords	1 cyl 400 trks/cyl	— 23 msec	2.82 Mbps Bit-Ser	B2373/3373/ 4373 100 Drives	—	\$900/mo- \$43,200 (D) \$200/mo (C)
	B 9472-1 <sup>6</sup>	2 Surfaces of 1 Disk	120 Mbits 15 Mbytes 2.5 Mwords	1 cyl 100 trks/cyl	— 20 msec	4.5 Mbps Bit-Ser	B6877/7877 20 Drives	—	\$1,400/mo- \$67,200 (D) \$350/mo (C)
	B 9472-2 <sup>7</sup>	2 Surfaces of 1 Disk	160 Mbits 20 Mbytes 3.33 Mwords	1 cyl 100 trks/cyl	— 35 msec	3.6 Mbps Bit-Ser	B6877/7877 20 Drives	—	\$1,400/mo- \$67,200 (D) \$350/mo (C)
	B 9473-1	16 Surfaces of 8 Disks	1200 Mbits 150 Mbytes 25 Mwords	1 cyl 1000 trks/cyl	— 20 msec	4.5 Mbps Bit-Ser	B6877/7877 20 Drives	—	\$5,350/mo- \$256,800 (D) \$350/mo (C)
Collins Radio	9200 A-1	16 Surfaces of 8 Disks	356 Mbits 33.6 Mbytes	128 cyl 32 trks/cyl	19.5 msec 12.5 msec	2.78 Mbps Bit-Ser	—	—	\$23,500 (OEM)

<sup>1</sup>Available in 40 Surface/20 Disk Configuration as Model B9375-12

<sup>2</sup>Available in 40 Surface/20 Disk Configuration as Model B477-1

<sup>3</sup>Available in 40 Surface/20 Disk Configuration as Model B9375-2

<sup>4</sup>Available in 40 Surface/20 Disk Configuration as Model B9375-10

<sup>5</sup>Available in 40 Surface/20 Disk Configuration as Model B9375-0

<sup>6</sup>Available in 4 Surface/2 Disk Configuration as Models B9472-3 & B9474-3

<sup>7</sup>Available in 4 Surface/2 Disk Configuration as Models B9472-4 & B9474-4, and in 20 Surface/10 Disk Configuration as Model B9473-2

The capacity of a drive unit is determined by several factors. The track density and the bit density in a given track determine the number of bits stored on a given surface area. Bits per inch for a given track is a function of recording method, bit clock rate, and surface velocity. Surface velocity, for a given track, depends upon disk rotation speed and the distance of the track from the spindle axis. Rotation speeds now are typically 2400, 3000, and 3600 rpm, with the IBM 2305 disk drive at 12,000 rpm.

### Recording Techniques

Three techniques find extensive use in the recording of data on rotating magnetic memories. One technique, non-return-to-zero inverted (NRZI), is found in certain devices where provision has been made for a synchronized read clock. NRZI recording affords maximum recorded data density; all flux transitions sensed by a read head represent logical "one" bits. It is not possible to determine,

**TABLE 2 • NON-REMOVABLE DISK DRIVES ..... Cont'd**

(Capacity > 50 Megabits)

Company	Model	Storage Media	Capacity	Organization (cylinders & tracks per cylinder)	Avg Access Time (position- ing & latency times)	Data Transfer Rate & Format	Controller & No. Drives Controlled	Interface	Price (D) - Drive (C) - Controller
Control Data	821 <sup>8</sup>	128 Surfaces of 72 Disks	2500/5000 Mbits	— 64 trks/cyl	80 msec —	2.51 Mbps	3553	—	—
	6638	72 Disks	790/1000 Mbits	—	80 msec —	1.68 Mbps Bit-Par	Integral	• CDC 6000 Series	—
Data Products	6040	40 Surfaces of 22 Disks	2000 Mbits 250 Mbytes	800 cyl 40 trks/cyl	55 msec 16.7 msec	1.87 Mbps Bit-Ser	—	—	\$60,000 (OEM)
	7010	40 Surfaces of 22 Disks	793 Mbits 22 Mwords	812 cyl 40 trks/cyl	55 msec 16.7 msec	2.31 Mbps Bit-Ser	7110/7111 16 Drives	• Univac 418, 494, 1106 & 1108	\$2,240/mo- \$98,700 (D) \$63,000 (C)
	7318 <sup>9</sup>	40 Surfaces of 22 Disks	934 Mbits 117 Mwords	812 cyl 40 trks/cyl	55 msec 16.7 msec	1.87 Mbps Bit-Ser	7360/7361 16 Drives	• IBM S/360 Models 30 & up <sup>9</sup>	\$2,130/mo- \$98,000 (D) \$54,000 (C)
Digital Development	7313	16 Surfaces of 8 Disks	67.6 Mbits	—	— 8.5 msec	3.96 Mbps	—	—	—
Honeywell	261	64 Surfaces of 36 Disks	900 Mbits 150 Mbytes	128 cyl 128 trks/cyl	15 msec 25.7 msec	Bit-Ser	260 8 Drives	• HON 200 Models 120 to 4200	\$3,868/mo- \$166,000 (D) \$26,100 (C)
	262	128 Surfaces of 72 Disks	1800 Mbits 300 Mbytes	256 cyl 128 trks/cyl	15 msec 25.7 msec	Bit-Ser	260 4 Drives	• HON 200 Models 120 to 4200	\$6,554/mo- \$297,000 (D) \$26,100 (C)
IBM	2302-3/4	46 Surfaces of 25 Disks	902 Mbits 113 Mbytes	500 cyl —	148 msec 17 msec	1.25 Mbps Bit-Ser	2841 2 Drives	• IBM S/360	—
	2305-2	12 Surfaces of 6 Disks	90 Mbits 11.2 Mbytes	—	— 5 msec	12 Mbps Bit-Ser	2835 2 Drives	• IBM S/360 Models 40 & up & S/370	\$6,400/mo- \$300,800 (D & C)
ICL	2805 <sup>10</sup>	12 Surfaces of 6 Disks	605 Mbits 101 Mbytes	256 cyl 12 trks/cyl	100 msec 25 msec	900 Kbps Bit-Ser	2803/1 14 Drives	• ICL 1900 Series	—
	2806 <sup>10</sup>	12 Surfaces of 6 Disks	1310 Mbits 218 Mbytes	256 cyl 12 trks/cyl	100 msec 25 msec	900 Kbps Bit-Ser	2803/1 14 Drives	• ICL 1900 Series	—
Systems Peripherals Div.	211	4 Surfaces of 2 Disks	96 Mbits 12 Mbytes	—	— 16.8 msec	3 Mbps Bit-Ser/Par	—	• SEL 810 A&B, 8200, 8600, 8800 • XDS Sigma 2, 3 & 5	—
Xerox Data Systems	720 E	4 Surfaces of 2 Disks	51.4 Mbits 6.2 Mbytes	—	— 16.7 msec	3 Mbps Bit-Ser/Par	—	—	\$25,000 (OEM)

<sup>8</sup>Available as Model 821-1 in 36 Disk Configuration, and as Model 821-2 in 72 Disk Configuration  
<sup>9</sup>IBM S/360-2314 Compatible  
<sup>10</sup>Available in 13- and 25-Disk Configuration Models

via the data itself, the occurrence of logical "zero" bits since no flux transition occurs.

The other two methods which find use in larger memories are phase modulation recording and double frequency recording. As opposed to NRZI, these methods record, effectively, only one bit of data for each two bits that are written; thus, for the same clock frequency, only half the effective data density is attained, but an advantage is gained in that, during a read operation, the read clock is recoverable from the read data itself for

both logical levels. There need not be dependence upon external synchronization signals when these recording techniques are used.

**Transfer Rate**

The sum total of the foregoing characteristics results in the data transfer rate. For bit-serial transfers at the drive unit interface, bit rate and data

**TABLE 3 • HYBRID DISK DRIVES**  
(Capacity > 50 Megabits)

Company	Model	Storage Media	Capacity	Organization (cylinders & tracks per cylinder)	Avg Access Time (positioning & latency times)	Data Transfer Rate & Format	Controller & No. Drives Controlled	Interface	Price (D) - Drive (C) - Controller
Iomec	2023	1 Fixed Disk & 2 2315 Disk Cartridges	72 Mbits 9 Mbytes 4.5 Mwords	609 cyl 2 trks/cyl	70 msec 20 msec	1.56 Mbps Bit-Ser	2800 4 Drives	<ul style="list-style-type: none"> <li>• DEC PDP-8, 12</li> <li>• Micro 810, 812</li> <li>• Data Gen Nova &amp; Supernova</li> <li>• GA 18/30</li> <li>• SPC-16</li> <li>• HP 2114B, 2116</li> <li>• Milacron CIP-2000</li> </ul>	\$15,575 (D) \$4,500 (C)
	2024	2 Fixed Disks & 2 2315 Disk Cartridges	96 Mbits 12 Mbytes 6 Mwords	812 cyl 2 trks/cyl	70 msec 20 msec	1.56 Mbps Bit-Ser	2800 4 Drives		\$17,200 (D) \$4,500 (C)
Per Data	104 Series	3 Fixed Disks & 1 Mag Tape Drive	66 Mbits (Disks)	—	— 8.5 msec	1.23 Mbps	Integral	<ul style="list-style-type: none"> <li>• DEC PDP-8, 11</li> <li>• HON 316, 516</li> <li>• Varian 620/i, 520/i</li> <li>• HP 2114, 2115A, 2116B</li> <li>• MAC-16</li> <li>• IBM S/360</li> </ul>	—

**TABLE 4 • DRUM DRIVES**  
(Capacity > 50 Megabits)

Company	Model	Capacity	No. Tracks	Avg Access Time	Data Transfer Rate & Format	Controller & No. Drives Controlled	Interface	Price
Bryant Computer Products	18.5B/1024	77.1 Mbits	1024	16.7 msec	Bit-Ser/Par	Series 720 8 Drives	<ul style="list-style-type: none"> <li>• Interdata Mod 1 to 5</li> <li>• DEC PDP-8</li> <li>• MAC-16</li> <li>• SEL 810</li> </ul>	—
	18.5C/512	77.1 Mbits	512	16.7 msec	4.52 Mbps Bit-Ser/Par	—	—	—
	18.5D/1024	153 Mbits	1024	—	4.52 Mbps Bit-Ser/Par	—	—	—
General Instruments Magne Head Division	7012-1024	70 Mbits	1024	8.7 msec	3.3 Mbps Bit-Ser/Par	—	—	\$35,800 (OEM)
	7018-1024	100 Mbits	1024	17 msec	3.3 Mbps Bit-Ser/Par	—	—	\$43,100 (OEM)
	7018-1536	150 Mbits	1536	17 msec	3.3 Mbps Bit-Ser/Par	—	—	\$56,400 (OEM)
Hughes Aircraft	MK III-16A	100 Mbits	640	—	Bit-Ser/Par	—	—	—
Univac	FH-1782	75.5 Mbits 2.1 Mwords	1536	17 msec	8.64 Mbps Bit-Par	FH-432/1782 8 Drives	• Univac 1100 Series	—
	Fastrand III	1400 Mbits 33 Mwords	—	35 msec	1.38 Mbps	Fastrand III 8 Drives	• Univac 1100 Series	—
Vermont Research	2032	71.6 Mbits	1024	17.5 msec	2 Mbps Bit-Ser	7100 16 Drives	<ul style="list-style-type: none"> <li>• DEC PDP Series</li> <li>• XDS CF16</li> </ul>	—
	2064	143 Mbits	2048	17.5 msec	16 Mbps Bit-Par	7100 16 Drives	—	—

transfer rate are the same. The question of data rates becomes important during system specification because data buffers, or some interfacing technique, may be necessary to prevent a computer channel or controller "traffic jam."

### Access Mechanisms

Positionable head drives contain an access mechanism which controls all movements of the read/write head(s) relative to the recording area of each disk surface. The mechanism includes a prime mover, its extension, and a carriage assembly. The carriage supports the position transducer, the heads, and a mechanical means for safe head loading and head retraction during start and stop operations. Prime mover types in use are hydraulic systems and voice-coil linear actuators. In the hydraulic systems, a piston is forced to move in the forward or reverse directions via solenoid valve controls; this results in conservatively safe and smooth motion with multiple speed capabilities. In an electrical power failure situation, reserve hydraulic pressure is employed to retract the carriage assembly; as the mechanism is restored to its retracted position the heads are lifted away from the disk surface to prevent contact. Drives which are designed with voice-coil actuators also perform these operations. These actuators are more recent in development and they have advantages of simplicity, (and therefore generally cost less), as well as faster motion. Access mechanism retraction in the case of power failure might not be a design feature; lower-priced units may just simply separate the heads away from the disk surface.

The critical function of an access mechanism, of course, is to position the heads accurately to an addressed track on the disk. There are two components to this requirement: the extended positioning of the carriage assembly and the separation of the head relative to the recording surface. Track-to-track positioning can be accomplished by an electro-mechanical detenting subassembly of the carriage, or by electronic techniques. The latter operates faster, silently, and depends for accuracy upon the mechanical tolerances of the transducer alone. The head/surface separation problem is resolved by the flying head design. In this design each head (or group of heads), is supported about 60 to 200 micrometers above the magnetic surface via difference forces. The head-arm assembly is a leaf-spring support which directs the head toward the surface; a second force, which is created by the air stream between the head and the moving surface, directs the head in the opposite direction. As a result, the head is balanced above the disk and should never contact the surface, but should ride over any irregularities.



The IBM 3330 disk-pack storage system, available in 2-, 4-, 6-, or 8-drive configurations with capacities of from 1600 to 6400 megabits, and a transfer rate of 6.45 megabits/second.

### SELECTION

The application of rotating memory for new, add-on, or OEM-type storage will relate to specifics on cost/performance and overall system considerations. General factors on such selection criteria are given below.

#### Cost Performance

The user of mass storage systems is primarily concerned with the cost/performance characteristics of an entire processing system as it relates to his job requirements. Disk and drum memory should be considered from the point of view of their true cost, their effect upon system throughput, reliability, system cohesiveness and flexibility, and software or programming effort.

Improvements in data density for a given mechanical arrangement of recording surface and transducer have been gained over the past years without a corresponding increase in drive cost. Some disk drives can store  $8 \times 10^5$  bits per square inch at densities of 4,000 bits per inch (per track) and 200 tracks per inch. The cost per bit on such drives can be as low as 0.0041 cents; drum facilities can even go as low as 0.0038 cents per bit.

The time to access stored data has decreased. For rotating memory devices having fixed-head per track configurations, increases in rpm has decreased the average access time for a drum to as low as 8 milliseconds, and to 5 milliseconds for some disk drives.

Reliability has received considerable attention from the manufacturer due to the comparative nature of the compatible and OEM drive business, and to the increased competition amongst the systems manufacturers. Reliability has been enhanced by improvements in the electro-mechanical design of rotating memory devices. For example, the extension of air bearing support to include the rotating mass comprising the disk, its

## 2314 COMPATIBLES ..... REVISITED

*An update of January's Technology Profile on 2311 and 2314 plug-to-plug compatible disk-pack drives*

Recent activity in the plug-to-plug compatible battle between IBM and the independent peripherals manufacturers has centered on the 2319 Disk Storage Facility.

The 2319 is an integral three-drive 2314-type storage system that utilizes the 2316 disk-pack. The system has a storage capacity of 88 megabytes, and was originally intended for use with the new S/370 Model 145. IBM has now extended the application of the 2319 to the S/360 Models 30 and up. Pricing is lower than the previously employed three-drive configuration of a 2312 single drive unit, a 2318 dual drive unit, and a 2314 drive controller (see **MODERN DATA**, page 64, January, 1971.)

There has been an immediate response from the independent peripherals manufacturers. **Potter Instrument, Tracor Data Systems, and Telex Computer Products** have all announced price reductions in their lines of 2314 (or 2319) compatible drives that undercut those of IBM. **California Computer Products** has taken another route, announcing a high-density line of 2316 disk-pack drives having twice the storage capacity of the 2314. These high density drives are still plug-to-plug compatible with S/360 computers and software (although disk-packs recorded on a standard density drive system cannot be read on the high density drives — and vice versa), and are priced 10% below the cost of an IBM 2319.

supporting hub, the shaft, and the motor rotor has compensated for any changes in mass which may be introduced by shock or wear. Other improvements relate to fluidic logic in place of relays and solenoids, to packaged integrated circuitry for drive control logic and read/write electronics, and to disk and disk-pack manufacture.

### System Considerations

Functional performance features to be considered involve the optimization of communications between the CPU and the mass memory — relieving the CPU of unnecessary operations — and the capability of the drive controller and FCU.

The past decade has provided certain concepts relating to general system architecture; they can provide insights on the functional role of each component, although this architecture is not the final word. Radical variations have already emerged or been announced by several large computer systems manufacturers.

The physical size of the mass memory and the overall system layout might also be of importance; floor space, cable configurations, and aisle locations in relation to the locations of the CPU and the FCU could impose some limitations.

### THE TABLES

The Tables present the major parameters of disk and drum memories having storage capacities in excess of 50 megabits. Table 1 covers **Removable Disk-Pack Drives**; Table 2 presents data on **Non-Removable Disk Drives**. **Hybrid Disk Drives** (non-removable/removable and disk/magnetic tape) are listed in Table 3, and **Drum Memories** are covered in Table 4.

The models presented in the Tables represent disk or drum memories that are either housed in a single cabinet or sold as an integral unit. Other configurations or multi-drive units, incorporating additional disks (or drums) on existing (or additional) spindles and having higher storage capacities, might be available; and the manufacturer should be consulted when such increased capacities are desired.

Further information on disk or drum drives described in Tables 1, 2, 3, & 4 may be obtained by referencing Tables 5, 6, 7, & 8; and using the Reader Service Card.

### REFERENCES

<sup>1</sup>TECHNOLOGY PROFILE—IBM 2311 & 2314 Compatible Disk-Pack Drives, **MODERN DATA**, January, 1971

<sup>2</sup>TECHNOLOGY PROFILE—Removable-Disk Memories, **MODERN DATA**, December, 1968

<sup>3</sup>TECHNOLOGY PROFILE—Disk & Drum Memories, **MODERN DATA**, May, 1969

## TABLE 5 • REFERENCE LITERATURE

For additional information on *Removable Disk-Pack Drives* (capacity greater than 50 Mbits) described in Table 1, circle the appropriate numbers listed below on the Reader Service Card.

COMPANY	READER SERVICE CARD NUMBER
Burroughs, Detroit, Mich. ....	250
Control Data, Minneapolis, Minn. ....	251
Digital Equipment, Maynard, Mass. ....	252
EDP Technology, Orlando, Fla. ....	253
Honeywell, Needham, Mass. ....	254
IBM, White Plains, N.Y. ....	255
ICL, New York, N.Y. ....	256
Information Storage Systems, Cupertino, Cal. ....	257
NCR, Dayton, Ohio ....	258
RCA, Camden, N.J. ....	259
Univac, Blue Bell, Pa. ....	260

## TABLE 6 • REFERENCE LITERATURE

For additional information on *Non-Removable Disk Drives* (capacity greater than 50 Mbits) described in Table 2, circle the appropriate numbers listed below on the Reader Service Card.

COMPANY	READER SERVICE CARD NUMBER
Bryant Computer Products, Walled Lake, Mich. ....	261
Burroughs, Detroit, Mich. ....	262
Collins Radio, Dallas, Texas ....	263
Control Data, Minneapolis, Minn. ....	264
Data Products, Woodland Hills, Cal. ....	265
Digital Development, San Diego, Cal. ....	266
Honeywell, Needham, Mass. ....	267
IBM, White Plains, N.Y. ....	268
ICL, New York, N.Y. ....	269
Systems, Peripherals Div., San Diego, Cal. ....	270
Xerox Data Systems, El Segundo, Cal. ....	271

## TABLE 7 • REFERENCE LITERATURE

For additional information on *Hybrid Disk Drives* (non-removable/removable & disk/magnetic tape — capacity greater than 50 Mbits) described in Table 3, circle the appropriate numbers listed below on the Reader Service Card.

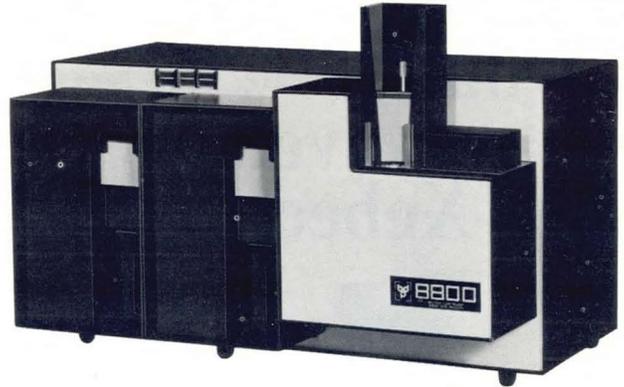
COMPANY	READER SERVICE CARD NUMBER
Iomec, Santa Clara, Cal. ....	272
Per Data, Hicksville, N.Y. ....	273

## TABLE 8 • REFERENCE LITERATURE

For additional information on *Drum Drives* (capacity greater than 50 Mbits) listed in Table 4, circle the appropriate numbers listed below on the Reader Service Card.

COMPANY	READER SERVICE CARD NUMBER
Bryant Computer Products, Walled Lake, Mich. ....	274
General Instruments, Hawthorne, Cal. ....	275
Hughes Aircraft, Culver City, Cal. ....	276
Univac, Blue Bell, Pa. ....	277
Vermont Research, North Springfield, Vt. ....	278

# Why we're introducing a not-so-high-speed high-speed card reader.



## 8800 multiple card reader

The Bridge Data Model 8800 card reader reads 80-column cards at a 650 cpm rate, 96-column cards at 1000 cpm.

In a world measured in nanoseconds, that's not so fast.

But in a world measured by the ability of someone to keep the machine fed, or by the ability of the machine to mate efficiently with 9600-baud high-speed terminals, it is comfortably quick.

And which world do you really live and work in? Right. The real world.

A world where long life (10 years, or 20,000 hours), reliability (1,000 hours MTBF), and accuracy (one possible error in  $300 \times 10^6$  data bits), are at least as sacred as achieving ultimate speed and status.

That's the world we design for. By building card readers that are fully compatible with standard 80-column cards and the new System/3 cards. (No sense building a machine that lasts ten years if it's obsolete in two.)

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And by building card readers with no-choke price tags.

There's more to the 8800 Series than this. (Screwdriver-simple maintenance, for instance.) But no more room to discuss it here.

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CIRCLE NO. 30 ON INQUIRY CARD

## NEW PRODUCTS

### MODEMS & MULTIPLEXERS

Codex has introduced the first members of two new families of data communications products, the 4800 Data Modem, and the 800 Time Division Multiplexer. The 4800 provides for error-free performance in the 4800 bits/second speed class. The performance of the 4800 is attributed to a modulation technique combined with a completely automatic and adaptive digital equalizer. Communication channel abnormalities which seriously degrade performance are effectively neutralized in the Codex design, to provide immunity to unconditioned and standard telephone channels. The 800 family of asynchronous time division multiplexers upgrade existing communications systems employing older techniques which have been made obsolete by modern data communication requirements. The con-

figuration flexibility provided by the Codex 800 assures that communication network design is only limited by the originality of the system planner. The Codex 800 allows the user to buy only the modules required for his immediate 50 to 1800 bit/second requirements. Expanded requirements involve plugging in additional channel modules or eight channel expansion groups. This technique permits the small user to implement a fully expandable TDM system at a cost previously associated with limited expansion frequency division techniques. Both the Codex 800 and the Codex 4800 have complete network fault isolation capability to permit the user to observe network performance and rapidly isolate any communications network malfunction. *Codex Corp., Watertown, Mass.*

Circle No. 320 on Inquiry Card.

### LARGE-SCALE COMPUTER

With the basic memory of 138 kilobytes, the NCR Century 300 is expandable to 2048 kilobytes with a cycle time of 650 nanosec for each 4-byte access. Although compatible with the Century Series' two smaller members, the 300 incorporates innovations to meet the throughput requirements of larger applications. The system's features include an arithmetic/logic processor consisting of a separate command setup unit and command execution unit. Each has its own access port to memory and their parallel operation eliminates command setup time in most instances. The I/O control provides up to 18-way simultaneity. By providing independent access to memory for the I/O control, the system can achieve a transfer rate of 4.3 megabytes with minimum interference to internal processing. The operator's console of the new sys-

tem includes a CRT subsystem to enhance operator/system communications. All peripherals of the Century 100 and 200 can be used with the new system. To fulfill the requirements for a random access device with a fast access time, the NCR 650 drum is being offered. It has a capacity of 4.2 million bytes and an average access time of 8.3 millisecc with a transfer rate of 1 megabyte per second. Also available is a controller which will increase the capacity of the NCR 657 disk unit. The controller allows operation of the 657 in either 30-million byte mode or 48-million byte mode. The system offers the complete set of high-level Cobol elements and full Fortran as well as NCR's own programming language, NEAT/3. The price range of the system is from \$15,000 to \$50,000 per month, with first customer delivery scheduled for February, 1972. *NCR, Dayton, Ohio*  
Circle No. 326 on Inquiry Card.

## MINICOMPUTER

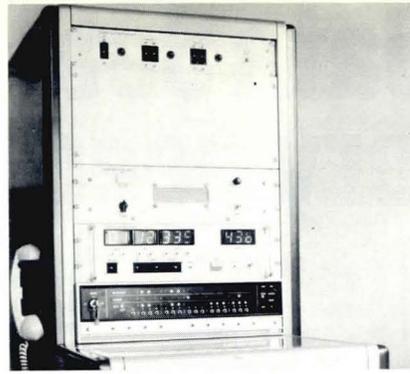
Electronic Processors, a subsidiary of Samsonite Corp., has introduced a 4K x 18 bit minicomputer which features modular architecture and master board connection. The EPI-118 employs a 900 nanosec core memory, expandable to 32K, TTL logic, and MSI throughout the system. Other features include four hardware registers, peripheral interfaces, and associated control logic. The price of the EPI-118 starts at \$5,900. *Electronic Processors, Englewood, Colo.*

Circle No. 347 on Inquiry Card.

## AUDIO MEMORY/RESPONSE

The Voicepac 2000 is a voice response system that uses the push-button telephone or acoustically coupled terminals as the computer input/output device. When interfaced to a data processing configuration, or as a stand-alone system with a minicomputer, the Voicepac conveys the alphanumeric input tones of the telephone to the computer which responds back over the communications facility, in a human voice, to the individual making the inquiry. Both on-line and stand-alone configurations are available with required interface capability for the IBM 360 and other computer systems. The Voicepac interface can also be configured to handle data communications between remote terminals like CRT displays, teletypewriters, printers, or other batch-oriented transmission devices. The computer's pre-recorded vocabulary is selected by the user and is stored in a memory unit which is a part of the Voicepac 2000 system. The only equipment requirements at a remote location is an inexpensive pushbutton telephone. The system has a vocabulary of 2000 words and can be expanded to provide even greater vocabulary sizes depending on individual customer requirements. The vocabulary can be revised on-site by the user. A 40-word vocabulary system is priced at \$27,000 and the 2000-word unit sells for \$62,000. *Periphonics Corp., Rocky Point, N.Y.*

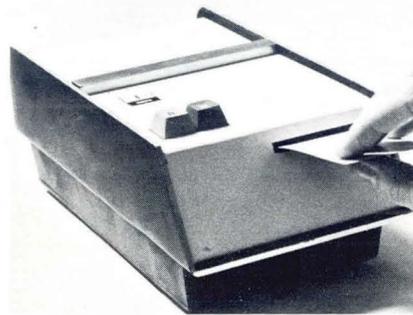
Circle No. 336 on Inquiry Card.



## DATA ACQUISITION SYSTEM

The SADAQ-II series of computer controlled data acquisition systems combine in one equipment rack all necessary functions of a central station control system. From this central station, automatic interrogation of remote monitoring stations, and initiation of supervisory commands take place under total control of the central computer. The unit checks the health and well being of all remote stations each time it demands data interrogation. It recalibrates sensor zero points at each reading request, automatically alarms the operator of out-of-tolerance conditions, and if desired, initiates corrective action. *Symetrics Engineering Corp., Satellite Beach, Fla.*

Circle No. 338 on Inquiry Card.



## MAGNETIC CARD READ/WRITE UNIT

The Magnetic Card Unit is designed for use with any data processing equipment as a manual input/output device. The unit uses credit card size magnetically-coated cards with a capacity of over 400 bytes of information. A file protect feature prevents accidental erasure of data on the magnetic cards. *Digital Information Devices, Lionville, Pa.*

Circle No. 352 on Inquiry Card.

## CRT DISPLAY

The ICL Model 7181 keyboard CRT terminal can display up to 2000 characters on a 15-inch screen. The 7181 has an upper and lower case 96-character set and uses MOS read-only memory for character generation. *International Computers Ltd., N.Y., N.Y.*

Circle No. 337 on Inquiry Card.

## KEY-TO-DISK

The Model 1140 Key-Disk system utilizes the shared processor concept to handle up to 32 local or remote Teletype or video data input stations. The system is capable of performing editing, table look-up functions, and preliminary verification. Options include magnetic tape recording for parallel acquisition, printers, and communications compatibility for direct batch transmission. *Eclectic Corp., Dallas, Texas*

Circle No. 351 on Inquiry Card.

## TELEPRINTING TERMINAL

The CDI 1010B is a small, multiple-copy terminal designed for time-sharing operations. The 1010B is compatible with the TTY 33 in code, format, and keyboard, and has a built-in acoustic coupler. The terminal is priced at \$2100 and is available from stock. *Computer Devices, Woburn, Mass.*

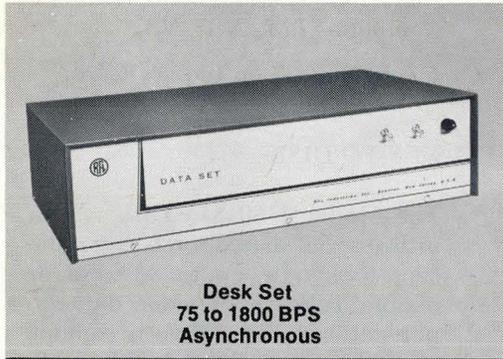
Circle No. 334 on Inquiry Card.

## CASSETTE TRANSPORT

The transport is a read-after-write unit featuring wide write (write gap 10% greater than full width of tape) and wide read, (center 67% of tape), to make information less sensitive to tape defects. It is designed to operate at 30 ips for reading, writing, rewinding, and searching. The instantaneous transfer rate is 1800 char/sec, and the average transfer rate, with 110 character blocks, is 1000 char/sec. Each cassette will store 90,000 characters in 100 character blocks. *Redactron Corp., Hauppauge, N.Y.*

Circle No. 335 on Inquiry Card.

# RFL builds Data Sets to meet every need



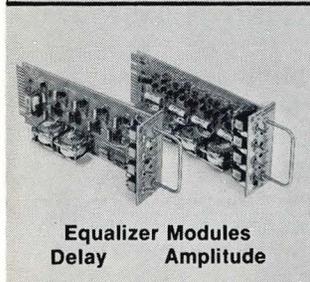
**Desk Set**  
75 to 1800 BPS  
Asynchronous



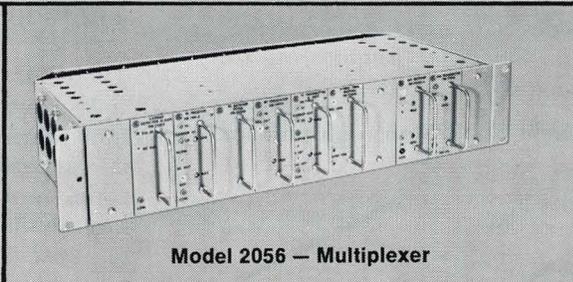
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**Model 3952 2400 Bit Data Set**



**Equalizer Modules**  
Delay      Amplitude



**Model 2056 — Multiplexer**

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## NEW PRODUCTS



### PROGRAMMABLE CALCULATOR

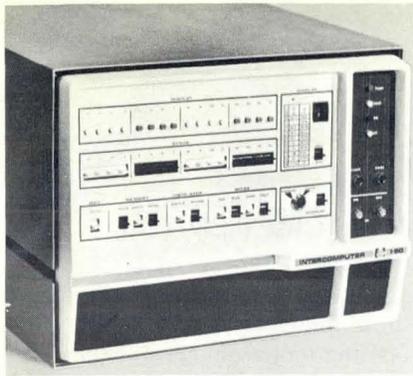
The Statistician 911 programmable electronic calculator is especially designed to perform statistical calculations and solve many other mathematical problems. Factorials can be obtained for any integer value of  $x$  from zero to 69 by pushing the  $x!$  key after entering the number  $x$ . Two keys permit independent and rapid accumulation of any value of  $x$  in the display into two different registers,  $K_{00}$  and  $K_{01}$ , without interfering with the calculation being carried out. Accumulating the square of a sequence of values can also be accomplished simply. The Statistician 911 bypasses computer "languages" and allows the operator to write equations directly on its keyboard. The instrument automatically observes correct algebraic hierarchy in performing all operations. In addition to keys for statistical calculations, the Statistician's keyboard includes a true equals key, individual left and right parentheses keys, hard-wired  $|x|^y$ , square root of  $x^2+y^2$ ,  $f(x)$ ,  $\ln x$ ,  $e^x$ ,  $x^2$ , square root of  $x$ ,  $1/x$ ,  $\text{int } x$ ,  $\text{remote}$ ,  $\sin x$ ,  $\cos x$ , and their arc. The basic model has 26 indirectly addressable stored constants (100 optional) and 85 program steps (256 optional). *Cintra, Inc., Sunnyvale, Cal.*

Circle No. 324 on Inquiry Card.

### DISPLAY COPIER

The 9750 Display Copier makes permanent records of alphanumeric or graphic CRT displays at a speed of 5 copies/min and a cost of less than 2¢. Paper capacity of the 9750 is a 460 ft. roll for copies and 350 ft. for offset masters. Copying speed is 12 sec. for first reproduction and 8 sec. for additional copies. *A. B. Dick, Chicago, Ill.*

Circle No. 328 on Inquiry Card.



### COMMUNICATIONS PROCESSOR

The i-50 is a low-cost (\$6,500) communications processor capable of handling up to 250 I/O channels. The system employs a 16-bit microprogrammed processor with a specialized instruction repertoire for data manipulation. Communications lines are serviced by firmware, freeing the processor for other data handling tasks. *Intercomputer Corp., Sherman Oaks, Cal.*

Circle No. 350 on Inquiry Card.

### HI-SPEED REMOVABLE DISK SYSTEM

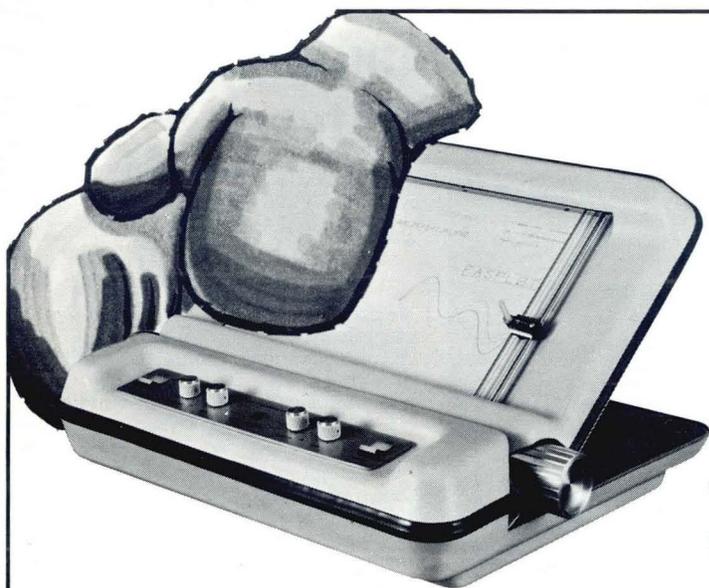
A mass memory system that combines fast head-per-track access (8.7 ms average) with the versatility of interchangeable disks is now available. This new memory system, called the Discstor 510, can increase efficiency and reduce costs in large data base digital processing operations by decreasing throughput time. Individual heads for each recording track are the basis for the high speed data access. 128 tracks per side add up to a total capacity of 10 million bits. A rotational rate of 3600 rpm provides a data transfer rate as high as 2.35 MHz. The Discstor 510 can be supplied as a desk top unit — completely self contained, or it can be supplied with its own stand to provide convenient storage for six disks. If required, standard RETMA rack mounting hardware can be provided. *General Instrument Corp., Hawthorne, Cal.*

Circle No. 325 on Inquiry Card.

### FP PROCESSOR FOR PDP-12

The FPP-12 floating point processor gives DEC's PDP-12 computer a dual processor capability and does calculations as much as 39 times faster than before because the floating point calculations are done by hardware rather than by software, which is usually the case. Typically, a three-word, 36-point floating point multiply took 1,100 microseconds when done by software, and 500 microseconds when done by software and an Extended Arithmetic Element. An FPP-12-equipped PDP-12 can do the same calculation in 28 microseconds while maintaining the same seven-digits of accuracy. The FPP-12 can be ordered with a new PDP-12 system, or it can be field installed on any of DEC's family of 12-bit machines. Minor revisions to existing programs usually will be required if an FPP-12 is added. Price of the FPP-12 is \$7,500. *Digital Equipment Corp., Maynard, Mass.*

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An off-the-shelf, relocatable, macro-assembler for all mini-computers, designated Mini-Dual, will operate in extremely small memory environments — as low as 8K bytes. The miniaturized macro-processor is compatible with Dual, the Meta-defined language processor; any program written for Mini-Dual can be processed by Dual. Mini-Dual includes external symbols, relocation, data definition directives, macro definition directives, and intrinsic functions to scan arguments of source statements. Price is \$15,000; lease arrangements are available. *Proprietary Software Systems, Los Angeles, Cal.*

Circle No. 389 on Inquiry Card.

## BUSINESS SOFTWARE

General ledger accounting, accounts receivable, accounts payable, payroll, and inventory management systems are available for implementation on ATRON's Data-manager and Data General's Nova and Supernova. These packages are available with single-user and multiple-user options, and adaptable to a variety of computer configurations. Although priced separately, these programming packages are available as part of a total computer system — including both the computer system and the programming packages. Each software package is completely documented and guaranteed to run on the specified system support as well as additional system applications. *Rhombic Research, Ft. Worth, Tex.*

Circle No. 378 on Inquiry Card.

## MANUSCRIPT EDITOR

MEDIT is an on-line manuscript editor for general text, letters, advertising copy and catalogs. The program, which has incorporated some of the ideas of ED (an editor running under CTSS at MIT) and DDT (an on-line debugging package), is word-oriented and uses a simple command language for searching, editing, formatting, and printing. MEDIT is presently available for PDP-10 T/S systems with versions adaptable to smaller, in-house computers. Price is determined by the nature and extent of application, but runs approximately in the \$125/mo. range. *Computer Interactive Services, Inc., Brookline, Mass.*

Circle No. 384 on Inquiry Card.

## More effective data and telecommunications start with Berglund Associates.

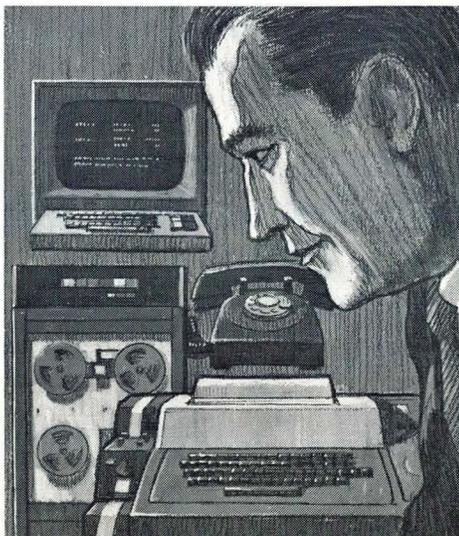
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## ACCOUNTS RECEIVABLE SYSTEM

Soft-Pak Services has announced the availability of its Accounts Receivable System (SPARS-2000), which is programmed in Bal for the IBM 360/30 and up. SPARS-2000 is adaptable to service-oriented organizations servicing all areas of business — industrial, professional, and retail. This system encompasses the following major features: 1) open item or balance forward; 2) descriptive billing; 3) multiple company or client; 4) complete audit trails; 5) detailed statements with ageing analysis; 8) transaction journals; 9) aged trial balance. SPARS-2000 is capable of accepting card, magnetic tape, paper tape or optical input. The systems package includes complete documentation, source decks, and object decks with job control cards. *Soft-Pak Services, Sea Cliff, New York.*

Circle No. 376 on Inquiry Card.

## MAINTENANCE & EXPANSION PROGRAM

SIMPLE (System for Integrated Maintenance and Program Language Expansion) includes a source program maintenance system, a Cobol pre-processor, and a program conversion aid. It provides linkage with compilers, allowing programs to be updated, compiled, and tested in the same run, and automatically audits program changes. SIMPLE also provides program backup; each time a program is changed, the previous version is saved. *Computer Services Corp., Southfield, Mich.*

Circle No. 387 on Inquiry Card.

## PDP-8 PACKAGE

The P-100A program package provides PDP-8 users with magnetic tape versions of programs normally supplied on paper tape by DEC. The package is contained within a tape cartridge, usable with any PDP-8 equipped with 4K of memory, a Teletype, and a Tri-Data CartiFile transport. I/O times are reduced by a factor of four from that required by paper tape systems. *Tri-Data, Mountain View, Cal.*

Circle No. 381 on Inquiry Card.

# DATA TRANSMISSION PROBLEMS?

## Let the Sierra 1914B help you solve them.

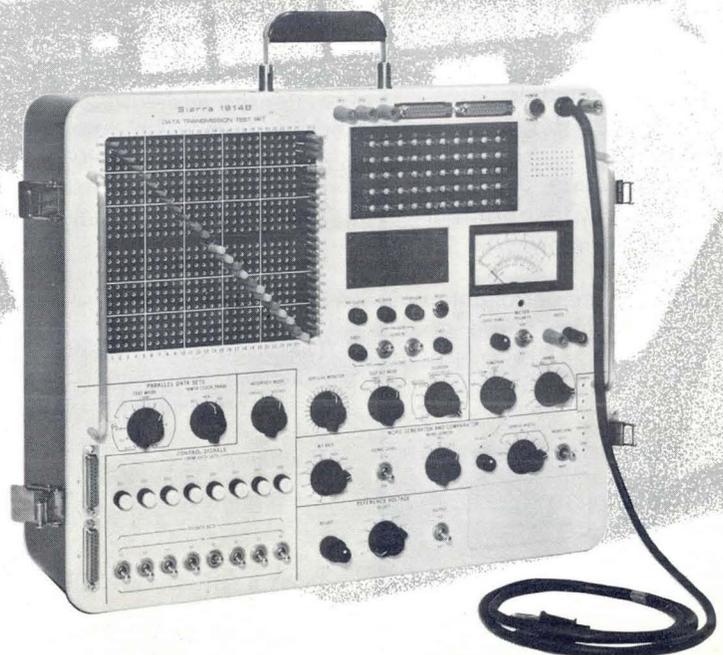
The Sierra 1914B Data Transmission Test Set localizes and identifies the problem. It checks all the supervisory control functions of a modem and the bit- and block-error rate of the entire data transmission system. The 1914B is a field instrument with laboratory features and can test both synchronous and asynchronous voiceband data systems.

It is designed for installation, maintenance, and troubleshooting tests by telephone company personnel, modem users and manufacturers, time-sharing computer companies, and many others.

The test set conforms to EIA RS232 interface specifications, is compatible with most modems, and is equivalent to the Bell System's 914B Data Test Set.

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CIRCLE NO. 35 ON INQUIRY CARD

## NEW LITERATURE

### PDP-8 AUDIO RESPONSE

A data sheet is available on the STAR (Sequential Talking Audio Response) system, an audio response peripheral for the PDP-8 having a 32-word vocabulary. *Cognitronics, Mt. Kisco, New York*

Circle No. 421 on Inquiry Card.

### TELECOMMUNICATIONS MONITOR

Task/Master, a generalized monitor for writing on-line application programs in high level languages, is described in a six page booklet. *Turnkey Systems, Norwalk, Conn.*

Circle No. 412 on Inquiry Card.

### TAPE MEMORY

The 6-page brochure provides details on the Model 6401, sealed-magazine, mag tape, bulk storage memory. *Raymond Engineering, Middletown, Conn.*

Circle No. 409 on Inquiry Card.

### METACOBOL

Applied Data Research has published a 19-page introductory guide to MetaCobol, a Cobol macro translator. *Applied Data Research, Princeton, New Jersey*

Circle No. 407 on Inquiry Card.

### CORE MEMORY

The Nanomemory 4850 — a field-expandable, 850 nanosec 4K to 33K, 20-bit core memory — is described in a 4-page folder. *Electronic Memories, Hawthorne, Cal.*

Circle No. 402 on Inquiry Card.

### INDUSTRIAL CONTROLLER

The VIP minicomputer — a ROM, plug-in PC card, programmable controller — is discussed in a 4-page brochure. *Struthers-Dunn, Bettendorf, Iowa*

Circle No. 416 on Inquiry Card.

### DIRECT ACCESS LIBRARY SYSTEM

A twelve-page brochure explains Panvalet, a security package for the central storage, retrieval, maintenance, control, and back-up security of all source and object programs, JCL and data cards. *Pansophic Systems, Lombard, Ill.*

Circle No. 410 on Inquiry Card.

### PRINTER & CRT

A four-page brochure describing the operating features and principal specifications of the Model 101 printer and the Model 301 CRT display device is available. *Centronics Data Computer, Hudson, N.H.*

Circle No. 400 on Inquiry Card.

### BANKING SERVICE

An on-line computer service for the management control of collateral loan activities is outlined in a new brochure. *Bank Com, Chicago, Ill.*

Circle No. 401 on Inquiry Card.

### LABORATORY COMPUTERS

A 300-page handbook, describing the hardware and software features and uses of PDP-12 laboratory computer systems, is available from Digital Equipment Corporation. The handbook contains sections on biomedical, chemistry, educational, industrial, and clinical laboratory systems, and covers the extensive PDP-12 software. *Digital Equipment Corporation, Maynard, Mass.*

Circle No. 403 on Inquiry Card.

### VIRTUAL MEMORY MINICOMPUTER

System 72, a small computer that uses a virtual memory concept via a large disk to decrease core memory, is discussed in a 12-page brochure. *Systems, Ft. Lauderdale, Fla.*

Circle No. 405 on Inquiry Card.

## ARITHMETIC PROCESSOR

A four-page folder describes the Array Transform Processor, a system capable of performing highly repetitive arithmetic processes found in operational calculus and linear algebra. *Raytheon Computer, Santa Ana, Cal.*

Circle No. 406 on Inquiry Card.

## 202-COMPATIBLE MODEM

A three-page brochure describes Tel-Tech's TT-202 Bell-compatible data set. *Tel-Tech, Rockvill, Md.*

Circle No. 411 on Inquiry Card.

## GRAPHIC TERMINALS

A set of six technical bulletins describing the Series 400 interactive display terminals is now available. *Compu-tek, Cambridge, Mass.*

Circle No. 404 on Inquiry Card.

## FOURIER PROGRAM

An applications bulletin, describing a minicomputer fast fourier transform program, is available from UniComp. The program enables the on-line, real-time operation of the COMP-16 or -18 minicomputers for simultaneous time and frequency domain analysis. *Unicom, Northridge, Cal.*

Circle No. 419 on Inquiry Card.

## MINICOMPUTER FOR SUPERMARKETS

Computer direction of supermarkets, with automated inventory control and management services, is the subject of an eight-page brochure. *Honeywell, Framingham, Mass.*

Circle No. 408 on Inquiry Card.

## GRAPHIC DIGITIZER

A brochure describing the features, applications, specifications, and available software for the Gradicon Series 1000 coordinate digitizer is available. *Edwin Industries, Silver Spring, Md.*

Circle No. 418 on Inquiry Card.

## OYER PRESENTS . . . ICAP '71

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- Conversion and Implementation
- Program Testing and Debugging
- ANSI Cobol

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