JULY 1970

MODERN DATA

TECHNOLOGY PROFILE: DIGITAL PLOTTERS

It's new.
It's fast.
It's Varian's 620/f.

Varian Data Machine's new "superfast" computer has a 750-nsec cycle time. That means it executes two and a half times faster than the well known 620/i.

And check these other outstanding features:

- 100% upward compatible from the 620/i.
- All 620/i software executes on the 620/f —you can take advantage of the extremely large library of software field-proven on the more than 1,200 620/i's in worldwide use.
- Fastest I/O in minicomputers.
- Powerful new addressing modes and instructions.
- Read-only memory.
- All 620/i peripherals plus a new low-cost line.

For full details, request the new handbook. The 620/f—another development that keeps us the big company in small computers.

U.S. Sales Offices: Downey, San Diego, San Francisco, Calif.; Washington, D.C.; Atlanta, Ga.; Chicago, Ill.; Waltham, Mass.; Ann Arbor, Mich.; Albuquerque, N. Mex.; New Rochelle, Syracuse, N.Y.; Fort Washington, Pa.; Dallas, Houston, Tex. Other offices worldwide.

Varian Data Machines, a Varian subsidiary, 2722 Michelson Dr., Irvine, Calif. 92664. Telephone 714/833-2400.

varian data machines

The Big Company in Small Computers

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All things to all men

. . . and to all software.
. . . and to all computer systems.

The first CRT display to contain a stored-program computer, the SPD™ 10/20 introduces a new dimension in compatibility. It can be anything the operator or the system requires. The magnetic core memory stores up to 2048 words and has a 1.6 microsecond cycle time – plus a repertoire of 58 instructions, making it unusually powerful for its size. It changes terminal characteristics as needed.

By validating, verifying and qualifying data – before transmission – SPD 10/20 can increase the performance and economy of your overall system. And it will give your operators a big lift at the same time.

Now in production. There is nothing else like it anywhere.

For further information, contact M.R. Clement, Jr., *Vice President of Marketing*

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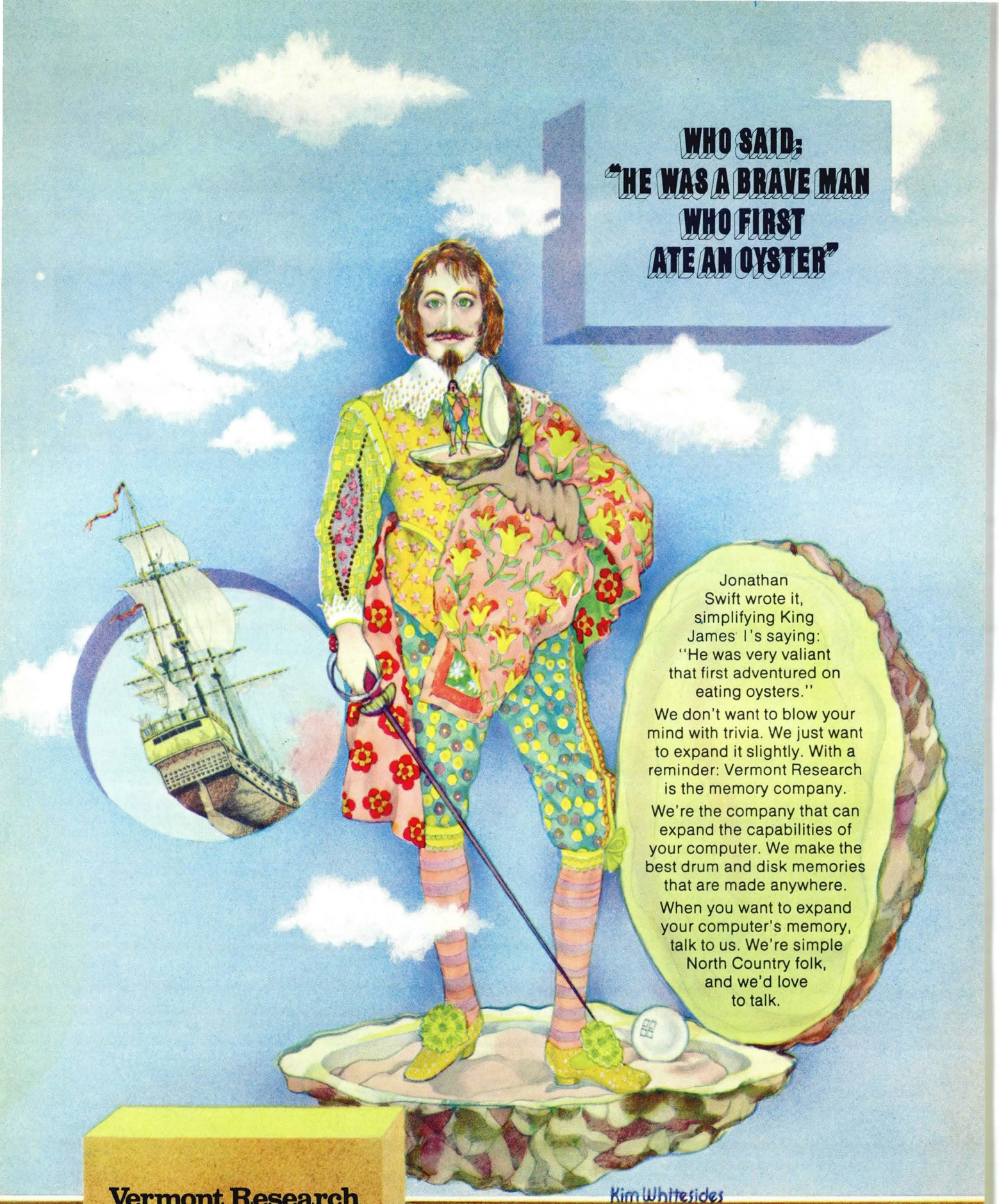

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DRUM AND DISK MEMORIES – CONTROLLERS

EXPAND YOUR MEMORY

CIRCLE NO. 3 ON INQUIRY CARD

MODERN DATA

JULY 1970 ■ VOLUME 3 ■ NO. 7

MEMORY CORES *

Dataram can produce nearly every ferrite core type required by the memory industry, with a capacity of 14,000,000 a month . . . with quality and economy. This is true, because Dataram exercises complete control, from powder processing and preparation . . . straight through to final testing, to assure mechanical and electrical perfection.

CIRCLE RS #6

CORE MEMORIES *

Dataram offers outstanding capacity/performance/cost on a big line of off-the-shelf standard Point Designed Memory Systems. These range from a 2K x 8 at 3 μs to a big, new PDM with 4K x 16 at 2 μs. Dataram also designs and produces the finest custom memories.

CIRCLE RS #7

Whatever you do in memory...

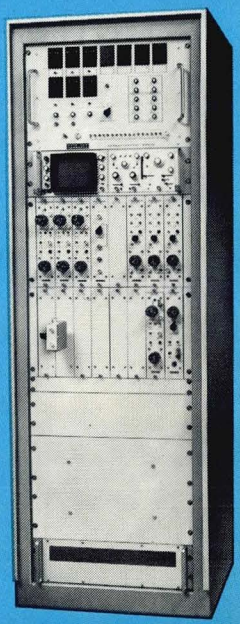
YOU'LL DO BETTER WITH

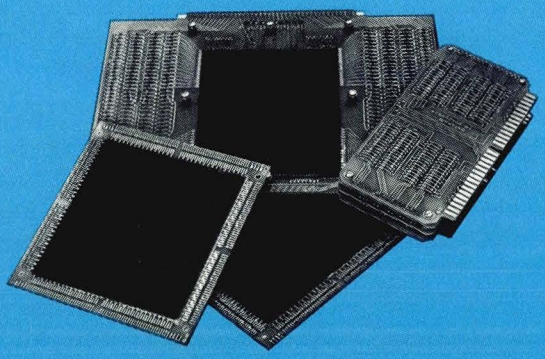
DATARAM CORPORATION

PLANES AND STACKS *

In planarstack construction, the core matrix is manufactured in a single plane on two or more cards . . . is wired in one operation, then folded and stacked. Quality planes are also available as units.

CIRCLE RS #8





TEST SYSTEMS *

We offer an inexpensive range of systems for automatic testing of cores, planes and stacks, and complete memories. Designed and manufactured originally for Dataram's own testing, these use-proven systems can test over a broad range of temperature, humidity and other environmental conditions. Systems all feature simplified, human engineered controls.

CIRCLE RS #9

* Everybody does better with Dataram, because Dataram has the *only completely integrated line* in the memory industry. This means Dataram uses its own cores to make its planes . . . its own planes to make Dataram stacks . . . and its own stacks to make its big line of standard memories. Certainly, Dataram uses its own test equipment to test its cores, planes, stacks and memory systems. Dataram also operates fully integrated facilities in Trinidad and the Philippines. You'll be glad Dataram is in memory in such extraordinary depth. For you, as a customer buying any part of the Dataram line, it means an extra dimension of product reliability . . . for less. Delivery is on schedule, too! Come on, you'll do better with us.

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PRINCETON, NEW JERSEY 08540

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☐ PLANES AND STACKS ☐ TEST EQUIPMENT

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CIRCLE RS #10

MODERN DATA

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

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

SUBSCRIPTIONS: Circulated without charge by name and title to U.S.-based corporate and technical management, systems engineers, systems analysts, EDP managers, software specialists, and other personnel who qualify under our qualification procedures. Available to others at the rate of $18.00 per year; single issues $1.75. Subscription rate for all foreign subscriptions is $25.00 per year (12 issues). POSTMASTER: **Send Form 3579 to:** Circulation Dept., Modern Data, 120 Brighton Road, Clifton, N.J. 07012. Controlled circulation postage paid at Concord, N.H.

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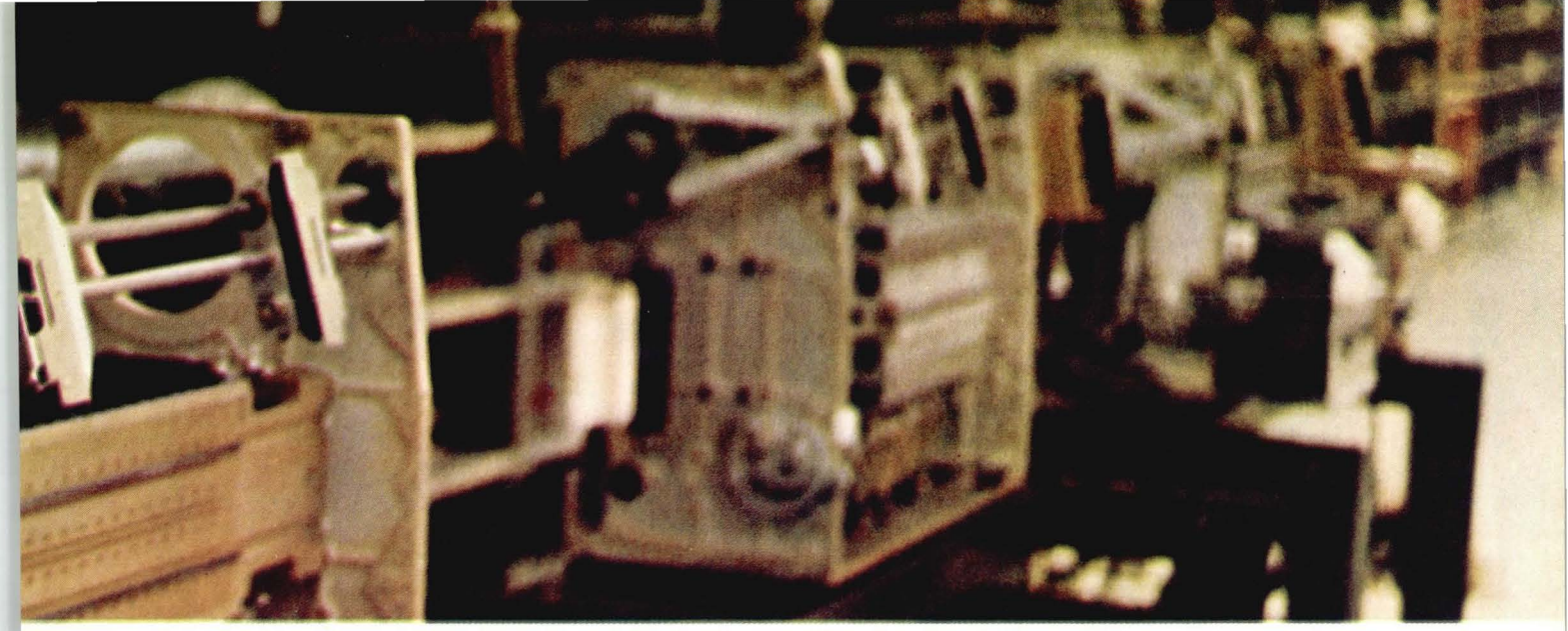
THIS ISSUE OVER 80,000 COPIES

"No one made a small, quiet, medium-speed chain printer for $9500. So Mohawk did."

George C. Hohl, OEM Marketing Director, discusses a new product.



"We saw a gap in the printer field. Either you paid a lot of money to get a lot of speed and sophistication, or you could pay a little and get very little in return. We decided to aim our printer somewhere in between.

"Chain printers are mechanically simpler, easier to maintain, less expensive. Their flat face characters give good print characteristics, too.

"Our design requirements were rough. We wanted 300 lines- per-minute with such niceties as easily changeable fonts, and yet we wanted to sell it for less than $10K. It had to be small, and yet we couldn't lose accessibility. The design engineers grumbled, but they made it.

"The changeable font cartridge is great—an operator can quickly switch the font chain—and we're offering fonts from 16 to 128 characters.

"We designed a disposable ribbon cartridge to make ribbon changes quick and clean. Paper handling is enclosed to stay clean, too. And everything that could be modularized, was modularized.

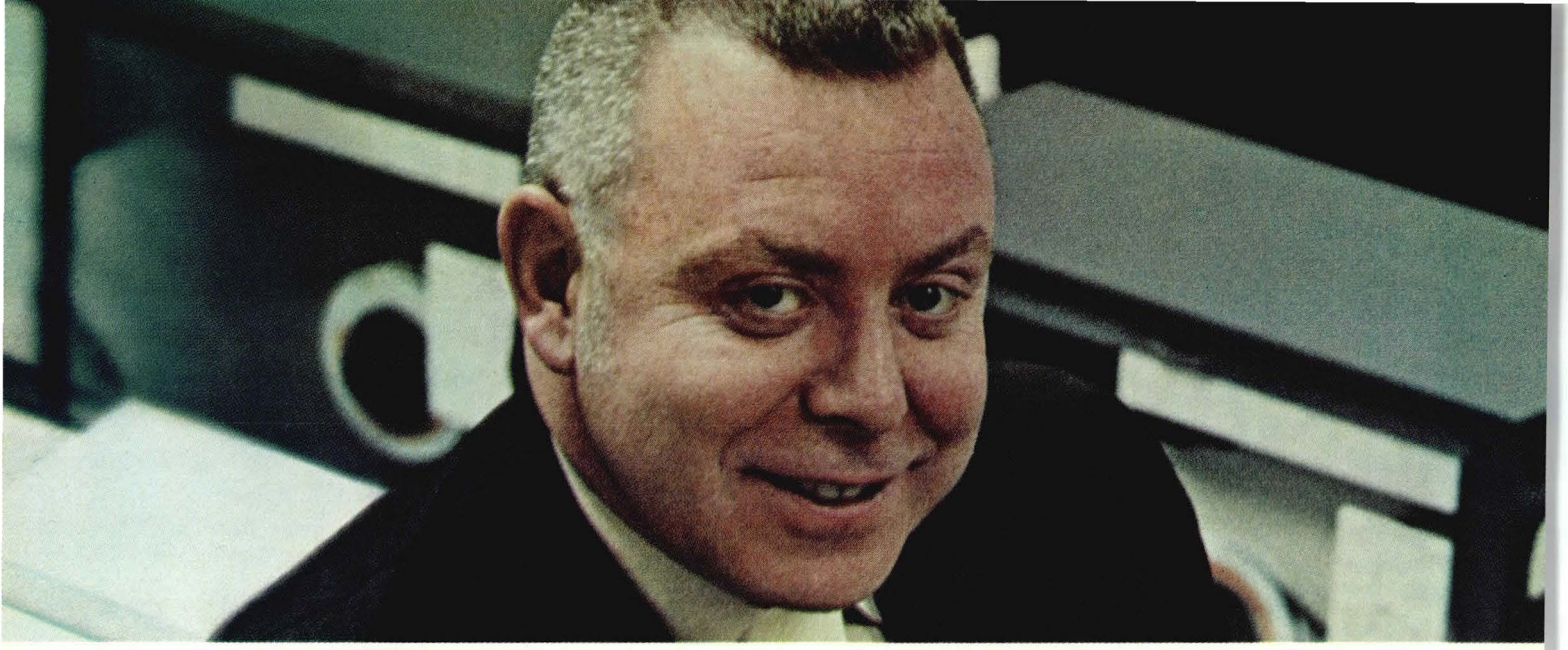
"We considered noise reduction vital—anyone who has worked in a printer room knows why. Well, compared to other printers, you'd hardly know this one was working.

"We're selling the printer for $9500 in OEM quantities, and some variations cost even less. So you get a lot of performance in a very little printer—for very little money."

Mohawk Data Sciences Corp.
Herkimer, New York

MDS

OEM MARKETING CENTERS: CORPORATE (315) 867-6475; NORTHEAST (617) 891-5870; SOUTHEAST (404) 631-3443; CENTRAL (312) 298-4141; WEST COAST (213) 685-5165.



"Our salesmen have told people not to buy Mohawk products."

Al Hoge, Vice-President, End-User Marketing, talks service.

"Sometimes we study a prospective client's needs and realize that he can't really use our equipment—or we see that another kind of system is better suited. We tell him to go elsewhere. Because eventually he'll have trouble or find out we misled him, and then how would we look? No, it's better to lose a piece of business than to do bad business.

"I believe a salesman should be able to help a prospective customer design the most effective, sophisticated peripherals system he can use.

"We've developed many of our products from listening to our salesmen. Back in the early days, for example, we had some 900 Data Recorders in the field. Well, our field people had been watching and listening to their customers, and had some suggestions they felt would improve operator performance. It meant developing a completely new backboard module, a major modification, and then retrofitting those 900 machines. Well, we did it, and we did it for free. We figured the machine needed the improvement, and the client shouldn't have to pay for it.

"A year later, those same salesmen came back with more ideas. We had to redesign the backboard module again, and, to make things worse, this job had to be done at our plant here in Herkimer. We had one hell of a logistics problem trying to get all those Data Recorders back in here without crimping our customers' operations. But we did it. And we didn't charge our customers one cent that time either.

"We're in the business to make a living, just like anybody else—we're not playing angel. But the fact is, the most successful companies in this business are the ones that look after their clients—the ones that put service ahead of hardware, even. If that's what it takes to get ahead, then that's the way we do business here."

Mohawk Data Sciences Corp.
Herkimer, New York

MDS

If we make you wait... we'll pay the freight.

Buy or lease our VISTA I alphanumeric display terminal in any model. If we don't ship it to you within 30 days ARO, we'll air freight it—FREE!

So, if you need a CRT terminal that's fast, silent, easy to read . . . that replaces a model 33 or 35 teletype with far more efficiency . . . that's compatible with *any* mini-computer . . . that's a completely self-contained, stand alone unit with keyboard, video presentation, control and refresh electronics—*plus a Data Phone interface and power supply . . . AND, if you want it NOW* . . . JUST MAIL THIS AD.

*THIS OFFER EXPIRES AUGUST 31, 1970

Specifications

Model	A	B	C	D
Characters/line	32	32	64	64
Number of lines	10	20	10	20
Character size (nominal)	.15" high, .10" wide			
Line spacing	.45 character height			
Character spacing	.40 character width			
Character format	5 x 7 dot matrix			
Character set	64 character ASCII			
Cursor	Non-destructive Blinking underscore			
Refresh rate	50/60 Hz			
Memory	MOS shift registers			
I/O rate	110-2400 BPS standard; High speed serial or parallel optional			
Communication interface	RS 232C or current loop			
Parallel interface	TTL logic, bit parallel, demand-response control			
Power	125 watts, 110-220 volts, 50/60 Hz			
Size	15" high, 17" wide, 27" long			
Weight	65 pounds			

Command Functions

- Cursor control — up, down, right, left, home
- Start blink, stop blink
- Erase screen

Interfaces

The standard interfaces allow connection to modems up to 2400 baud. Available as options are serial or parallel data interfaces up to 800 characters/second synchronous, or up to 1500 characters/second in a demand-response mode.

Operating Modes

I/O	Full duplex or ½ duplex
Format	Roll or page

Options

- Hard copy output
- Magnetic tape input and output
- Card or badge reader input
- High speed data transmission up to 1500 character/sec.

SALES TERMS

Terms of sale for the company's products are net 30. Shipment will be made FOB Burlington, Mass., prepaid, best way unless otherwise specified by the customer.

WARRANTY

Ninety days warranty on parts and service. Twelve months on parts manufactured by Infoton. Manufacturer's warranty on all other parts (no less than ninety days or more than twelve months).

PRICES	PURCHASE	MONTHLY LEASE*
VISTA 1A	$1,495.00	$ 78.75
VISTA 1B	$1,995.00	$ 97.50
VISTA 1C	$1,995.00	$ 97.50
VISTA 1D	$2,495.00	$116.25

*includes maintenance for three year lease plan

YES! **I want to ☐ lease ☐ purchase the following VISTA I CRT terminals within 30 days ARO. I understand that if I have to wait . . . *you'll* pay the freight, air freight. ***

MODEL	QUANTITY	UNIT PRICE	TOTAL PRICE
☐ VISTA 1A			
☐ VISTA 1B			
☐ VISTA 1C			
☐ VISTA 1D			

Total Price $_____

Please check one: ☐ 110 Baud ☐ 300 Baud ☐ Current Loop

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

P.O. # _____

Authorized Signature _____

MAIL TO: INFOTON INCORPORATED
Second Avenue, Burlington, Mass. 01803

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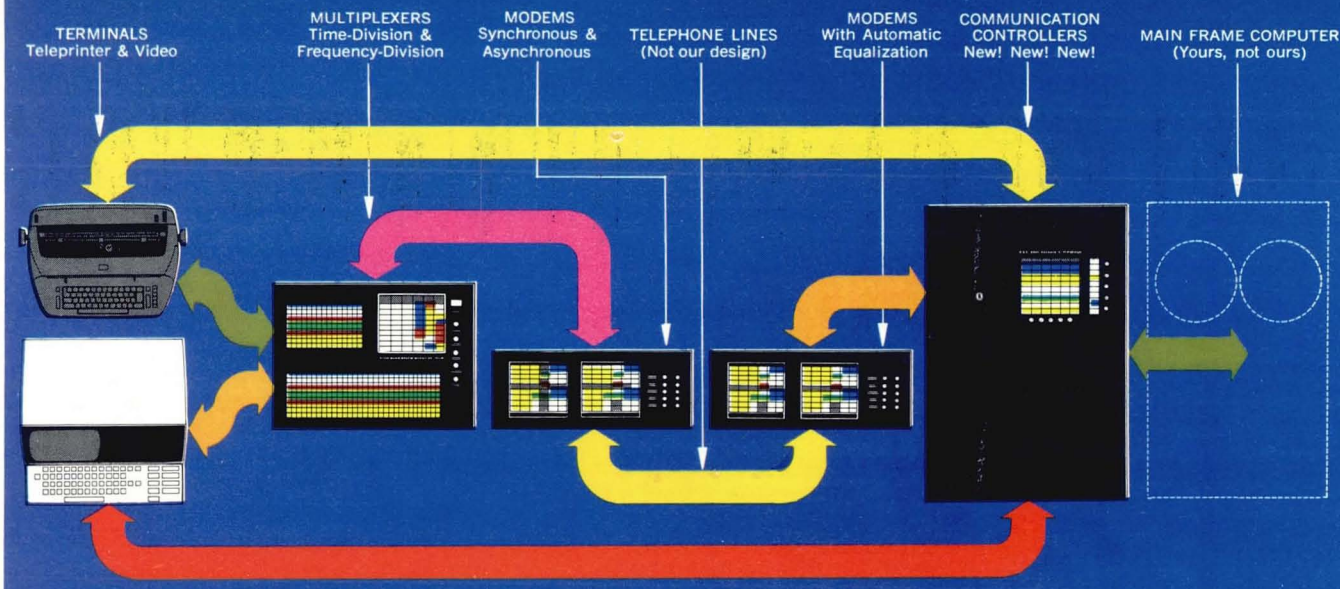

ONLY ADS can offer you the system study, software, hardware and field maintenance to move data from fingertips to readout — hard copy or video.

ADS HARDWARE includes terminals, multiplexers, modems and communication controllers:

TERMINALS include a hard copy teleprinter and a video terminal useful for data display, remote computer operation and "instant" data transmittal. The teleprinter operates in three code-modes at the flick of a switch: ASCII, BCD, and Correspondence. It is self contained within a standard typewriter case. Off-line storage is offered for both units via a magnetic cassette unit.

MULTIPLEXERS & MODEMS by ADS save telephone line costs, simplify system design, and feature complete front panel diagnostic display — an ADS exclusive. Various channel capacities, intermixed baud rates, byte-interleaved, bit-interleaved, with full contention, automatic baud rate detection, and automatic modem equalization.

COMMUNICATION CONTROLLERS at the computer end of the teleprocessing network receive, store, and route data messages. Data is fed to and from the computer appropriately addressed, in proper sequence, with minimum delay.

SOFTWARE & MAINTENANCE are provided with all ADS hardware.

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American Data Systems

provides "Everything"

ADS

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AMERICAN DATA SYSTEMS
8851 Mason Street, Canoga Park, California 91306

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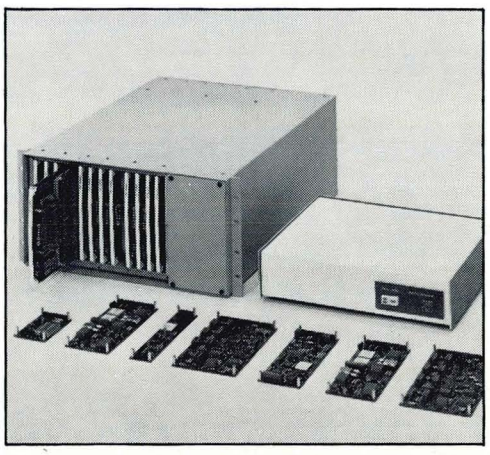
1800 bps

only Collins has it

Collins TMX-202 FSK data sets operate at 1800 bps over full- or half-duplex, unconditioned telephone circuits. Available as desk top or wall mount, standard rack mount, or printed circuit modules for both OEM and end-user applications.

The TMX-202 is another example of the engineering and manufacturing excellence achieved at Collins through use of the C-System, a computer-controlled system which integrates design and production—as well as other management control functions—into a single network.

Call or write Collins Radio Company, Data Equipment Marketing, Dept. 600, Newport Beach, California 92663. Phone: (714) 833-0600.



COLLINS

COMMUNICATION / COMPUTATION / CONTROL

MAC
AND THE
AUTOMATIC DRAWING MACHINE
or
The Speediest Pen on Paper

Bless our cycle time! Our hero, MAC the Computer, has triumphed again. It's now ramrodding a breakthrough in high-speed X-Y plotting.

In the Xynetics automated drafting system, MAC 16 controls a unique writing head that zips pen along paper at up to 40 ips. Twice as fast as other systems.

And with resolution of ±0.001". Gad!

Great line-drawing speed, but how about that bottleneck: annotation? Under MAC's control, the amazing writing head can put down 120 words per minute in 0.070" characters. Which, we'll vow, matches the speed of tape-controlled impact typewriters.

And there's more. All because of a revolutionary writing device and MAC. MAC, with 1-microsecond cycle time, an 8K core that works splendidly with FORTRAN IV, and a surprisingly low price.

"Hard to believe!" some doubters may exclaim. They, and you, can get the full story by circling our number. That's the way Xynetics got started.

Lockheed Electronics
Data Products Division
A Division of Lockheed Aircraft Corporation

CIRCLE NO. 15 ON INQUIRY CARD

Put the other plotter maker on the spot. Ask him for a comparative demo. His and ours.

We'll show up.

What you'll find (if he accepts the challenge) is that our incremental plotter is faster, more effective and costs less.

And here's what you get for all that less money. Delta Control.* An exclusive. Lets you move up to 1443 steps in X and Y from a single command. (That's not a special or an extra, either. It's standard.) That's why we can reduce computer write time as much as 30:1.

What's their name is trying to duplicate Delta. By adding on a computer. Which cost you thousands extra. Many thousands.

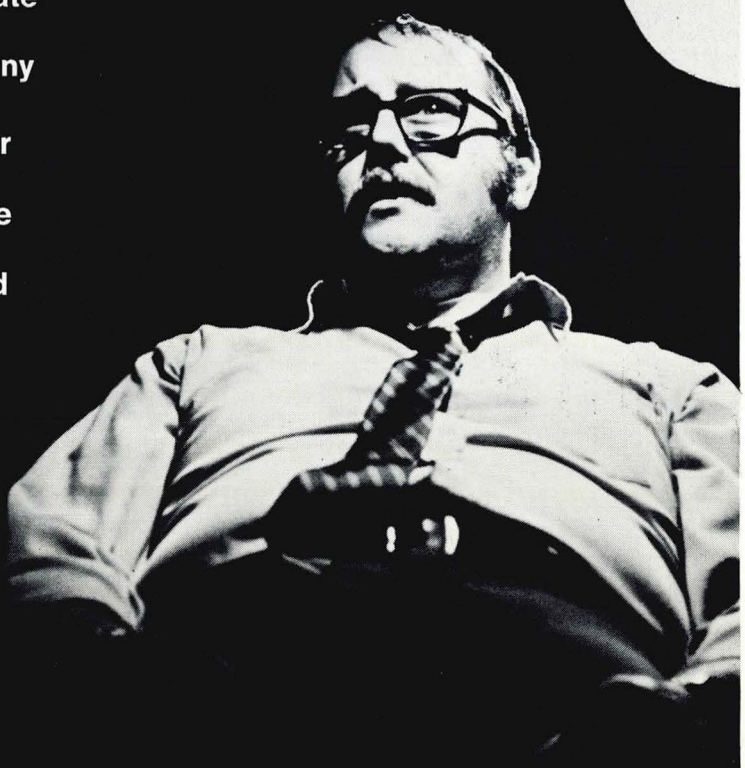
You'll find we out-versatile the other brand, too. Because ours is the only incremental plotter that can operate on-line or from three off-line inputs: mag tape, punched tape and punched cards. And, computer extra or not, we're the only ones with programmable step size, speed control and a foul-proof manual plot interrupt.

In case that's not tempting enough, we throw in the software. No charge.

At this point, when the other guy's folding his hardware and silently stealing away, we toss in the clincher. We can deliver in 30 days.

To put us to the test, just call collect (213) 781-7100. Ask for Demo Service. Or write UCC Graphic Systems Division. 14761 Califa Street, Van Nuys, California 91401.

*patent pending



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UNIVERSITY COMPUTING COMPANY

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KEY-EDIT

reduces data preparation problems to an absolute minimum

Reduces
errors to a minimum
Accuracy of source documents is checked at moment of data entry. KEY-EDIT's built-in computer filters out errors with variety of powerful editing routines.

Reduces
need for verification
The powerful edit routines can verify your data as it is keyed into the system, thereby reducing the cost of duplicate keying for verification.

Reduces
elapsed time and scheduling problems
Data that requires verification can be verified by one operator while it is being encoded by another operator—cuts job time in half.

Reduces
required floor space
KEY-EDIT actually saves up to 50% in floorspace over keypunch and key-to-tape units because of compact key stations.

Reduces
equipment problems
KEY-EDIT's fixed head magnetic drum is more reliable than the moving head disk found in other systems. And KEY-EDIT's fewer tape drives ensure even further reliability.

Reduces
personnel turnover
KEY-EDIT provides a far more pleasant working environment. This easy-to-learn system is virtually noiseless. Data handling is minimal.

Reduces
data preparation costs
You don't have to wait for your big computer to find source document errors. Checking and editing routines dramatically speed-up work cycle.

Reduces
job turn-around time
Fewer operators. Less equipment. Improved accuracy. Greater flexibility and productivity all add add up to significant savings.

Reliability is the key to KEY-EDIT. This most advanced data preparation system is in operation now at major high-volume EDP installations. KEY-EDIT works. It is proven. No "dealing in futures." Equally reliable is delivery. KEY-EDIT can be operational for you in as little as ninety days. This reliability is ensured by Consolidated Computer's coast-to-coast staff of experienced marketing and technical personnel.

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You've got the best computer for the job . . .

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CØMPLØT™ with me!

DP-5 $11,000.

Plotting online is 4 times faster with the Ultra High Speed DP-5 Incremental Plotter. Designed for computer graphics, it plots at a continuous speed of 1200 increments per second. No special programs required. Step size is factory set at .005″ or .0025″.

Used in a time sharing mode, the PTC-4 Plotter/Teletypewriter Controller linked to the DP-1 Digital Plotter provides 11″ wide reproducible graphs, charts, and drawings at a remote location—direct from the computer.

PTC-4 $5900
DP-1 $3500

MTR-2
$11,000

Offline plotting is now an economic reality with the MTR-2 Magnetic Tape Reader. It operates with the DP-1, DP-3 and DP-5 Plotters to form a complete offline system. The MTR-2 accepts IBM compatible tapes.

Offline plotting in addition to computer I/O capability The MTR-9 is a superior system offering faster plotting yet uses less computer time. New END-STEP™ MODE software reduces computer time and tape lengths by 10:1. Operates with any speed incremental plotter. Has high speed search with block selection. 7 or 9 track IBM format. Operates with the DP-1, DP-5 or DP-3 22″ wide, 300 increment per second plotter.

MTR-9 $21,000. DP-3 $6,400.

houston instrument | DIVISION OF BAUSCH & LOMB

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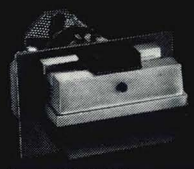
(713) 667 7403 CABLE HOINCO

THE RECESSION READER
50 CHARACTERS/SEC., $350



When it comes to value in perforated tape readers, no one can match the new Tally R-50.

This modular unit features the same proven advantages and built-in reliability common to Tally readers at credibility gap prices. Look what you get for $350.

The Tally R-50 perforated tape reader operates asynchronously at speeds up to 50 char/second and features a new "top load" read head design to allow fast convenient "straight line" tape loading. Positive hole/no-hole starwheel sensing assures accurate reading.

Tapes of 5, 6, 7, or 8 level in standard 11/16", 7/8", or 1" widths can be read without modification. Any tape material can be read without regard to color or opacity.

Options include end of tape switch, teletypesetter configuration, 230 VAC, 50 Hz power, and 19" rack mounting.

For information on the Tally R-50, call your local Tally man or contact us here at the factory. Please address Tally Corporation, 8301 South 180th St., Kent, Washington 98031. Phone 206-251-5500. In Europe and the U.K., address Tally House, 7 Cremyll Road, Reading RG1 8NQ, Berkshire, England. Phone Reading 580-142.

TALLY®

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This 64-page report will give you the basic costs and performance factors involved in making that decision

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how to distribute 650 lb of computer information in a number 10 envelope

It doesn't take long to accumulate 100,000 pages of computer output. But with impact printing, what do you have? 650 pounds of paper on your hands. Difficult to decollate, burst and bind. Impossible to lift by hand, expensive to mail and store. Unsuitable for the urgencies of modern decision making.

With DatagraphiX Micromation, you can hold the equivalent of 18,000 computer pages in the palm of your hand. Any page can be accessed within seconds from the display screen of an inquiry station. Providing hard copies on demand. High volume production printing from film on preprinted forms at 5,200 pages per hour. Or you can reduce a 1000 pounds of paper printout to a few ounces and mail it over long distances overnight at less than 50 cents.

Micromation is more than a 30,000 line-per-minute computer printer. It's the best communicator a computer can have. Moving needed information to its multiple destinations to improve business. Keeping fact files fresher up, down, and across your organization. Disseminating computer generated reports more immediately to your customers, stockholders, or others inside or outside the company.

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An open letter to AT&T

from the company who will let a lot of your data communications customers do you out of $100,000 a year.

Undoubtedly your first reaction to us will be a sense of irritation at a certain loss of revenue.

If that's your only reaction, you'll be making a big mistake.

Allow us to explain.

We, the Dynelec Systems Corp., have developed a unique approach to data communications that is, by conservative estimate, 400% more efficient than that used in other systems now operating.

With our equipment, up to 120 mixed-speed data terminals can be accommodated simultaneously over each voice-grade line.

This is 4 times as many as in any other system.

Which means that multi-location data communications customers will be able to concentrate and send far more data, more economically, to and from their computers than they ever could before.

But substantial reductions in leased line and modem costs alone are only part of the story. Great additional savings are made through use of our equipment.

For example, our basic, low-cost communications multiplexor, the ™DyneCoM 70W, grows as customer needs grow.

Because of its modular design, a user can start off inexpensively with as few as 2 channels and plug in additional circuit boards to handle up to 64 mixed-speed terminals.

Other 70W features include the unit remaining operative despite channel failure, simple visual diagnostics, self-service maintenance, up to 4 speeds and any code, and automatic speed selection.

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The Dynelec approach opens such vast new vistas in data communications that they far outweigh any AT&T revenue loss that results from the savings we can help customers enjoy.

For full details, write us or call: (201) 447-0900.

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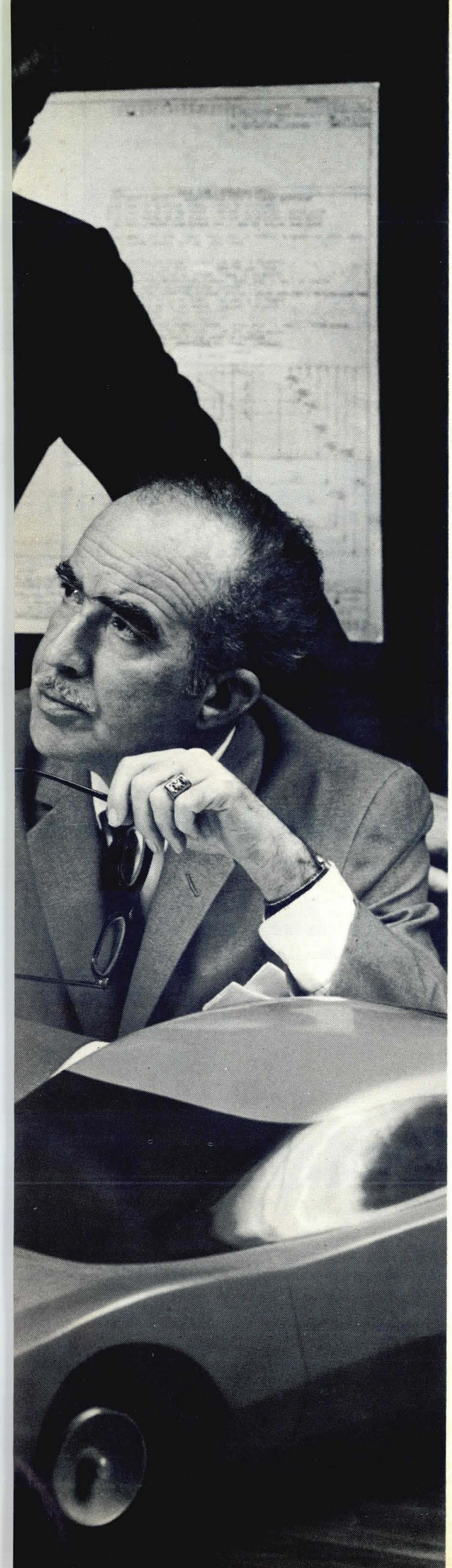
SYSTEMS CORP.
139 HARRISTOWN ROAD, GLEN ROCK, N. J. 07452

CIRCLE NO. 21 ON INQUIRY CARD



Computer downtime could cost this user his share of a multi-billion dollar market.

That's why he depends on Gerber Scientific and Hewlett-Packard.

In the automotive market, being second with a hot new body design just doesn't make it. That's why car manufacturers are turning to computerized drafting systems, like those made by The Gerber Scientific Instrument Company, South Windsor, Connecticut.

The auto industry knows that computers can mean the margin of difference—when they're working. But when they're not, you just might be "last under the checkered flag." That's why trouble-free performance was a key factor in Gerber Scientific's computer selection for its Series 1200 and 700 controls. These drafting systems make it possible to bring fresh new auto design concepts to market in record time. Gerber's systems are also slashing design time and costs in electronics, aircraft, garments, maps and other detailed work that used to take weeks of manual effort.

Sure Gerber Scientific chose our 2114 computer because they knew it could do the job. And was priced right. But more important, they knew they could count on superb reliability —and depend on world-wide HP service and support back-up—if and when needed. We have 141 service centers in the United States and around the world. For an OEM, this can be a very reassuring fact.

There are other reassuring facts about our small computers. Like Direct Memory Access, a feature now available with the new HP 2114B. The DMA option gives you the flexibility to use high-speed peripherals. And it makes possible the acquisition of very high-speed data. Yet this computer's base price is only $8500. If you're looking for something a bit more powerful, try the HP 2116B. It's the heart of our popular time-share, real-time executive and disc operating systems. Cost: $24,000.

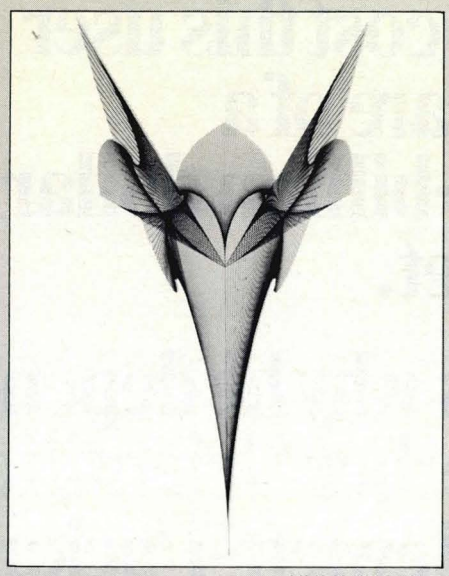
Get the full story on computers you can depend on. Call your nearest HP sales office or write to Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

HEWLETT hp PACKARD

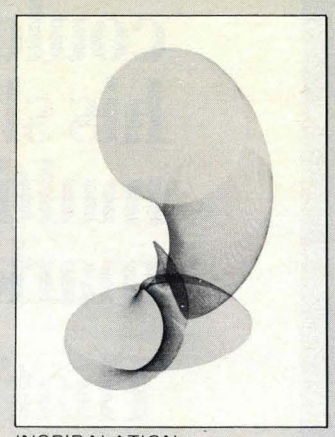
DIGITAL COMPUTERS

CIRCLE NO. 22 ON INQUIRY CARD

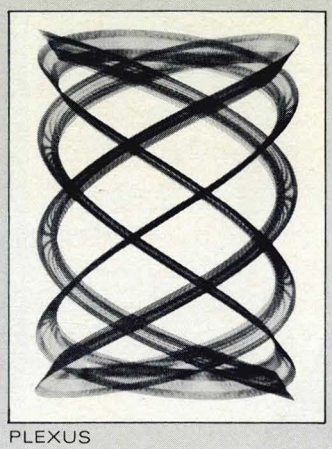
22942



HUMMINGBIRD



INSPIRALATION



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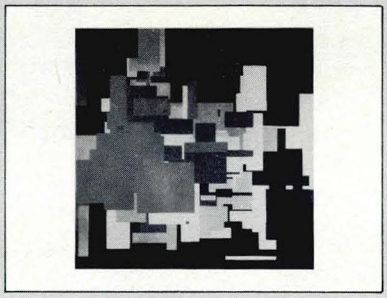

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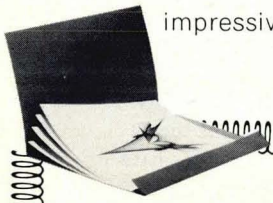

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This beautifully-put-together sample plot is yours for the asking.

It's a composite plot produced by Dresser's new Lasergraphic Plotter—the LGP-2000. On one 30-inch by 40-inch plot you'll get a glimpse of the LGP-2000's unique plotting capabilities. There's a photo of the earth composed of 1,600,000 points that's done in 16 shades of gray. There's a piece of a contour map that was originally produced with 3,000 inches of line and 2,000 characters of annotation. And there are other things like grid squares, alphabets, seismic records and concentric circles that will prove to you that the LGP-2000 is really a new dimension in computer graphics.

There are two things that you can't see on the composite plot: the LGP-2000's speed and its plotting size capability. It will plot up to 40 inches wide by 100 feet long. And it will do it as fast as your computer can feed it data. The LGP-2000 drew the entire 30-inch by 40-inch composite plot in only 3 minutes and 10 seconds. No other plotter can offer you speed like that.

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The average reading time for this ad is 30 seconds. In this time Dresser Systems' LGP-2000 could have plotted 30,399,690 bits of information.

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.

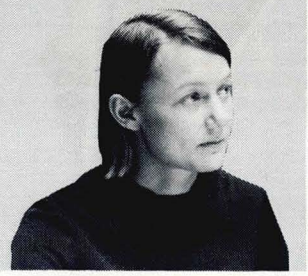
From this experience evolved the obvious need for a powerful report generator. One that would be easy to use, yet so powerful and fast it could be used as a report utility as well as for on-demand reports. In other words . . . CULPRIT.

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 compiled, 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.

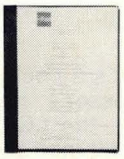
Processing speeds are close to those for well-designed and laboriously hand-coded programs. Remember . . . this isn't an ordinary report generator. You just load and go.

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 memonics 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!



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Title.....

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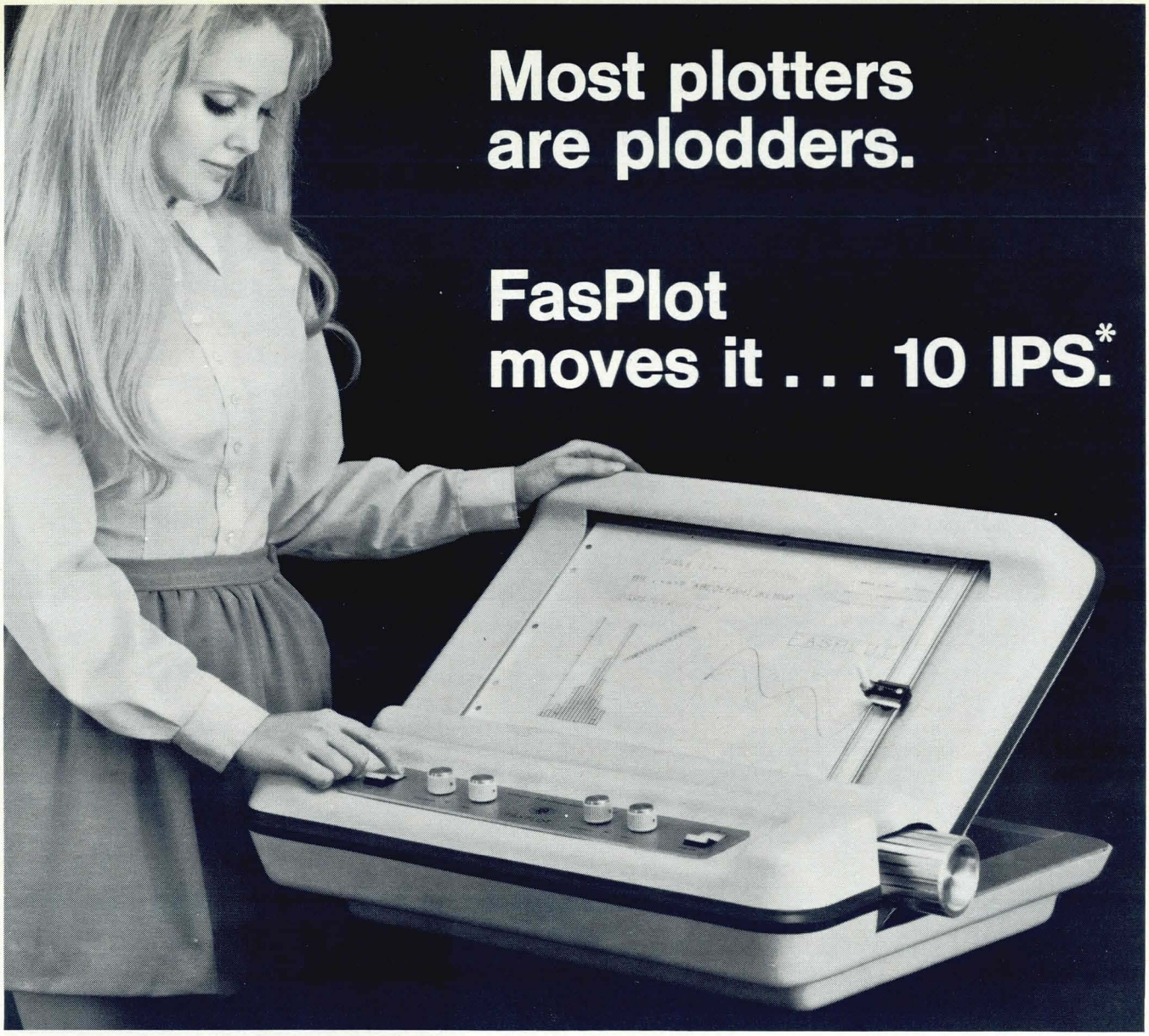
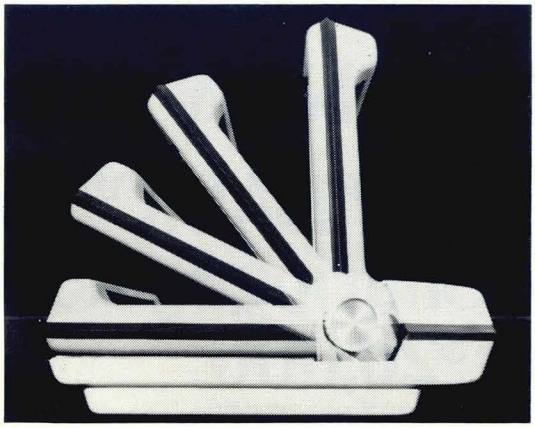
Cullinane Corporation

Cullinane Corporation

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





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WANG'S NEW 3300

The First "BASIC" Time Sharing System Under $20,000

The 3300 is a time sharing mini-computer system for only ¼ the cost of subscription services or other in-house time sharing systems. That, in itself, is very therapeutic. And any anxieties about communicating with a computer can be eliminated by BASIC. The popular conversational language, ideal for beginners and experts alike. It's simple to get involved with a 3300. Begin a system with just one terminal if you like. Then add hardware as needed to accommodate up to 16 users, or to broaden system capability. It's truly mind expanding.

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How can you determine the best software package for your needs?

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AUERBACH Software Reports is a new reference service updated bi-monthly that answers the computer user's pressing need for quick, accurate information. It's being prepared by AUERBACH's staff of computer analysts with over ten years' experience gathering and publishing first-hand information behind them. It gives you the facts you need to decide whether to develop a software system in-house or buy an existing one. And it enables you to select the right package for *your* application from the more than 3000 software programs now being offered.

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As a complete looseleaf reference service, *AUERBACH Software Reports* will be introduced early in the fall. However, the first two Reports—*Inventory Control* and *Payroll*—are now being published as separately bound editions. If you subscribe now, you'll receive a full year's service beginning in October plus free copies of these and other advance Applications Reports. These 60-120 page Reports are also available individually at $90 each.

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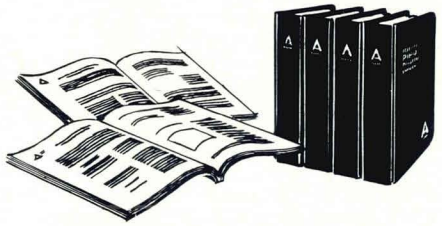

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NEWS ROUNDUP

COMPUTERS COULD ENABLE WORLD TAKEOVER

"If the present trend toward centralization and scientific-technological miracles persists for much longer, we face the very real danger of a rigidly controlled society," according to Prof. Charles Padden of the John Marshall Law School in Chicago. Writing in *The Decisive Utterance*, a publication of the school's Student Bar Association, Prof. Padden claims that "the nervous system of such a body politic will be a highly-integrated national, international, perhaps even universal, computer network into which will be plugged the human robots of an early tomorrow." What is happening, Prof. Padden feels, is that too much information about individuals is being assembled, and eventually it all will be combined into the "electronic bowels" of a single data center. The danger, he says, is that power-hungry people or groups will gain illicit access to this mass of personal data, and use it to control whole populations.

DIGITAL EQUIPMENT PDP-8 UNDER $5K

According to Nick Mazzarese, DEC's vice president for small computers, it was only a matter of time before DEC came out with a full-scale mini priced under $5K. The company's latest entry in the PDP-8 line of 12-bitters is the PDP-8/E, a complete 4K mini priced at $4990. DEC believes the 8/E, which is fully-compatible with the rest of the PDP-8 line, will be received with at least the same enthusiasm as the company's PDP-8/S. At $9100, the 8/S was the first full-scale mini priced under $10K, and, since its announcement in 1967, has passed the 1100 mark in sales.

The 8/E will eventually phase out both the 8/I and 8/L, which comprise DEC's present PDP-8 stable. The 8/E's operating instructions are slightly faster than either previous model, and I/O transfers on the 8/E are executed in 1 usec. as opposed to 4.25 usec. on the 8/I or 8/L. David Chertkow, engineering manager for the PDP-8 series, gives the busing concept utilized in the 8/E as the reason for its increased speed and lower price. The 8/E backboards are completely pre-wired to accept all system elements, including the 3-board processor, as simple plug-ins. This not only contributes to faster speeds along the common bus line, but, since it allows all options to be pre-wired, reduces assembly costs significantly. Additional 8/E features include two new ROM options and several new instructions. Deliveries are expected early in 1971.

NO SHORTAGE OF CANDIDATES

The Los Angeles chapter of the Association for Computer Machinery reported that a recent job opening for a college EDP Manager at the California State Colleges, instead of bringing the expected six applicants, brought 175, and most of these were Ph.Ds. Nearly 100,000 aerospace workers, many in computer-related jobs, have been laid off work in the past 28 months. The ACM points to tightening of the economy, financing difficulties, and government spending cut-backs as factors contributing to the youthful computer industry's first recession.

HONEYWELL-GE COMPUTER AGREEMENT

Honeywell's recently-announced agreement in principle with General Electric to combine computer operations is still very much unresolved. The new company, which would include the present Honeywell computer operations and GE business computer equipment interest, would be 81-½%-owned by Honeywell and operated as a Honeywell subsidiary. The agreement calls for GE to receive 1,500,000 shares of Honeywell common stock together with notes totaling $110 million, which would be interest-free for one year. Still unresolved, however, are such hurdles as: 1) securing U.S. and foreign government approval, 2) determining the final product line mix, and 3) organizing, staffing, and locating the yet-to-be-named new company. (One suggested name: "The Other Computer Company.")

Except for GE's time-sharing services and process control systems operations, the proposed subsidiary would take in all of GE's domestic and international computer interests, including GE's shares in the Bull-GE operations in France. GE's overseas operations, which account for the larger part of its computer business, were profitable in 1969. This is an important factor in GE's appeal, since it complements Honeywell's strong position in the U.K. Other advantages cited by Honeywell are: • the transaction would broaden its product line substantially since GE has extensive product offerings both larger and smaller than those of Honeywell; • the resultant company would give Honeywell a solid "Number Two" position behind IBM; and • the marriage of GE and Honeywell R&D efforts would be expected to prove both economical and fruitful.

Both companies have been very tight-lipped about providing details of the intended transaction – an understandable position considering the current sensitivity of both the employment and financial markets. (A selling spurt at the time of the announcement lopped 25 points off the price of Honeywell stock.) A sampling of opinion by MODERN DATA, however, indicates that reactions to the proposed transaction have been generally favorable. The consensus of opinion seems to be that a strong "Number Two" would encourage more toe-to-toe competition with IBM and thereby contribute toward a healthier marketplace.

Interactive Graphics

for the Tektronix T4002 Graphic Computer Terminal

With the introduction of the 4901 Interactive Graphic Unit and Joystick accessory, graphic input capability is now available for the Tektronix T4002 Computer Terminal. The Interactive Graphic Unit is a valuable aid wherever graphic analysis of statistical data is fundamental to: thorough scientific investigation—effective computer-aided instruction—informed decision making.

The 4901 and optional Joystick are *software* supported. The software permits coordinate identification, display rotation and overlaying, menu picking and other frequently repeated functions in graphic formatting.

The new 4901 generates a bright, no parallax, orthogonal crosshair cursor. The cursor is easily and accurately positioned with the desk-top Joystick. You enter data points and instructions through the T4002 keyboard. This means complete graphic interface without removing your hand from the Joystick.

Tektronix Application Engineers, especially trained in the capabilities of Tektronix Information Display Products, will discuss with you the full versatility of the T4002 Graphic Computer Terminal. A T4002 demonstration provides an excellent opportunity to discuss software support, machine compatibility, interface options and maintenance. Contact your Application Engineer through any Tektronix office (57 domestic—48 foreign) or directly by calling (301) 825-9000 Baltimore; (617) 894-4550 Boston; (415) 326-8500 Palo Alto. Or write Tektronix, Inc., P. O. Box 500, Beaverton, Oregon 97005.

T4002 Graphic Computer Terminal	$8,800
4901 Interactive Graphic Unit	$ 450
Optional Joystick (015-0175-00)	$ 250

U.S. Sales Prices FOB Beaverton, Oregon

The new, no parallax crosshair cursor is positioned with the desk-top Joystick.

Tektronix, Inc.
committed to technical excellence

CIRCLE NO. 28 ON INQUIRY CARD

INTERNATIONAL NEWS

ARGENTINE EDP — The Argentine EDP market remains brisk in a setting of high economic activity, according to a recent on-the-spot survey conducted by the U.S. Dept. of Commerce. Over 50 percent of Argentine EDP equipment has been installed in the past four years. There is a 15 percent annual growth rate forecast, with EDP sales expected to climb to over $19 million in 1975, at which time the total expenditure for hardware and software is expected to reach $90 million. U.S. companies supply virtually all of Argentina's EDP hardware imports. Labor piracy in not uncommon for trained Argentine EDP personnel. Salaries for programmers range from $4,300 to $7,000; for analysts from $5,100 to $8,600; and for operators from about $2,300 to $2,850.

LEASING IN GREECE — Computer leasing is becoming very popular in Greece. About 65 government-related agencies and leading private enterprises are now leasing computers. There are five service bureaus in Athens used by smaller firms. The value of installed electronic computers is estimated at $18 million, of which 80-percent is controlled by American interests. Because of the lack of trained personnel to operate computers, the Greek Productivity Center has established a program to train professional programmers.

NOT SO ROSY — Dick H. Brandon, head of Brandon Computer Services of London and New York, recently told a London gathering that the market for computer services was not so rosy. According to the **Financial Times of London,** he said that there has been over-optimism in the computer industry, and that a number of operations, such as time-sharing, have been overly stressed. Mr. Brandon stated his belief that not a single U.S. firm was making a profit at this moment in time-sharing services.

DANISH PRODUCTS — The market in Denmark for EDP equipment was estimated at $27.2 million in 1969, compared with $25.3 million in 1968. Imports were expected to account for 88 percent, or $24 million, of the 1969 market. Denmark's imports of EDP equipment rose from $15 million in 1966 to $21.7 million in 1967, an increase of 44 percent. However, in 1967 and 1968, imports increased by only about 5 percent annually. This sharp decline in import growth rate is attributable mainly to the economic slowdown which occurred during 1967-68. The current brisk recovery should bring a resumption of strong demand. Imports in 1970 are expected to rise by slightly less than 20 percent to $28 million and to continue to increase at an annual 20 percent rate through 1973. The U.S. Dept. of Commerce estimates that the U.S. share of the Danish import market for EDP equipment was approximately 20 percent during the 1966-68 period. In 1968, the U.S. provided $4.3 million, or about 19 percent, of imports. This share was surpassed only by France, which supplied $6.3 million, or 27.8 percent, of the import market. W. Germany and the United Kingdom followed the U.S. closely, the former supplying $4 million of imports, a 17.7 percent share, and the latter $3.3 million, a 14.6 percent share.

AUSTRIAN PROSPECTS — Prospects for increased hardware sales by the U.S. to Austria are not very promising since much of this business will probably shift to European-based producers in the future, concludes the U.S. Dept. of Commerce. In 1967-68, direct exports of U.S. computers amounted to only $4.28 million. However, USDC believes that there is a market for customized software and EDP peripheral equipment that is "virtually untapped."

BRAZILIAN MARKET — A Commerce Dept. survey estimates that the Brazilian EDP market will expand at an average annual rate of 20 percent through 1974, at which time it will approach $38 million. Imports must fulfill essentially all Brazilian EDP needs. Presently the U.S. supplies 37 percent of the hardware market. While the U.S. is the principle source of EDP suppliers, its share has been declining as the result of a shift by U.S. suppliers to foreign subsidiaries.

ITALIAN PRODUCTION — The Journal of Commerce reports that Italy's production of electronic computers in 1969 approached $1.3 billion. Production is expected to continue increasing at a fast rate as private and state Italian companies, and American and German firms located in Italy, reorganize in the battle for domestic and international orders. There now are about 2,500 electronic computers operating in Italy. An industry estimate says the number will reach 3,100 by the end of 1970 and over 20,000 by 1980.

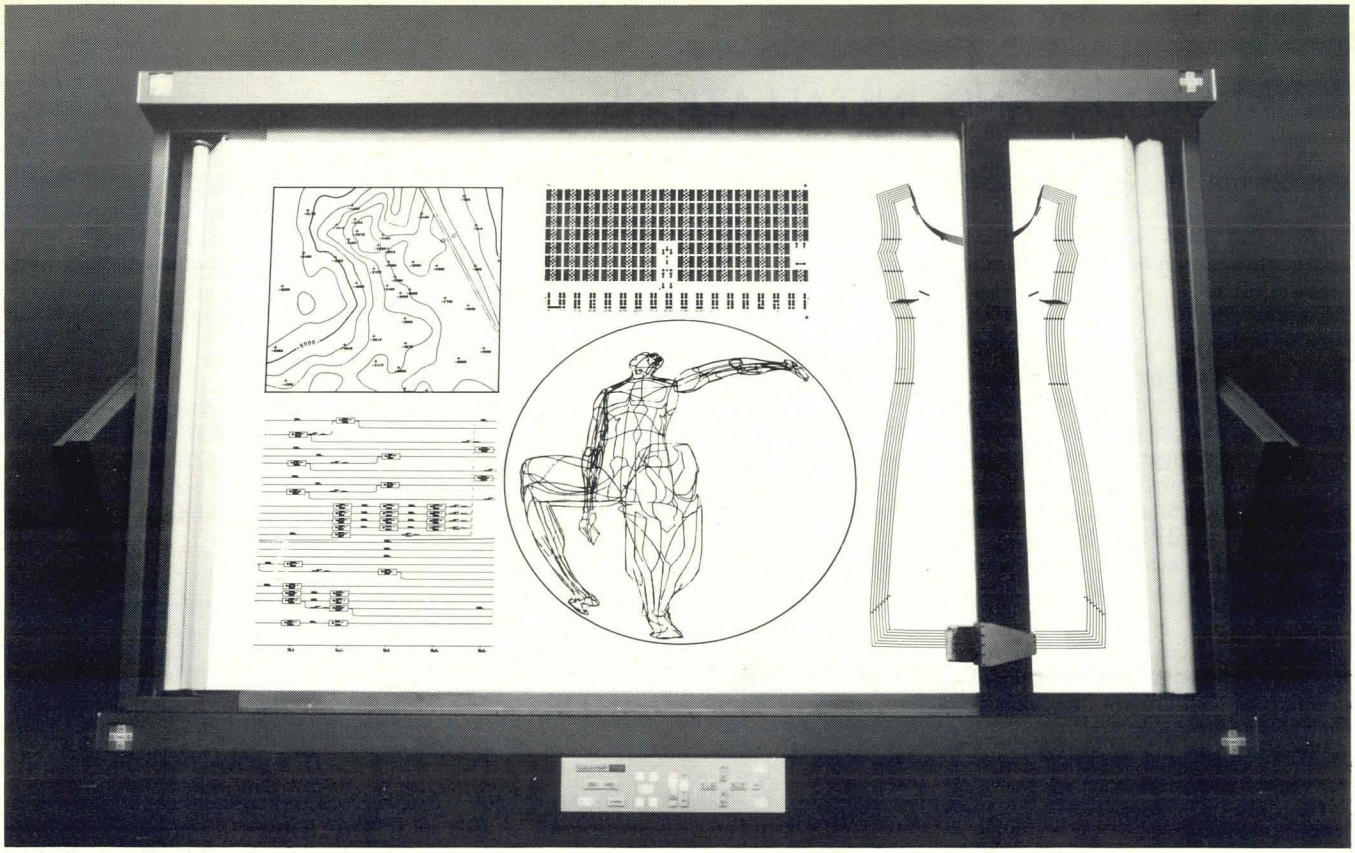
QUICKLY AROUND THE WORLD

The Royal Turf of Thailand has ordered a Control Data 3100/3300 interlinked computer system valued at nearly $1.5 million to process racetrack betting information and calculate dividends on winning tickets.

Two Univac 9400 real-time computer systems valued at approximately $1 million have been ordered by the Europe Container Terminus Co., Rotterdam, Holland, to expedite the rapidly increasing volume of container freight traffic in the port of Rotterdam.

The Hebrew University of Jerusalem and ILTAM, the Government Corporation for Planning and Research, are organizing the 1970 International Seminar on Advanced Programming Systems to be held on the campus of the Hebrew University in Jerusalem for two weeks, from July 26 to August 6.

The battle of the minis intensifies in Britain as the result of the formation of a new computer company. The new firm, Database, will offer Clary Datacomp Systems' 404 computer in most Commonwealth countries and Western Europe, and has the right to manufacture in the U.K.



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CIRCLE NO. 29 ON INQUIRY CARD

ORDERS AND INSTALLATIONS

A contract to expand the mainframe memory of Applied Logic Corp.'s Dual AL-10 (PDP-10) interactive time-sharing system has been awarded to the Data Products Div. of Lockheed Electronics Corp. The contract is valued at more that $800,000.

United Air Lines announced agreement with IBM on plans for a new, nationwide passenger reservation center now under construction in Denver, Colo. Over a period of years, the contract could involve some $50 million for IBM equipment and technical services. The United system will use an S/360 Model 65 which later will be replaced with more powerful Model 195s. The order follows the cancellation of a previous contract with Sperry Rand's Univac Division for a similar system.

Bowles, Andrews and Towne, consulting actuaries, have purchased 1,475 portable KeyPact computer terminals from Computone Systems, Inc. The order represents a $1.5 million investment and marks the largest single order for KeyPact terminal equipment to date.

Computer Sciences Corp. has received a contract to provide extensive services in systems analysis and computer programming to NASA's Goddard Space Flight Center at Greenbelt, Md. The $3 million contract covers a one-year period and contains options for two one-year extensions. The value of the award has been estimated at $11 million if all contract options are excercised.

A manufacturing contract for $9.7 million has been awarded to the Instrument Div. of Lear Siegler, Inc. by Data Input Devices, a firm that designs and sells digital encoders. The contract calls for Lear Siegler to deliver the encoders over an 18-month period.

A $5 million contract calling for the implementation and management of a computerized information retrieval system designed to serve the automotive parts distribution industry has been awarded by Computer Catalogs, Inc., Boston, to Moll Associates, Inc., Watertown, Mass.

Informatics, Inc., Sherman Oaks, Cal., announced a $5 million cost plus fee supplemental agreement award from the National Aeronautics & Space Administration. The award, aggregating $5,035,000, represents a supplemental agreement under an existing contract with Informatics/TISCO, Inc., a wholly-owned Informatics subsidiary, for a one-year continuation of the operation of the NASA Scientific and Technical Information Facility in College Park, Md.

Wang Laboratories, Inc. received a telegram from Senator Edward M. Kennedy advising the company that General Services Administration has contracted for an indefinite quantity of Wang's calculators. The order could result in possible sales of $4,455,600 if federal agencies purchase according to presently indicated requirements.

Sanders Associates has received a $2.7 million developmental contract from the Federal Aviation Administration for a basic model of a radar air traffic control display subsystem. The subsystem will be used in human factors and other design considerations for the enroute portion of the National Airspace Air Traffic Control System.

Ampex Corp. has received a contract for approximately $1.4 million to supply core memory stacks to Nixdorf Computer AG West Germany for use in new Nixdorf 800 and 900 series computers. Stack configurations will include 512, 1024, 2048, and 4096 words by 12 and 18 bits.

Shearson, Hammill & Co., Inc., a Wall Street stock brokerage and investment banking firm, has installed a Control Data Brokerage Control System valued at nearly $2.5 million. The dual CDC 3300 system will provide order matching and confirmation of customers' stock market transactions.

International Communications Corp. announced the receipt of an order in excess of $750,000 from Lufthansa Airlines for high-speed modems to provide the data transmission links for Lufthansa's international seat reservation system. The Lufthansa order brings to ten the number of major airlines using ICC's Modem 4400 data sets for their reservation systems.

General Logics Inc. of Dallas, Texas has ordered one Univac 9200 and two Univac 9400 computer systems valued at approximately $2.4 million. When installed this summer, the computers will be used to service a nationwide data communications network for industrial applications.

Ampex Corp. has received a $1.1 million order from the Friden Div. of the Singer Co. to supply digital tape drives for the Singer's System Ten business computers.

The first of two large-scale GE-635 information systems ordered by the U.S. Air Force Data Services Center recently was installed in the Pentagon. The Air Force signed a $12.2 million contract last year for two, dual General Electric GE-635 information systems and five small-scale GE-115 systems. The GE-115s are scheduled to be installed this fall while the second dual GE-635 is scheduled for installation in early 1971.

May Co. announced it will lease and install a new credit authorization system developed and produced by TRW Data Systems. The system calls for installing over 1,400 small keyboard terminals beside cash registers in all of the May Co.'s 17 Southern California retail stores.

Computing and Software, Inc. announced the receipt of an estimated $600,000 facilities management contract with Systematic Services of California, Inc., Oakland.

Bryant develops a line of mini-controllers compatible with leading mini-computers.

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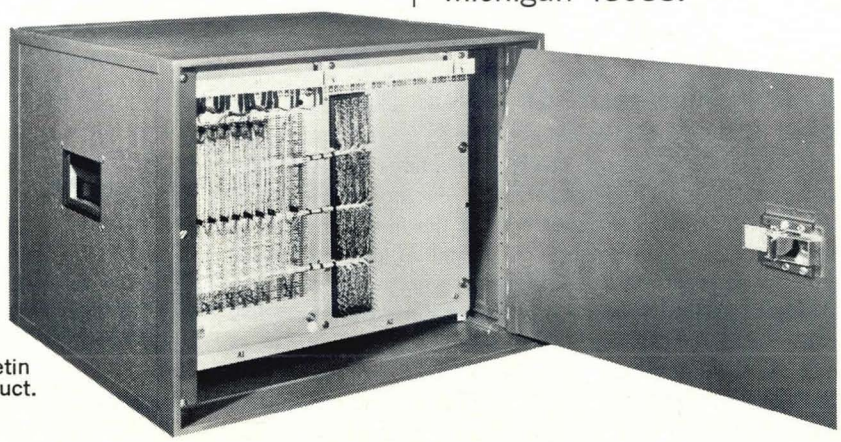
That's the way our new Bryant Series 720 works out. It's a compact, low-cost controller that is instantly compatible with your mini-computer (either the MAC 16 or Interdata 3).

But that's only part of the story. The 720 is instantly expandable from 0.6 million bits to 70 million bits, depending on which of the 8 different Bryant storage memory systems you utilize. Incidentally, only Bryant can offer this wide range of storage expandability.

Hold it, there's more. A fully expanded system can interface two computers with up to eight storage units and two computers can operate off one storage system simultaneously. (And they're available in cabinets or can be rack mounted in your equipment.)

But this is only the beginning. Two more mini-controller systems (compatible with the PDP-8 and SEL-810A mini-computers) will be available later this year. And by 1971, Bryant will have systems to interface with most of the major mini-computers on the market.

If you're interested in maxi-results, why don't you drop us a line. Bryant Computer Products, 850 Ladd Road, Walled Lake, Michigan 48088.



Watch for next month's Bryant Bulletin and another new Bryant product.

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CIRCLE NO. 30 ON INQUIRY CARD

Harold V. Semling, Washington Editor

DC DATASCAN

MAGNETIC TAPE MANAGEMENT—The U.S. Comptroller General has reported to Congress that there is a need for further improvement in the management of magnetic tape by NASA's Goddard Space Center. The General Accounting Office found that on June 30, 1969, Goddard had over 900,000 tapes containing data that had been transmitted and received by tracking stations in various parts of the world. After receiving an earlier GAO report, NASA established new policies and procedures and agreed to study ways of increasing Goddard's capacity for rehabilitating magnetic tapes. GAO, however, believes that additional action is desirable since many of the tapes are being held without plans for eventual processing, or not retrieved from experimenters after processing.

TECHNOLOGY ASSESSMENT — The House Subcommittee on Science, Research, and Development is holding hearings on legislation (H.R. 17046), "The Technology Assessment Act of 1970." The purpose of the legislation, sponsored by Rep. Emilio Q. Daddario (D.-Conn.) is to provide Congress with a continuing capability for evaluating technology and its uses. The new Office of Technology Assessment — which would be composed of 13 members, including representatives of the House and Senate, legislative agencies, and the public — would commission various independent organizations to assess the impact of developing technologies for the Congress. The technical assessment process is defined by Rep. Daddario as "a system of improved information into the legislative process so that management decisions can insure the realization of full benefits from scientific knowledge and minimize the unwanted, unintended, and unanticipated consequences of applied science."

POSTAL PREDICTIONS — Mail volume, which last year reached 82 billion pieces, is expected to more than double in the next twenty years. Postal projections say the mail will reach 166 billion pieces in 1991. Increased growth of facsimile transmission is expected, but the Post Office views this electronic advancement "as a limited communication means to specialized business users who need and can afford the required terminal equipment during the next few years." Postal officials warn that higher costs per unit are inevitable without drastic improvements in processing productivity. Radical departures are required in distribution techniques, mechanization design, and coding practices.

JOB BANK COMPUTERS — For fiscal 1971 the Labor Department has asked for funds to install Job Bank computers in 81 metropolitan areas across the country. "In addition to the intrinsic operating efficiencies that should accompany introduction of these computers, they will permit us to make available to the disadvantaged a far wider range of jobs than have been available to them in the past," said Under Secretary of Labor James D. Hodgson.

CENSUS REPORT — Manufacturers' shipments of electronic computing equipment in 1967 were valued at $4,046 million according to a preliminary report just issued by the Dept. of Commerce's Bureau of the Census. The total number of employees in the industry was 98,000 and payrolls totaled $798 million. "Value-added-by-manufacture," an approximation of the value of products shipped less the cost of materials used was $1,921 million.

TRAVELER'S FILE — The Senate Constitutional Rights Subcommittee is continuing its survey of federal data banks containing statistical or administrative personal information on individuals. The Subcommittee has sent a questionnaire to the Secretary of Treasury asking for a complete report on a Customs Bureau computerized data bank on travelers. The Secretary was asked to submit a report describing the guidelines governing access to the data and its use by other agencies; the specific subject areas concerning an individual's background; the security devices and procedures used to protect confidentiality of the data; and other areas of interest to the Subcommittee.

CONSTRUCTION UNEMPLOYMENT — To stabilize seasonal unemployment in the construction industry, a joint Labor-Commerce Dept. report has recommended the development of a local construction labor market information system. The system would be a cooperative undertaking of contractors, building-trade unions, and the Dept. of Labor. Computer matching programs would be utilized to develop forecasts that would focus on seasonal variations for specific crafts and locations. If this program proves useful for the construction trades, it might be expanded to serve other sectors of the economy with seasonal problems.

IN BRIEF

Eighteen grants totaling $523,800 have been awarded by the National Science Foundation to expand and strengthen a state-wide cooperative program of educational computing activities among institutions of higher learning in Georgia.

The detailed input-output structure of the U.S. economy has been made available on magnetic tape. More information can be obtained from the National Economics Division, Office of Business Economics, U.S. Dept. of Commerce, Washington, D.C. 20230.

The FCC has developed a computer program to recognize seasonal and geographic differences, and other variables necessary to evaluate the trends in telephone service quality.

Theim Industries of Torrance, Cal. has been named the Small Business Subcontractor of the Year. The small metal-working and precision machine shop produces airborne computer module chassis and missile computer radar.

Two months ago, Raytheon Computer introduced the new 1.5μs 704 Computer.

We just changed our minds.

We've speeded up the 704 by a third and made it more powerful. And, best of all, we didn't change the price.

Now the 704 has a 1μs 4k memory that's expandable to 32k for those big data performances. And DMA to get to it — fast.

The 704 has 4 addressable registers and 74 instructions. It's big in software. Over 400 programs and subroutines available off-the-shelf. Software that most small computers don't even offer. All field proven and working.

Like our exclusive executives and monitors for disc and mag tape operating systems or for batch processing. And our 360-compatible superset of USASI FORTRAN IV. And our conversational FORTRAN in just 4k. And the only small-computer Sort/Merge package. And the fastest, most accurate math library in the class. (Try us with a benchmark.)

And the Raytheon Computer 704 is just as big in hardware. With options like hardware multiply/divide, bootstrap and a high-speed, real-time Array Transform Processor. And interfaces that let our computer talk to anything you've got. Analog or digital. Processing or control. One-of-a-kind or OEM.

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CIRCLE NO. 31 ON INQUIRY CARD

CORPORATE AND FINANCIAL NEWS

COMPUTER TREND ANALYSIS

Three major trends will determine the computer markets, products, and technology of the 1970s, according to Quantum Science Corp., technological information service company with offices in New York and California. Speaking at the recent International Computer Conference in Washington, D.C., J. Peter Ross, v.p. of Quantum Science Corp's Adv. Technology Div., said that the rapid introduction of dispersed computer systems will dictate new product developments in terminals, equipment, memories, and software. Second, the movement towards total service because of increasing system complexity will mean that computer services will become the fastest growing sector in the EDP industry, expanding from $7.9 to $20.1 billion by 1973. The third factor mentioned was the increasing importance of overseas markets and competition. Quantum Science predicts that foreign markets are increasing 50% faster than those in the U.S., and that foreign companies are preparing to attack world markets. By 1973, 44% of U.S.-based computer sales will be to foreign markets, according to Mr. Ross.

COMPUTER DIMENSIONS SIGNS $2 MILLION CONTRACT

Computer Dimensions, Inc., a leading data processing firm announced it signed a $2,100,000 data processing contract with Budget Industries, Inc. of Los Angeles. CDI also has an agreement to acquire a computer firm controlled by Budget. Under terms of the contract, CDI will take over the entire data processing operation currently maintained by Budget Industries, a $35 million-a-year conglomerate listed on the N.Y. Stock Exchange, and move its operations to CDI's Los Angeles data processing center where it will handle all of Budget's present processing requirements. In addition, Budget currently holds stock and convertible debentures representing 80 per cent ownership in Miller-Ellis Computer Systems, Inc., a Los Angeles company. As part of the agreement, CDI will acquire Budget's interest in Miller-Ellis on a stock for stock trade. The total acquisition transaction involves $435,000.

NO EDP JOB SHORTAGE

Even though hiring rates have temporarily declined due to the economic slow-down, expansion of computer applications will create 40,000 new professional and para-professional data processing jobs this year, according to Source EDP, Inc., Chicago-based EDP recruitment firm. The company's 1970 *Computer Salary Survey and Career Planning Guide* predicts that by year-end, more than 80,000 computers will be used in the U.S., with deliveries reaching more than 10,950 units in the 12-month period. In a summary of new job opportunities in the computer field, the survey shows "more than 10,000 people will be added to the ranks of computer professionals. Opportunities will be such that an average of three outstanding positions will exist for each competent computer professional."

ALWAYS ROOM FOR ONE MORE

About to add its name to the ever-expanding roster of companies providing keypunch replacement equipment is Entrex, Inc. of Lexington, Mass. The company's System 480 line will consist of CRT-to-disk-to-mag. tape configurations enabling up to 64 "Data/Scope" operators to share an integral computer for data input and verification. Entrex president Barry M. Harder obviously believes in hiring seasoned sales and marketing personnel: his team includes Paul Landry, formerly regional sales mgr. for Mohawk and national mktg. mgr. for Honeywell's Keytape product line; and Steve Schwartz, formerly promotion mgr. for Keytape and Viatron's System 21.

ISL EXPERIENCES CASH FLOW PROBLEM

Information Systems Leasing Corp. of Jenkintown, Pa. has notified its shareholders that the firm is experiencing serious financial difficulties and is engaged in merger/acquisition talks with two companies having compatible interests. In a letter to share- and warrant-holders, Mrs. Mary K. Hawes, president, said the company presently "has a critical cash flow problem . . ." and ". . . no sources of capital sufficient to allow it to continue its operation after June 1, 1970."

MERGERS & ACQUISITIONS: **Automatic Data Processing, Inc.**, a national computer services company, has reached an agreement in principle to acquire the Houston computer center and data processing operations of **Petro-Chem Computing, Inc.**, a wholly-owned subsidiary of Duquesne Natural Gas Company of Houston . . . **Academy Computing Corp.** has agreed in principle to merge **Compute America Corp.** into Academy. Both companies are headquartered in Oklahoma City . . . **Carci Computab Systems, Inc.**, a manufacturer of business forms for computers, has been merged into **Cybermatics Inc.**, an independent software company. . . . **ITS Computing, Inc.** of Dallas has merged with **BMS Data Processing, Inc.** of Atlanta, Georgia. ITS provides specialized programs for businesses. BMS offers management information packages. . . . **Computer Products, Inc.** of Ft. Lauderdale and **Scientific Systems Services, Inc** of Satellite Beach, Fla. have completed an agreement whereby Computer Products has acquired 51% of Scientific Systems Services' stock. . . . **Computest Corp.** of Cherry Hill, N.J. has agreed in principle to acquire **"Three Sigma," Inc.**, a Phoenix, Arizona manufacturer of disk memory test equipment. . . . **Vidar Corp.** of Mountain View, Cal. has agreed in principle on the terms of Vidar's proposed acquisition by **Continental Telephone Corp.**, St. Louis. . . . **On-Line Systems, Inc.** has acquired the PDP-10-based remote-access time-sharing business of **Davis Computer Systems, Inc.** . . . **Redcor Corp.** of Woodland Hills, Cal. and **Penta Computer Associates, Inc.** of NYC jointly announced that an agreement in principle has been reached under which Redcor would acquire the assets of Penta on a pooling of interest basis. . . . **Tab Products Co.** of Palo Alto announced the sale of its Data Input Center division to **United Financial Data Centers, Inc.** of Detroit, Mich. . . . **Unitech, Inc.**, of Austin, Texas plans to merge with **Infotronics Corp.**, of Austin. Unitech is engaged in conducting studies related to signal analysis and system design, and developing computer software and systems products for industry. Infotronics manufactures a line of digital instruments used in the processing of analytical data . . . **Wellington Computer Systems Inc.** of NYC has

acquired all of the stock of **Advanced Management Planning, Inc.**, a Bethesda-based consulting firm. Wellington provides management consulting and implementation services. Other Wellington wholly-owned subsidiaries include: Telemax Corp., which provides an on-line reservations service, and Wellington Data Utilities, Inc., a facilities management and EDP services firm.

RECENT ENTRIES IN THE COMPUTER FIELD: The **Boeing Computer Services Division** has been formed to include all of Boeing's present computing capabilities located in Philadelphia; Huntsville, Alabama; Wichita, Kansas; and Seattle. Initially, over 3,000 Boeing employees will be assigned to the new division. As one of the world's largest users of computer technology, Boeing's inventory of computer equipment is valued at over $100 million. . . . **Corporate Presence, Inc.**, a full-service advertising/salespromotion/public relations agency, has been formed in White Plains, N.Y. to serve the data processing industry. . . . **EAST Corp.** (Eastern Automated Systems Technology Corp.) is a new diversified marketing and computer consulting firm with headquarters in Mineola, N.Y. . . . **Formscan, Inc.**, based in Pasadena, Cal., will provide input automation design and consulting services for businesses or computer installations. . . . **Identicon Corp.**, Waltham, Mass., will design and manufacture data processing and automation equipment for materials-handling and control applications. . . . Infoton Inc. has organized **ILC Leasing Corp.**, an affiliate that will purchase and lease Infoton's series of CRT display terminals and OCR systems. . . . **Insurance Systems of America, Inc.** has been formed in Atlanta, Ga. by 15 major life insurance companies to market insurance application software and other computer related services to the insurance industry. . . . Western Union Corp., Data Research Corp., and Western Union Computer Utilities, Inc. have established **International Data Terminals, Inc.** to engage in the development and manufacture of a line of data-terminal equipment. IDTI will be based in Ft. Lauderdale. . . . **Intertel, Inc.** has been formed in Burlington, Mass. as a supplier of data communications products. . . . Management Concepts, Inc. has formed **Malt Keyboard Dynamics, Inc.** as a wholly-owned Chicago-based subsidiary. The new company will offer professional training programs designed to improve keyboard operator skills and productivity. . . . **Mnemotech Corp.**, an integrated circuit and core memory company, has been formed in Levittown, Pa. . . . Larse Corp. of Palo Alto has announced the formation of **Pacific Telecommunications Laboratories** (PTL), a new division. (PTL) will be responsible for research and development of selected telecommunications products, including electronic telephone switching systems and related subsystems, and terminal apparatus. . . . **United Software Corp.**, with offices in the greater Philadelphia, Minneapolis, and N.Y. areas, has been formed by several former members of Univac's EXEC-8 management and design team. . . . **University Instruments Corp.**, Boulder, Colo., has been formed as an affiliate of KDI Corp., Cincinnati, Ohio. One of the company's first products will be optical computer communications links.

BOX SCORE OF EARNINGS

Company	Period	Revenues	Net Earnings (Loss)	Earnings (Loss) per Share
Beta Instrument	Yr. 12/31/69	916,952	(691,294)	(.76)
	Yr. 12/31/68	599,503	(105,172)	(.13)
Bresnahan Computer	6 mos. 3/31/70	2,980,000	325,000	.17
	6 mos. 3/31/69	1,204,000	149,000	.10
Computer Dimensions	3 mos. 3/31/70	1,216,586	85,842	.07
	3 mos. 3/31/69	934,314	(155,501)	(.17)
Computer Microfilm	Yr. 12/31/69	410,302	(22,339)	(.08)
	11 mos. 12/31/68	30,746	(144,062)	(.58)
Computing and Software	3 mos. 1/31/70	14,440,000	1,218,000	.31
	3 mos. 1/31/69	13,986,000	896,000	.23
Control Data	3 mos. 3/31/70	125,539,000	1,678,000	.09
	3 mos. 3/31/69	131,730,000	16,572,000	1.13
Corporation S	Yr. 10/31/69	818,837	(1,089,201)	(.82)
	Yr. 10/31/68	621,562	(382,546)	(.76)
CUC	6 mos. 3/31/70	3,295,031	(1,071,019)	(1.26)
	6 mos. 3/31/69	6,488,595	425,152	(.50)
Data Architects	Yr. 11/30/69	3,505,813	72,524	.06
	Yr. 11/30/68	2,845,135	(6,238)	(.01)
Data Documents	6 mos. 3/31/70	12,151,032	448,906	.96
	6 mos. 3/31/69	10,252,936	425,851	.92
Datamation Services	Yr. 12/31/69	3,638,492	(516,540)	(.46)
	Yr. 12/31/68	3,957,960	328,895	.30
Dataram	9 mos. 1/31/70	1,580,710	85,252	.11
	9 mos. 1/31/69	387,588	(234,918)	(.38)
Data Systems Analysts	Yr. 12/31/69	2,073,773	81,224	.11
	Yr. 12/31/68	1,612,957	38,130	.06
Fabri-Tek	Yr. 3/27/70	21,200,000	561,903	.18
	Yr. 3/27/69	15,800,000	369,463	.12
Hewlett-Packard	6 mos. 4/30/70	174,068,000	11,704,000	.46
	6 mos. 4/30/69	151,959,000	11,688,000	.46
Management Assistance	6 mos. 3/31/70	32,985,000	(41,000)	(.01)
	6 mos. 3/31/69	36,383,000	(512,000)	(.12)
Management Data	Yr. 2/28/70	8,250,000	784,000	.80
	Yr. 2/28/69	5,035,000	449,000	.50
Mohawk Data Sciences	9 mos. 4/30/70	77,215,000	6,400,000	1.17
	9 mos. 4/30/69	59,575,000	4,745,000	.87
National Computer Systems	Yr. 1/31/70	2,889,904	12,258	.03
	Yr. 1/31/69	2,679,252	177,408	.46
North Atlantic Industries	53 wks. 1/3/70	3,866,221	86,539	.21
	52 wks. 12/28/68	4,227,926	285,745	.70
Planning Research	9 mos. 3/31/70	46,969,220	2,344,119	.49
	9 mos. 3/31/69	40,863,053	1,965,945	.44
Sperry Rand	Yr. 3/31/70	1,755,443,000	81,014,000	2.37
	Yr. 3/31/69	1,607,340,000	77,036,000	2.26
SYS Associates	Yr. 12/31/69	844,489	71,682	.15
	Yr. 12/31/68	277,056	(265,609)	(.82)
Technitrol	3 mos. 3/31/70	3,116,022	102,379	.07
	3 mos. 3/31/69	2,970,078	88,664	.06
Tracor Computing	3 mos. 3/31/70	1,721,743	(145,015)	(.03)
	3 mos. 3/31/69	1,663,002	(454,330)	(.17)
University Computing	3 mos. 3/31/70	37,000,000	4,206,000	.61
	3 mos. 3/31/69	19,000,000	3,690,000	.56
Western Union	3 mos. 3/31/70	101,042,000	7,163,000	.72
	3 mos. 3/31/69	95,273,000	6,133,000	.71
Xerox	3 mos. 3/31/70	402,557,000	46,046,000	.59
	3 mos. 3/31/69	338,823,000	38,401,000	.50

COMPUTER STOCK TRENDS

	COMPANY	EXCH.	VOL. (SHARES IN 100's)	1970 HIGH	1970 LOW	PRICE 6-5-70	NET CHG. FROM MONTH AGO	EARN./SHR. (LATEST 12 MONTHS)	P/E RATIO
SUPPLIES & ACCESSORIES	ADAMS MILLIS	NY	565	15.2	8.2	10.0	–1.0	1.05	9
	BALTIMORE BUS. FORMS	OTC	--------	21.0	12.4	12.4	–4.0	0.92	13
	BARRY WRIGHT	AM	552	25.3	7.5	9.5	–0.4	0.80	11
	CAPITOL INDUSTRIES	AM	1992	53.5	16.4	26.2	–8.2	2.08	12
	DATA DOCUMENTS	AM	120	35.6	17.2	20.4	–3.2	1.82	10
	DATA PACKAGING	OTC	--------	28.6	9.4	12.0	–1.0	0.76	15
	DENNISON MFG.	NY	1248	25.2	11.4	13.6	–1.2	1.44	9
	DUPONT	NY	6616	118.2	92.4	112.7	3.7	7.35	15
	ENNIS BUS. FORMS	NY	264	19.0	12.0	14.5	–0.1	0.95	14
	GENERAL BINDING	OTC	--------	30.4	14.0	19.0	–2.4	0.76	25
	GRAPHIC CONTROLS	OTC	--------	17.2	8.1	9.2	0.2	1.10	8
	LEWIS BUS. FORMS	OTC	--------	20.0	11.0	13.0	–0.4	0.86	15
	MEMOREX	NY	24642	166.6	63.4	79.0	–0.4	1.71	46
	3 M	NY	6693	114.6	77.4	85.3	–8.5	3.21	26
	MOORE CORP. LTD.	TSE	--------	38.0	27.6	30.0	–5.2	1.26	23
	REYNOLDS & REYNOLDS	OTC	--------	48.4	30.0	35.4	3.4	1.27	27
	SAFEGUARD INDUSTRIES	AM	492	16.1	7.2	9.5	–1.2	0.79	11
	STANDARD REGISTER	OTC	--------	30.4	21.0	21.4	–2.4	2.13	9
	UARCO	NY	288	39.2	25.3	26.4	–2.0	2.21	11
	WALLACE BUS. FORMS	OTC	--------	41.0	25.0	30.0	–2.4	2.16	13
SOFTWARE & SERVICES	APPLIED DATA RESEARCH	AM	901	24.2	4.1	5.2	–0.4	(d)0.40	----
	APPLIED LOGIC	OTC	--------	18.4	4.6	4.6	–1.4	-------	----
	ARIES	OTC	--------	8.0	1.6	1.7	–0.1	-------	----
	AUTOMATIC DATA PROC.	AM	7042	47.6	22.1	30.3	–1.7	0.59	50
	BOLT, BERANEK & NEWMAN	OTC	--------	11.2	6.0	7.0	0.4	0.32	21
	BOOTHE COMPUTER	OTC	--------	25.4	12.0	12.4	–5.4	1.62	7
	BRANDON APPLIED SYS.	OTC	--------	9.4	2.2	3.0	–0.4	-------	----
	COMPUTER APPLICATIONS	AM	1585	12.3	2.6	3.3	–1.5	(d)5.51	----
	COMPUTER ENVIRONMENT	OTC	--------	14.0	3.6	4.0	–3.4	-------	----
	COMPUTER EXCHANGE	OTC	--------	8.2	2.4	5.4	1.4	0.08	62
	COMPUTER INVESTORS	AM	296	12.3	3.7	6.2	–0.2	0.39	15
	COMPUTER METHODS	OTC	--------	2.4	1.0	1.0	–0.2	-------	----
	COMPUTER PROPERTY	OTC	--------	15.2	5.6	8.0	–1.0	0.76	10
	COMPUTER SCIENCES	NY	7860	34.1	7.5	11.3	–1.5	0.41	26
	COMPUTER TECHNOLOGY	OTC	--------	12.6	2.2	3.0	–1.4	0.12	25
	CTC COMPUTER	OTC	--------	19.0	2.4	3.2	0.2	-------	----
	COMPUTER USAGE	OTC	--------	8.4	4.2	4.6	–1.6	(d)1.58	----
	COMPUTING & SOFTWARE	AM	2357	75.6	18.5	24.6	–5.4	1.19	20
	COM-SHARE	OTC	--------	14.6	3.2	3.2	–2.2	-------	----
	CYBER-TRONICS	OTC	--------	15.0	2.0	3.0	–2.0	0.11	27
	CYBERMATICS	OTC	--------	14.2	5.2	6.4	–3.4	-------	----
	DATA AUTOMATION	OTC	--------	24.0	4.6	6.0	–1.4	-------	----
	DATA DYNAMICS	OTC	--------	3.5	1.2	1.4	0.0	-------	----
	DATA PROC. FIN. & GEN.	NY	7170	32.0	6.5	12.0	1.0	1.23	9
	DATA SYSTEMS ANALYSTS	OTC	--------	5.4	2.4	3.6	0.6	0.06	50
	DATRONIC RENTAL	OTC	--------	8.0	3.0	4.0	–0.4	-------	----
	DEARBORN COMPUTER	AM	1237	24.1	10.2	13.2	–0.6	1.86	6
	DECISION SYSTEMS	OTC	--------	4.2	1.4	2.4	0.4	-------	----
	DIGITAL APPLICATIONS	OTC	--------	6.6	1.4	2.4	0.0	-------	----
	DIGITEK	OTC	--------	4.4	1.6	1.7	–0.5	-------	----
	DPA, INC.	AM	1064	10.3	3.6	5.3	0.2	0.85	5
	EFFICIENT LEASING	OTC	--------	5.0	1.6	2.2	–0.2	-------	----
	ELEC. COMP. PROG. INST.	AM	369	11.4	5.1	6.7	0.7	0.14	42
	ELEC. DATA SYSTEMS	OTC	--------	161.0	31.0	36.0	–29.0	0.39	92
	GREYHOUND COMPUTER	AM	559	14.1	5.7	7.4	–0.2	1.05	6
	INFORMATICS	OTC	--------	20.4	4.4	8.0	1.2	0.09	88
	INTL. COMPUTER	OTC	--------	7.4	3.4	4.6	0.2	-------	----
	INTL. COMPUTER SCIENCES	NAT	--------	3.3	1.2	1.3	–0.3	-------	----
	LEASCO	NY	8853	30.4	7.7	11.1	–2.0	2.51	4
	LEVIN-TOWNSEND	AM	7913	19.3	3.0	6.5	1.4	0.82	7
	LMC DATA	OTC	--------	3.5	1.3	1.7	0.1	(d)0.01	----
	MGMT. ASSISTANCE	OTC	--------	4.0	1.5	2.1	–0.3	(d)2.07	----
	MANAGEMENT DATA	AM	--------	25.4	11.2	14.0	–3.1	0.77	19
	NATIONAL COMP. ANAL.	OTC	--------	8.4	3.0	3.2	–0.6	-------	----
	PLANNING RESEARCH	NY	4396	53.2	13.5	19.2	–3.4	0.68	27
	PROGRAMMING METHODS	OTC	--------	27.0	9.0	13.0	0.0	-------	----
	PROGRAMMING SCIENCES	OTC	--------	16.6	3.2	6.2	2.6	-------	----
	PROGRAMMING SYSTEMS	OTC	--------	5.4	2.1	3.0	0.0	0.16	18
	SCIENTIFIC COMPUTER	OTC	--------	3.5	1.7	2.0	–0.2	0.12	16
	SCIENTIFIC RESOURCES	NY	5596	14.5	4.4	5.4	–0.4	(d)0.78	----
	SYSTEMS CAPITAL	OTC	--------	8.0	3.0	3.6	–0.2	-------	----
	TIME SHARE	OTC	--------	7.0	2.0	2.4	–0.4	0.13	15
	TRACOR COMPUTING	OTC	--------	7.4	2.1	3.2	–0.3	-------	----
	URS SYSTEMS	AM	1177	28.0	5.4	7.2	0.6	0.78	8
	UNITED DATA CENTERS	OTC	--------	4.6	2.4	3.4	–0.1	-------	----
	UNIVERSITY COMPUTING	NY	25509	99.3	19.4	25.1	–8.4	2.58	9
	US TIME SHARING	OTC	--------	13.4	3.0	3.4	–1.6	-------	----

(d) Deficit
New listing in this issue

All security prices and net change are expressed in dollars and eighths of dollars (e.g. 62.2 is 62¼). Trading volume is not given for over the counter stocks. ALL DATA COMPUTED BY SCANTLIN ELECTRONICS, EXCLUSIVELY FOR MODERN DATA.

	COMPANY	EXCH.	VOL. (SHARES IN 100's)	1970 HIGH	1970 LOW	PRICE 6-5-70	NET CHG. FROM MONTH AGO	EARN./SHR (LATEST 12 MONTHS)	P/E RATIO
PERIPHERALS & COMPONENTS	AMP	NY	2657	57.2	41.0	45.7	–3.1	2.03	22
	AMPEX	NY	9403	48.4	13.5	17.6	–4.2	1.44	11
	APPLIED MAGNETICS	OTC	--------	25.4	10.0	14.0	–0.4	0.39	35
	ASTRODATA	AM	2619	34.7	5.2	8.0	–2.7	0.39	20
	ASTROSYSTEMS	OTC	--------	9.2	2.1	3.1	–0.7	0.34	8
	BUNKER RAMO	NY	9770	14.4	6.1	8.1	–1.5	0.54	14
	CALCOMP	AM	6415	33.7	13.1	18.4	–1.7	0.32	56
	CHALCO ENGRG.	OTC	--------	5.0	2.2	2.2	–1.2	-------	----
	CODEX	OTC	--------	35.0	4.2	8.6	0.61	0.26	30
	COGAR	OTC	--------	94.0	39.0	46.0	–4.01	(d)1.25	----
	COGNITRONICS	OTC	--------	13.6	4.0	6.2	0.6	(d)0.22	----
	COLLINS RADIO	NY	1784	37.2	14.5	17.2	–3.2	0.98	17
	COMCET	OTC	--------	50.0	8.0	8.0	–8.0	-------	----
	COMPUTER COMM.	OTC	--------	36.0	8.0	12.0	–5.0	-------	----
	COMPUTER CONSOLES	OTC	--------	22.0	7.4	12.0	3.6	-------	----
	COMPUTEST	AM	783	28.3	13.4	17.4	–4.5	0.85	20
	CONRAC	NY	493	32.2	11.0	13.5	–3.3	1.20	10
	DATA 100	OTC	--------	16.6	5.4	7.0	0.0	(d)0.97	----
	DATA PRODUCTS	AM	7314	25.4	7.0	10.1	–4.3	0.26	38
	DATARAM	OTC	--------	15.4	6.2	7.0	–1.0	(d)0.44	----
	DATASCAN	OTC	--------	27.0	9.4	11.0	–3.0	-------	----
	DIGITRONICS	OTC	--------	13.6	5.4	6.2	–0.6	0.18	33
	ELEC. ENGRG. OF CAL.	AM	531	14.5	3.4	5.2	–1.0	(d)0.30	----
	ELEC. MEMORIES & MAG.	NY	3252	40.1	10.4	15.6	–3.3	0.78	19
	EXCELLO	NY	810	27.4	19.6	21.3	–3.4	2.59	8
	FABRI-TEK	OTC	--------	8.2	3.6	4.6	0.0	0.19	21
	FARRINGTON MFG.	OTC	--------	17.3	2.3	4.0	–0.6	(d)0.06	----
	GERBER SCIENTIFIC	AM	442	38.5	12.5	15.0	–6.6	0.68	22
	GRAPHIC SCI.	OTC	--------	42.2	7.4	14.0	2.0	(d)1.37	----
	HI-G	AM	362	16.6	7.6	9.3	–0.6	0.08	112
	INFORMATION DISPLAYS	OTC	--------	20.0	6.0	8.0	0.0	-------	----
	ITEL	AM	2948	25.4	6.1	9.6	–2.0	0.86	10
	LOGIC	OTC	--------	14.2	5.2	7.2	0.2	-------	----
	MILGO	AM	24831	40.4	15.0	20.3	–10.0	0.19	105
	MOHAWK DATA SCIENCES	NY	8289	87.0	27.6	33.6	–7.3	1.36	24
	NORTH ATLANTIC IND.	OTC	--------	7.6	3.2	3.4	–0.4	-------	----
	OPTICAL SCANNING	OTC	--------	52.0	16.0	21.0	–3.0	(d)0.45	----
	POTTER INSTRUMENT	AM	6214	42.6	23.5	26.4	–6.4	0.93	27
	RECOGNITION EQUIP.	OTC	--------	83.4	21.4	30.0	2.0	(d)0.51	----
	SANDERS ASSOCIATES	NY	2864	29.7	9.7	12.2	–1.4	(d)0.25	----
	SANGAMO	NY	1108	29.1	12.3	15.0	–1.7	0.59	25
	SCAN-DATA	OTC	--------	53.0	7.0	14.0	0.0	-------	----
	SEALECTRO	AM	287	12.6	3.6	5.0	–1.3	0.20	25
	SYKES DATATRON	OTC	--------	9.0	4.2	7.2	1.6	-------	----
	TALLY	OTC	--------	23.0	10.0	14.0	3.0	(d)2.73	----
	TELEX	NY	77263	25.7	11.0	14.7	–5.0	0.68	29
	TEXAS INSTRUMENTS	NY	7467	134.4	79.5	83.0	–22.2	3.16	26
	VARIFAB	OTC	--------	4.6	2.0	2.4	0.0	-------	----
COMPUTERS	BECKMAN	NY	1136	51.4	21.5	28.5	–3.4	1.52	18
	BURROUGHS	NY	15594	172.6	100.1	116.3	–12.5	3.42	33
	CONTROL DATA	NY	10222	122.4	35.6	42.0	–2.0	3.19	13
	DATA GENERAL	OTC	--------	34.2	19.0	24.0	–1.0	(d)0.17	----
	DIGITAL EQUIPMENT	AM	12128	124.0	57.0	68.0	–17.0	1.31	51
	ELECTRONIC ASSOCIATES	NY	1117	11.5	4.1	5.2	–1.3	(d)0.86	----
	GENERAL AUTOMATION	OTC	--------	42.0	11.6	16.0	2.4	(d)0.61	----
	GENERAL ELECTRIC	NY	10014	77.5	60.2	66.5	–4.6	3.07	21
	HEWLETT-PACKARD	NY	7200	45.7	26.5	28.2	–13.0	1.01	27
	HONEYWELL	NY	7889	152.0	73.0	89.0	–30.4	4.25	20
	IBM	NY	17777	387.0	237.0	270.0	–26.6	9.01	29
	INTERDATA	OTC	--------	12.6	6.2	6.2	–1.6	0.07	85
	LITTON INDUSTRIES	NY	19744	38.0	16.1	19.0	0.1	2.13	8
	NCR	NY	11254	63.0	48.6	53.0	–7.4	2.06	25
	RCA	NY	10978	34.5	20.0	22.2	–1.6	2.09	10
	RAYTHEON	NY	3661	33.5	16.1	21.6	–1.6	2.39	8
	REDCOR	OTC	--------	34.2	6.0	8.4	–5.4	0.14	57
	SCIENTIFIC CONTROL	OTC	--------	8.6	2.2	3.6	–0.2	(d)2.43	----
	SPERRY RAND	NY	15550	40.3	24.2	26.2	–1.4	2.37	10
	SYSTEMS ENGRG. LABS.	AM	11904	49.1	14.2	16.4	–9.0	0.81	19
	SYSTRON DONNER	NY	1150	28.5	8.7	12.3	–2.5	1.16	10
	VARIAN ASSOCIATES	NY	5562	29.1	12.1	15.1	–3.3	0.91	16
	VIATRON	OTC	--------	50.4	8.6	8.6	–10.6	(d)0.83	----
	WANG LABS.	AM	3773	51.6	21.1	25.4	–5.4	0.68	36
	WYLE LABS.	AM	1305	9.4	3.5	4.6	–0.6	0.31	12
	XEROX	NY	24663	115.6	70.0	80.6	–4.6	2.17	36
AVERAGES	COMPUTER STOCKS			36.2	15.1	17.7	–18.4%	0.83	21.3
	DOW JONES INDUSTRIALS			811.31	631.16	695.03	–5.2%	3.30	12.8

CORPORATE PROFILE

Featured this month:

COMPUTING AND SOFTWARE, INC. (American and Pacific Coast Stock Exchanges)

1900 Building, Century City, Los Angeles, California 90067

DIRECTORS: **Norman E. Friedmann,** chairman of the board and president; **Andrew Chitiea; Robert G. Sims; Bertin A. Weyl; Charles Crocker; Robert T. Davis; Roger Lee**

BACKGROUND: Computing and Software, Inc. and its nationwide divisions and subsidiaries are primarily engaged in the processing and sale of information products and providing an expanding array of marketing and financial services. C&S was incorporated in 1966, and was listed on the American and Pacific Coast exchanges in 1968. During the past four years the corporation has grown from approximately $6 million in annual sales to about $80 million by the middle of fiscal year 1970.

Management emphasizes development of data bases which meet requirements of established markets, and information products which require sophisticated computing techniques. C&S is involved in acquisitions of an increasing number of information files, and with geographic expansion of its computing activities.

FACILITIES: Corporate offices are located at Century City in Los Angeles. Computing centers and additional facilities are located in principal cities throughout the United States and Canada. Among these are Chicago, Washington, D.C., New York, Boston, Minneapolis, Houston, Dallas, Kansas City, Honolulu, San Francisco, Toronto, and Montreal.

PRODUCTS/SERVICES: C&S is service oriented, managing and operating computer centers, and applying computers to specialized information exchanges. The company has developed and acquired a variety of proprietary program packages which are utilized to provide customers with specialized reports such as those pertaining to trust and law office accounting; land investment and joint ventures; oil industry production reporting and accounting; etc. In addition, it provides complete payroll and general accounting systems, numerous programming projects, and commercial and governmental facilities management contracts. C&S offers marketing services which involve direct mail techniques utilizing applicable data bases. The company uses computer systems to maintain mailing lists, process responses to direct mail solicitation, analyze responses, and mass produce personalized computer letters. As part of its financial services, C&S provides real estate loan origination and servicing functions for commercial properties.

The corporation also operates education facilities for the data processing field, offers skilled temporary personnel to assist major companies in their conversion of data files to computer processable form, and manufactures components for the computer peripheral equipment market.

CURRENT POSITION: During the first half ended April 30, 1970, C&S earnings were $0.65 per share, up 36 percent from the $0.47 for the similar period in 1969. Net income in the first half rose to $2,986,000 on sales of $39,398,000, up from the $2,123,000 on sales of $34,804,000 (excluding discontinued operations) a year earlier, after restatement for all pooling of interests.

OUTLOOK: Computing and Software is in the process of converting its credit information files on nearly ten million individuals into computer processable form. The firm contemplates eventual expansion of its data product activities into the data communications and display fields, coincident with its objective to market information services on a nationwide basis.

FINANCIAL SUMMARY: The following statment of earnings depicts consolidated results of C&S operations for four years ended October 31, 1969, after restatement for businesses acquired prior to that date in pooling transactions. Also shown are comparative interim statements for the current and prior reporting periods which include restatement for all businesses acquired in poolings prior to April 30, 1970.

YEAR ENDED OCTOBER 31

Year	Revenues	Net Income	Net Income Per Share
1969	$64,420,000	$4,155,000	$1.11
1968	53,377,000	2,687,000	0.73
1967	43,353,000	2,071,000	0.58
1966	34,238,000	1,299,000	0.38
Six months (ended 4/30/70)	39,398,000	2,986,000	0.65
Six months (ended 4/30/69)	34,804,000	2,123,000	0.47

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Sangamo's T113ATS is a completely solid state data modem designed for two-wire full duplex operation. Total price is under $200. End to end compatibility with thousands of Western Electric 103A2 or 103E data sets permits immediate assimilation into existing systems without any terminal modifications. Since the T113ATS is electrically connected to the telephone network, 60 db channel separation is guaranteed. And performance is not degraded by second harmonic distortion prevalent in other coupling methods. By designing the T113ATS for a specific application, the cost was minimized. Data set lease charges for only 7 months will more than equal the total purchase price. It's easy to install, with only a medium sized screwdriver.

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T707

CIRCLE NO. 32 ON INQUIRY CARD

COMMUNICATIONS CLINIC

PRIVATE LINE SHARING

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

In December of 1968, AT&T proposed tariff revisions to allow large-scale shared uses of voice grade and narrow band private line services. This rather dramatic departure from historical policies and attitudes became effective on February 1, 1969, despite vigorously-worded opposition from Western Union. Claiming that the changes would ". . . restructure the communications industry via the introductions of middlemen, arbitrageurs, etc., . . ." Western Union viewed the situation potentially damaging to its own private line business. The FCC described Western Union's apprehensions as ". . . highly speculative . . .," stating that ". . . charging or resale by the customer . . . would raise serious questions as to whether the customer would be engaged in a common carrier service requiring certification and the filing of tariffs . . ." Neither approving nor disapproving the tariff changes, the FCC simply let them take effect.

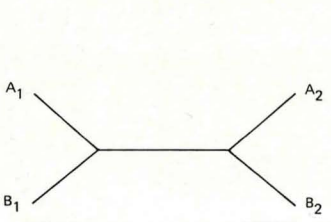
With the sharing rights having been available now for a year and a half, there are no signs of Western Union's eminent demise from lost private line revenue. Similarly, there do not appear to be any public signs of arbitrageurs. We know there are entities that have considered it, but we know of no substantive moves to date. We believe this is because few people understand the provisions or they're afraid that litigation might ensue as to what constitutes "a common carrier service requiring certification and the filing of tariffs."

Aside from arbitrageurs, we wonder how much straightforward sharing there is between end-users. We don't imagine there is very much among small users – the ones who might benefit the most – because the small users are not as likely to know of it or seek it out. Because of this, we thought a review of sharing might be useful.

Joint use arrangements are furnished under Section 3.1.5 of tariff FCC 260 (All references herein are to said tariff as of May 1, 1970.) for narrow band and voice band channels, excepting those voice channels which may access the switched network, e.g., foreign exchange service. Joint use is not allowed on any services based in whole or in part on bulk bandwidth services, that is, a voice channel derived from Telpak could not be jointly used. A notable exception to this is that the entire bandwidth of the type 11240 or 11048 channels may be arranged for joint use.

Joint use arrangements are provided to, and in accordance with, the instructions of a "customer" who also specifies the "joint users." The cost is that for the shared facilities at their normal rates, plus 10%. This total is billed among the joint users per the customer's instructions, but the customer remains responsible if any joint users do not pay. Any facilities used solely by a joint user, i.e., a service terminal, are also billed to that joint user, but remain the customer's responsibility.

So far in this discussion, we have implied only an alternate use of a channel by two or more users. As shown in Fig. 1, for example, first user A transmits between his stations, A_1 and A_2; then user B transmits between his stations, B_1 and B_2. This is fine for A and B and is unsatisfactory only to the extent that A and B must coordinate or schedule their respective use of the service. There is, however, another refinement to joint user provisions which make the possibilities even more attractive – multiplexing. With multiplexing, a customer can lease a voice grade line, install multiplexers of appropriate capacity,* and let joint users make use of the narrow band channels so created. This enables the joint users to have continuous use of their channels, eliminating the need to schedule channel use between joint users. Also, because of the leverage available through multiplexing, very substantial communications cost reductions are possible. The problem, of course, is that of initial coordination and funding of the multiplexer. If a user has enough justification in his own right for a multiplexer, he can



(Fig. 1)

(Fig. 2)

ERRATA

In the May Clinic on multiplexing, the equation seeking the mileage at which a four 150 bps channel FDM system is equal in cost to four separate 150 bps channels had two errors.

1. The $275 for equipment did not include $13.75 for each of the eight station arrangements required in type 1006 service.

2. The equation was based on mileage for one 150 bps channel (1.925x) instead of four such channels (7.7x).

The effect of these corrections is such as to show that in the example, the FDM system is cheaper for **any mileage** instead of only above 33.1 miles. The point was valid even though the algebra was poor. We apologize for any confusion we created.

*See "Go Forth and Multiplex" Communications Clinic, MODERN DATA, May 1970.

increase his return on investment by opening it up for joint users. If no system is installed, however, it becomes a matter of someone taking the initiative to form and finance a joint user group.

An example of this would be where four companies are each operating computer centers in City A, with each CPU being accessed by 150 bps conversational terminals in City B, as shown in Fig. 2. In the Communications Clinic in the May issue of MODERN DATA on the subject of multiplexing, as amended by the Errata notice at the start of this Clinic, we showed that for one practical set of assumptions, multiplexing four circuits was cost-effective for any distance at all, that is, if the four companies of Fig. 2 got together, they could save money regardless of the distance from A to B. In joint usage, however, the situation is slightly different. The multiplexing savings are not quite as much because of the 10% joint use surcharge; the local channel changes from the multiplexers to the CPU's and to the terminals; and the termination changes at those points. Notwithstanding these expenses, it is apparent that shared multiplexers can be powerful cost reducers, and should be considered by every private line user. ▲

THE SYSTEMS SCENE

THE NEW SCAPEGOAT

The Systems Scene is a regular monthly column written by Jerome Wiener and Thomas DeMarco of **Mandate Systems, Inc.** Readers are invited to submit comments and questions on new developments in systems to: **The Systems Scene, MODERN DATA, 3 Lockland Avenue, Framingham, Mass. 01701**

As part of a panel addressing the recent Spring Joint Computer Conference, Dr. Herb Grosch made the statement: "Programmers are jerks." He went on to explain that there are no real computer professionals.

As a past programmer and member of the panel, I feel I should say a word or two on the subject. A lot of money has been wasted by programmers – that is for sure. Systems were built that never ran. Programs were written when there was no need for them. Systems have been tuned and honed to the point of making as many as 1 million mistakes per second. The whole concept of GIGO was a great leap forward from the people who gave you AIGO (Anything In–Garbage Out).

A resume that came to my desk recently gave a detailed account of building a solitaire-playing program. (The system randomizes the deck and allocates cards into a solitaire hand, then plays out the game to the end; 200 games per minute.) Imagine spending $18,000 per month for a machine that plays with itself. What's a mother to do?

Perhaps the time has come to cease talking of computers in terms of oiling the wheels of business and talk more about the true role they have taken on: toys. Our sober-minded economy spends about $10 billion per year on computers and has little to show for it beyond their amusement value. Programmers are paid fat salaries to play with these toys. Will the real jerks please step forward?

Inherent in all this name-calling is the idea that wasting large sums of money is somehow reprehensible and – worst of all – an indication of (shudder) incompetence. Clearly, wasting money is one of the most creative things man does.

Our government wastes roughly $2 million per hour in Vietnam, $250 million on a useless census, and spends $583 million per year to administer forests that used to administer themselves for free. Are these people jerks? Nonsense! To go through money at that rate takes brilliance, imagination, big thinking, and, most of all, nerve.

Dr. Grosch's own National Bureau of Standards, has an annual budget of $36 million per year. Think of it. $36 million!!! Frittered away on such urgently needed things as Omnitab Compilers and measurements of thermal conductivities of potatoes. Pure genuis.

In fact, programmers are not professionals. Programming is not a profession anymore than canoeing, first aid, or swimming. It's more like a merit badge.

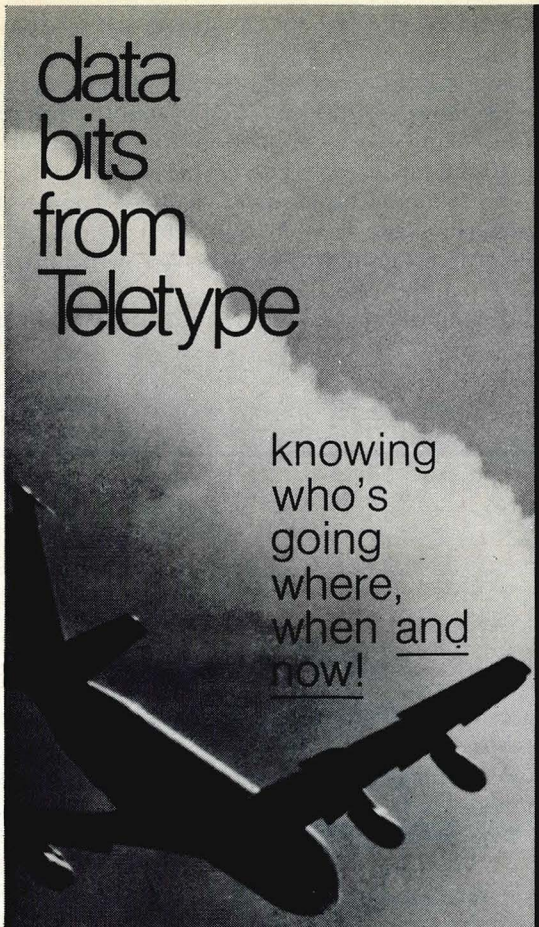
Because of a temporary shortage, the market has ascribed a very high value to programmers. We now have a situation in which translation from English to Fortran costs 50% more than translation from English to Chinese.

The programmer, because of his inflated salary, is expected to act like a professional even though he may have learned his trade in only a few months.

Calling programmers jerks and blaming our condition as a very ex-glamour industry on them is a pointless evasion of responsibility. The failures that have mattered have been the conceptual ones. When computer centers exist only to serve status, it is no wonder that programmers find ways to use up machine time. (After all, computers play solitaire for the same reason people do: they are bored.) When Mystical Information Systems are built by non-managers to help bad managers manage, it is no wonder that failure results.

Our industry must come to grips with the same hard problems of management, economy, cost justification, and control that all industries have to face. And when money is wasted, in the last analysis, the biggest jerk is the one that pays. ▲

data bits from Teletype



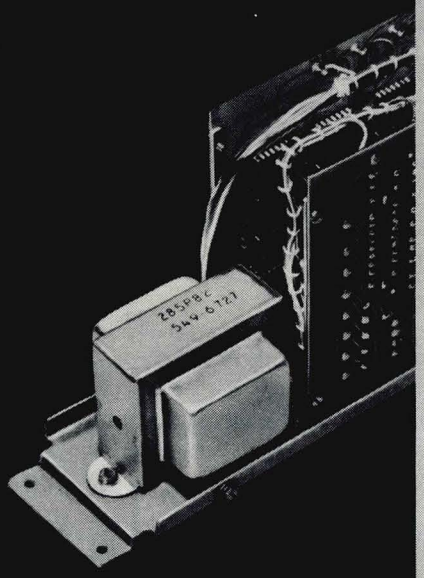
knowing who's going where, when and now!

Maintaining a passenger flight manifest is a vital part of airline operations. And highly complex. One carrier, that deals with hundreds of flights and some 25,000 people daily, recently reduced some of the problems involved by integrating high-speed Teletype® equipment into its system.

Computerized manifest data, compiled in the airline's central office, is sent to departing terminals two hours prior to each flight. It's used in a variety of ways: As a boarding checklist. In computing aircraft weights and balances. For meal details. To meet special requests for wheelchairs, etc.

At the time of departure, "no show" passengers are deleted from the manifest, standby names on board are added, and the list resubmitted via Teletype equipment to central office computer for updating. The computer then generates the "official" manifest and sends it to both departure and arrival terminals involved, at 1050 wpm. The send-receive operation usually is complete before the flight gets into the air.

Teletype's Stuntronic™, electronic selective calling station controllers, also helped reduce computer port requirements of this system by 90%.



keeping a multistation network under control

Teletype has a simple solid-state logic device that provides a truly practical and economical way of establishing automatic control over multi-terminal data systems. The Stuntronic™ station controller is what it's called.

This helpful accessory provides station interface, control, and response for all ASCII compatible Teletype data terminals. Can be used with model 33, model 35, model 37, Telespeed™ and Inktronic® equipment. It will recognize all incoming station signals and respond to its own address characters.

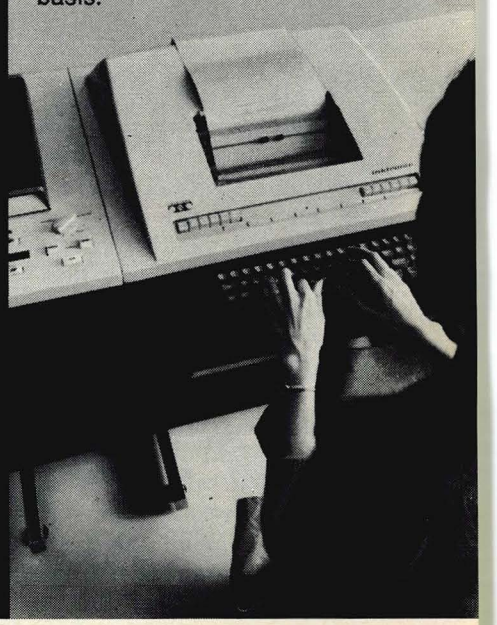
More than 100 different control arrangements are possible with the Stuntronic station controller — including detecting vertical parity errors and establishing computer communication and intra-circuit communication among a variety of system terminals.

total on-line time: divide by twelve

If you have a number of low-speed terminals in your time-sharing system that generate heavy loads of on-line time, it may pay dividends to do the above arithmetic. The Teletype Inktronic terminal is about twelve times faster.

This electronic, solid-state terminal will generate 128 ASCII combinations. Print 93 alphanumerics in upper and lower case. It achieves 1200 wpm printing capability. Charged ink droplets are drawn to the page through a series of electrodes that form the character called for. The ink supply and guidance system has only one moving part. So the Inktronic terminal requires little maintenance. And it's really quiet.

It has more than on-line operational economy, too. Uses ordinary teleprinter paper. And inexpensive ink. Like most equipment in the Teletype line, you won't find a more capable terminal on a price/performance basis.



on track with 80,000 cars

Numbers: important in every business. But, no one has to contend with more of them than a railroad. Keeping the digits straight that identify rolling stock alone, staggers the imagination. These numbers represent big money to railroad and customers alike.

One major railroad uses over 500 high and low speed Teletype terminals in its system to provide the type of car utilization that means business and profitable operation. The terminals are linked to a computer by communications channels.

The Teletype equipment has parity error detection capabilities. Important in keeping the identity and location of over 80,000 cars straight. Teletype solid-state terminal logic permits the computer to poll stations and terminals to respond automatically.

Data generated includes immediate car availability, projected car availability in 1 to 3 days, condition of cars, what type of goods each can handle. Locomotive power available. Enabling the railroad to provide shipper customers the equipment they need for loading, when needed. The data system handles over 30 million data bits daily.

recommended reading

Teletype has a number of brochures on equipment, applications, and case history data. A short description of what is available is contained in: "How to get answers to your questions about Teletype equipment." Write for your copy.

Teletype data communication equipment is available in send-receive capabilities of up to 2400 words per minute. Included are hard-copy, magnetic-tape and paper-tape terminals, error control devices, options and accessory equipment to fit most data communication system requirements. For information write:

TELETYPE CORPORATION
Dept. 40-13, 5555 Touhy Ave., Skokie, Ill. 60076
machines that make data move
Teletype is a trademark registered in the U.S. Pat. Office

CIRCLE NO. 33 ON INQUIRY CARD

THURBER J. MOFFETT, Mgr., Interactive Graphic Systems ■ TRW Systems Group, Redondo Beach, California

ON-LINE

BOOB TUBE GRAPHICS

On-Line is a regular monthly column concerned with various developments in computer technology particularly in the areas of computer graphics and computer-aided design. The author, Thurber J. Moffett, is a nationally-recognized expert in interactive graphic systems. Readers are invited to submit comments and questions regarding subjects covered in this column to: **On-Line, MODERN DATA, 3 Lockland Avenue, Framingham, Mass. 01701**

When it isn't convenient to have a console on-hand, promoters of computer graphic systems often say, "It's something like TV," when trying to explain to a potential user what the system looks like and does. To the guy trying to understand conversational graphic computing for the first time, this comparison is ample enough. But to those really smitten with graphics and who try their hand at it, the similarities between computer graphics and TV soon fall short on substance. Graphics hardware isn't much like TV hardware at all, particularly in price.

The idea sounds good, though. Why **can't** a graphic terminal be made the way TV sets are, i.e., for a few hundred rather than a few thousand bucks and with gray scale or color thrown in? This question, it develops, has been receiving some real attention of late.

IBM's Federal Systems Division has now developed digital television (DTV) – a computer display technology using industrial grade television monitors. Digital images have high resolution, uniform intensity, and inherent relative accuracy. Alphanumeric and graphic data can be mixed with pictorial data from a television camera, either closed circuit or broadcast. The image can be black-on-white, white-on-black, or in color. The viewing screen can be split – a television picture and computer data side-by-side. Since the hardware is commercial, reliability is high and maintenance relatively easy.

DTV is a high-speed digital system that converts alphanumeric or graphic information from a computer into video signals that drive television monitors.

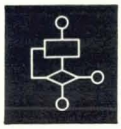
A full alphanumeric/graphic system has five subsystems. The **control subsystem** interfaces with the CPU or communication unit. It contains the logic and timing for the display system. Keyboards and cursors are interfaced to the CPU for data entry. The **symbol generator** receives computer-coded characters from the control subsystem. It retrieves the appropriate symbol format from a self-contained memory and transfers them to the digital raster store. The **vector generator** is a special arithmetic unit designed to calculate, point-by-point, the display elements comprising the best approximation of a straight line connecting the end points of the vector. The **digital raster store** is a core memory. Each element of the picture tube is associated with a core in the raster store. Information from the symbol generator sets cores, ones or zeros, indicating lighted or dark picture elements. This "core map" is read out in a television format and transferred to the **refresh buffer**, which is a fixed head, digital disk rotating at 30 rps (matching the TV frame rate).

The console is equipped with a keyboard and cursor controls – joystick, stiff stick, or direction keys. Black and white screens are from 8 to 27 inches and color screens range from 14 to 25 inches. Resolution levels are from 525-line to 945-line. Addressable elements are the controllable discrete points on the face of the tube. In the 525-line system, 480 vertical and 640 horizontal elements are used, yielding about 300K points. 840 vertical and horizontal elements are used in the 945-line system for a total of 700K points.

DTV is now available to System 360 interfacing directly into either a multiplexer or selector channel, or by communication lines. IBM states that device support access method and diagnostic routines may be provided with the operating system and hardware configuration, and that application software support must be the subject of a separate specification or user-supplied. A wide range of applications is suggested by IBM, encompassing message switching, CAI, CAD, MIS, process control, command and control, and signal analysis.

I wonder what they do about the commercials? ▲

DAVID G. HAMMEL, Systems Consultant • Raytheon Co., Bedford, Mass.



CONFERENCE REPORT

INTERDISCIPLINARY CONFERENCE ON MULTIPLE-ACCESS COMPUTER NETWORKS

EDITOR'S NOTE: The Interdisciplinary Conference on Multiple-Access Computer Networks, sponsored jointly by MITRE Corp. and the Univ. of Texas at Austin, was held at the Univ. of Texas on April 20, 21, 22, 1970. The theme of the conference was to expand upon the inter-relationship of computers and communications and to examine the impact of multiple-access computer networks on society. This report summaries the key ideas discussed at this conference.

The multiple-access computer network to the user represents computing efficiency through the sharing of hardware, software, and personnel. If a remote user can be serviced in a manner that is indistinguishable from the service rendered at a computer installation, he can realize the full power of a large-scale computer complex at costs that can make computer ownership impractical and/or uneconomical.

To those with mutual interests, the network affords an effective means to communicate remotely and dynamically integrate dispersed activities. The network's ability to shorten significantly the turn-around-time allows the user to react to changing problem factors quickly and thereby produce cost savings.

INTERDEPENDENCE OF COMPUTERS AND COMMUNICATIONS

The successful optimization of a multiple-access computer network requires the integration of computer and communication systems to best meet user needs. This task is complicated by the fact that computers are capable of handling many communication functions, such as store-and-forward message switching, multiplexing, and message concentration; and that communication networks employ digital equipments that are capable of handling many data processing functions.

At present, communication carriers are regulated monopolies and they are restricted from providing data processing services. On the other hand, computer companies are unregulated and several of them are attempting to diversify into microwave communications. In order to resolve the situation, the FCC has adopted a tentative decision as of April 1, 1970—Docket Number 16979.

PRIVACY AND PROTECTION

On the subject of privacy and protection, it was concluded that there is no way to verify completely network hardware, and that software proves to be too complex to examine all avenues of security. Given sufficient funds and time any security can be broken. The problem is to determine the cost factor that should be attached to realizing privacy.

TECHNOLOGICAL ADVANCEMENTS

Communication facilities will expand significantly in the next ten years. It is estimated that the present communication network will be one-half of that in existence by 1974 and one-sixth of that in existence by 1981. The developments of economical wide band two-way communications and satellite communications will have great impact on the growth of computer networks.

As digital logic costs decrease, computers will be developed with greater emphasis given to satisfying the needs of language designers. Languages will embody fewer restrictions, making them easier to learn and use. There will also be more standardization of languages and system primitives to facilitate communications within heterogeneous networks.

With lower cost hardware, more logic will be designed into network terminals to afford greater manipulation of data. This will reduce both systems response time and the communications load to a network node. One of the more important aspects of terminal design will be the establishment of more effective information-gathering techniques.

NETWORK TRENDS

The multiple-access computer networks will become the dominant form of computer usage. In 1969 there were 156 companies offering time-shared services and they grossed about 75 million dollars. In 1975 the participating companies may not increase in number, but it is estimated that the gross income will approach 2 billion dollars.

Computer networks will become more specialized. There will be a growing market for single-application time-shared systems as typified by banking, manufacturing, distribution, financial, retail, and special service industries. These special systems will grow at a rate of 35% per year over the next 5 years. At the same time, the data processor growth rate for all applications is expected to be 10-15%.

SOURCE DATA AUTOMATION

KEYBOARD-TO-TAPE DATA ENTRY DEVICES

What do you envision when someone mentions keyboard-to-tape? Probably a "keypunch-like" device which records data on magnetic tape. Maybe a little bit faster because it replaces punched cards with magnetic tape, but essentially a "more electrical/less mechanical" keypunch. You're describing the basic features of original keyboard-to-magnetic-tape devices which today constitute only the tip of the proverbial iceberg of keyboard-to-tape (KBT) varieties available.

All keyboard-to-tape keypunch replacements can be divided into two basic categories: "free-standing keystations," and data entry systems for "central collection and control." The keystations in the latter systems cannot stand alone. They must be connected via either cable or communications facilities to a central control. Certain KBT options, such as data communications and computer interfaces, create some overlap between the two categories.

SOURCE DATA AUTOMATION is a monthly column provided by Lawrence A. Feidelman and the staff of **FAIM Information Services Inc.** This month's column was written by Bennett Landsman, a senior systems analyst with FAIM. Questions from readers on any aspect of SDA will be answered as space permits. Address questions to: **SDA, MODERN DATA, 3 Lockland Ave., Framingham, Mass. 01701**

FREE-STANDING KEYSTATIONS

Free-standing keystations contain both their own control logic and their own collection medium. The collecting medium generally used is magnetic tape, both computer compatible and cassette. The magnetic tape drive may be either continuous or incremental. Over 70% of the current KBT market uses continuous drive KBT equipment. Continuous drive devices enter data in three basic steps, illustrated in Fig. 1.

Incremental tape devices record each data character on tape as it is keyed in. This provides for truly variable length records. However, error correction and data edit software requirements are more difficult than with continuous tape (i.e., fixed record length) KBT equipment.

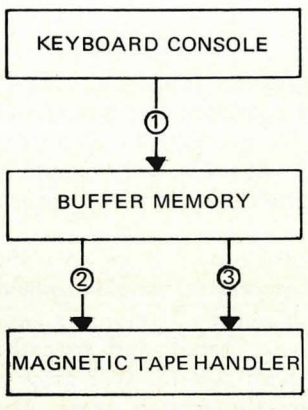


Fig. 1 Data entry flow for continuous drive KBT device. Step. 1. Data is keyed into a buffer memory. Corrections can be made by backspacing and overkeying the desired character or characters. (An error made with keypunch equipment would require punching a new card.) **Step 2.** The data record, upon either automatic or manual record release, is written on tape. It is also still in the buffer memory. **Step 3.** This involves backspacing the tape, reading the record just written, and comparing it with the data in the buffer memory (read-after-write check). This is done to verify that the data keyed in has been correctly recorded on tape.

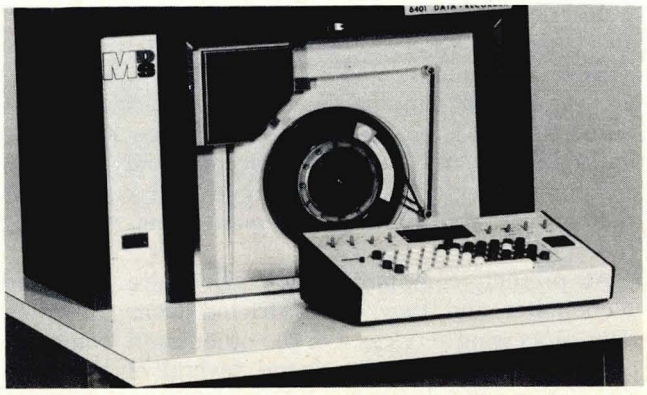


Fig. 2 Free-standing keyboard-to-computer-compatible magnetic tape keystation. (Mohawk Data Systems Model 6401.)

There are two basic types of keystations in the free-standing category. One is the direct key-to-computer-compatible tape keypunch replacement device whose keyboard generally conforms to that of an IBM 029 keypunch. Fig. 2 illustrates this type of KBT. The

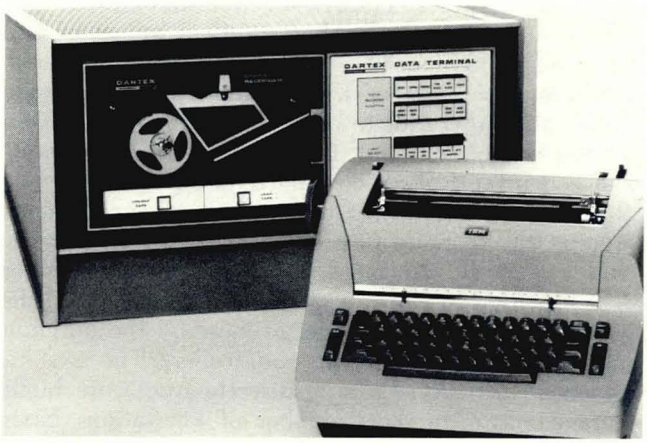


Fig. 3 Free-standing typewriter/cassette system (IBM Selectric and Talley Corp. "Dartex" terminal.

Fig. 4 Central collection and control key-to-disk-to-tape system. (Logic Corp. LC-720.)

other type of free-standing keystation consists of an electric typewriter (e.g., IBM Selectric) which records data concurrently on both paper and a magnetic tape cassette. This device type, shown in Fig. 3, generally offers a communications interface option. A typical application for this type of device is in a branch sales office. Every evening (to take advantage of lower communication line rates), the data collected during the day can be transmitted to the main office The receiver is either a cassette-to-computer-compatible magnetic tape converter or a small computer. The data can then be processed. Reports can be transmitted back to the branch office in a similar fashion.

CENTRAL COLLECTION AND CONTROL DATA ENTRY SYSTEMS

The second category of keyboard-to-tape devices, the central collection and control equipments, are relatively new entries in the data entry field. Each individual keystation contains a minimum amount of logic and independent buffer storage. It is connected by either cable or communications interface to a central control unit, which is either a hardwired controller or a small computer. The final collection medium is computer-compatible magnetic tape, with most systems utilizing a disk for intermediate buffer stor-

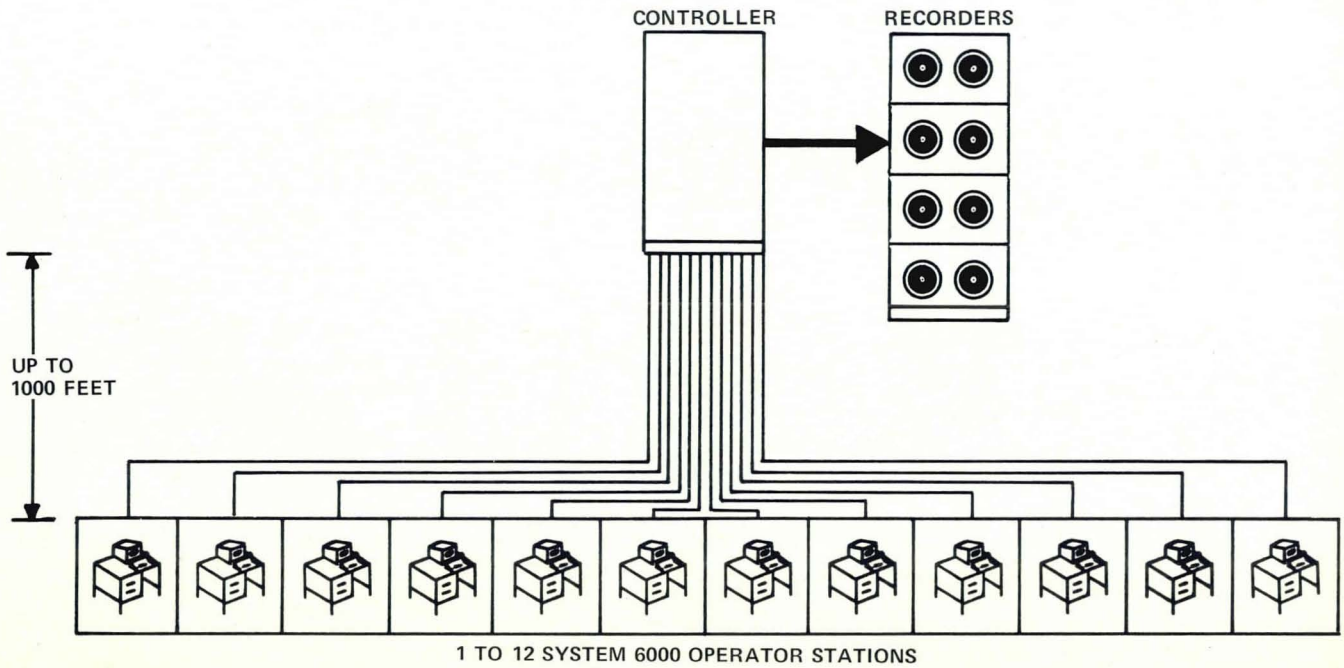


Fig. 5 Central collection and control multiple recorder system. (Sanders System 6000.)

age. Data records are accumulated, verified, and even batched on disk before being transferred, under supervisor control, to a computer-compatible magnetic tape unit. An example of this type of unit is shown in Fig. 4. Another type of central collection and control KBT device automates the pooling problem by use of multiple magnetic tapes as the central point collection medium. This type of KBT is shown in Fig. 5, and allows the supervisor to direct the output of any keystation to any tape unit. In addition, several operators can concurrently be recording data on the same tape, thus eliminating any further pooling requirements. Again, this is made possible through the use of the buffer memory associated with the central controller, which is used to alleviate data input timing problems.

There are differing points of view on the optimum number of keystations per controller. The systems which go to magnetic tape directly from core buffer storage maximize their number of keystations based on keying, memory, and tape speeds. Those systems utilizing a disk for intermediate storage appear to rationalize their maximum allowed sizes on reliability vs. cost considerations. That is, if the system only provides eight keystations per control unit, only eight keystations go down with a central controller failure. On the other hand, systems which provide for a large number of keystations (e.g., sixty-four) are more economical, since the cost per keystation drops as the central collection and the control unit cost is spread over more stations.

Many options are available with KBT equipment. These include communications and computer interfaces, CRT displays, extensive editing/formatting features, etc. A word of caution: one should talk with present users of the equipment under consideration to verify that the equipment exists and is reliable. Unfortunately, at this stage of development, some announced devices are still "paper tigers."

CONCLUSION AND PREVIEW

The most difficult problem after a decision has been made to choose an SDA device for your data entry needs is to make the actual choice of device among the myriad of device types available. The first step in the process is to choose the actual device class, that is, key-to-tape, optical reader, magnetic reader, portable data recorder, etc. This can be done usually by considering the general characteristics of each device class in light of the data entry application characteristics (i.e., the type of application, data volumes, verification and checking requirements, etc.). Once the device class is chosen, then the actual device type and device within that class must be selected. Throughout both these levels of selection, economic considerations are of vital importance. The next few columns in this series on Source Data Automation will discuss the relative economics of key-to-tape and optical character recognition equipment. ▲

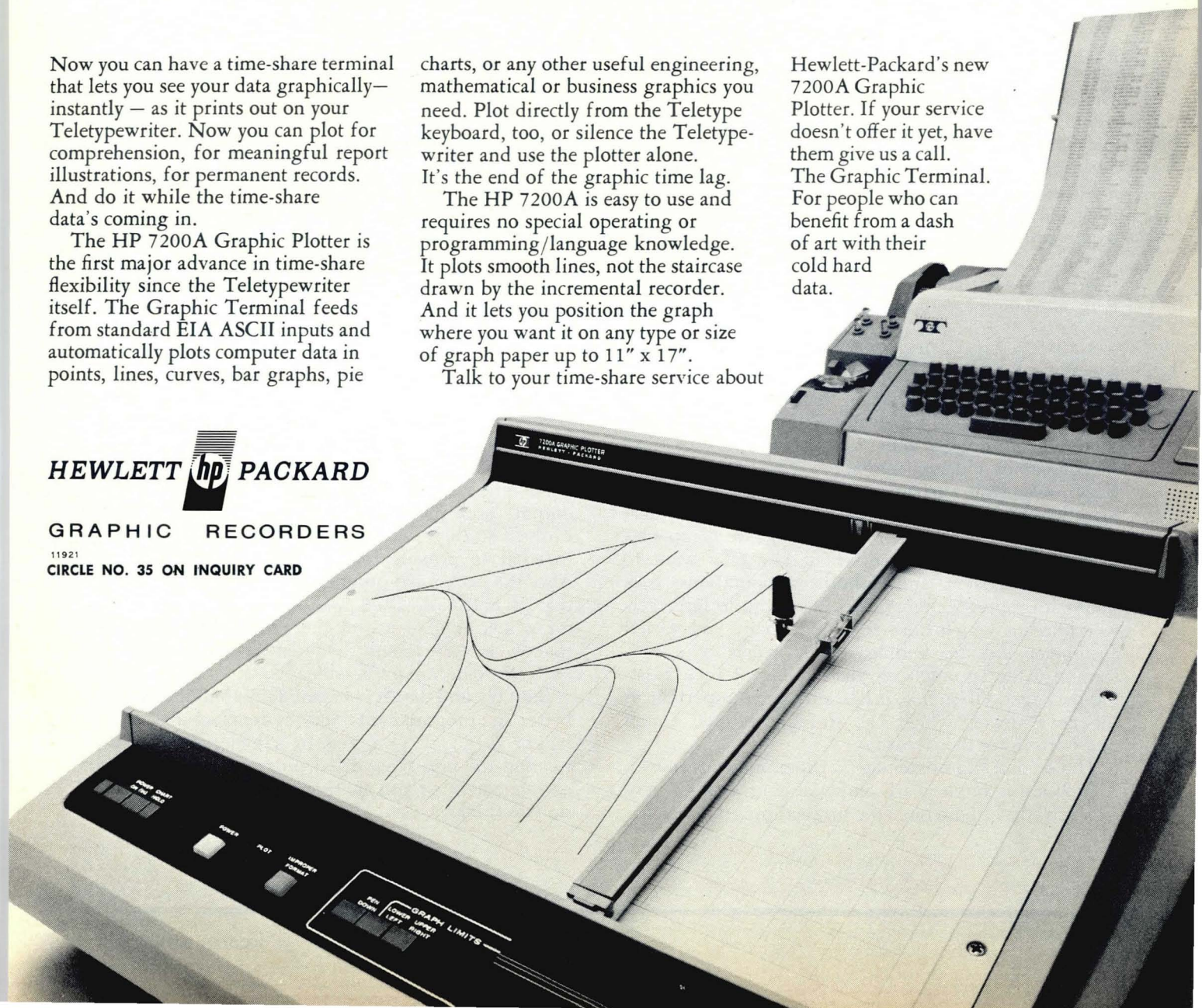
Draw your own conclusions with this new time-share terminal.

Now you can have a time-share terminal that lets you see your data graphically—instantly — as it prints out on your Teletypewriter. Now you can plot for comprehension, for meaningful report illustrations, for permanent records. And do it while the time-share data's coming in.

The HP 7200A Graphic Plotter is the first major advance in time-share flexibility since the Teletypewriter itself. The Graphic Terminal feeds from standard EIA ASCII inputs and automatically plots computer data in points, lines, curves, bar graphs, pie charts, or any other useful engineering, mathematical or business graphics you need. Plot directly from the Teletype keyboard, too, or silence the Teletypewriter and use the plotter alone. It's the end of the graphic time lag.

The HP 7200A is easy to use and requires no special operating or programming/language knowledge. It plots smooth lines, not the staircase drawn by the incremental recorder. And it lets you position the graph where you want it on any type or size of graph paper up to 11" x 17".

Talk to your time-share service about Hewlett-Packard's new 7200A Graphic Plotter. If your service doesn't offer it yet, have them give us a call. The Graphic Terminal. For people who can benefit from a dash of art with their cold hard data.



HEWLETT hp PACKARD

GRAPHIC RECORDERS

11921

CIRCLE NO. 35 ON INQUIRY CARD

SOFTWARE FORUM

SHOULD ALL PROGRAMS BE GENERALIZED PROGRAMS?

Software Forum is a regular monthly column written by Ken Falor and the staff of **Cullinane Corporation** exclusively for MODERN DATA. Questions from readers on any aspect of software will be answered, as space permits, in this column. Address all questions to: **Software Forum, MODERN DATA, 3 Lockland Avenue, Framingham, Mass. 01701**

A pretty good case can be made that almost all programs should be generalized programs, and that the generalized way to write is the right way to write. General program writing is, to summarize: 1) *the design of a program so that it incorporates many reports and input options, multiple processing alternatives, and simple, modular interfaces for other options and modifications;* 2) *the establishment of the data base with general-purpose numeric and alphanumeric fields whose utilization and purpose may be established by the user;* 3) *the writing of the program in a clear main-chain-plus-subroutine fashion, well commented with meaningful data and procedure names;* 4) *written in as restricted a form of Cobol or Fortran as possible; and* 5) *well-written and well-organized i.e.,* **meaningful** *documentation.*

The advantages of having only generalized programs around would be several. The foremost is transferability. This is becoming more and more important as companies change computers (or operating systems), even from the same manufacturer. Their heavy investment in progams should be protected. It is also becoming more and more important to companies looking forward to a time when they may want to centralize division and subsidiary operations with minimum reprogramming. It is important to large service bureaus which have to service many and varied customers and are finding it costly and time consuming to do so much reprogramming of their existing packages. Of course, it has long been important to the government, which has strongly pushed Cobol and Fortran for these reasons.

The second big advantage is programmer turnover. A program is often nearly impossible or at least very expensive to fathom once the original programmer has left. And this happens often, as we should hardly need to point out. Generalized programs, because of the coding itself, the heavy documentation that accompanies them, and their flexibility, are easier to understand and to fix.

Economy and run speed are also important advantages. For the service bureau or corporate EDP center, the writing and running of a single generalized program servicing many clients is substantially more economical and faster than writing and running a separate program for each client.

Last, but not least, is the fact that generalized programs have a longer and more versatile life. This is because the program more readily changes to meet a changing organization and external environment (tax laws, for one thing), and is more easily adaptable to sudden acquisitions or expanded responsibilities (consolidations or centralizations of computer power).

Someday, as vice presidents and controllers become more computer-sophisticated, they will be asking some people why they must rewrite or revamp a program when another group they know (perhaps in another division or subsidiary) is still using the same program successfully despite similar changes in requirements. Which group do we want to be in?

What kinds of programs need **not** be generalized? One-shot deals, of course, and short-lived temporary programs (providing they are not the kind of "temporary" programs that lasts forever); self-contained programs, those that have a fixed or simple input and output, like utility programs; and programs that involve a new system area, where varied types of input, output, and processing requirements have not yet evolved so there would exist a lack of information as to what to provide for beyond the existing system. Also, the occasional program requirement for a system that is unusually fixed and seldom changes, and/or for which volume use of the program is planned so that even very minor redundancies or compromises with efficiency are intolerable.

But, by and large, we maintain that it would be better if programmers and systems analysts were taught to do all programs in a generalized fashion, treating the non-generalized program as an exception or refinement of use in special circumstances. What do you think? ▲

WHAT HATH BABBAGE WROUGHT DEPT.

WRITE-ONLY MEMORY

This revolutionary new product (printed verbatim) has been nominated by MODERN DATA *to receive the hallowed "*WHAT HATH BABBAGE WROUGHT*" Award for "Most Significant Computer Advance of* 1970."

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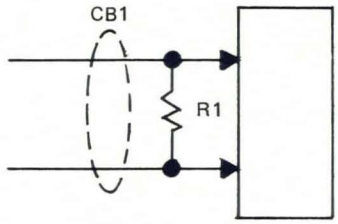


Fig. 1 Two-wire CME configuration

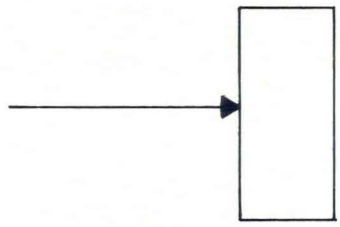
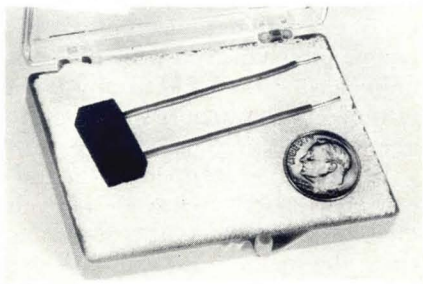


Fig. 2 Single-wire CME configuration



Houston Instrument announces an important new computer memory element (CME). For want of a more descriptive name, the CME is called Write-Only Memory.

The CME accepts digital data in a variety of formats. Data is stored at densities far exceeding those realizable in plated wire and semiconductor memories. Cost per bit of storage is at worst negligible. I/O problems are minimal and greatly simplify the design of even the most exotic hardware and software.

The CME is all solid-state, and may be fabricated from N- or P-channel substrate materials, or perferably from some non-conductive substance such as glass or seasoned wood. Preliminary tests of the Model CME indicate that there may be no correlation between the substance used and the utility of the CME.

The model CME was formed from a block of pine wood (*pinus pacificus*) of approximately 2 cc. volume. First tests were run on the two wire configuration (Fig. 1). Parallel data was serialized using conventional techniques and shifted into the CME bit serially at what can be described as a random rate (average). The two-wire configuration (Fig. 1) shows little advantage over the single-wire input (Fig. 2) except that R1 was more easily connected to match the most probable characteristic impedance of the connecting cable (CB1). Except for this convention there is little measurable difference between the single- and two-wire input configurations. Later it was determined experimentally that the parallel-to-serial converter could be eliminated by adding as many wires to the input of the CME as there are bit lines on the computer I/O bus.

At this stage not much is known of the various parameters of the CME. Successful operation of the Model CME was achieved by rather inelegant methods with little difficulty. It is probable that the actual usefulness of the CME will prove to be essentially independent of technical considerations in any case. It is known, however, that greater than $2^{3115}-1$ bits can be stored in a CME of about 2 cc. volume as described above. While no overflow or other effects could be observed, bit buckets (BB) or auxiliary CME's (ACME's) constructed similarly to the pilot CME can be provided. No thought has been given to the problems associated with attempting to stack CME's and ACME's.

A preliminary but rather superficial search has been made of the literature in an effort to uncover prior art. Although very little is mentioned, it is probable that at least part of the time much electronic data processing (EDP) data storage devices exhibit some or all of the characteristics of the Write-Only Memory. The commercial possibilities of CME are awesome. The potential for reducing EDP pollution generated by the larger systems in particular suggest that in Write-Only Memory may lie the solution to many ecological, sociological and economic problems.

For further information, contact Houston Instrument, Division of Bausch & Lomb, Inc., 4950 Terminal Avenue, Bellaire, Texas 77401; telephone 713-667-7403; TWX 910-881-5782.

UP THE SYSTEM DOWN-TIME

EDITOR'S NOTE: These comments are a disorganized, rambling treatment of the state-of-the-art, systems organization-wise. No realistic solutions to problems are proposed and the entire situation portrayed probably doesn't bear any similarity to the systems operations in your company or any other company. If you will keep in mind that the author has had many years experience as a Systems Analyst (What is it?) and is totally biased and opinionated, you will probably conclude that his remarks are as far off the mark as any consultant you could hire. He firmly believes that all things are apparently what they appear to be.

Who really is "The User"? We give a lot of lip service to the myth that there is such an individual who presumably orders, approves, and receives benefit from systems work. In reality, it is not unusual for a project leader to finish a job without meeting all the people affected. And if he did, it is unlikely that he could at any point in time get the majority of them to agree to anything reasonable.

It is time we stopped chasing after the "User" who at best is merely someone with whom to share the blame. The real objective is to find out what is in the company's best interest and get as close to that as our abilities and our "users" will permit.

Find the one or two people most affected and get their approval at each significant development step. This in no way mitigates the project leader's responsibility; it hopefully minimizes the chance that he won't get the rug pulled out from under him before he goes on the air.

THE SYSTEM OBJECTIVE

Most systems effort is initiated because the present operations is obviously FUBARB *(No satisfactory translation was available at press-time. "Fouled-Up Beyond All Reasonable Belief" comes close.*—Ed.) and "why doesn't somebody do something"?

Some slob gets told (or volunteers) to go forth and do good; he thereafter gets praise and maybe a little help when he tries to find out what it's all about. Somebody (the project leader or some manager up the line who has half a head on his shoulders) had better say precisely what he expects to get accomplished . . . in writing!

This is a tough job because it requires thinking and so it probably won't get done. So the project leader will wander around costing everybody money while he listens to "reasons" why he really can't change anything. When he finally gets embarrassed or somebody screams at him to do something, he will go into a frenzy of programming and automate the FUBARB system. It then becomes an AFUBARB system, and this process accounts for approximately 92.3% of the business systems which presently litter the American business community. The 92.3% figure coincidently is the same percentage of systems analysts who can tell you all about the significance of the moon-probe system but who can't read a P/L statement for an ice cream parlor. (The figure drops to 86.1% for middle managers.)

OVERALL SYSTEMS PLANNING

This has not been tried by enough companies and consequently there have been more MIS's than hits. The problem seems to be that we can't distinguish between fundamental business functions nor develop a manageable set of projects for automating them even if we could.

A possible solution might be to hire an MIS director and have him serve as the recording secretary for the company president. This is on the theory that the first prerequisite for leadership is that you must know where you're going. The whole idea is offered with grave reservations since it is completely untried.

One certainly can be pointed out: Don't hire an MIS director

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and expect him to develop your plan – you'll simply have to fire him like most other companies have. After all, who wants someone else telling him where to go and how to get there?

PROJECT MANAGEMENT (IF ANY)

Invariably, the project leader is given some people ("Sorry, they were the only ones available.") on a temporary basis and told to get something done. We usually feel so guilty about not being able to tell him exactly what he is to get done that we don't want to further burden him with any administrative responsibilities for his people, such as: who should get promoted or fired, or be re-assigned, or anything.

If the project leader does a good job in spite of our withholding all classical means of employee motivation, we pride ourselves that we did the right thing; if he fails, we prove to ourselves that he couldn't have handled the administrative responsibility anyway. How wise we are. . . .

SYSTEMS MANAGEMENT

The only method anyone has ever discovered for implementing systems has been the systems project approach. Yet in most systems shops one must penetrate downward through multiple layers of titles and organizational elements before he finds anyone with project responsibility. This proves that system men have at least one quality which we actively seek while recruiting them: inventiveness! No wonder company management can't figure out what's going on.

Once we find a project leader who somehow gets things done, we promote him to a more "responsible" position where he will have no further direct project responsibility. If the hapless project leader doesn't work out too well, he remains a project leader because he needs more experience. The only exception to this routine is where the project leader is not a technician. A man who is not a technician is never promotable to a non-technical level in systems organizations. One should not attempt to prove this rule to himself upon its logical merits, but rather observe that it is in effect in most systems organizations.

It is fortunate that the systems promotion system is not flawless. Occasionally we promote incompetent project leaders and get them off the firing line, while passing over good ones and thus allowing them to continue doing projects. No system is perfect.

WANTED: SYSTEMS ANALYST

What is a "Systems Analyst"? As most businessmen know, no one knows. The Systems Analyst might be a computer systems technician, a business trouble-shooter, anything in between, or nothing at all. Positive identification might be easier if we had some of the old titles such as Efficiency Expert. Of course, a title like that couldn't last for long with people feeling as they do about efficiency.

Titles like Business Analyst, Applications Designer, Program Analyst, etc., might save the company some money on recruitment expense. If the company really doesn't know what it wants, it should continue to run want ads for Systems Analysts. That way, the quality of the response will match the quality of the recruiters.

This technique also helps personnel make its quota of interviews and justifies the Systems Manager's position that good people really aren't available.

THE REAL PROBLEM

We periodically read editorials in trade publications about the systems gap and how we have failed to use the tremendous potential of our computers. Admittedly, companies have poured millions into computers, but what is money for if you don't spend it? I would suggest, however, that we Systems Managers and Analysts start a letter campaign to suppress such editorials. Some ambitious vice-president somewhere is going to read one and replace us with businessmen. That would be a blow to our professionalism and leave us without a response at cocktail parties when people ask us what we do. ▲

LIFE INSURANCE FIRMS LOOKING TO OUTSIDE SYSTEMS MANAGEMENT

Life insurance companies are finding that facilities management and computer service organizations can help them reduce the costs of managing their in-house data processing operations.

According to information gathered by the Institute of Life Insurance, almost ten per cent of all plant and equipment expenditures by life insurance companies in 1967 was for data processing equipment. Moreover, the survey predicted, by 1975 life insurance companies would be spending almost thirty per cent on their computer operations.

While this kind of statistic is geared to bring joy to the data processing industry, there is still some gloom on the horizon. Many insurance executives are voicing dissatisfaction with their installations – and their rising cost.

A 1968 study by the management consulting firm McKinsey and Company predicted some of the problems the insurance companies are now facing. "From a profit standpoint," said the report, "computer efforts in all but a few companies are in real trouble. Faster, costlier, more sophisticated hardware; larger and increasingly complex and ingenious applications: these are in evidence everywhere. Less and less in evidence are profitable results. This is the familiar phenomenon of diminishing returns."

What McKinsey had found was that the corporate management strategies had not kept pace with the rapid changes of the data processing industry. Management was still regarding their computer systems as a sort of super clerk that reduced general and administrative expenses; the companies had failed to utilize their data processing capabilities to solve important operating and management problems – the very area where computer technology can be most rewarding.

A growing number of life insurance companies are beginning to recognize the existence of a gap between the computer's potential and its practical achievements. Nevertheless, at present there is a feeling among insurance executives that the profitability ratio is extremely low in their data processing departments. "The problem," according to one insurance executive, "is easily stated: we have not yet refined our general and administrative procedures and therefore our costs have not been reduced. But we are not the only culprit. The computer manufacturers have done a remarkable job of selling us hardware, but a poor job of creating efficiency software."

One insurance company that was determined to cut its data processing costs while improving upon its systems operations is the Pierce National Life Insurance Co. of Los Angeles. Pierce put its system into operation in 1966 at a great expense with the expectation of realizing some benefits in the near future. As costs continued to grow instead of decline, the company decided to re-evaluate its needs and take a new approach toward data processing.

"We figured on an investment of $300,000 to get an information flow system established," says Pierce National president, Ralph Head. "About a year later when we discovered that we had spent $600,000 we became alarmed. We suddenly found ourselves so deeply involved in the computer business that we increased our investment and started selling time on our machines to recover our outlay which ultimately reached $2.5 million – a sum we are now having to write off."

"If I were to sound a warning to life insurance company executives, and I think one is certainly timely, it would be this: Like many other life insurance companies we were motivated to reduce administrative costs. But we had no one but the manufacturer to turn to for advice, and hardware manufacturers are in the business to sell equipment. If originally we had done what we did later – pay for expert outside help – we would have saved a lot of money and avoided some terrible headaches."

For many life insurance companies, one way out of the computer maze is the computer service company. Within the last three years, literally dozens of these service organizations have sprung up offering time-sharing, application programs, operations programs, and facilities management to the harried corporation. The great attractiveness of the computer service industry is its ability to keep pace with advancing computer technology and to retain qualified personnel, whereas corporations often find that their in-house computer departments experience personnel turnover at an astounding rate.

The manpower problem was a major factor in the decision of Southwestern Life Insurance Co. of Dallas to develop a facilities management contract with Electronic Data Systems Corp., despite the fact that Southwestern had been operating a notably successful data center itself for years.

According to William Seay, President of Southwestern Life, "We simply felt that EDS, with its highly-skilled cadre of professionals, could develop an integrated third-generation computer system faster than we could. Hopefully, within 18 months we will have problem-solving applications on stream that will provide an excellent management tool for decision making."

While Electronic Data Systems and companies like them are doing a complete facilities management operation, there is also a new kind of EDP service com-

pany emerging – a service that expands upon the facilities aspects of computerization and aims at the decision-making level. These management service specialty companies are moving ahead in the area of management consulting/computing services.

One such company, Tracor Computing Corp. of Austin, Texas, calls its service "systems management" and one of its "specialty" fields is in life insurance. TCC's concept of systems management is rather basic: presently, most management information systems are simply perpetuated daily cycles of administrative and accounting details – necessary but only a rudimentary task for an integrated computer operation. What is required is information to cover three vital areas of managerial responsibility: long-range planning, quality control, and simulation of the total operation of the company. This insures the company that its computer system is responsive to the needs of management.

One of TCC's clients, Pierce National Life Insurance, is in total agreement with this concept. At the time Pierce and TCC first got together, the insurance company was spending more than $125,000 a month on computer rentals and software packages. Finding that the costs were continuing to rise, Pierce signed a 5-year systems management agreement with TCC that included a facilities management assignment, the installation of a modified consolidated functions plan, the design of a computer feasibility check, and the establishment of a system to simulate customer responses to new policies. Finally, along with the computer operations, TCC provided a management consultant who was a specialist in the life insurance business. This was the key to the systems management approach.

Pierce's response to the new arrangement was highly favorable. According to President Head, the company is now spending $45,000 monthly for its entire operation – a saving of $80,000 a month.

TCC's success with Pierce has been duplicated with the National Western Life Insurance Co., which already had its own management information system before it called in an outside firm. National Western's main problem was in staffing and in finding the programmers who were knowledgeable in the life insurance business. That problem, and others, seem to be well on the way to being solved. "At the onset, we defined our objectives and TCC has gone a long way to working them out," says National Western Vice President L. G. Morris. "The quality of work is so much improved that we are overwhelmed." Morris is also quick to point out that the company is also realizing a saving in expenditures.

While the systems management is not a panacea for all computer problems, many life insurance executives are looking closely at the prospects of retaining a computer service organization to help them out of the maze. For one thing, these service companies are offering life insurance firms the key to greater profitability by cutting their in-house costs. More importantly, the computer service approach is permitting top management of the life insurance company to become more directly involved with the computer system it has installed and making sure that the system is responsive to the needs of the company today and tomorrow. ▲

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EDWARD N. CHASE, Editor • Display Terminals, Carlisle, Mass.

TECHNOLOGY PROFILE

INTERACTIVE CRT DISPLAY TERMINALS

Part 3 - Graphic CRT Terminals

EDITOR'S NOTE: This article is the third in a three-part series which updates the original Technology Profile on CRT Terminals which appeared in the July, August, and September 1968 issues of MODERN DATA. Now out-of-print, the original series generated thousands of requests for reprints and follow-up surveys. The purpose of this updated series of articles is to present background information on the characteristics and uses of interactive CRT display terminals together with a comprehensive listing of companies supplying them. Part 1 of this series (May) discussed the present and future of the terminal market, terminal interfacing techniques and problems, and software requirements. Part 2 (June) covered the hardware characteristics of alphanumeric and limited-graphic terminals, and provided a tabulation of the important characteristics of each terminal now being marketed. This article (Part 3) describes and tabulates terminals with full graphic capability.

The history of the development of graphic CRTs is a varied one, but primarily one of terminals custom-designed for specific computers and particular applications such as military command and control, process control, and engineering design. Only recently have terminals designed to interface to a variety of equipment without custom engineering become popular, and most of these incorporate a minicomputer for local storage and manipulation of the data base. Such minicomputer terminals can be locally or remotely interfaced to a larger time-sharing computer, and can often be expanded to self-contained graphic computers using minicomputer options and peripheral devices.

The third and final part of this CRT survey emphasizes these general-purpose terminals; their characteristics are shown in Table 1. Terminals that are custom-configured, interface only with specific computers, or require semi-custom interfaces are listed in Table 2. These include terminals with direct-memory-access parallel word transfer from the host computer. We have excluded terminals which (as best as we can determine) are no longer being marketed, or are obviously designed for military applications.

TERMINAL TYPES

Graphic terminals belong in one of the three categories described in Part 2 of this series: video, storage tube, or programmed scan. The Corning Data Systems 904 has a CRT that is a variant of the storage tube for its optical projection system: the photochromic glass faceplate will store an image (black on white) for about 15 minutes. Storage tube and programmed scan terminals use either analog or digital (often called incremental) hardware to draw vectors, curves, and characters. With digital logic, the path of a vector or curve between its end points, or the components of a character, are computed and displayed either by closely-spaced dots or by short strokes. With analog logic, only the end points of a vector or curve are required for voltage integrators to define the path. Digital logic is slower and often more expensive than analog logic, but permits accessing

the coordinates of any point along the path of a vector or curve directly. The display method for vectors-analog, digital dot, or digital stroke – is given for each terminal in Table 1.

Programmed scan terminals must continually rewrite the displayed image, and the amount of textual and graphic data that can be displayed at the flicker-free refresh rate is inversely proportional to the time required to draw a single point, vector, curve, or character. Table 1 shows the number of sequential one-inch vectors or sequential characters that each terminal can display in one refresh cycle. This permits comparing terminal display capacities. For storage tube terminals, the time required to write (and store) a single vector or character is given.

POINTERS

Various pointing devices for the input of CRT coordinate positions may be available. The photoelectric light pen (see Fig. 1) sets an indicator when light from the momentarily-glowing phosphor is within its field of view. The item being displayed can, therefore, be detected by the controller, and its coordinates or identifying code transmitted to the interfacing computer. Special tracking patterns can be displayed to follow the movement of the light pen across the screen. The trackball or joystick (see Fig. 2), or one of its variants; and the tablet (Fig. 3), convert position input voltages to digital X and Y coordinates corresponding to the CRT coordinate system. An analog, digital, or software comparison must be made between the ball or stylus position and successive positions of the electron beam as it traces the picture in order to determine the item being selected. Since coordinate input requires no light-sensing, however, these devices can also be used with storage tube terminals. Knobs, dials, and the alphanumeric keyboard are also used for pointing.

Terminals with pointers may enter and display points and vectors without going through the interfacing computer. This ability to construct ob-

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After graduating from Harvard University in 1962, **Edward N. Chase** joined Charles W. Adams Associates, subseuently becoming technical editor of Adams' ***Computer Display Review.*** He is presently employed as a software and display specialist for the Dynamic Processes Branch, Air Force Cambridge Research Laboratories.

EDWARD N. CHASE

WHEN THE KEYCAPS ARE OFF

Keyboard Considerations For Display Terminals

JAMES F. COLLIGAN, Pres. • Control Devices, Inc., Woburn, Mass.

The ability of most keyboards to provide reliable encoding is taken for granted today whether the keyboards use reed switches or some form of solid-state signal generation. Specifications may look the same, but — with an eye to improving display terminals — critical examination of keyboards, both on paper and in person, can pay good dividends. Keyboard touch, for example, is one performance feature that isn't adequately covered by any manufacturer's description of nominal force. Only an operator's touch test can answer that question.

Reliability should be judged on the basis of far more than the number of key closures or the MTBF of components. For example, if several displays or data entry terminals are to be operated at a single location and from a central computer, the input power requirements of the keyboard may be a factor. Keyboard performance specifications may be satisfactory, but they become academic if the keyboard fails to operate because of power line drops. Another point to remember in reviewing specifications is that current draw determines heat generated at the keyboard and can affect operating stability.

Operators can also affect reliability by doing such things as spilling coffee or a cold drink directly on the keyboard, not uncommon with the tremendous number of terminal users today. Or they might discharge static electricity to a keyboard which, in some cases, could affect data entry. Reliability should include dependable encoding even under adverse operating or environmental conditions.

Encoding accuracy may also be affected by interference from such sources as ground loop or power line pickup. Keyboards which provide a high-level DC output (normally 5 volts) overcome this problem. If they do it without amplifiers, they provide economy as well.

Streamlined designs put a premium on keyboard silhouette. Typically, reed switches with their long elements and designs which incorporate diodes or other means of encoding in the keys, do not permit the lowest silhouettes. A design which uses solid-state techniques to couple the signals, and uses standard key components, can keep silhouettes as low as ¾" and may even make it practical to design the entry station into work surfaces directly.

Caveat emptor still applies, for, when the keycaps are off, all keyboards are not the same.

jects is customarily available only in terminals which incorporate a minicomputer controller, but such terminals as the ARDS 100A may optionally provide the feature in hardware. If its make is known, the terminal's minicomputer and its memory characteristics are shown in Table 1.

MINICOMPUTER TERMINALS

Minicomputer terminals can be much more flexible (and expensive) than those controlled only with hardware or firmware. They can decode the

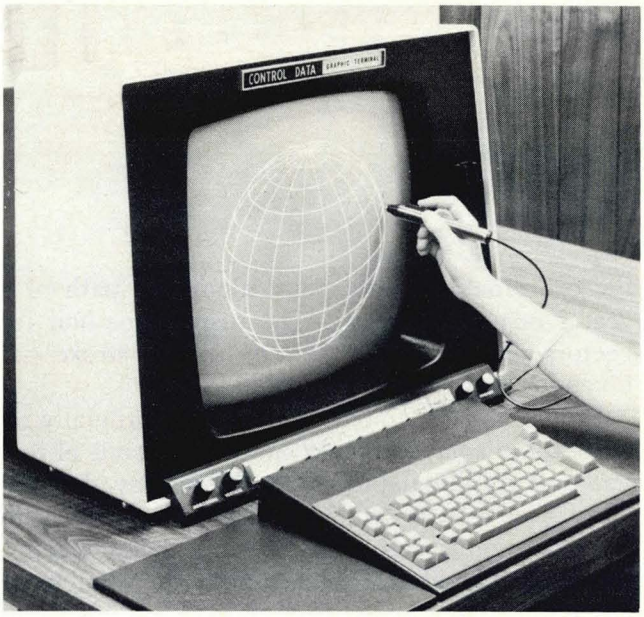


Fig. 1 Light pen in use with Control Data GRID Display

interfacing computer's data structure into the instruction words needed to drive the display, and can similarly construct data structure words from graphical information for transmission to the mainframe. In addition, most have a combination of

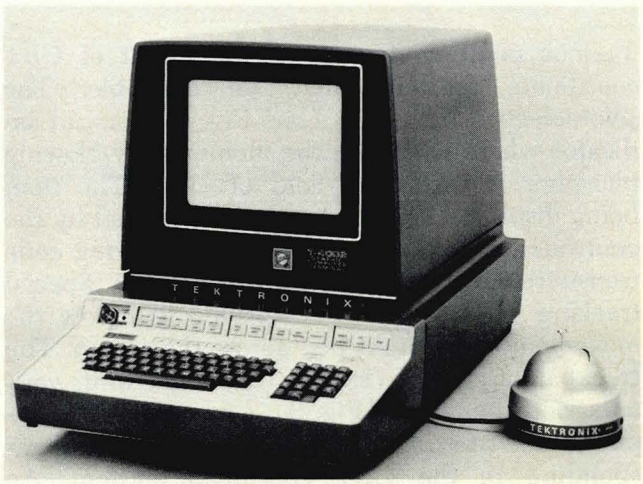


Fig. 2 Tektronic Trackball with T-4002 Terminal

hardware and software that permits view manipulations. These manipulations include scaling and rotating the entire image and graphic elements relative to the image, and windowing the data structure to display only that portion which is within the visible CRT raster (coordinate grid). Information Displays' IDIIOM, Adage's AGT series, and DEC's KV Graphics are sophisticated enough to expand into self-contained graphic systems. However, this expansion requires a considerable software investment and each manufacturer's systems package should be carefully studied to see if it fulfills the intended application.

INSTRUCTION WORDS

The CRT image of a programmed scan minicomputer terminal is usually generated by a display processor that accesses buffered and coded display instruction words from the computer's memory via a direct access channel ("cycle-stealing"). A hypothetical set of such words for a 16-bit machine is given in Fig. 4 to illustrate the nature of the coding of various display functions. Storage tube terminals generally have simple byte-oriented instructions: two bytes for a short vector and control bits, four bytes for a long vector.

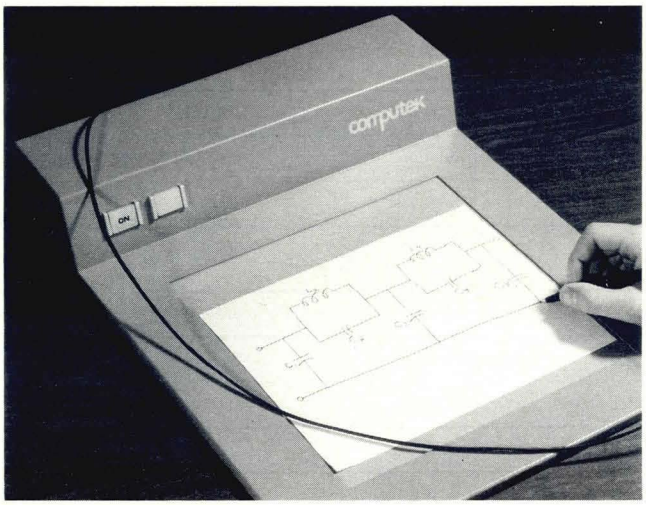


Fig. 3 Computek Tablet

Certain features, if implemented in the display instruction words, can reduce software requirements and enhance display performance. One such feature applicable to buffered displays is the **jump-to-subroutine** instruction, which permits one subpicture subroutine to be accessed many times, with the beam positioned at different places on the CRT for each access. Regardless of whether subroutining is in hardware or is software-simulated, it is effective only if relative vectors (X- and Y-coordinate deltas) rather than absolute vectors (X- and Y-coordinate end-of-vector positions) can be specified. If the subpictures return the beam to its starting point (line AC in Fig. 5) using either relative position or unintensified relative vector, subpictures may be relative to each other to form larger subpictures. If curve-generating hardware is not provided, short vector instructions permit curve approximations with a significant saving in the number of instruction words used. Conversely, if long vectors are not available, several short vectors will be required to draw a long vector whose larger component length exceeds the maximum short vector component.

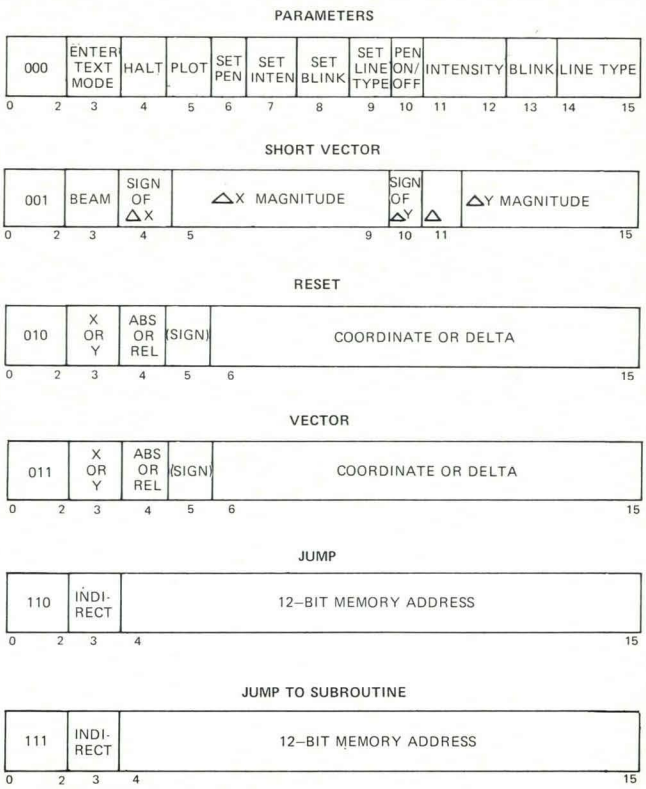


Fig. 4 Illustrative Instruction Words

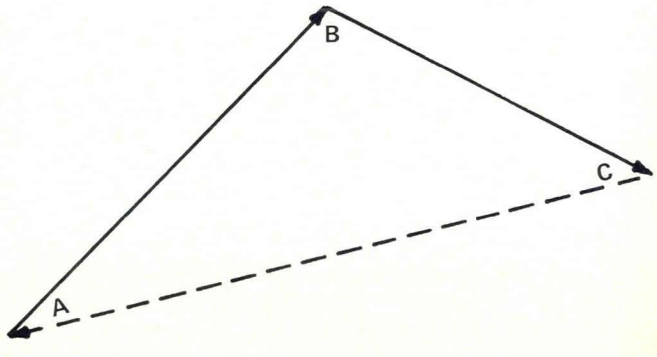


Fig. 5 Closed Subrouting

TABLE 1 • GENERAL-PURPOSE GRAPHIC CRT TERMINALS

Manufacturer	ADAGE			COMPUTEK	
Model	AGT/10	AGT/30	AGT/50	400/10	400/1
Screen Size, In.	12x12	12x12	12x12	8.3x6.4	8.3x6.4
Refresh Rate	40 hz	40 hz	40 hz	storage tube	storage tube
Vectors Per Frame	2940	2940	2940	1.0 msec write time	1.0 msec write time
Characters/Frame	optional 1950	optional 1950	optional 1950	none	0.5 msec write time
Characters Per Line	80	80	80	none	85
Lines of Characters	30	30	30	none	40
Insert By:	line	line	line	N/A	none
Delete By:	line	line	line	N/A	none
Tabulation	yes	yes	yes	N/A	none
Page Roll	no	no	no	N/A	no
Formatting	no	no	no	N/A	no
Pointers	light pen, optional tablet, joystick, trackball & dials	same	same	optional joystick @ $1000, tablet @ $2700	same
Object Construct	yes	yes	yes	no	no
View Manipulations	2D zoom, shift & rotate	3D zoom, shift & rotate	3D zoom, shift & rotate	none	none
Visible Raster	1024x1024	1024x1024	1024x1024	1024x800	1024x800
Positioning Modes	absolute & relative	absolute & relative	absolute & relative	relative	absolute & relative
Vector Modes	absolute & relative	absolute & relative	absolute & relative	relative	absolute & relative
Maximum Component	32768 ru	32768 ru	32768 ru	63 ru	1023 ru
Display Method	analog	analog	analog	analog	analog
Character Codes	64 ASCII, 96 optional	64 ASCII, 96 optional	64 ASCII, 96 optional	N/A	96 ASCII
Character Method	optional stroke	optional stroke	optional stroke	none	analog curve & stroke
Computer	Adage DPR2	Adage DPR 2	Adage DPR2	none	none
Memory	4K 30-bit core, 2.0 usec	8K 30-bit core, 2.0 usec	16K 30-bit core, 2.0 usec	none	none
Phosphor	P7 (white)	P7 (white)	P7 (white)	P1 (green)	P1 (green)
Interface Type	RS232B or parallel	RS232B or parallel	RS232B or parallel	RS232B	RS232B
Duplex Mode	full	full	full	full	full, optional half
Bit Rate	up to 50,000	up to 50,000	up to 50,000	up to 20,000	up to 20,000
Options	8K-32K core, mass storage, slave CRTs, hardcopy, programmable intensity	16K-32K core, mass storage, slave CRTs, hardcopy, 3D clipping	32K core, mass storage, slave CRTs, hardcopy, 3D clipping	vertical CRT, parallel interface, cassettes, slave CRTs	same, plus special symbol generator for up to 230 symbols
Purchase Price	$60,000 (no interface)	$125,000 (no interface)	$175,000 (no interface)	$6,700	$8,400
Monthly Lease	—	—	—	—	—
Remarks	Hybrid computer drives CRT. 2D transformation matrix of view and of any items in view. Upward compatible.	3D transformation with intensity cued to depth. A/D converter on transform array permits decoding complex figures.	Includes hardware for high-speed curves of short vectors & shaded objects. 3D with depth-cued intensity.	Upward compatible. No keyboard. 300 1-inch vectors per second at 1200 bps.	FORTRAN software for graphic & text manipulation by interfacing computer. Nice characters.

NOTE: Purchase prices are for standard terminal configurations (including keyboard and interface) without maintenance. Lease prices include maintenance. See text for a complete explanation of pricing.

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

Manufacturer	COMPUTEK (cont'd)	COMPUTER DISPLAYS	CONTROL DATA	CORNING DATA SYSTEMS	DATA DISC
Model	400/20	ARDS 100A	240	904	6500
Screen Size, In.	8.3x6.4	6.4x8.3	12x12	8.5x11	7x9
Refresh Rate	storage tube	storage tube	50 or 60 hz	photochromic storage	video disc
Vectors Per Frame	1.0 msec write time	2 msec write time	2000 at 50 hz	—	N/A
Characters/Frame	0.5 msec write time	1.2 msec write time	4000 at 50 hz	3.2 msec write time	0.4 msec write time
Characters Per Line	85	80	86	72	85
Lines of Characters	40	50	64	64	51
Insert By:	none	none	—	none	optional line
Delete By:	none	none	—	none	optional line
Tabulation	none	no	—	none	horizontal & vertical
Page Roll	no	no	—	no	no
Formatting	no	no	—	no	optional
Pointers	same	optional mouse @ $395, joystick @ $360	light pen	mouse or joystick @ $350	—
Object Construct	no	optional @ $1295	yes	no	no
View Manipulations	none	none	—	none	N/A
Visible Raster	1024x800	1081x1415	1024x1024	793x1024	512x512 or 256x512
Positioning Modes	absolute & relative	absolute	absolute & relative	relative	absolute
Vector Modes	absolute & relative	relative	absolute & relative	relative	absolute (see REMARKS)
Maximum Component	1023 ru	1023 ru	1023 ru	255 ru	511 ru
Display Method	analog	digital dot	analog	digital	video (see REMARKS)
Character Codes	96 ASCII	94 ASCII	64 ASCII, optional 128	full ASCII	64 ASCII
Character Method	analog curve & stroke	7x9 dot	digital stroke	5x7 dot	5x7 video, 7x10 optional
Computer	none	none	special	none	none
Memory	none	none	4K 12-bit core, 1.2 useq	none	976K-bit disk
Phosphor	P1 (green)	P1 (green)	P31 (green)	N/A	P39 (green)
Interface Type	RS232B	RS232B	RS232B or parallel	RS232B	16-bit parallel
Duplex Mode	full, optional half	half, full & echo	full	half & full	input only
Bit Rate	up to 20,000	1200, optional 50,000	—	110,300 & 1200	—
Options	same as 400/15	cassettes, 1130 interface @ $3300, hardcopy camera @ $274 margin detect @ $280	Unbuffered I/O channel, 8K-12K core	IBM 1130 & 1800 interfaces, paper tape, overlay slide kit	dedicated minicomputer processor, character readback, color multiplex
Purchase Price	$12,400	$8,485	$68,900 (parallel interface)	$19,650	4 units under $27,000
Monthly Lease	—	—	$1,515 (parallel interface)	$820	—
Remarks	Includes analog curve generator using endpoint & slope data. FORTRAN software for specifying curve segments.	30 vectors or 120 characters per second at 1200 bps. 200 vectors or 800 characters per second at 50,000 bps.	Dashed vectors, blink mode & rotated text provided.	Optical system permits nonstoring cursor & slide overlays. Price includes photohardcopy. 82 vectors/sec at 1200 bps.	Multiterminal system; 32 units under $102,000. Hardware writes rectangles, including horizontal & vertical lines.

NOTE: Purchase prices are for standard terminal configurations (including keyboard and interface) without maintenance. Lease prices include maintenance. See text for a complete explanation of pricing.

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

Manufacturer	DIGITAL EQUIPMENT	HENDRIX	IMLAC	INFORMATION DISPLAYS	
Model	KV Graphics	5100	PDS-1	IDIIOM	B1
Screen Size, In.	6.5x8.3	13x11	8x8 (adjustable)	16x12 or 13x13	16x12 or 13x13
Refresh Rate	storage tube	60	40 (adjustable)	30	30
Vectors Per Frame	4.9 msec write time	—	500	1450	1450
Characters/Frame	3.0 msec write time	—	1,040	3300	3300
Characters Per Line	72	100, 80, 60 or 40	128 (adjustable)	128	128
Lines of Characters	56	24, 30, 40 or 60	64 (adjustable)	64	64
Insert By:	line	line & character	line & character	line & character	none
Delete By:	line	line & character	line & character	line & character	none
Tabulation	horizontal	—	horizontal & vertical	horizontal	none
Page Roll	—	yes	optional	—	none
Formatting	no	yes	yes	—	none
Pointers	joystick	—	light pen @ $900	light pen	light pen
Object Construct	yes	no	yes	yes	no
View Manipulations	shift & scale (not dynamic)	N/A	none	shift	none
Visible Raster	800x1024	256x256	2048x2048	1024x1024	1024x1024
Positioning Modes	absolute & relative	absolute	absolute	absolute & relative	absolute & relative
Vector Modes	absolute & relative	absolute	relative	relative	relative
Maximum Component	1023 ru	255 ru	3 ru scalable increments	1023 ru	1023 ru
Display Method	analog	digital stroke	digital stroke	analog	analog
Character Codes	64 ASCII	64 ASCII, 96 optional	96 ASCII, to order	62 ASCII, 96 @ $2700	62 ASCII, 96 @ $2500
Character Method	software	digital stroke	7x9 stroke, others optional	analog	analog
Computer	DEC PDP-8/L	none	Imlac PDS,	Varian 620/i	none
Memory	4K 12-bit core	—	4K 16-bit core, 2.0 usec	4K 16-bit core, 1.8 usec	none
Phosphor	P1 (green)	—	P39 (green)	P31 (green)	P31 (green)
Interface Type	RS232B	RS232B, others optional	RS232B or any other	RS232B, parallel optional	TTL 16-bit parallel
Duplex Mode	half & full	half, full & echo	half, full & echo	full	N/A
Bit Rate	—	2400, higher optional	up to 9600	—	—
Options	any PDP-8/L computer option	drum, disk, magtape, special characters hardcopy, blink, italics, superscript	4K core @ $3800, TTY interface @ $750, paper tape reader interface @ $350	8K core @ $13,720, paper tape reader @ $3,390, photohardcopy @ $43,285, disk @ $23,710, others	monitor @ $11,100, photohardcopy @ $40,000, microfilm @ $30,000
Purchase Price	$20,200	—	$8,845	$95,050	$39,440
Monthly Lease	—	—	$329	$3,485	—
Remarks	Hardware graph, circle & arc generators. Graphic executive software for nested display lists & text editing.	Cursors bracket text to be transmitted.	Software-controlled features permit compatibility with all existing alphanumeric displays, plus graphics.	Includes 4 character sizes, blink, 4 line types, circle & graph generators, function keys with coded overlays.	An IDIIOM without computer. IDI also builds custom displays.

NOTE: Purchase prices are for standard terminal configurations (including keyboard and interface) without maintenance. Lease prices include maintenance. See text for a complete explanation of pricing.

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

Manufacturer	MONITOR DISPLAYS	SANDERS ASSOCIATES	TEKTRONIX	UNIVAC
Model	8100	ADDS/900	T-4002	1557/1558
Screen Size, In.	12x12	14x14 (960 CRT)	8.3x6.5	12x12
Refresh Rate	30 (programmable)	60	storage tube	60
Vectors Per Frame	5,000	4,166	10 msec write time	3300
Characters/Frame	2,000	4,800	.5 msec write time	3300
Characters Per Line	80	112	85	80
Lines of Characters	25	74	39	56
Insert By:	line & character	—	none	—
Delete By:	line & character	—	none	—
Tabulation	horizontal	—	—	—
Page Roll	no	—	none	—
Formatting	no	—	none	—
Pointers	light pen	light pen, optional joystick, trackball, mouse or tablet	joystick @$700	optional light pen
Object Construct	yes	—	none	—
View Manipulations	none	optional shift & rotate N/A		—
Visible Raster	1024x1024	1024x1024	1024x742	1024x1024
Positioning Modes	absolute	absolute & relative	absolute	absolute & relative
Vector Modes	relative	absolute & relative	absolute	absolute & relative
Maximum Component	1023 ru	1023 ru	127 ru	1023 ru
Display Method	analog	analog	analog	digital stroke
Character Codes	64 ASCII	64 ASCII, 96 optional	96 ASCII	64 ASCII
Character Method	digital stroke	digital stroke	7x9 dot	digital stroke
Computer	Varian 620/i	Varian 620/i, others available	none	special
Memory	8K 16-bit core, 1.8 usec	8K 16-bit core, 1.8 & 1.3 usec	none	8K 18-bit core, .7 usec
Phosphor	P31 (green)	P31 (green)	P1 (green)	P31 (green)
Interface Type	optional RS232B	optional RS232B	RS232B or parallel	RS232B or Univac 1108
Duplex Mode	—	—	half & full	—
Bit Rate	up to 40,800	—	—	—
Options	magtape, disk, paper tape reader & punch, plotter, photo hard-copy, second CRT	video mix, conic generator, A/D convertor, 13 & 21-inch CRTs, projection display	PDP-8 interface @ $75 extra, camera @ $400	4K memory
Purchase Price	$65,000	$100,400 (no interface)	$8,800	$126,000
Monthly Lease	—	—	—	$3,640
Remarks	Includes circle & arc generator, 90° ccw characters, 4 line types, display subroutining.	Pushlist display subroutining. Graph mode. Line types & 8-level gray scale. 4 character sizes & italics.	2 character sizes, 4 positions for left margin.	Controller drives 1-3 consoles. 2 intensities & 3 line types.

NOTE: Purchase prices are for standard terminal configurations (including keyboard and interface) without maintenance. Lease prices include maintenance. See text for a complete explanation of pricing.

TABLE 2

SPECIAL-PURPOSE AND SEMI-CUSTOM GRAPHIC CRT TERMINALS

Manufacturer	Model	Interfacing	Priced Under
Control Data	250	CDC 3000 & 6000 series	$140K
Control Data	1744/274	CDC 1700	$90K
Control Data	3344/274	CDC 3300 & 3500	$90K
Digital Equipment	Graphic-15	DEC PDP-15 memory access	$20K
Evans & Sutherland	LDS-1	DEC PDP-9 & PDP-10, or to order	$200K
Information Displays	CM 10000	to order (modular design)	$40K
International Business Machines	2250 Model 1	IBM System/360 series	$120K
International Business Machines	2250 Model 3	IBM System/360 series	$280K
International Business Machines	2250 Model 4	IBM 1130	$120K
Monitor Displays	8190	16-bit parallel to order	$20K
Stromberg-DatagraphiX	1090	parallel to order	—
Systems Engineering Laboratories	816A	SEL 800 series or 16-bit parallel to order	—
Xerox Data Systems	7580	XDS Sigmas 5 & 7 memory port	$50K

TABLE 3 • REFERENCE LITERATURE

For more information on the graphic CRT display terminals described in Tables 1 and 2, circle on the reader inquiry card the manufacturer numbers listed below.

Company	Reader Inquiry Card Number
Adage Inc., Boston, Mass.	240
Computek Inc., Cambridge, Mass.	241
Computer Displays Inc., Waltham, Mass.	242
Control Data Corp., Minneapolis, Minn.	243
Corning Data Systems Inc., Raleigh, N.C.	244
Data Disc Inc., Palo Alto, Cal.	245
Digital Equipment Corp., Maynard, Mass.	246
Evans & Sutherland Computer, Salt Lake City, Utah	247
Hendrix Electronics Inc., Londonderry, N.H.	248
IMLAC Corp., Waltham, Mass.	249
Information Displays Inc., Mount Kisco, N.Y.	250
IBM Corp., White Plains, N.Y.	251
Monitor Displays, Fort Washington, Pa.	252
Sanders Associates Inc., Nashua, N.H.	253
Stromberg-DatagraphiX Inc., San Diego, Cal.	254
Systems Engineering Labs., Ft. Lauderdale, Fla.	255
Tektronic Inc., Beaverton, Ore.	256
UNIVAC (Sperry Rand Corp.), Philadelphia, Pa.	257
Xerox Data Systems, El Segundo, Cal.	258

SPECIAL TERMINALS

There are two terminals with extraordinary features that deserve special mention. The CRTs of the Adage AGT series are driven by a hybrid computer used as a controller. This provides dynamic three-dimensional (two-dimensional in the AGT/10) windowing, translation, and rotation of the image. In addition, intensity is depth-cued intensity to enhance the 3D illusion. The Evans & Sutherland LDS-1 offers similar capabilities with a digital display processor and analog vector-drawing hardware. The LDS-1 also provides both orthogonal and perspective projections. Both displays are designed for highly interactive real-time simulation applications.

PRICING

Terminal purchase prices in Table 1 include the CRT, controller(s), alphanumeric keyboard (if available), input devices not separately priced or listed as optional, and modem or parallel interface. Purchase prices do not include maintenance. Monthly lease prices are for a one-year or the minimum lease period, whichever is greater, and include maintenance.

For more information on the CRT terminals described in this article, refer to the reader inquiry number listed in Table 3.

WANT TO SEE WHAT YOU ARE TALKING ABOUT...
CLEARLY AND IN PERSPECTIVE?

PICTURE LDS-1 IN YOUR PLANT

Combining high speed line display with fast graphic processing, Evans and Sutherland Computer Corporation's Line Drawing System, Model 1, is uniquely capable of displaying very complex objects. It lets you and everyone else see what you are talking about!

The Evans and Sutherland Display Processor is the only link needed between the data base in the main memory and the picture on the scope. The LDS-1 extracts graphic information directly from the data base without costly central processing unit programs. For the first time, you can see the data base in perspective in real time!

LDS-1 performs real-time rotation and translation, real-time perspective presentations, and real-time clipping and scaling required for magnified views without any central processing unit software.

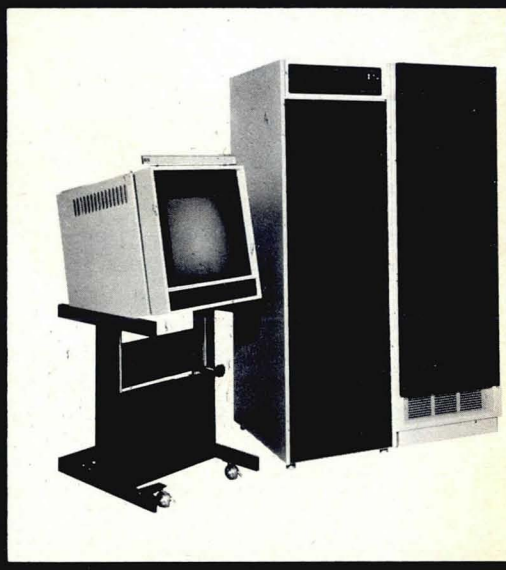
Use of the Evans and Sutherland Line Drawing System, Model 1, with a special hand viewer called the Lorgnette provides detailed displays in stereo and color.

The Evans and Sutherland LDS-1 enables the user to display effective drawing areas of more than an acre and still "zoom" in to examine a 10-inch square without loss of resolution. Clipping can be performed 100 times faster than with software. It displays 2,500 line pictures in 1/30th of a second, but it can process a data base many times larger.

LDS-1 can be used as a subsidiary time-shared processor to drive currently existing remote scopes. It also can be installed on any scientific computer.

We would like you to have the complete picture of our Line Drawing System.

For more information, contact: Evans & Sutherland Computer Corporation, 3 Research Road, Salt Lake City, Utah 84112.



EVANS & SUTHERLAND COMPUTER CORPORATION

CIRCLE NO. 38 ON INQUIRY CARD

Melvin Appelbaum, Sr. Operations Res. Consultant • Pepsico, Inc., New York, New York

SEVEN STEPS TO SIMULATION

Editor's Note: In order to develop the complex but programmable structure we call a "simulation model," we must first simplify an even more complex, "real-world" process. In this article, the author simplifies the process of developing the model.

The *avant garde* of the systems science clique use the term **simulate** to imply the art of mathematical model development. The mathematical model is merely a set of relationships that react and/or interact with a given set of conditions. Exploration of the environment in which the model resides is the quintessence of simulation. It is the model's behavioral responses to directed stimuli in which we are primarily interested. Thus, simulation is a method which places a model in a typical realistic situation and exerts forces that manipulate it by deterministic or probabilistic procedures. The development of a computer simulation model requires the following seven basic steps (see Fig. 1).

1. Problem Definition—The problem must be carefully defined and the proposed solutions outlined. This entails a description of the analyses and criteria necessary to develop and satisfy the experiment's objectives.

2. Simulation Decision—After evaluating the objectives of the problem, it may be found that the proposed solution will incur heavy computer costs and possible failure to reach the desired objectives with any degree of confidence. This may result in a decision not to use a computer simulation until the problem and proposed solutions can be further refined.

3. Data Collection and Reduction—The process of gathering the facts necessary to solve a problem is defined as data collection. The classification and preparation of the information collected is called data reduction. Insufficient data is often the reason simulation models fail. The model's worth is a direct function of its data.

4. Model Development—The mode of the model's behavioral response is accomplished by an appropriate statistical process which the analyst uses to develop functional relationships between a set of carefully analyzed variables. These relationships are bonded by a decision process which determines the degree of the model's complexity and, in turn, is directly related to the programming effort required.

5. Model Evaluation—At this stage of development, the model is tested to ascertain its ability to reach the desired goals and to examine the initial assumptions made in the model development phase. The approach consists of statistically comparing the model's expected responses with historical data. If the variance proves significant, the model is rejected.

6. Simulation Programming—Programming effort begins only after the model has been completely evaluated. The initial phase requires a detailed flow chart describing all mathematical relationships, interactions, logical decision processes, and type of output report generator. Next, code is written in a language most suitable to the problem and to the capability of present or anticipated staff.

Standard general-purpose languages, such as Fortran and Cobol, are highly flexible and easy to master. In addition, they offer compiler availability for almost any system configuration, high compilation speeds, and ease of debugging. Their major disadvantage arises from the complexity of sequencing events within the model. When this complexity becomes excessive, the analyst should consider using a version of one of the recently developed "simulation languages," such as GPSS and Simscript, which are designed specifically to overcome this problem.

His most important criteria for choosing a language, however, will very likely be of an economic

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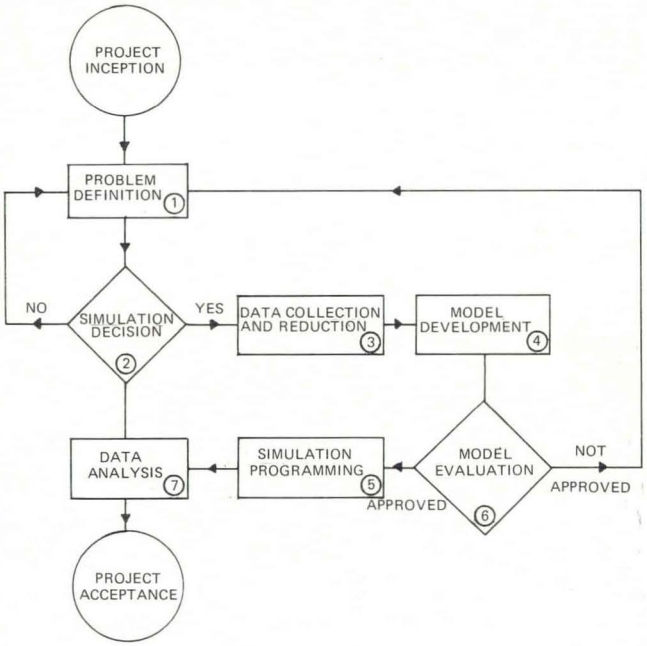

Fig. 1. Simulation Model Development Procedure

nature, and will depend primarily on such conditions as: ▪ complexity of the problem in each language as related to programming time; ▪ the cost and availability of required hardware and software (specifically the computer/compiler); and ▪ the cost and availability of trained personnel.

7. Analyzing the Simulated Data—the last phase of computer simulation—is by far the most complex phase. Except for the fact that the output will be in a time-differenced form (time-series) if the model is dynamic in character, there are at least as many ways to interpret simulated data as there are analysts.

This step is simplified to the degree that the analyst has had an accurate "feel" for the output data at the project's inception. But any extra investment in attempting to predict this data as far back as the problem definition and data collection and reduction phases is risky. On the one hand, the analyst may be repaid by acquiring better insight into desired results and by becoming more alert to extreme (exceptional) cases which might otherwise be overlooked during the development and evaluation phases. (The argument being that the earlier the analyst is aware of his output limits, the more likely he will be to note conditions which would test them.) On the other hand, there is the danger that he will place too much value on preliminary data.

The final analysis, however, is a pragmatic one. Either the system "works" (accurately predicts "real-world" events) or it doesn't. If it does, we accept it. If it doesn't, we have only one alternative: to start over, checking each of the steps we have described. For regardless of the techniques or procedures we incorporate into a simulation model, its method of development remains unchanged. ▲

TECHNOLOGY PROFILE

DIGITAL PLOTTERS

One of the most interesting, but least publicized of the sub-industries that comprise the computer field is the digital plotter business. For years, digital plotters have been utilized in an impressive array of applications, from the manufacture of tiny printed circuit boards to the design of mammoth ships. Still, they have never received the kind of warm love that is offered to minicomputers or even the widespread interest enjoyed by their cousins, the line printers. This article compensates for such neglect and surveys the characteristics and applications of such plotters.

Within this article, a digital plotter will be defined as equipment that accepts digital inputs from computers or from off-line storage media and produces a permanent picture that can be viewed directly without magnification. This definition excludes analog input devices, computer output microfilm devices, and graphic CRT displays — which normally don't produce a permanent record. However, equipment which plots on film and does not involve magnification is included. Teleprinters and line printers that have plotting capabilities, but are not exclusively employed as plotters, will also be omitted.

HISTORY

The development of digital plotters closely parallels the development of the computer. In 1952, an EAI ad read: ". . . This new Dataplotter . . . will automatically plot a cartesian curve composed of incremental points or symbols from IBM card data at maximum machine reading speed." The ad continued: "It will accept data from other inputs—magnetic tape, keyboards, digital computers, etc. . . ." The list of interfaces hasn't changed much over the years, except that the emphasis has shifted away from punched card input to on-line, magnetic tape, and punched paper tape input.

One of the pioneers in the field was California Computer Products (CalComp), which became, and remains, the dominant company in the plotter industry.

The early plotters were basically analog devices that were attached to digital-to-analog converters. By the late 50s, plotters designed specifically for digital data processing had made their appearance. These accepted command information as well as X,Y coordinates in the input stream, making it possible to program an input computer to control the plotter. By 1960, all of the fundamental elements of today's plotting systems — moving plot heads, controllers, input interfaces, software for input computers — had been implemented. Current developments in plotter technology involve improvements in speed and accuracy at a lower cost.

HOW A PLOTTER WORKS

Fig. 1 shows the system configuration of a typical modern-day plotter, the EAI 430. With minor differences, it is identical to the configurations of virtually all digital plotters on the market today. The major differences occur in the types of equipment and software supplied along with the plotter. For example, EAI will supply a magnetic tape transport, a computer interface, and plotter software. Others will offer the computer as part of an integral system: a magnetic tape transport isn't supplied and the interface to the computer is internal to the system. Options might involve paper tape inputs, card inputs, teletypewriter inputs, or communication facility inputs in place of, or in addition to, the magnetic tape transport.

The plotting operation begins with a set of input data to be plotted, expressed as an equation in two or three variables, either as a set of discrete points, or as any other computer-sensible description of the picture to be generated. The input data can also contain alphanumeric information which is used to annotate the picture.

The computer interprets the input data and creates an output sequence of information which is routed either to the plotter through interface circuitry or to an intermediate storage medium for off-line plotting.

When the data arrives at the plotter, it is decoded and the plotting is performed. The input usually consists of coordinate information interleaved with commands such as **Pen Up, Pen Down, Draw a Circle, Draw an Arc, Draw a Straight Line, etc.**

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The coordinate information is expressed as an increment or as an absolute value. Absolute values are expressed with respect to an origin that is established by an operator entry or by a preliminary command. Incremental values are measured from the current plotted point position.

The distinction is important in two ways. In applications where a communication channel is involved in the plotting system, a cumulative effect can be caused by an error in a given plotted point if the incremental method is used. That is, suppose a string of data consists of the points (0, 0), (1, 1), (2, 2), and (3, 3). If these coordinates are transmitted as absolute values, and if the second value is in error because of noise in a communication line, then the plotted sequence might contain the point (9, 9), let's say, instead of (1, 1). The remaining points, (2, 2) and (3, 3), are unaffeced by the error. But if incremental coordinates were used, the correctstring would be (-,-), (1, 1), (1, 1), (1, 1). With the error, the string would be (-,-), (9, 9), (1, 1), (1, 1), and the plotted points are (0, 0), (9, 9), (10, 10), (11, 11), . . . The error affects the entire string following it. Thus, in time-sharing and similar applications, absolute coordinates are used.

On the other hand, the incremental method uses the on-line computer and off-line storage more effectively. For the value (X_2 - X_1), the incremental value is usually much smaller (and occupies less storage) than either X_2 or X_1; the plotter needs no hardware to "remember" the location of the origin so the system is less expensive. Therefore, in cases where interface noise is not a problem the incremental method is used.

When the plotter has some internal read-write storage and an appropriate set of logic, it is possible to specify some kinds of plots with relatively small amounts of data. For example, when plotting a circle, you can specify, point by point, a set of coordinates that the plotter can draw to form the circle. With more advanced logic, which calls for less strain on the input computer, the input specifies the origin of the circle in incremental or absolute coordinates, and the radius; the plotter then draws the circle automatically.

As another example, suppose you want to draw a dotted line. Usually, the input command sequence – whether with absolute or incremental coordinates – will define the path to be drawn, with the (X,Y) information interleaved with alternating **Pen Up** and **Pen Down** commands. Each stroke that makes up the dotted line is defined with a set of inputs. If a more sophisticated plotter is used, the input defines the starting point and the end point (or the direction and magnitude) of the entire line segment, along with a **Dotted Line** command.

PLOTTER SOFTWARE

From the standpoint of the casual user, the central question is, "How much work do I have to do in order to get my data plotted?" There are a variety of answers, depending on the nature of the problem and on the availability of software.

At one end of the spectrum lies the time-sharing environment, in which the user wants to take a quick look at a set of data with an absolute minimum of difficulty. In this situation, the software is simple, and the operation is simple. The user names the set of data, specifies which variable will be X and which will be Y, and presses the "Go" button. The time-sharing computer cranks out the sequence of coordinates and controls the pen. The

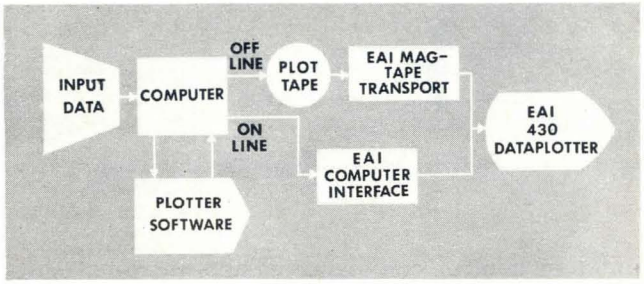


Fig. 1 System Configuration of Electronics Associates Inc. Model 430 Data Plotter

user may find it necessary to generate each point to be plotted, unless he has an algorithm for creating the data or unless the data already exists in a file. The plotter will display everything it receives from the computer, so the user must write programs to filter the data if only a subset of a file is to be plotted.

At the opposite pole, there is the large plotting facility with a huge in-house flatbed or drum-type plotter interfaced with a large-scale computer that has a full complement of software (basic, functional, and application) to support the plotting function.

Basic software generates coordinate information

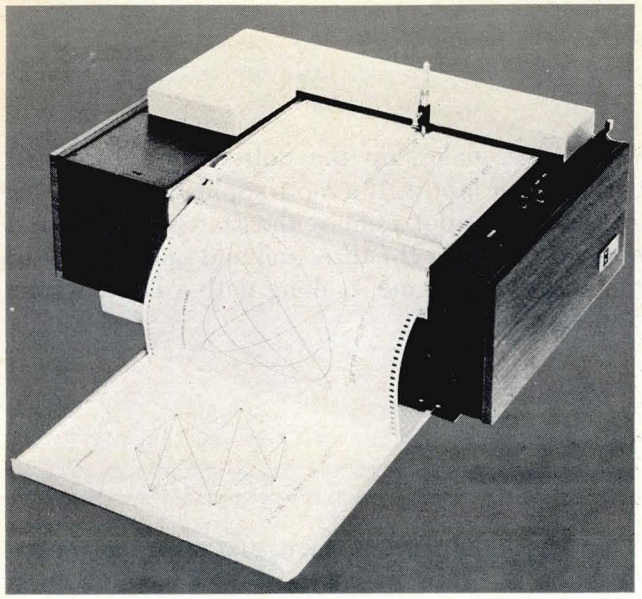


Fig. 2 Zeta Research Model 230 Plotter

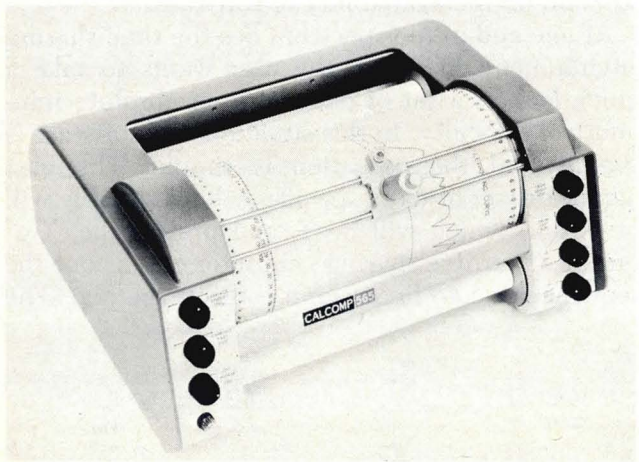


Fig. 3 California Computer Products Model 565 Drum Plotter

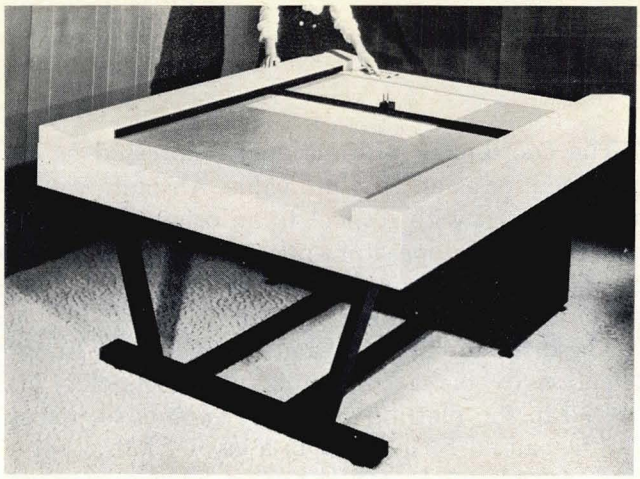


Fig. 4 Computer Graphics Corp. Model DPS-7 Flatbed Plotter

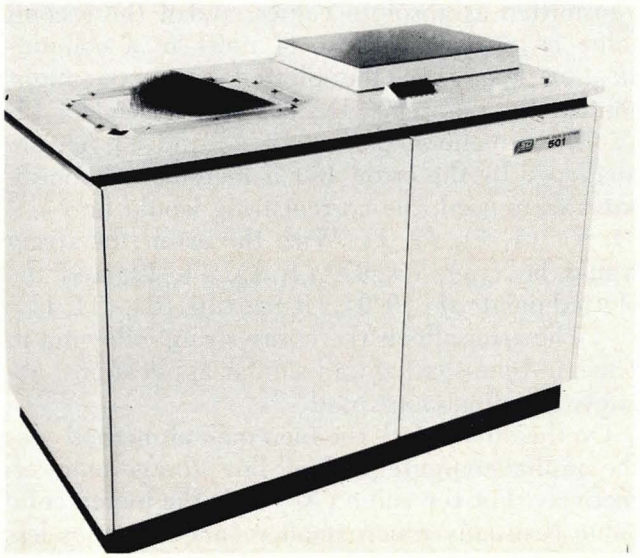


Fig. 5 Spatial Data Systems, Inc. Model 501-3 3-Dimensional Wire Plotter

and pen control commands. The functional software permits the user to specify complete functions, such as arrowheads, dashed lines, and certain geometric shapes, with a few inputs. The application software is used for specific jobs, such as contour mapping. The objective is to reduce the amount of programming required to generate a given plot.

With a large plotting facility, a user can produce an architectural drawing, a printed circuit board master, a computer program flowchart, or a perspective drawing, assisted by application programs. For example, to draw a PERT chart, the user need only to identify the PERT program files to the appropriate application program, and the chart will be produced automatically, completely annotated and ready for analysis. The program controls the plotting completely.

TYPES OF PLOTTERS

Plotters come in a wide variety of shapes, sizes, and flavors. There are the small time-sharing terminals (Fig. 2), the small- to middle-sized drum plotters (Fig. 3), and the small, medium, and large flatbeds (Fig. 4), whose combined capabilities satisfy the requirements of virtually all users. Then there are others like Dresser Systems' LGP-2000 and Xynetics' Model 1000, which offer unusually high plotting speeds and unique plotting techniques; Spatial Data Systems' plotter (Fig. 5), which imbeds steel wires in a board to create an actual 3-dimensional plot; and Auto-trol, which markets a combination drum and flatbed plotter.

Perhaps the clearest notion of the power and versatility of digital plotters may be gained by examining the plots shown in Figs. 6-10.

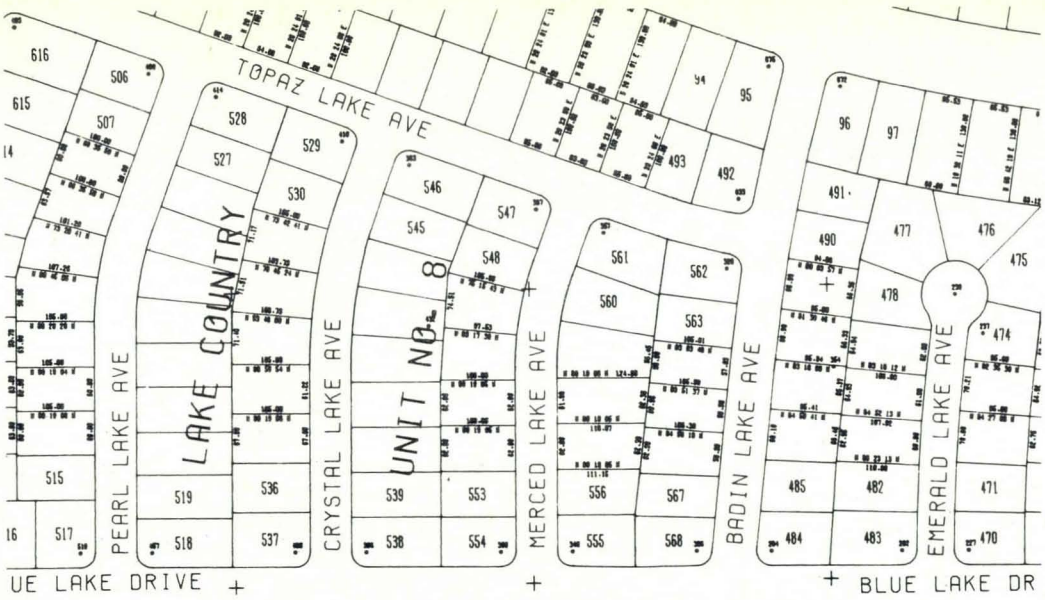


Fig. 6 Real Estate Subdivision Plot (Courtesy of California Computer Products)

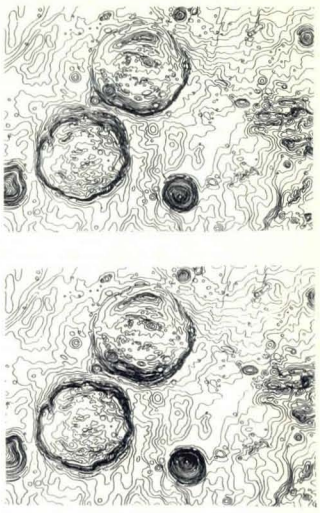


Fig. 7 Stereo Plot of Lunar Surface (Courtesy of California Computer Products)

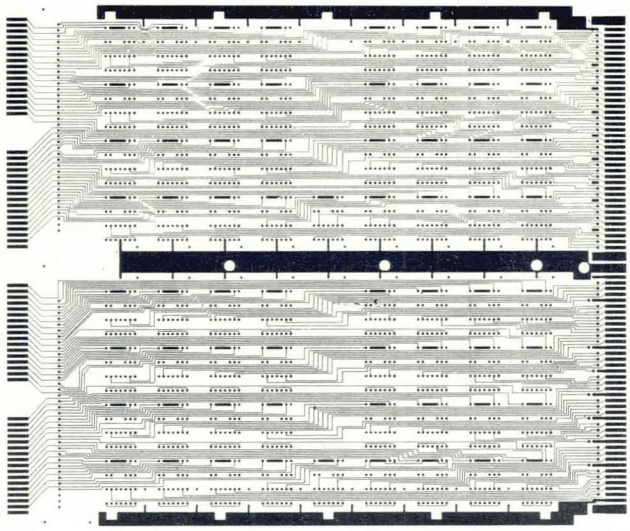


Fig. 8 Printed Circuit Drawing (Courtesy of Gerber Scientific Instrument Corp.)

SELECTING A PLOTTER

The potential user must go through a careful evaluation process in choosing a plotter. First, he must establish that a plotted hardcopy output is absolutely necessary for his application. If his need for graphics is for only a few minutes, he may be better served by a CRT display. When there is a very large file of drawings, and reduction of paperwork is the prime consideration, then a computer output microfilm system should be used.

Once the need for a plotter is established, the evaluator proceeds to consider the type of plotter. This choice is largely constrained by three major factors: cost, the nature of equipment (particularly computers) already available to the user, and plotting volume. Other constraints – the accuracy, resolution, and repeatability of the plotted output – may not be important.

Cost comparisons usually uncover significant price spreads among various systems with apparently similar plotting capabilities. The trick is to find the system that will satisfy all of the user's requirements with the lowest cost of ownership over some period of time (say 5 years), taking labor costs into account when computing the total cost. With man-hours included, the least expensive hardware may not provide the least expensive system when more elegant equipment incorporates labor-saving features.

Cost evaluation should also include maintenance and software. Basic plotter control programs for major manufacturers' computers or for major languages like Fortran are included in plotter prices, but functional and applications software is usually extra. The possibility of leasing must also be considered; not all manufacturers provide it.

In almost all situations, the user will want to limit himself to plotters that can interface with his existing computers. Some plotting systems carry their own computers to get around that problem.

Plotting volume influences the acquisition of an in-house plotter as opposed to the use of a plotting service bureau. These bureaus are available in every section of the country and are the logical choice where the user's plotting load will be relatively light and where the bureau has the capability. If the user can afford the normally slower turnaround time provided by a service bureau, then this can well be the most effective method of plotting. In large organizations, the service bureau may even be able to match or improve the turnaround time that could be realized in-house!

The importance of accuracy, repeatability, and resolution are application-dependent. For plotting

TABLE 1 • DIGITAL PLOTTER CHARACTERISTICS

COMPANY	Arvin Systems	Auto-trol Corp.	Boston Digital Corp.	California Computer Products (CalComp)	
MODEL NO.	1197F2	6030	N/CV 1105; N/CV 2905	502, 602, and 702 Series	618 and 718 Series
APPLICATIONS	Flight Training; Artillery Field Use	Printed Circuit Boards; Highway Cross Sectioning; PERT Charts	Drafting; N/C Verification	See Under Other Features	See Under Other Features
INPUT					
Media	On- or Off-Line	On-Line; Punched Card; Paper Tape; Mag Tape; Keyboard	Paper Tape (300 char./sec)	On-Line Mag Tape (7- or 9-Track)	On-Line Mag Tape (7- or 9-Track)
Data Description	BCD plus sign word	Absolute or Incremental Coordinates (±NN.NNN)	9 Channel EIA Standard Code; ASC II Optional; Word Address, Variable Block; EIA Standard Format	—	—
INTERNAL LOGIC					
Processor	—	Hardwired	—	—	—
Special Functions	—	Dashed and Centerline Drawing; Mirror Image; Rotation; Scaling	Linear Interpolation Circular Optional	—	Automatic Data Manipulation and Parity Checking (900/937/618 and/718)
SOFTWARE	—	—	—	CalComp Basic	CalComp Basic
CHARACTERISTICS					
Dimensions	30" x 30"	40" x 40"; 40" x 60"; 60" x 60"; 11" to 36" wide drum	11" wide drum x 120' (1105) 28.5" wide drum x 120' (2905)	31" x 34"	54" x 72"
Maximum Speed	Plot 10"/sec; Slew 20"/sec	10"/sec	90"/min.	4.2"/sec (502); 3.1"/sec (602); 11.9"/sec (702)	1.4"/sec (618); 4.6"/sec (718)
Accuracy	.05% of full scale	.005"	—	—	—
Repeatability	.01% of full scale	±.001"	—	—	—
Resolution (Step, Increment Size)	—	.0005"	.005"	.002" (502); .001" (602; 702)	.0005"
PRICE	—	$21,400 to $50,000	$16,775 (1105) $20,475 (2905)	—	—
OTHER FEATURES	—	Combination Flatbed and Drum Plotter 62-Character Printer 4 Maintenance Centers	Plotters are CalComp Model 565 (1105) and 563 (2905)	APPLICATIONS: Interactive Design; Drafting; Data Reduction; Real-Time Plotting; N/C Verification; Mapping; Graphing; IC Mask Cutting; Printed Circuit Artwork; Garment Grading CONFIGURATIONS: Controllers and Interfaces for Wide Range of Computers; Remote Interfaces for Terminals or Modems; Mag Tape Drives for Off-Line Operation 33 Maintenance Centers	

TABLE 1 • DIGITAL PLOTTER CHARACTERISTICS (Cont'd.)

COMPANY	California Computer Products (Cont'd.)				
MODEL NO.	728 Series	563 and 565 Series	663 and 665 Series	763 and 765 Series	1136 Series
APPLICATIONS	See Under Other Features	See Under Other Features	See Under Other Features	See Under Other Features	See Under Other Features
INPUT					
Media	On-Line Mag Tape (7- or 9-Track)	On-Line Mag Tape (7- or 9-Track)	On-Line Mag Tape (7- or 9-Track)	On-Line Mag Tape (7- or 9-Track)	On-Line
Data Description	—	Positive/Negative Pulse	8-Vector Format, Positive/Negative Pulses; 24-Vector Format, 5-Bit Command Signals	8-Vector Format, Positive/Negative Pulses; 24-Vector Format, 5-Bit Command Signals; Zip Mode, 5-Bit Command Signals	4-Bit Messages; Input Rate 4 Times Plotting Rate
INTERNAL LOGIC					
Processor	—	—	—	—	—
Special Functions	Automatic Data Manipulation and Parity Checking (900/937/728)	—	—	—	Y-Axis Elecronic External Scaling Capability
SOFTWARE	CalComp Basic; Contour Mapping; IC Masking; Subdivision Mapping; Critical Path Network	Simple Fortran	Simple Fortran	Simple Fortran	Simple Fortran
CHARACTERISTICS					
Dimensions	48" x 72"	11" wide drum x 120' (565) 28.5" wide drum x 120' (563)	11" wide drum x 120' (665) 28.5" wide drum x 120' (663)	11" wide drum x 120' (765) 28.5" wide drum x 120' (763)	11" and 34" wide drums x 120'
Maximum Speed	4.6"/sec	300 incr./sec; 200 incr./sec for .010" incr. (563 only)	450/900 incr./sec; 350/700 incr./sec. for .010"/.005" (663 only)	450 incr./sec and 1687 incr./sec (Zip Mode); 350 incr./sec and 1312 incr./sec (Zip Mode) for .010"/.005" incr. (763 only)	2600 incr./sec (Max.); 1800 incr./sec (Abrupt Changes)
Accuracy	.0025" Full Area; .0012" 20" x 20" Area	—	—	—	—
Repeatability	—	—	—	—	—
Resolution (Step, Increment Size)	.0005"	.010", .005", or .1mm.	.010"/.005", .005"/.0025", or .0025"/.00125"	.010"/.005", .005"/.0025", or .0025"/.00125"	.05"/.025"
PRICE	—	—	—	—	—

OTHER FEATURES APPLICATIONS: Interactive Design; Drafting; Data Reduction; Real-Time Plotting; N/C Verification; Mapping; Graphing; IC Mask Cutting; Printed Circuit Artwork; Garment Grading
CONFIGURATIONS: Controllers and Interfaces for Wide Range of Computers; Remote Interfaces for Terminals or Modems; Mag Tape Drives for Off-Line Operation
33 Maintenance Centers

TABLE 1 • DIGITAL PLOTTER CHARACTERISTICS (Cont'd.)

COMPANY	Computer Graphics Corp.	Concord Control, Inc.	Digital Equipment Corp.	Dresser Systems Inc.	Electronic Associates, Inc (EAI)	Electronic Data Display
MODEL NO.	DPS-7; 4021 DM-2	Universal Graphics Processor (UGP); Mark 8 Coordinatograph	XY15 Series, Models AA, AB, BA and BB	LGP-2000	430/100 and 430/200 DATAPLATTER	PT-1
APPLICATIONS	Drafting; Mapping; Data Reduction	Contour Mapping; Cartography; Computer-Aided Design; Printed Circuit and IC Artwork	General Plotting; Alphanumerics	Cartography; Printed Circuit Artwork	Drafting; Mapping; Data Reduction	Printed Circuit Artwork; Business Data Plotting
INPUT Media	On-Line; Mag Tape (7- or 9-Track)	Punched Card; Paper Tape (300 char./sec); Mag Tape; Keyboard (ASR 33)	On-Line to PDP-15 Computer; Off-Line	On-Line at Computer Speeds; Mag Tape	On-Line; Mag Tape (7- or 9-Track)	On-Line; Teletype
Data Description	Incremental; 6-Bit Characters; Manual for Paper Size Selection; X and Y Offset	ASCII (TTY, Paper Tape) NRZI (Mag Tape) Hollerith or Binary (Punched Card)	Incremental	Serial Raster Scan; Black/White: 4,000/8,000 bits/scan (.01"/.005" step); Shades: 16,000/32,000 bits/scan (.01"/.005" step)	—	Absolute X and Y
INTERNAL LOGIC Processor	—	4K 12-Bit Words; Expandable to 32K	—	—	—	—
Special Functions	Program Selectable Pens	Operates as Plotter, Digitizer or Interactive System; On-Line Edit of Drawings	Alphanumerics	Black and White, and Gray Shading in 16 Scales	Point and Line Plotting; Alphanumerics; 3rd Order Polynomial Interpolation; Internal "Look Ahead" for Velocity Control	— —
SOFTWARE	Fortran	Fortran	—	Packages for IBM 360; Line, Tone, Sequential Data Trace, and Seismic Data Packages	—	—
CHARACTERISTICS Dimensions	30" x 30" (4021 DM-2) 45" x 60" (DPS-7)	40" x 50" (UGP); 60" x 60" (Mark 8)	12" wide drum x 120' (AA and AB); 31" wide drum x 120' (BA and BB)	40" wide x 100' film	31" x 36" (430/100); 54" x 76" (430/200)	10" x 15"
Maximum Speed	On-Line: 3.6"/sec Off-Line: 3.2"/sec	Line Trace 1"/sec; Plot 2"/sec; Slew 5"/sec (UGP) Line Trace 1"/sec; Point Plot 6"/sec (Mark 8)	12,000 steps/min (BA); 18,000 steps/min (AA, AB and BB)	1900 scan lines/min (.005" step); 3800 scan lines/min (.01" step)	Line Trace 20"/sec; Curve 16"/sec; Slew 30"/sec; Point 30"/min (430/100); Line Trace 12"/sec; Curve 12"/sec; Slew 18"/sec; Point 23"/min (430/100)	13.7"/sec
Accuracy	±.05% of full-scale	±.002" (UGP); ±.001" (Mark 8)	—	±.05%, X and Y	—	.02"
Repeatability	±.01% of full-scale	±.001" (UGP); ± .0005" (Mark 8)	—	—	.003" (430/100); .004" (430/200)	.01"
Resolution (Step, Increment Size)	±.004"	.001" (UGP); .0005" (Mark 8)	.01" (AA and BA) .005" (AB and BB)	.01"/.005", X and Y	.001" (430/100); .00125" (430/200)	—
PRICE	Starts at $26,000 (4021 DM-2) and $31,750 (DPS-7)	$150,000–$200,000 (UGP); $225,000–$300,000 (Mark 8)	$8,900 (AA and AB); $13,400 (BA and BB)	$100,000 (On-Line) $175,000 (Off-Line)	$33,000–$60,000 (430/100) $50,000–$80,000 (430/200)	$4,000
OTHER FEATURES	High-Speed Plotting Controller Optional	—	—	Laser Beam Plotter	48–Character Printer Optional	Republic Corp. Plotter

TABLE 1 • DIGITAL PLOTTER CHARACTERISTICS (Cont'd.)

COMPANY	Geo Space Corp.	Gerber Scientific Instrument Corp.			
MODEL NO.	DP-203	723	1233	2032	2075
APPLICATIONS	Drafting; Mapping; Flow Charting; Printed Circuit Artwork; Holographic Plots	Drafting; N/C Verification	Drafting; Printed Circuit and IC Artwork	Drafting, Printed Circuit and IC Artwork	Drafting; Lofting; Digitizing; N/C Verification
INPUT					
Media	On- or Off-Line	Mag Tape; Paper Tape; Teletype	Mag Tape; Paper Tape; Punched Card; Teletype	Mag Tape; Paper Tape; Punched Card; Teletype	Mag Tape; Paper Tape; Punched Cards
Data Description	Data: 8-Bit Bytes; Intensity: 2 Bytes every 16 msec	Absolute and Incremental	Absolute and Incremental; Word Address or Tab Sequential Format	Absolute and Incremental; Word Address or Tab Sequential Format	Absolute and Incremental; Word Address or Tab Sequential Format
INTERNAL LOGIC					
Processor	——	4K, 16-Bit CPU	8K, 16-Bit CPU	8K, 16-Bit CPU	8K, 16-Bit CPU
Special Functions	Variable Width and Solid, Dashed or Dotted Lines; Circles; Symbols; Alphanumerics; Gray Shading in 32 Scales	Linear and Circular Interpolation	Linear and Circular Interpolation	Linear, Circular and Parabolic Interpolation; Alphanumerics	Linear, Circular and Parabolic Interpolation; Alphanumerics
SOFTWARE	Fortran Callable Routines	Fortran; Assembler; Utilities	Provided for Internal Processor	Provided for Internal Processor	Provided for Internal Processor
CHARACTERISTICS					
Dimensions	40" x 60"	34" x 44"	24" x 24"	48" x 60"	5' x 24' (60" x 188")
Maximum Speed	40" x 60" Area in 75 sec at any shading	600"/min	60"/min (axial)	75"/min (axial)	750"/min
Accuracy	± .001"/inch or ± .001"/ft	± .005"	±.0005" (Full Area); ±.0003" (10" x 10");±.0001" (3" x 3")	±.0009" (Full Area); ±.0006" (24" x 24")	±.004"
Repeatability	± ½ dot over 40" x 60" Area	±.0025"	±.0001"	±.0005"	±.002"
Resolution (Step, Increment Size)	100 or 200 points/inch	.001"	.0001"	.0001"	——
PRICE	$37,000 (On-Line) $125,000 (Off-Line)	$58,000	$145,000	$200,000	$230,000
OTHER FEATURES	Plots on Paper or Film Darkroom is not needed	——	Optical Exposure Head	Optical Exposure Head or Variable, 24-Aperture Photo Head	——

TABLE 1 • DIGITAL PLOTTER CHARACTERISTICS (Cont'd.)

COMPANY	Graphic Data Inc.	Hewlett-Packard	Houston Instrument	I/O Systems	Kongsberg Systems, Inc.	Omega-T Systems, Inc.
MODEL NO.	71 B	7200A	COMPLOT DP-1, DP-12, DP-3, DP-5	Transplotter	KINGMATIC 1215, 1800 and 2637	FasPlot
APPLICATIONS	Scientific Information Systems; Mapping; Geologic Survey	Graphic Output for Computer, Teleprinter or Time-sharing System	Drafting; Mapping; Graphing; N/C Verification	Graphic Output for Computer, Teleprinter, and Time-sharing System	Drafting; Mapping; Cartography; Electronic Artwork	Graphic Output for Computer, Teletype or Time-sharing Systems
INPUT Media	On-Line Multiplexed; Mag Tape (7- or 9-Track); Telepack Interface Modem	On-Line Teletype	On-Line; Mag Tape; Teletype; Data Set (DP-12)	On-Line; Mag Tape; Paper Tape; Teletype	On-Line; Mag Tape; Paper Tape; Punched Card	On-Line; Paper Tape (30 char/sec); Teletype (8 Level)
Data Description	Vector Command (±ΔX, ΔY); Alphanumerics	Absolute, X and Y; ASCII	Incremental	Absolute ASCII	Binary Vector; EIA; ASCII; ISO	Absolute or Incremental; ASCII
INTERNAL LOGIC Processor	Hardwired	—	—	—	Fixed Logic; Hon H316-01; IK, 12-Bit CPU	—
Special Functions	Linear and Circular Interpolation	Linear Interpolation; Point Plotting	—	Point Plotting	Linear, Circular and Parabolic Interpolation; Symbol Scaling and Storage	—
SOFTWARE	—	—	Provided for Host Computer	Fortran IV	I/O and Executive Routines for Internal Computer	Basic and Functional for Time-sharing Systems
CHARACTERISTICS Dimensions	11" x 17" fed from 500' roll	11" x 17"	12" wide x 144' Fanfold 23" wide x 144' Fanfold (DP-3)	11" x 17"	48" x 60" (1215); 6' x 5' to 6' x 35' (1800); 8' x 12' (2637)	11" x 17"
Maximum Speed	4"/sec	1 point or line in 1.1 sec	3" or 1.5"/sec; 6" or 3"/sec (DP-5)	Point-to-Point 1/30 sec; Slew 30"/sec	400"/min (1215); 600"/min (1800 and 2637)	10"/sec
Accuracy	±.005"	±.03"	±.01"/.005"; ±.005"/.0025" (DP-5)	.3%	±.001" (12" x 12" on 1215); ±.002" (36" x 36" on 1800 and 2637)	—
Repeatability	—	.007"	±.002"/.001"; ±.001"/.0005" (DP-5)	.1%	±.0004" (1215); ±.0008" (1800 and 2637)	—
Resolution (Step Increment Size)	—	.005"	.01"/.005"; .005"/.0025" (DP-5)	.005"	.00025" to .002" selectable	.01"
PRICE	$15,000–$25,000	$3,300	$3,550 (DP-1); $4,550 (DP-12); $6,400 (DP-3); $11,000 (DP-5)	$3,200	$55,000–$70,000 (1215); $125,000–$180,000 (1800); $135,000–$160,000 (2637)	—
OTHER FEATURES	Electrostatic Matrix Writing	—	—	—	—	—

TABLE 1 • DIGITAL PLOTTER CHARACTERISTICS (Cont'd)

COMPANY	Perspective Systems, Inc.	Spatial Data Systems Inc.	Timeshare Devices Inc.	Time Share Peripherals Corp.	Tridea Electronics
MODEL NO.	RECORDOMAT 1250-2	501-3	C/P 701 and 701-4	TSP-212	ALDRAFT
APPLICATIONS	Drafting; Illustrative, Perspeitive and Axonometric Graphics	Hard Copy (3-D) Plotting	Graphic Output for Computer, Teleprinter, and Time-sharing Systems	Graphic Output for Computer, Teletype or Time-sharing Systems	Drafting
INPUT					
Media	Mag Tape (7- or 9-Track)	Mag Tape (7-Track)	On-Line; Teletype; Paper Tape	On-Line (IBM 2741, 1050); Teletype; Modem Lines	On-Line; Mag Tape (7- or 9-Track); Paper Tape (300 char/sec)
Data Description	Absolute or Incremental; 2- or 3-Axis Data	Incremental	Absolute, ASCII	Absolute	Word Address Format (Mag Tape); Word Address or Tab-Sequential Format (Paper Tape)
INTERNAL LOGIC					
Processor	4K, 16-Bit, Expandable	Plugboard Programmable	—	—	Varian 620/i; 8K, 16-Bit
Special Functions	Coordinate Transformations; Interactive Operations	Axes Motion Reversal	—	—	Linear, Circular and Parabolic Interpolation; Perspective or Isometric; Alphanumerics and Symbols; Rotation; Dashed Line Generator
SOFTWARE	—	Fortran for Input Computer	Basic; Fortran	Basic and Fortran for Input Computer	Fortran IV Compiler, Assembler; Utilities; Math Library for Internal Computer
CHARACTERISTICS					
Dimensions	30" x 40"	11" x 17" x 3" Volume	8½" x 11" (701); 11" x 17" (701-4)	11" x 17"	5' x 4' to 5' x 24'
Maximum Speed	3.2"/sec	—	.3 sec/point	150 to 225 lines/min	600"/min
Accuracy	—	—	.2%	1/256 of full scale	± .004"
Repeatability	.005"	—	—	—	± .002"
Resolution (Step, Increment Size)	.005"	.01" on X, Y and Z Axes	1/1024	1/512 of full scale	—
PRICE	$84,000	$23,500	$3,375	$3,300 (quantity discounts)	$125,000-$200,000
OTHER FEATURES	Also Serves as Digitizer	Steel Wires Fixed in Plotting Board for 3-D Image	—	—	6-Position Pen Turret 90-Position Optical Head with Variable Area Exposure

TABLE 1 • DIGITAL PLOTTER CHARACTERISTICS (Cont'd.)

COMPANY	Universal Drafting Machine Corp.	University Computing Co.,—Graphic Systems Division	Varian Graphics and Data Systems Div.	Xerox Data Systems	Xynetics, Inc.	Zeta Research
MODEL NO.	ORTHOMAT 4000	2000	STATOS—5 Model 500	7530	1000	230
APPLICATIONS	Drafting; Orthographic or Perspective Graphics; N/C Verification	Drafting; Mapping; N/C Verification	Geophysical Plotting; Computer Graphics	Graphic Output for Computer	Drafting; Lofting; Mapping; Charting	Graphic Output for Computer, Teletype or Time-sharing Systems
INPUT Media	Teletype; Paper Tape	On-Line; Mag Tape (7- or 9-Track); Paper Tape; Punched Cards	On- and Off-Line	On-Line with XDS Computer	Mag Tape (7- or 9-Track)	Teletype; Modern; Accoustic Coupler
Data Description	Word Address Format	Incremental X, Y	Video Raster, 15 μsec/byte, 8-Bit Parallel, to 128-Bit Serial Stream; Discrete Inputs of 10-Bit Binary (500,000 points/sec) or 13-Bit BCD (166,000 points/sec)	8-Bit Bytes	End Point Coordinates	Incremental
INTERNAL LOGIC Processor	PDP 8/L, 4K, 12-Bit	Fixed Logic	—	—	8 K, 16-Bit CPU	—
Special Functions	Linear Interpolation, 2 of 3 Axis Select; Rotation; Orthographic and Perspective; Formal Conversion	Programmable Plotting Speed and Stop Size; Block Data Transfer	—	—	Scaling; Rotation; Annotating	—
SOFTWARE	Basic Drafting Programs; Special Application Programs	Basic Commands; Functional Subroutines; Contouring; Charting	—	Functional Software; Applications Subroutines from User's Group Library	Fortran IV for Internal Processor	—
CHARACTERISTICS Dimensions	4′ x 6′	29.5″ wide drum fed	15.5″ wide drum x 500′	11″ wide drum x 120′	5′ x 8′	8.5″ x 11″
Maximum Speed	400″/min	7.07″/sec	4″/sec	3″/sec	Lines 56″/sec; Curves 40″/sec	270 steps/sec
Accuracy	±.006″	±.0025″	±.5%	—	±.005″	—
Repeatability	—	±.0025″	±1% of 2000 increment sample width	—	±.001″	—
Resolution (Step, Increment Size)	±.001″	±.0025″ to .01″	.005″	.01″	.001″	—
PRICE	$70,000	$16,500 (On-Line) $47,750 (Off-Line)	$14,900	$13,000	—	$6,250
OTHER FEATURES	6-Position Pen Turret Optical Position Locator	Block Data Transfer Allows 1443 increments in X and Y to be plotted from Single Command	Gray Shading	—	—	Marketed by Tymshare, Inc.

TABLE 2 • REFERENCE LITERATURE

For additional information on digital plotters, circle, on the reader inquiry card, the appropriate numbers listed below.

Company	Reader Inquiry Card Number
Arvin Systems, Inc., Dayton, Ohio	200
Auto-trol Corp., Arvada, Colorado	201
Boston Digital Corp., Ashland, Mass.	202
California Computer Products, Anaheim, Cal.	203
Computer Graphics Corp., Miami, Fla.	204
Concord Control, Inc., Boston, Mass.	205
Digital Equipment Corp., Maynard, Mass.	206
Dresser Systems, Inc., Houston, Texas	207
Electronic Assoc. Inc., W. Long Branch, N.J.	208
Electronic Data Display Services, Downey, Cal.	209
Geo Space Corp., Houston, Texas	210
Gerber Scientific Instru. Co., Hartford, Conn.	211
Graphic Data, Inc., Burlington, Mass.	212
Hewlett-Packard Co., Palo Alto, Cal.	213
Houston Instruments, Bellaire, Texas	214
I/O Systems, Natick, Mass.	215
Kongsberg Systems, Inc., Bedford, Mass.	216
Omega-T Systems, Inc., Richardson, Texas	217
Perspective Systems, Inc., Seattle, Wash.	218
Spatial Data Systems, Inc., Goleta, Cal.	219
Timeshare Devices, Waltham, Mass.	220
Time Share Peripherals Corp., Wilton, Conn.	221
Tridea Electronics, El Monte, Cal.	222
Universal Drafting Machine, Bedford Hgts., Ohio	223
Varian-Graphics Systems Div., Palo Alto, Cal.	224
Xerox Data Systems, Santa Monica, Cal.	225
Xynetics, Inc., Canoga Park, Cal.	226
Zeta Research, Lafayette, Cal.	227

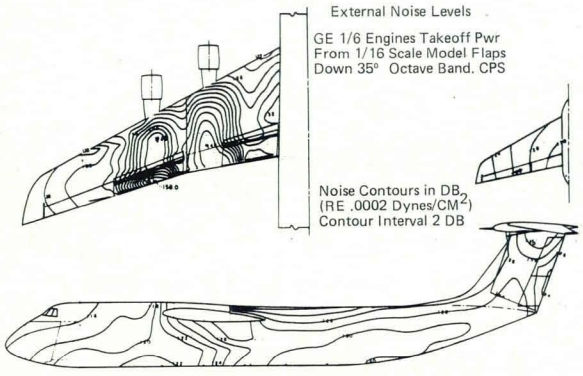


Fig. 9 Jet Aircraft Noise Contour (Courtesy of Electronics Associates Inc.)

$y = f(x)$, they usually don't matter; for creating a printed circuit board master, they are as important as any other consideration.

The user will also want to consider the past performance records of the companies supplying the plotters. Reliability and quality of maintenance service are vital elements in any evaluation.

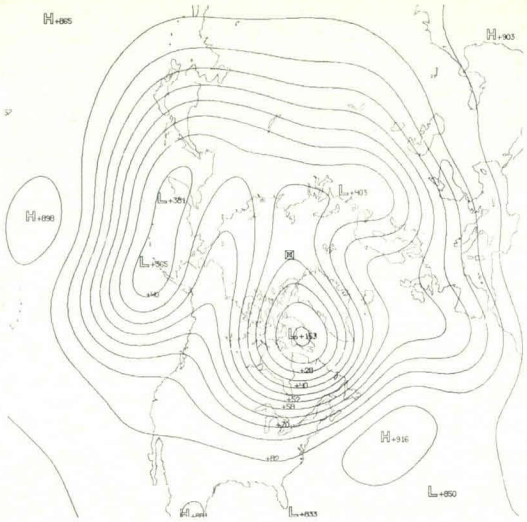


Fig. 10 Weather Map (Courtesy of Varian-Graphics and Data Systems Division)

THE TABLES

The Digital Plotter Characteristics Table (Table 1) is organized to give the potential user a starting point for selecting a plotter. It furnishes an overview of some of the significant evaluation parameters.

All of the various types of plotters have been collected in the one table without further breakdowns by category. The reader can readily distinguish between large and small units by looking at plotting surface dimensions; he can distinguish between expensive and inexpensive systems by examining price ranges. This does not mean, as the foregoing text has tried to indicate, that all plotters are functionally interchangeable.

In some instances where the manufacturer offers a wide variety of configurations, a representative sampling of them was made for presentation in the Plotter Characteristics Table.

The "Special Features" of the internal logic are in addition to the normal plotter control logic which is incorporated into every digital plotter.

The "Software" describes the programs furnished for the internal processor if the plotting system has one, or for an interfacing computer.

The term "Resolution" may be used interchangeably with "step size." It defines the smallest distance between successive plotted points.

The pricing information must be interpreted with care, since it represents the cost of some equipment configuration or group of configurations defined by the manufacturer.

Table 2 lists digital plotter manufacturers with each keyed to a reader inquiry number for requesting additional information via reader inquiry card. ▲

NEW PRODUCTS

MINICOMPUTER

The OMNUS-1 is a minicomputer system designed for both general-purpose and dedicated system applications. It uses a high-speed, full-duplex, single bus structure (called the Omni-Buss) that is shared by the processor, arithmetic unit, processor registers, memory units, and all I/O controllers. The machine features: direct memory addressing to 32,768 16-bit words, over 1,000 instructions, a large number of program-accessible registers, register paging, and efficient memory stacking instructions. Core is plug-in modular in 2K or 4K increments; 1.2 usec. cycle time. The instruction set provides for "transfers": arithmetic, and logical operations to be performed upon combinations of the elements connected to the Omni-Buss, including: memory-to-register, register-to-memory, register-to-register, register-register-to-register, literal-to-memory and register, and selected I/O register to/from memory or register, I/O device controllers are logically connected to the Omni-Buss with a "connect device" instruction. A connected device controller data buffer is operated upon by the computer in the same manner as a processor accumulator or general-purpose register. This feature allows for "Dynamic I/O Processing"; i.e., a single-word instruction not only performs the data transfer, but simultaneously operates upon it. A device controller incorporating a small read-only-memory (200 ns) can execute high-speed I/O subroutines or provide a hardware bootstrap. The basic OMNUS-1 includes direct memory access (DMA) and 16 priority interrupts. The standard control console displays all system registers, provides 16 data switches, and enables dynamic and step control functions, including "breakpoint." Price of the OMNUS-1 with 2K words of core is $5,950. *Omnicomp Computer Corp., Santa Ana, Cal.*

Circle No. 285 on Inquiry Card.

INTERACTIVE DESIGN SYSTEM

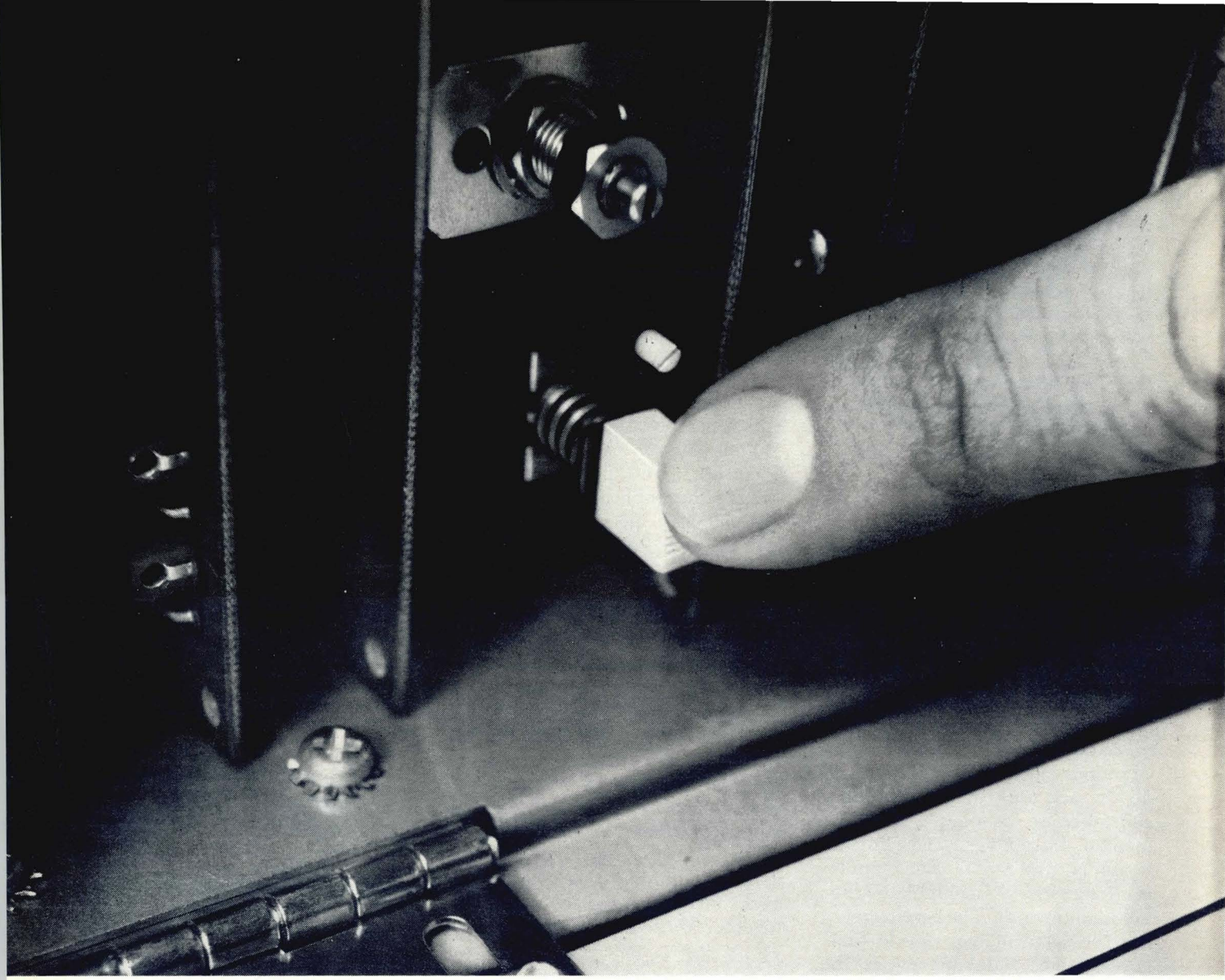
The "Design Assistant" is an interactive graphical system that allows a user to generate and work with a computer representation of circuit mask layouts. When a composite layout is complete, the system automatically produces data describing the individual mask levels. This data is used directly for automatic artwork generation and design documentation. The Design Assistant is available as a complete hardware/software system. The hardware includes a graphics terminal – consisting of a Computek storage tube display, keyboard and data tablet – and an IBM 1130 computer. No user programming is required and software interfaces are available for a variety of artwork generation equipment. In a typical application, the user begins by retrieving his layout from his disk file and displaying it on the storage tube. The user can display an arbitrary composite of individual levels, any portion of the composite, or some of the composite at any degree of detail. The user interacts with the Design Assistant with freehand symbols drawn on the data tablet with an electronic stylus. These symbols give commands to the system and indicate positions of elements and components. Layout editing capabilities include adding, deleting, stretching, shrinking, rotating, flipping, and moving of selected components. Changes to a component are reflected as changes to all individual levels on which the component is defined. For example, when a transistor is deleted from the layout, its emitter, base, base insert, and contacts and contact cuts are all deleted from the appropriate levels. The Design Assistant hardware, including Computek 400/20 display, GT50/10 graphic tablet, and IBM 1130 interface is priced at $17,815. A perpetual license for software is priced at $45,000. The software is implemented for the IBM 1130; a minimum configuration is the IBM 1131 Model 2B CPU ($44,720) with IBM 1442 Model 6 card/read punch ($14,140) and IBM 1132 line printer ($11,010). The manufacturer does not act as a source for IBM equipment, but will arrange for leasing of the Design Assistant hardware and software through a third party. *Applicon Incorporated, Burlington, Mass.*

Circle No. 282 on Inquiry Card.

CALCULATOR SERIES

The Wang Series 100 consists of four self-contained printing units: two for scientific/engineering problems, and two for statistical work. There are both 6- and 14-register models, each register capable of adding, substracting, multiplying, and dividing 12-digit numbers. All units are fully programmable with one or two optional punched card readers (60 programming steps per card). The flexibility of the units extends to their use as adding machines, e.g., a "penny mode" treats all entries with an implied two decimal places; "roundoff" keys cause pennies or dollars to go to the next whole significant digit for decimal fractions of .5 or greater. Function keys (some optional) permit a full range of trigonometric and power operations, including power summations and operations with engineering constants. An "underflow" feature automatically drops off decimal place digits from the right, insuring 12 significant digits of accuracy without blocking the entire system in the event of an overflow. Size of the units is 12″ wide, 18 ⅜″ deep, and 7-⅜″ high. *Wang Labs., Inc., Tewksbury, Mass.*

Circle No. 340 on Inquiry Card.



If your system goes to pieces, press a button and our modems tell you which piece went.

ZAP!

You're down. And that's where you stay until a serviceman finds the trouble (time! time! time!) and fixes it.

Before you break down just thinking about it, here's a thought to cheer you up. It doesn't have to be that way. Not if you get smart and get an Ultronic modem.

Our modems do everything everybody else's do.

When things are going fine, they just sit there, quietly modulating and demodulating.

But when the fun starts, they turn into crack troubleshooters. Their panel of buttons isolates various parts of your data transmission system. In just a few minutes, a serviceman can locate the part that's giving you trouble. Which saves a lot of time.

Saves a lot of money, too. Ultronic double-duty modems cost only about what you'd pay to lease somebody else's single-duty jobs for two years.

How can you go wrong? You've got Ultronic experience behind you all the way. The experience that comes from running one of the world's largest on-line data communications systems. Plus the experience of over 300 technicians in 56 major cities. Just in case anything ever does go wrong.

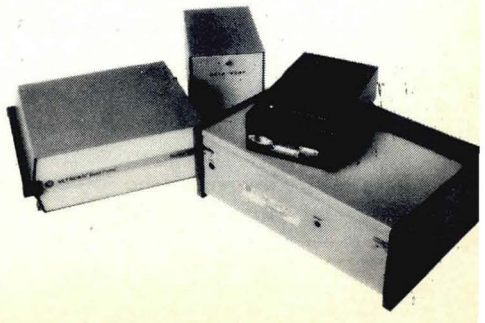
Check with us. At Ultronic Systems Corp., Mount Laurel Industrial Park, Moorestown, New Jersey 08057. For a system or a modem, we've got what you want. TDM and FDM, multiplexers, front end controllers.

If you need modems that give you peace of mind by watching each piece of your system, call us at (609) 235-7300.

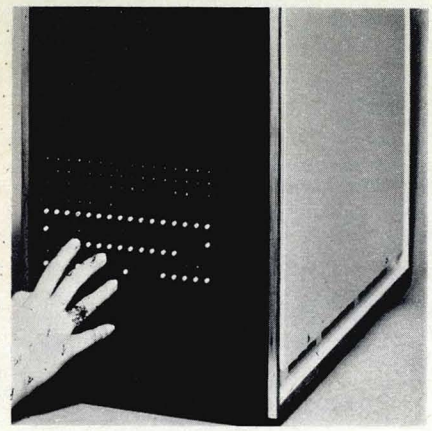
ULTRONIC SYSTEMS

SYLVANIA

GENERAL TELEPHONE & ELECTRONICS



CIRCLE NO. 41 ON INQUIRY CARD



TWO MINICOMPUTERS

Two minicomputers from Texas Instruments Inc., designated the Model 980 and Model 960, are for general-purpose and process control applications, respectively. The Model 980 (shown) is a 16-bit machine with one usec. memory cycle time, 400 nsec. memory capacity of 4096 words (expandable to 65,536 words). Eighty-five instructions, including multiply and divide, are used in the computer, and software includes a real-time monitor, assembler, and Fortran compiler. The Model 960 computer is designed to manipulate bits, fields, and words. The core memory has the same memory cycle time, access time, and capacity as the Model 980. Expansion is provided for 256 interface card locations, each with 16 input and 16 output lines. An expandable DMA channel is also builtin. Sixteen 16-bit registers are included for rapid context switching and mutiple-base register usage. Software includes a programming support monitor, process automation monitor (with on-line debugging routines and floating-point software), programming system (with a symbolic assembly language – SAL960 – which permits assembly on the Model 960, Model 980, or the System/360), diagnostics, and utility programs. Among the applications for which the 960 was specifically designed are discrete control of machine tools and assembly machines, instrument and system control, and supervision and monitoring of discrete event and continuous-flow operations. Described as the key to the Model 960's flexibility is it's "Communications Register Unit," or "CRU," which provides the interface to accommodate a wide variety of application-oriented devices. As many as 4096 input and output lines may be handled by a single 960 computer. Each I/O line may be addressed independently, or up to 16 lines may be addressed together as a conventional channel. *Texas Instruments Inc., Houston, Texas.*

Circle No. 301 on Inquiry Card.

PRINTER OUTPUT MICROFILMER

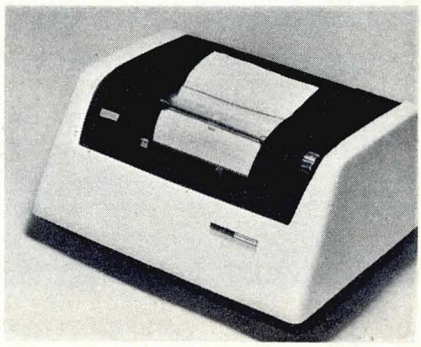
The ATI Model 1000 Formscopier automatically transfers computer printer output data from continuous fanfold forms onto microfilm. The system is not as sophisticated as COM (Computer Output Microfilm), where magnetic tape triggers a display on a cathode-ray tube that can then be microfilmed with an automatic camera. Instead, the POM, or Printer Output Microfilm system consists essentially of an input tray for stacking fanfold forms, a sprocket drive for carrying forms through the copier, a rotary camera with dual lens, and a receiving or output tray for collecting copied forms. The operator places printed forms on the input tray, threads the lead sheet through the copier, and stands by while forms are microfilmed. Copied forms stack automatically in the receiving tray. The Formscopier handles printer hard copy output data at a rate adjustable between 15 and 56 inches per second with automatic exposure control. The top speed corresponds to a photo rate of 20,000 lines per minute, assuming six printed lines to the inch. The lower speed allows easy stacking of forms at the beginning of a run. The ATI POM system costs $4800 and leases for $140/mo. A desktop version will sell for $2500. *Advanced Terminals Inc., Maple Glen, Pa.*

Circle No. 279 on Inquiry Card.

TWO COMs

Two new computer output microfilm (COM) units have been introduced by Beta Instrument Corp. The Beta COM 400 includes a 7- or 9-track tape transport, a 64-element character set, image rotation controls, a precision CRT display, a forms overlay, and a 16mm camera. It is priced at $68,000, and will be offered on both a sale and lease basis for delivery in the fourth quarter of 1970. The second new addition, the Beta COM 700, utilizes a multi-format camera for the direct printing of microfiche. The 700 system, which accommodates 70mm, 35mm, and 16mm film, includes a general-purpose digital computer. The Beta COM 700 costs $141,500 and is also being offered on a rental basis. *Beta Instrument Corp., Newton Upper Falls, Mass.*

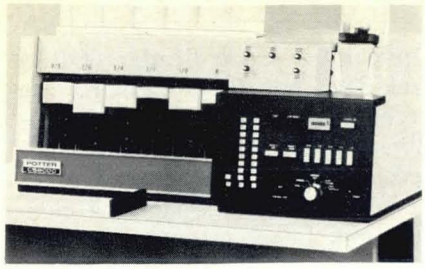
Circle No. 278 on Inquiry Card.



IMPACTLESS PRINTER

The Repco 120 is an impactless printer for use with minicomputers and data terminals. Designed to handle serial (RS 232B) or parallel (TTL levels) data of 64-character standard ASCII code, the unit can be used as an input/output terminal over telephone or private wire communications lines when interfaced with a modem or acoustic coupler. The Repco 120 prints up to 120 cps asynchronously (80 characters per line, 6 lines per inch vertically) on electrosensitive paper in a 5 x 7 dot matrix format. It can be optionally supplied with an alphanumeric keyboard. Price in quantities is $995. *Repco Incorporated Computer Peripherals Div., Orlando, Fla.*

Circle No. 275 on Inquiry Card.



SYSTEM 3 PERIPHERALS

The CS 8000 card sorter (shown) and the CR 8000 card reader are designed for use with IBM S/3 96-column cards. The CS 8000 offers card sorting at 1500 cpm from an input hopper with 2000 card capacity to six output stackers with 600 card capacities. Sort functions include numeric, alphanumeric, and optionally alphabetic and selective sorts. All 96 characters can be read in one pass. The off-line sorter may be converted to an on-line reader with reading rates of 1500 cpm synchronously or 1000 cpm on demand, while giving the CPU full control over the 6 output stackers. The CR 8000 card reader features a reading rate of up to 1500 cpm. Optionally available on this new line of card equipment is the ability to read the Potter Magnetic Character Bar Code, which allows 128 characters to be stored on the standard System 3 card, a 25% increase in the quantity of data. All magnetic character output data is both man-and machine-readable and can be prepared on an office typewriter by non-EDP personnel. *Potter Instrument Co., Plainview, N.Y.*

Circle No. 289 on Inquiry Card.

TERMINAL TRAINER

The Compu-kee Model 40 is a basic trainer for multi-access computer terminal operations. By simulating all the major functions of a computer terminal, the Model 40 enables a company to train employees in keyboard and procedural skills without tying up on-line equipment. The components of the Model 40 include a program console with lighted display panel, an integrated punched tape reader, and an alpha, numeric, or alphanumeric keyboard unit. *Kee, Inc., Baltimore, Md.*

Circle No. 314 on Inquiry Card.

XDS BUSINESS COMPUTER

The XDS Sigma 6, and a new systems program, the XDS Data Management System, constitute Xerox Data Systems' first system designed primarily for business applications. Sigma 6 is a medium-size multi-use computer which will lease for $12,000 to $18,000 per month depending on configuration. A typical configuration with 131.072 bytes of core memory, 100 megabytes of disk storage, card reader and punch, line printer, magnetic tape units, and I/O processor will lease for $13,500 per month. The computer, which will be capable of handling batch, remote batch, on-line, and time-sharing activities concurrently, will be supported by a number of business-oriented programs, including the new XDS Data Management System (DMS). DMS is designed for generalized file structuring and accessing in such business applications as production control, order entry, and accounts payable and receivables. The system will be operational on Sigma 5, 6, and 7 computers and will be separately priced. A range of operating systems and other business-oriented programs will also be available for use with the Sigma 6 computer. Operating systems will include the XDS Batch Processing Monitor, and Universal Time-Sharing System. Business-oriented programs will include the XDS Cobol compiler and Manage, a generalized information retrieval system. Primary hardware characteristics of the Sigma 6 include an I/O processor capable of handling up to 48 channels of data concurrently, a memory map for efficient core utilization, byte-string decimal arithmetic (including floating point), and a communication subsystem. The computer has a dual-access memory expandable from 131,072 bytes (32,768 words) to 524,288 bytes (131,072 words). Its memory cycle time is 300 nsec./byte (1.2 usec./word). *Xerox Data Systems, El Segundo, Cal.*

Circle No. 302 on Inquiry Card.

PERFORMANCE ANALYZER PRINTER

The Model 7721 is designed to be used with all analyzer models in CPA's 7700 series of computer performance analyzers. Printing of analysis data is performed in either of two print modes – tabular digital, or graphical output—and eliminates the need for attended operation of the analyzer. *Computer and Programming Analysis, Inc., Cherry Hill, N.J.*

Circle No. 295 on Inquiry Card.

COM READER/PRINTER

A COM reader/printer, the Bell & Howell Autoload III, is designed for high-speed cartridge lookup of computer-generated film. The unit provides dry electrostatic prints of information from magnetic tape output in less than ten seconds. It will also accept roll film and will produce positive prints from either positive or negative film. *Bell & Howell Micro-Data Division, Chicago, Ill.*

Circle No. 318 on Inquiry Card.

CRT TERMINAL

A desktop display terminal designed to be plug-interchangeable with Model 33 and 35 Teletypes, consists of a CRT display and keyboard and is interfaced to a communication line. Called the Seventy Series Model 73 Interactive Display Terminal, it uses the ANSI character code and displays the 64-character upper case 1968 ANSI standard graphic subset. The Model 73-1 has 12 lines of 5 x 7 matrix characters; the Model 73-2, 24 lines. Characters are displayed either white on black, or black on white. The terminal operates in two modes. In the on-line mode, each character entered through the keyboard is transmitted to the computer which retransmits it to the terminal for storage and display. In the block/edit mode, characters are directly entered into buffer storage and are displayed. Displayed data may be changed by using the entry marker and control keys. The "send" key causes transmission of the data to the computer in a block. Standard connection of the terminal to an acoustic coupler or 103-type data set is via an EIA interface. Basic price is $3,950, with leases starting at $118 per month. *DATA 100 Corp., Minneapolis, Minn.*

Circle No. 329 on Inquiry Card.

BAR CODE READER/PRINTER

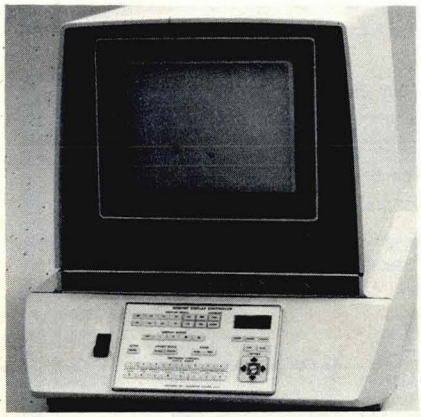
Optical Bar Code Reader (OBR) and Bar Code Printer (BCP) can accommodate such diverse items as library books, medical or insurance record folders, or packaged products found in a warehousing environment. Label reading is asynchronous so that noncontinuous conveyor-type motion poses no problem. The optically-read data can be recorded on tape or cards, or, optionally, read into an on-line computer for real-time traffic control and inventory updating. *Cambridge Information Systems, Inc., Cambridge, Mass.*

Circle No. 320 on Inquiry Card.

DUAL PROCESSOR

The Tempo II dual processor features a complete program-controlled reconfiguration capability for multiprocessing applications such as isolated foreground/background, load-sharing redundant systems, etc. The system incorporates a wide range of modular hardware and software packages. Both master/slave and load-sharing modes are provided: the master/slave processor is available either as a balanced or unbalanced configuration; the load-sharing dual processor is capable of graceful degradation. Standard hardware includes 16K of core memory distributed in any way between memory ports, 16 index/arithmetic hardware registers, 16 levels of priority interrupts (8 internal, 8 external), multi-programming controls, privileged instructions, hardware multiply and divide, 6 fully-buffered I/O channels (3 dedicated), 32K word drum with controller, ASR-33 terminal, and 60Hz real-time clock. Software includes assembler, debug, Fortran IV, mathematics library, and peripheral I/O subrouting. Basic monitor includes drum or magnetic tape system, debug executive, macro assembler, and Fortran IV. Operating system modules include monitor modules, real-time system modules, batch processing system modules, file manager, and debug monitor. *Tempo Computers, Inc., Anaheim, Cal.*

Circle No. 297 on Inquiry Card.



GRAPHIC DISPLAY

The Tektronix T4005 Graphic Display is composed of two parts – a Graphic Display Controller (GDC) and a Tektronix 11-inch Direct-View Bistable Storage Display Unit. The GDC contains the operator controls and the hardware which processes computer outputs into the data required for graphic and alphanumeric displays. The GDC hardware performs a number of graphic editing functions such as scaling, offsetting, magnifying, framing, and augmenting. The GDC can drive four distinct display devices under both manual and software control. The display device is a storage tube which retains the display after it is written once. Features include display scaling, zooming, augmenting, ability to drive multiple displays, several convenience controls, multiple software and interrupt controls, status indicators, and positioning controls which offer two methods for positioning a portion of the display. The price of the T4005 Graphic Display is $7850. *Tektronix, Inc., Beaverton, Oregon.*

Circle No. 293 on Inquiry Card.

OCR PAGE READER

The "Challenger", an optical character recognition page reader system to sell for under $35,000, includes a scanning unit, recognition system, full 110-character output line buffer, an edit-reject display with an alphanumeric keyboard, and a telecommunications interface. Also available, as an output option, is an IBM 360-compatible tape unit. A programmed machine, the Challenger reads line-by-line at speeds up to 12 lines/sec. (1320 chars./sec.), and features automatic scanning adjustment to compensate for line skew. Selective field scanning is accomplished through the use of delimiter marks on the documents. The Challenger reads the 57-character USASI OCR-A alphanumeric set. *Infoton Inc., Burlington, Mass.*

Circle No. 277 on Inquiry Card.

MODEM

The PDC-1200/5, a 1200 bps modem, is equivalent to the Western Electric 202C-6 and offers a full range of features including automatic answering, supervisory channel, and long space disconnect. Operational features include improved carrier detection, 150 bps capability on the reverse channel, and crystal-controlled tone frequencies. *Penril Data Communications, Rockville, Md.*

Circle No. 286 on Inquiry Card.

PROCESS/TERMINAL SYSTEM

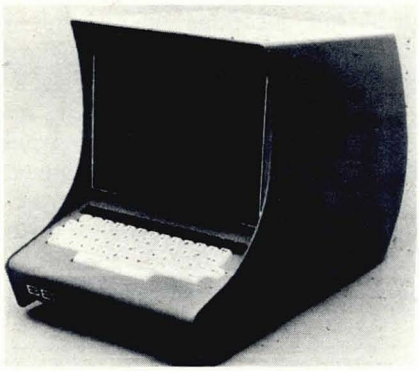
The System Seventy Extended Computing System is designed to provide a unified solution to the problems of data collection, data entry, and data communication. The sstem is designed around a general-purpose mini-computer communicating with keyboard CRT terminals, and includes capability for disk storage, magnetic tape preparation, and two-way communication with an IBM 360. *Mark Computer Systems, Plainview, N.Y.*

Circle No. 315 on Inquiry Card.

DISPLAY TERMINAL

The new Hazeltine 2000 standalone, solid-state TV display terminal is a direct roll-in replacement for Teletype equipment. It features a flicker-free 1998-character display, and offers both split-screen and flexible editing capabilities, including character, and line insertion and deletion. Other features include hard copy, remote monitors, and data transfer to and from magnetic tape cassette. *Hazeltine Corp., Little Neck, N.Y.*

Circle No. 309 on Inquiry Card.



TELETYPE-COMPATIBLE CRT DISPLAYS

Two new Teletype-compatible CRT display terminals are said to be the smallest, slenderest units available for time-sharing use. Alpha-103, an 800-character display, is Teletype-interchangeable, having a 40 character per-line, 20-line storage capacity. Alpha-105, a 1600-character display, is a direct plug-for-plug replacement for Teletype terminals with an 80 character per line, 20 line display capability. Both models are standalone units measuring 12″ wide, 14″ high, and 20″ deep. They feature a Teletype keyboard plus 14 optional black control keys for tabbing, 4-way cursor control, text editing, formatting, interface with digital printers, magnetic tape cassettes, and on- or off-line communication with computers. Alpha-103 prices start at $3,495 with delivery in 30-60 days. Alpha-105, the 1600-character version, is priced as low as $4,095 with 90 day delivery. *Beehive Electrotech, Salt Lake City, Utah.*

Circle No. 298 on Inquiry Card.

SMALL COMPUTER

Mini/Max, a 16-bit computer, is available in configurations ranging from a bare CPU (under $2500) to a "maxi" system. A modular design enables system manufacturers to purchase any of several computer configurations, and cabinet, rack, and/or console mounting is available. A comprehensive control panel can be supplied for intermediate to large systems, or for in-house applications. The panel can be located remotely, furnished blank, or omitted. Off-the-shelf peripherals include Teletypes, high-speed paper tape reader and punch, 300 LPM printer, and a disk controller to accommodate disk storage for 2.048 million words. Software includes assembler, diagnostics, arithmetic packages, and utility packages. Processor features include 21 addressable registers with as many as 12 hardware index registers, plus up to 256 hardwired priority interrupt lines, 16 16-bit input buffer registers and 16 16-bit output buffers. *Infotronics Corp., Austin, Texas.*

Circle No. 292 on Inquiry Card.

I/O TERMINAL

The "Gemini" is a modular multipurpose T/0 terminal with both batch and time-sharing capability. Among the features combined in the programmable 1K memory terminal are a 25-30 cps split-platen printer, permitting on-line retrieval without disturbance of batch transaction handling; a dual tape deck with incremental drives and simultaneous read-write capability; and a combined typewriter/10-key adder keyboard. Although the Gemini communicates with available hardware—from key-to-tape units for batch operation, to standard computer communications interfaces—it has been introduced with polling unit and communications monitor. The terminal will be available to users on a lease basis at a basic price of less than $200 a month, or for purchase at leass than $10,000 in quantities. *Factsystem Inc., Chicago, Ill.*

Circle No. 287 on Inquiry Card.

DIGITAL I/O MODULE

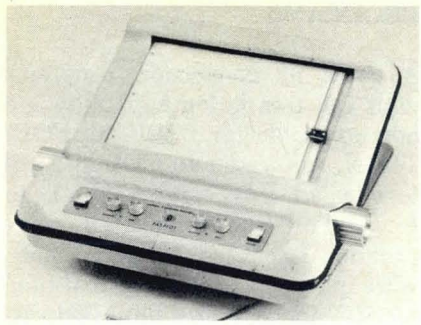
The Varian Digital Input/Output module is designed as an accessory to the Varian 620/i computer. The unit provides the user with a quick and flexible method of connecting instrumentation and equipment with digital I/O provisions to the 620/i. The module is especially useful in setting up experiments, breadboarding prototype systems, and developing specialized interfaces. Special features include buffered I/O registers, flag and reset control lines, lamp display of 16-bit data word, toggle switches for manual data entry, sense switches, sense line inputs, and optional interrupt capability. Normal operation is under program control using the standard 620/i instruction set for data transfer via the unit. *Varian Graphics and Data Systems Div., Palo Alto, Cal.*

Circle No. 290 on Inquiry Card.

TAPE EVALUATOR/CLEANER

"The Inspector," an off-line device, will clean and evaluate a 2400-foot reel of standard half-inch computer tape in 5.3 minues for both directions of travel. It will also print out locations of permanent dropouts on an optional auxiliary printer, if required. The unit's self-sharpening crescent steel blades remove loose oxide and debris from both sides of the tape. Removed debris is carried away by a vacuum-produced airflow. In each direction of tape travel, the oxide side is cleaned by two sets of blades and the plastic base side by one set of blades. Thus, in one complete forward and reverse pass, the tape contacts a total of six sets of cleaning blades – four on the oxide side and two on the backing side. Unlike other computer cleaning machines, the "Inspector" controls tape tension by vacuum pressure. Tension is, therefore, not affected by tape speed or pack radius variations. The vacuum chamber itself senses actual tape tension with a series of photocells, and the unit's servo drive constantly corrects to maintain proper tape tension. No capstans are used and no mechanical strain is placed on the tape. The actual tape tension is adjustable between 6 and 8 ounces. Other features include desktop configuration, IBM-compatible reel hub, and selectable 7- or 9-track format with standard density of 800 bpi; 1600 bpi optionally. Base price of the unit is $6250. *Graham Magnetics Inc., Graham, Texas.*

Circle No. 283 on Inquiry Card.



X — Y PLOTTER

Combining solid state control circuitry with an analog recorder, the FAS-PLOT plotter can either be hardwired to teletypewriter terminals or used off-line with its own 30cps paper tape reader. An automatic segmenting mode may be selected for either the X or Y axis, which enables the plotter to create graphs composed of preset increments representing months, dollar amounts, or anything readily divisible into equal segments. In addition, FAS-PLOT features a tiltable plotting bed up to 90°, and an operational plotting speed of 10 ips. It may be used with any size paper up to 11″ x 17″, and is available with either a felt-tip pen or a liquid ink pen. Complete software packages are available on request. *Omega-T Systems, Inc., Richardson, Texas*

Circle No. 284 on Inquiry Card.

PLOTTER TAPE READER

The MTR-2 tape reader accepts IBM-compatible 800-bpi, 9-track, ½″ tape on 10″ or smaller tape reels. Particularly useful with medium- and large-size computers, the MTR-2 plugs into any digital graphic plotter to form an off-line plotting system. The software provides a single code group: one character will step the plotter one increment. Automatic beginning and end-of-tape sensing is provided. Tape speed is 1.5 ips for 300 increments/second plotter or 6.0 ips for 1200 increments/second. Rewind speed is 100 ips. The price is $11,000 or $550 per month on a lease/purchase plan. *Houston Instrument Div. of Bausch & Lomb, Bellaire, Texas*

Circle No. 311 on Inquiry Card.

REMOTE JOB ENTRY TERMINAL

First product of a new company is the GH-500: a programmable, medium-to-high-speed remote job entry terminal which consists of a CPU with 4K by 8 bits of core memory (expandable to 16K bytes), 400 cpm card reader, 300 lpm buffered line printer, and console typewriter. A communications interface, complete with the software controller to communicate to the central processor of the user's choice, is provided in the basic configuration at no additional cost. Connection may be 2-wire or 4-wire, half or full duplex. Operation is synchronous or asynchronous at speeds of up to 2000 baud on switched network; up to 9600 baud on private wire. Software includes card and conversational assemblers, card and tape IOCS, basic utility system, subroutine library, and the communications controller. Peripherals include card readers, punches, paper tape, magnetic tape, and disk subsystems. Single unit purchase price is $39,625. *GH Computers, Inc., Los Angeles, Cal.*

Circle No. 336 on Inquiry Card

NEW SOFTWARE AND SERVICES

DATA MANAGEMENT SYSTEM

SYSTEM 2000 is a generalized information and data management system designed to provide rapid and simplified interaction with a large, dynamic data base. The system consists of four separate capabilities, or modules, each of which participates in either the creation or continuing use of a data base. The DEFINE module specifies the names of the various fields within the data base; the LOAD module accepts either a free-field or fixed-field input string of data values for the newly-defined data base, and effects its construction. Existing data bases may be accessed through either the RETRIEVAL module or the UPDATE module. In general, both modules accept commands composed of an action verb, an operation list, and a Boolean expression. System 2000 can be used in either a remote batch or on-line conversational mode. It is currently operational on CDC 6000 computers. *Management Research International, Inc., Austin, Texas.*

Circle No. 363 on Inquiry Card.

INFORMATION RETRIEVAL SYSTEM

An information retrieval system called DARE, which stands for Data Acquisition in a Rush Environment, has been used by attorneys in searching for specific legal cases and has numerous other applications. The system searches an index of keys, which may be conversational English words of up to 46 characters in length, rather than individual records. In addition, the system provides searching by logical expressions, such as "and", "or", and "not." Parentheses may also be used. DARE is provided free to users of Allen-Babcock's time-sharing service. *Allen-Babcock Computing Inc., Palo Alto, Cal.*

Circle No. 351 on Inquiry Card.

GRAPHICS LANGUAGE

PAL for Precision Artwork Language, facilitates the transformation of precision artwork requirements into a set of commands suitable for controlling an automatic drafting system. In essence, PAL serves as a "translator" to automate drafting at the draftsman's level and provide the draftsman with a way to communicate in a natural mode to the computer and automatic drafting plotter. Implemented for the Honeywell DDP-116, CDC 6500, GE 635, DEC PDP-15, IBM 7094 and 360 digital computers, the PAL system consists of two parts: 1) the language specification which defines the elements of the language and explains how the elements of the language can be used to describe artwork requirements, and 2) a computer program (processor) which transforms parts programs written in PAL language into commands for the automatic drafting system. *Automated Graphic Technology, Champaign, Ill.*

Circle No. 355 on Inquiry Card.

PROPERTY RECORDS SYSTEM

Uni-Group, a property information system, mechanizes and allows for: detailed property records with control of acquisitions, withdrawals, disposals, and transfers; automated insurance value computations; controlling historical cost, reserves, and provisions; computing depreciation expense, investment tax credit, depreciation changeover, and recapture; and lease analysis studies. Other possibilities are forecasting cash flow; planning new construction costs based on current values of existing facilities; evaluating division, department, and product profitability; maximizing return on fixed asset investment; and controlling maintenance contracts. *American Appraisal, Milwaukee, Wisc.*

Circle No. 352 on Inquiry Card.

LANGUAGE CONVERSION PROGRAMS

A series of conversion programs with full translation capability are now available for BASIC to FORTRAN, Autocoder to COBOL, Autocoder to BAL, and COBOL to PL/1. The BASIC to FORTRAN program is offered both as a software package and as a real-time service, and operates on a 360 system with a 100K partition. Other translation programs are offered as a service with all or part of a three-step sequence available to clients. The first step is a feasibility study to evaluate potential success of conversion. The second stage consists of a machine translation which accounts for approximately 85% translation. The third step provides a fully operational COBOL Program complete with flow charts and program testing. *CRC Computer Radix Corp., New York, N.Y.*

Circle No. 358 on Inquiry Card.

DOCTOR'S BILLING PACKAGE

A self-adapting medical billing and management system is offered for purchase as a complete service bureau software system as well as a processing service. SA/MED is said to utilize an easily-specified "profile" feature that allows the system to adapt itself to each user's requirements. The profile allows the user to define different parameters for each doctor on the system, such as insurance forms required, report sequence, collection procedures, and other information unique to each doctor or doctor's group. The system will accept an unlimited number of profiles and will adapt itself to each one at execution time. The SA/MED system accepts input from remote terminals such as teletypewriters or Viatron terminals. The system is written in self-documenting Cobol and will operate on any 360/25 or above with a minimum of 48K memory and two disk drives. It can be licensed for a one-time cost of $12,600, or licensed on a use plan for $3600 plus .05 per statement processed per month. *Occidental Computer Div. of Executive Computer Systems, Inc., Oak Brook, Ill.*

Circle No. 370 on Inquiry Card.

STATISTICAL ANALYSIS APPLICATION

A flexible statistical analysis application called CROSUM reads an EBCDIC file and cross tabulates up to six dimensions with up to three levels of control. Cross tabulations and summary tabulations are printed for each unique value of the control field with computed percentages, column totals, and table totals. CROSUM is written in Fortran for IBM equipment in an OS mode. It is priced at $4900 with source decks and documentation. *Diversified Data Services and Sciences, Inc., Bethesda, Md.*

Circle No. 364 on Inquiry Card.

COBAL DEVELOPMENT SERVICE

A new time-sharing service called COBUG (for Cobol debugging facility) provides the commercial user with an integrated system for developing, debugging and testing Cobal programs. The service is implemented on Interactive Data Corp.'s time-shared IBM S/360 Mod 67's using their own proprietary time-sharing software. COBUG supplements the user's in-house equipment by producing Cobol programs which can be run in production on the user's own equipment. *Interactive Data Corp., Waltham, Mass.*

Circle No. 366 on Inquiry Card.

LINEAR PROGRAMMING SYSTEMS

OPHELIE II and OPHELIE MIXED, two large-scale mathematical programming systems, are offered to users of Control Data 6000 Series systems. A linear Programming Subsystem, Matrix Generator, and Report Generator are the basic elements of OPHELIE II. OPHELIE MIXED is an expansion of OPHELIE II that adds to the latter's features the ability for deriving both pure and mixed integer solutions to problems such as forecasting capital investments. *Control Data Corp., Minneapolis, Minn.*

Circle No. 359 on Inquiry Card.

SHIPPING RATE GUIDE

The Numerax "Quick Rate" is a computer-produced and maintained guide of shipping rates for eight separate methods of transportation. The Guide is made available in 8½"x11" loose-leaf form and requires only one rate accessing step for each of the shipping alternatives covered. Each page represents a concise reference of the comparative rates and charges for package and class-rated freight from one pound to trailer load. The essential shipping facts relating to the application of rates are presented for each mode. Guides are produced from 500 origin cities, each containing a set of key origin/destination city pairs, and presented on individual pages. 20,000 destination points are included per guide, arranged in destination city sequence within destination state. *Numerax, Englewood Cliffs, N.J.*

Circle No. 368 on Inquiry Card.

SYSTEM DESIGN SYSTEM

COST is a total service package for automating the design of computer systems architecture including the communications systems, central computer facility, and advanced informations system data bases. COST 11 utilizes a library of simulation models and data base design programs to offer problem solving capability in the areas of computer selection, configuration determination, software design, load balancing, identification of resource bottlenecks, and cost effectiveness trade-off studies. One of the major features in COST 11 is WRAP (Weighted Record Analysis Program), an automated procedure for data base development. Starting with a computerized users' profile that contains a list of data elements, base quantities related to these data elements, and details of all real-time and batch transactions, WRAP helps an information system designer to formulate his optimal data element groupings, logical file organization, and physical record layout and file organizations. *Systems Architects, Incorporated, Braintree, Mass.*

Circle No. 377 on Inquiry Card.

INVENTORY SYSTEM

PROFIT II is an inventory management system that uses magnetic tape and/or disk packs for information storage. The system, which has been developed for Honeywell Series 200 computers, features forecasting techniques that reflect both life-cycle and seasonal trends, ordering techniques for independent or joint item replenishment, and warehouse delivery schedules. PROFIT II is available as a four-tape system that requires a Series 200 computer with main memory of 20,480 characters, a three-disk system with main memory of 24,576 characters, or as a tape and disk system with 28,672 characters of main memory. *Honeywell EDP Div., Wellesley Hills, Mass.*

Circle No. 365 on Inquiry Card.

BASIC COMPILER

A compiler for the Basic language called PENNY:BASIC is said to compile a 250-card program for less than 1¢. This is based on its performance of 125,000 cards/min. on an S/360 Mod. 65. The compiler is "compile-and-go" and currently runs in batch under OS/360. It includes facilities for running many "compile-and-go" jobs in one OS/-360 job step. Minimum core is 25K bytes. Rental is $150/mo. *Schroeder Associates, Arlington, Mass.*

Circle No. 375 on Inquiry Card.

GOVERNMENT MARKETING GUIDE

A marketing notebook entitled "Government-Industrial Complex: ADP Systems, Components, and Consulting Services" describes computer marketing opportunities with the government and with government prime contractors. It identifies computer installations, users, selection and reviewing offices, procurement procedures, and major programs offering subcontracting opportunities. The 1000-page notebook sells for $90. ($175 incl. quarterly revisions and monthly market intelligence reports.) *Stearns House Co., Stamford, Conn.*

Circle No. 376 on Inquiry Card.

NEW LITERATURE

CAPABILITIES BROCHURE

The full complement of services offered by Systems Technology Corp. in all phases of automation, instrumentation, and inspection is covered in a 4-page brochure entitled "Automation Creations." STC capabilities encompass research, development, and manufacturing of custom-designed products for automation, phase-structured systems engineering of analog and digital process control applications, technical consulting, and studies of alternate techniques for improving production and inspection procedures. *Systems Technology Corp., Warminster, Pa.*

Circle No. 422 on Inquiry Card.

DATA ACQUISITION SYSTEMS

A brochure on data acquisition systems entitled "Industrial Information Systems" starts by examining the need and uses for such systems, as opposed to other means of data handling, from meters and recorders to computers. The brochure also describes actual installations in a variety of industries. Other areas in the literature include systems specifications and notes about proposals, manuals, and quality control. *Electronic Modules Corp., Timonium, Md.*

Circle No. 411 on Inquiry Card.

DATA COLLECTION SYSTEMS

Six-page 2-color brochure describes seven families of data collection stations derived from 11 basic subassemblies that can be combined into 41 standard combinations and housed in 5 standard cabinets. Each of the seven series offers a particular combination of basic data collecting and reporting facilities: card input, keyboard input, message-response indicators (illuminated fixed legends), and printed numbers on paper tape. A block diagram shows the linkup of internal and external elements of a typical data collection station. *Decitron Communications Systems, Brooklyn, N.Y.*

Circle No. 409 on Inquiry Card.

CASSETTE RECORDER

Bi-directional operation, read-after-write data guarantee, and interchangeability of Norelco-type cassettes are among the features described in this data sheet on the Cipher Model C200 cassette transport. *Cipher Data Products, San Diego, Cal.*

Circle No. 430 on Inquiry Card.

ROTATING MEMORY

A 4-page brochure on the DISKSTOR 505 Head-Per-Track Removable Media Rotating Memory System consists of a basic technical outline plus an illustrated walk-through of the ten steps required to operate the system. The brochure also contains a separate six-page bulletin that covers general specifications; physical characteristics; environment; typical controller interface lines; a sample data format; typical controller timing characteristics; and disk system interface lines. *Systematics/Magne-Head Div. of General Instrument Corp., Hawthorne, Cal.*

Circle No. 420 on Inquiry Card.

STRIP PRINTER

Four-page, two-color "Spec/Data Sheet" describes KDI Adtrol's new Model SP-1 200 cps electronic strip printer designed and developed for use in a broad range of communications requirements. *KDI Adtrol, Inc., Broomall, Pa.*

Circle No. 414 on Inquiry Card.

GLOSSARY OF TERMS

More than a hundred words are defined in a "Glossary of Commonly Used Computer Terms." Definitions provide cross references, synonyms and/or antonyms, and table illustrations where necessary. In defining abbreviations, root words are given in addition to the explanation. *General Automation, Inc., Orange, Cal.*

Circle No. 410 on Inquiry Card.

DIGITAL DATA ACQUISITION SYSTEMS

"How to Make Measurements Automatically" provides a basic exposition of digital data acquisition systems and explains how they can automatically measure temperature, pressure, force, strain, and other physical parameters. The brochure also provides a detailed system description and lists the considerations involved in selecting the components of an automatic-measurement system. *Vidar Corp., Mountain View, Cal.*

Circle No. 421 on Circle Card.

COLLEGE ADMISSIONS SOFTWARE

Four-page brochure entitled "A CASE Study of a Potential Reject" describes CASE, an acronym for College Application Statistical Evaluation System. CASE is a software package designed to relieve college admissions officers from "red-tape" bookkeeping. The system compiles, computes, calculates, and formats statistical college admission data. *Business Services Div., PHI Computer Services, Inc., Arlington, Mass.*

Circle No. 425 on Inquiry Card.

BUFFER-STORE

A new operator's manual describes the Wiltek DS-3 data storage device for on-line storage, buffering, and data rate conversion. The 8-page brochure reports that the unit stores up to 50,000 characters at a cost of only one cent per bit, and offers read and write capabilities up to 333 cps. *Wiltek, Inc., Wilton, Conn.*

Circle No. 424 on Inquiry Card.

POINT-PLOT "SCRAPBOOK"

A 36-page booklet containing typical "Typagrams" (point-plots) is offered by the Typagraph Corp., manufacturers of a data terminal which types text exactly as a conventional teleprinter, yet also has the capability of producing X-Y plots from time-sharing computer lists. Sample TYPAGRAMS include voltage vs. frequency, undamped transient response, polynomial and cycloid plots, gross margin, cost of sales and pre-tax profits as a percentage of sales, and other scientific and business plots. *Typagraph Corp., San Diego, Cal.*

Circle No. 423 on Inquiry Card.

TECHNOLOGY TRANSFER STUDY

"Survey of an Emerging Service Industry: Technology Transfer" is the title of a fold-out brochure which describes a comprehensive study of this emerging industry and describes several of the leading companies in the field. *TTA Information Services Co., San Mateo, Cal.*

Circle No. 439 on Inquiry Card.

MEDICAL APPLICATIONS

Several operational computer systems using standard display terminals with sophisticated communications devices in the medical field are described in a six-page brochure. Applications described include patient monitoring, a medical information system, and computer-assisted instruction for medical students. *Computer Communications, Inc., Inglewood, Cal.*

Circle No. 413 on Inquiry Card.

SIMULATION CAPABILITIES

Two brochures from Simulation Associates describe the company's capabilities and services. "Instant Preplay" is a basic description of simulation for organizations contemplating simulation work. "Kiviat on Simscript II Plus" is a description of that simulation language written by its architect. *Simulation Associates Inc., White Plains, N.Y.*

Circle No. 419 on Inquiry Card.

VIDEO TERMINALS

The TelTerm family of three desktop video terminals is described in a new brochure. Over 2100 alphanumeric characters can be displayed at one time by the TelTerm terminals, and each model provides blinking and scrolling capabilities, and can display fixed and variable data fields. *Delta Data Systems, Cornwell Hts., Pa.*

Circle No. 405 on Inquiry Card.

STRIP PRINTER

A full-color brochure describes the Clary SP20 digital printer, a compact strip printer designed to handle stock market, inventory, and manufacturing data. The brochure contains electrical and performance specifications, covers both desk- and rack-mount versions, and includes interface information and a timing chart. *Clary Corp., Precision Instru. Div., San Gabriel, Cal.*

Circle No. 403 on Inquiry Card.

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