VOLUME 9, NO. 9

SEPTEMBER 1979

Digital Design

The Magazine of Systems Electronics

Printer Selection

Programmable Devices

Single-Chip 6801 μC

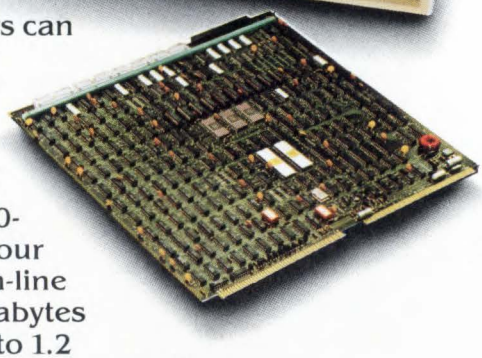
Printer/Plotters

Nova, Eclipse and PDP-11 Users:

TAKE YOUR COMPUTER, ADD ONE BALL DISK CONTROLLER, AND MIX OR MATCH FOUR DISK DRIVES.

At last. Intelligent disk controllers for your Nova/Eclipse or PDP-11. They plug right into the host computer. They accommodate both removable and Winchester fixed media drives. And best of all, they allow intermixing of any four SMD interface-compatible disk drives. That's right, four drives in any mix of standard capacities, transfer rates or organizations.

The new 3255 Disk Controller for Nova and Eclipse
Now, Nova and Eclipse users can meet their particular mass storage needs with a wider choice of drives. The 3255 controller allows intermixing of any four Storage Module, Winchester or 3330-type disk drives (including our own Ball drives) for total on-line storage of up to 1200 megabytes and data transfer rates up to 1.2 megabytes/second. All this from a single board, host-resident controller with the latest operational features.



Standard features: Automatic 11-bit ECC. Self-diagnostics. A 2K FIFO data buffer. Support of multiple record length formats, overlapped multiple seeks, strobe/track offset error recovery, and much more.

The new 3211 Host-Resident Disk Controller for PDP-11
All the same features of the 3255, including drive intermix capability, are available with the 3211 controller for the PDP-11 series. The 3211 emulates the DEC RM02 controller without software modification.

Ball is more than a controller supplier—Add our BD Series 50 or 80 megabyte drives and you have a fully integrated, ready-to-run data storage subsystem. You get a smooth running package with single source responsibility.

Looking for more capacity? Ask about the BD-100.

BALL . . . WHERE QUALITY HAS BEEN A TRADITION FOR 99 YEARS.

Ball Computer Products
860 East Arques Avenue, Sunnyvale, California 94086 (408) 733-6700

Tell me more about:

☐ 3255 Disk Controller for Nova/Eclipse
☐ 3211 Disk Controllers for PDP-11
☐ BD-50, BD-80 and BD-100 disk drives
☐ Data storage subsystems

NAME TELEPHONE

ORGANIZATION

ADDRESS

CITY, STATE AND ZIP

Ball Computer Products Division

Circle 68 on Reader Inquiry Card

Vision One/20

image processing by
COMTAL®

The Versatile "YES" Machine

Professional talk about the most sophisticated digital image exploitation equipment always mentions the leader, COMTAL. ☐ **YES**, and that includes the Vision One/20 with its unique features backed by the experience gained in developing superior image processing systems. ☐ **YES**, Vision One/20 has an exclusive 12K firmware operating system and up to 48 megabytes of dynamically allocatable refresh image memory and graphics. ☐ **YES**, field upgradeability through options such as expandable memory, video input and output, as well as TV rates for videotaping. COMTAL's "**YES**" system requires a minimum of training for effective utilization. Other options such as magnetic tape and disc storage are available. Specialized image processing hardware is available for image arithmetic combination, convolution, Landsat classification, plus small area color correction, and all function in real-time, in 1/30 second. ☐ **YES**, all this—in a system that can accommodate future growth as application requirements expand. Multiple user capability, up to 4 work stations, offers resource sharing. ☐ **YES**, with COMTAL's leadership pacing the state-of-the-art, it adds up to flexibility now—and flexibility later. ☐ **YES**, Vision One/20 image processing systems have dual-ported random access memories starting at 512x512 pixels at multiples of 4 bits of brightness depth, with growth up to 4096x4096-24 bit pixels. ☐ **YES**, random access refresh memories are constantly growing in size and shrinking in cost. Digital image rotation is a reality now. ☐ **YES**, a 24 bit x 24 bit color computer is available for image composition, as is independent arbitrarily shaped small area processing capability in monochrome and color. There's high resolution digital stereo and instantaneous—1/30th second—convolution for filtering. Or, bigger filters exist by recursively iterating and updating kernels 30 times/sec. ☐ **YES**, Vision One/20 provides stand-alone full feature image processing as well as the ability to interface to numerous host computers. ☐ **YES**, dynamic refresh memory partitioning allows for different applications. ☐ **YES**, real-time roaming, with window sizes 512x512 pixels or larger, through the data base, as well as 2X and 4X zooming and 3x3 convolution at 70 MIPS—all implementable in real-time. Ask about the future of image processing from the company with renowned research experts, hardware experts, firmware experts and software experts. COMTAL's field service offices on the East and West coasts are there to help users. ☐ **YES**, successful sales representation worldwide as COMTAL triples its present production capacity in new facilities.

Is all this expensive? ☐ **NO**.....We invite your inquiries—and ☐ **YES**, we have the answers.

COMTAL®

P.O. Box 5087, Pasadena, California 91107
(213) 797-1175; TWX 910-588-3256

METROLOGIE
La Tour d'Asnières, 4, av. Laurent-Cely,
92606 Asnières-France
(1) 791.44.44 Telex: Metrolog 611 448

ROHDE & SCHWARZ
ENGINEERING AND SALES GMBH
5000 Köln 1 Postfach 10 15 44
Sedanstrasse 13-17 Germany
Telefon (Köln 0221) 77 22-1 Telex 8 885 417

Circle 34 on Reader Inquiry Card

WHAT SPERRY UNIVAC IS DOING IN THE MINICOMPUTER BUSINESS.

At Sperry Univac Mini-Computer Operations, we're making some big plans for our future and maybe yours.

The minicomputer industry has been growing by 20% - 35% every year. And as the industry grows and develops, applications for minicomputers appear virtually limitless.

We recognize that the market and the opportunities in the minicomputer industry are vast.

That's why, when we decided to enter the minicomputer market two years ago, we made the commitment to do it right.

OUR BROAD-MINDED PLANS.

Sperry Univac is one of the few companies in the world offering a complete range of data processing equipment from minis to mainframes.

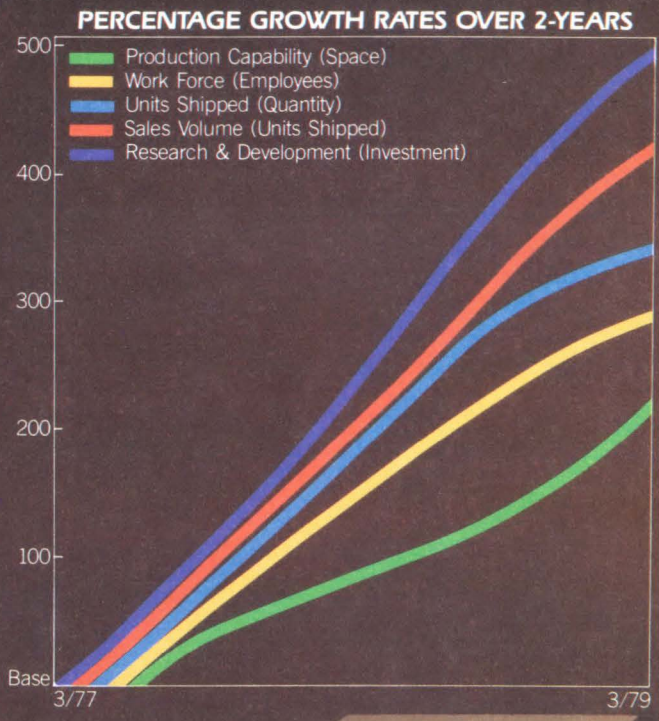
Our goal at Mini-Computer Operations has been to provide our customers with dependable, up-to-the-minute equipment. Equipment that can be readily adapted to incorporate new capabilities and give end users control advantage by standardizing their DDP systems.

Our entire line of minis was designed to let you develop sophisticated distributed networks with Sperry Univac or IBM hosts. Or in both environments concurrently.

And we're still able to deliver our high performance, adaptable equipment with a reasonable price tag.

WE DO IT ALL.

We not only build the minis, we provide complete support with competitively priced peripherals and software. In fact, we offer QL-77, an easy-to-use query language and we were one of the first vendors to provide Pascal.



Sperry Univac was the company that developed SUMMIT, the operating system that allows you DDP capabilities with either IBM or Univac hosts.

And we've recently introduced an array of enhancements and peripherals which include the Sperry Univac Disk Storage System, Serial Printer and the 128KB/256KB Error Correction Memory.

WE'RE GIVING IT EVERYTHING WE'VE GOT.

We have to. We have a reputation to uphold.

In just two years our Mini-Computer Operations production facilities have more than doubled. We've grown out of three buildings into 11 and nearly tripled our work force.

But most important to our current and future customers, our research and development budget is five times what it was just two years ago.

YOU'RE NEVER FAR FROM SERVICE.

The Sperry Univac sales and service network is one of the largest and most responsive in the world. With over 8000 customer engineers available to keep our minis up and running, we can provide prompt, complete service worldwide.

And that service is the finest available. We've established a major computer education center in Princeton, New Jersey and several regional training schools throughout the United States and Europe. Our educational system insures the degree of excellence and competency in our service staff necessary to maintain our equipment at peak performance.

PUTTING IT ALL TOGETHER.

At Sperry Univac we have a reputation for quality, performance and service in the computer industry.

That's why we've committed ourselves to a major investment in production facilities, quality control and worldwide service. Our goal is to produce a complete line of dependable, reasonably priced minicomputers and peripherals that are as respected as Sperry Univac mainframes.

We plan to become a big name in minicomputers by doing all the little things right.

For more information, write to us at Sperry Univac Mini-Computer Operations, 2722 Michelson Drive, Irvine, California 92713. Or call (714) 833-2400, Marketing Communications.

In Europe, write Headquarters, Mini-Computer Operations, London NW10 8LS, England.

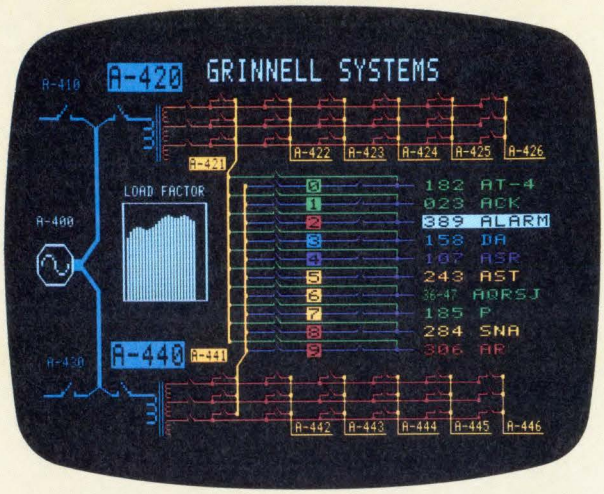
In Canada, write Headquarters, Mini-Computer Operations, 55 City Centre Drive, Mississauga, Ontario, L5B 1M4.

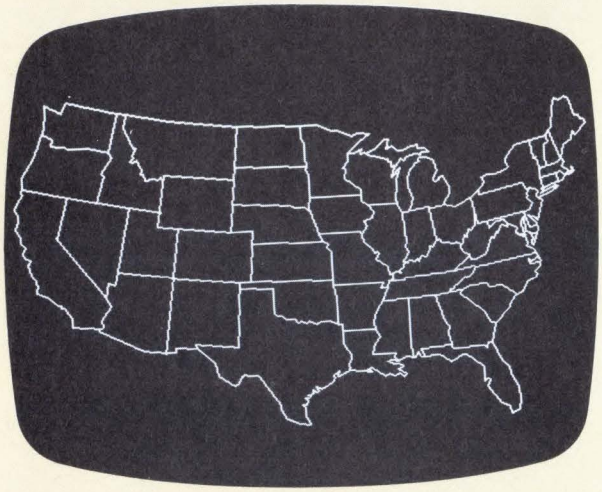
SPERRY UNIVAC

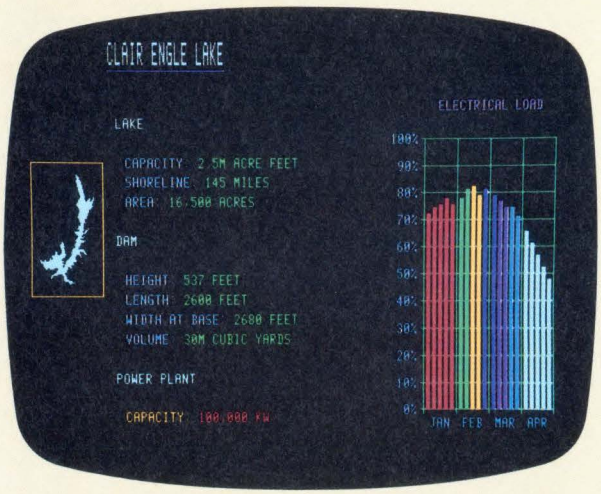
SPERRY UNIVAC IS A DIVISION OF SPERRY RAND CORPORATION

Circle 23 on Reader Inquiry Card

Vector graphics. OEM prices.







Now, with Grinnell's GMR-37 graphic display systems, you can have the resolution and input advantages of dot matrix television for about the same price as more limited character-based systems.

And, every GMR-37 display is a complete operating system: display generator, MOS refresh memory, vector and rectilinear graphics, alphanumerics in 4 sizes, bi-directional RS-232 computer interface and RS-170 video interface. Systems, including power supplies, are housed in a 7″, rack-mountable chassis and drive standard closed circuit monitors.

Four basic GMR-37 models can be tailored to fit into almost any computer-based system. Here are just a few examples. (Prices are F.O.B. San Jose, and quantity discounts are available. TV monitors are extra.):

GMR 37-20: $3700
256 x 512 resolution, one channel RGB color plus blink. (Two channels: $4500)

GMR 37-30: $4500
512 x 512 resolution, one channel RGB color plus blink.

GMR 37-60: $4700
1024 x 1024 resolution, one channel B/W.

In addition, you can also have several economical options: independent cursors, joysticks, keyboards, special character sets and 16 bit, plug-compatible parallel minicomputer interfaces.

Further, if you ever want to move up, Grinnell has a complete line of larger systems—all software compatible with the GMR-37—to do things like animation, image processing and real-time frame grabbing.

So, if quality graphic displays are important to your product, look at the GMR-37 line. For a quotation on the system that meets your specific requirements, call or write.

GRINNELL SYSTEMS

2159 Bering Drive, San Jose, California 95131 (408) 263-9920

Circle 24 on Reader Inquiry Card

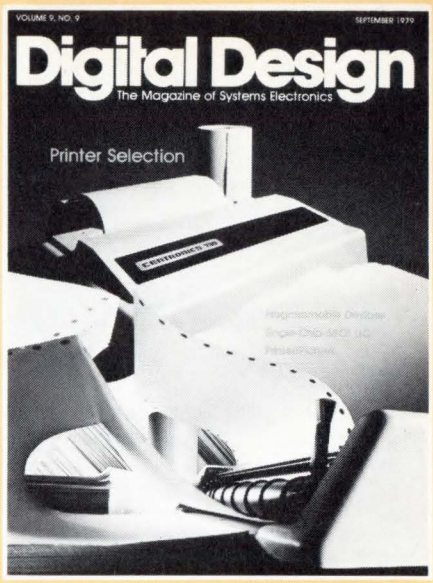
VOLUME 9, NO. 9 SEPTEMBER 1979

Digital Design

The Magazine of Systems Electronics

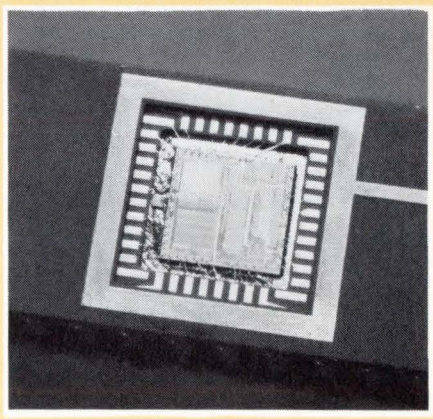
Features

Departments



ON OUR COVER

Printers have evolved to more capable and flexible units over the past decade. Our thanks to Centronics Data Computer Corp. for providing the photographs. Cover design by Richard D. Sarno.



DIGITAL DESIGN
Publication Number: USPS 407-010

Published monthly by Benwill Publishing Corp., a Morgan-Grampian Company, 1050 Commonwealth Ave., Boston, MA 02215. Application to mail at controlled circulation rates is pending at Long Prairie, MN 56347.

Digital Design

The Magazine of Systems Electronics

Publisher Yuri R. Spiro
Editorial Director George King
Editor Paul Snigier

Managing Editor Vic Farmer
Special Projects Editor Israel Katz
Associate Editor William Belt
Associate Editor Harry Shershow
Assistant Editor Katsuzo Suzuki
Art Director Richard D. Sarno

Staff Artists

David Bastille, Sue Genser, Steve Fischer, Josh Randall, Donni Richman, Susan Ross

Production

Sarah Jeweler, Jonna Yager

Circulation Manager

David L. Harriman

Circulation

Sue Duchin, Regina Harrington, Elli Holman

Editorial Assistants

Cheryl Dunphy, Julianna Crosier, Linda Ketchum, Claudia Majetich, Susan Hull, Chan Wedemeyer

General Administration

Sarah Binder, Don Schaff, Martha Hawkins, Sena Shaffer, Maureen Riordan, Marlene Stibal, Esther Shershow

Editorial Offices

Publishers Office: (213) 478-3017
Western Office: (714) 675-7123
Eastern Office: (617) 232-5470

Director of Publications Harold G. Buchbinder

SUBSCRIPTION POLICY

DIGITAL DESIGN is circulated only to qualified research, development and design engineers in all branches of industry, government institutions and universities. To obtain a complimentary subscription, request(on company letterhead) a qualificaton card from Circulation Director. For change of address, attach old address label from recent issue to new company letterhead or note telling us what your old address was. Send this plus request for new qualification card to:

Circulation Department
DIGITAL DESIGN
1050 Commonwealth Ave.
Boston, MA 02215

Subscripton rates: Domestic subscroptions for non-qualified subscribers, groups, libraries or companies, $25/yr. International subscriptions, $35/yr.

DIGITAL DESIGN solicits editorial material and articles from engineers and scientists. Contributors should submit duplicate manuscripts typed with two spaces between lines. All illustrations should be clear; components on all schematics and line drawings should be labeled. The editors assume no responsibility for the safety or return of any unsolicited manuscripts.

BPA CIRCULATION: 54,369 (JULY, 1979)

Published monthly by Benwill Publishing Corporation, a Morgan-Grampian Company, Harold G. Buchbinder, Chief Executive Officer; George Palken, President; Domenic A. Mucchetti, Treasurer; Executive, Editorial and Subscription Offices, 1050 Commonwealth Ave., Boston, MA 02215. Telephone: (617) 232-5470.

OUR PDP-11* MAGTAPE CONTROLLER IS GOOD AS GOLD

every two hours of every working day somebody puts a TC-130 on a PDP-11 computer

Here are just a few of the reasons why more people put TC-130's on their PDP-11 systems than any other magtape controller:

- Software compatible – embedded design
- Mixed density – 1600 bpi PE and 800, 556, 200 bpi NRZ
- Intermix 9 track and 7 track, up to 8 drives
- Fits all PDP-11 Series Computers
- Dual speed – switch selectable, 12.5 to 125 ips

SEND FOR COMPLETE INFORMATION

western peripherals

Division of WESPERCORP

(714) 991-8700 • TWX 910 591-1687
Cable WESPER
1100 Claudina Place, Anaheim, CA 92805

Western Peripherals Service Centers located in:

Anaheim, California (714) 991-8700
Linthicum, Maryland (301) 796-2236
Lewisville, Texas (214) 436-5577
Zeist, Netherlands 03404-21344

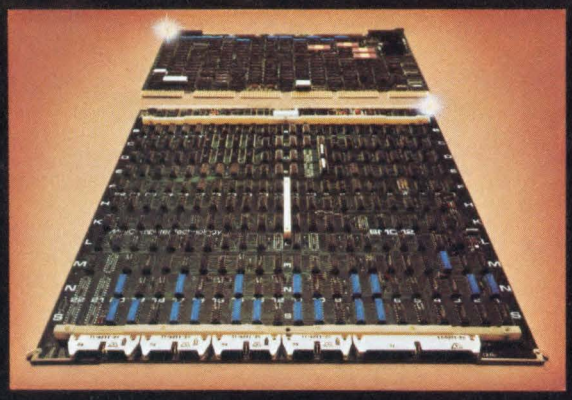
* Trade name of Digital Equipment Corp.

Circle 9 on Reader Inquiry Card

MiniComputer Technology

The solid name in disk controllers introduces two smart new single boards. For DEC and Data General.

Above,
the SMC11 (DEC)



Below,
the SMC 12 (DG)

They're ready for delivery now. Intelligent storage module disk controllers with multi-drive capability, multiple sector transfer, and hardware error correction. They come complete with cables and manuals. For $3580, quantity one.

These controllers are substantial achievements. But then we've been making single board disk controllers for DEC, Data General, and Interdata systems for over four years. And more than three thousand trouble-free units are out there working now.

Mail us the coupon and we'll send you the full story. Give us an order and within thirty days we'll have as many of these disk controllers as you want on your loading dock or on your desk. That's not just a promise. It's a solid guarantee.

MiniComputer Technology

2470 Embarcadero Way, Palo Alto, California 94303, (415) 856-7400

Name _____

Title _____

Computer Type _____

Drive Type _____

Company _____

Address _____

City _____ State ____ Zip _____

Telephone ( ) _____

Circle 2 on Reader Inquiry Card

Interdata people,
ask about the SMC903.

Our raster-scan systems are fast becoming leading contenders for top honors in the digital computer graphics and image display field. The clarity and conciseness afforded by monochrome resolutions as high as 1280 X 1024 and full-color versions to 1024 X 1024 pixels, are good reasons why. There's many more . . . let's peruse just a few.

16-Bit High-Speed Programmable Processor.
Consisting of 16 general purpose and 9 operational registers, plus a set of 55 mnemonic instructions, along with 16-bit writeable control storage, the processor can manipulate data at internal cycle rates of 150 ns.

And it provides automatic DMA access, selective erase, user selection from a range of over 16-million different color intensities, plus flicker-free operation.

Modular, Versatile Hardware.
Since Genisco's systems are capable of being expanded from a single monochrome memory plane to a number of planes that support the full range of gray scales or colors required, you can inexpensively start-out and add-on as needed. Our monitor control module lets you operate up to 12 monitors, mix TV/Video and remotely monitor — as well as fill areas outlined in the bit-map memory — and allowing RS232 interfacing with a keyboard, trackball, joystick or graphics tablet.

Genisco also provides a full complement of standard minicomputer interfaces or can economically build one to suit. Scroll/Zoom and high-speed Character-Vector Generator hardware are also available.

Cost-Effective Graphics for the OEM.
For applications where minimal cost without sacrifice in performance is a major consideration, Genisco offers the GCT-3400 OEM models.

FORTRAN Software.
In addition to the Basic Graphics instructions and diagnostics provided with the system, Genisco offers GRAFPAC II, the most comprehensive FORTRAN Callable Subroutine Package available for raster graphics.

Since space does not allow for greater enumeration of the many ways your computerized displays can be truly picture-perfect, contact Genisco — a name that has stood for technological expertise for over 30 years — 17805 Sky Park Circle Dr., Irvine, CA 92714, (714) 556-4916.

High-Resolution.

It's just one way Genisco makes your pictures perfect.

The Perfect-Picture People

GENISCO COMPUTERS

A DIVISION OF GENISCO TECHNOLOGY CORP.

Circle 45 on Reader Inquiry Card

Letters

Flat Panels Improving

Dear Editor:

The article "Intelligence: How Will It Affect Alphanumeric and Graphics Terminals" (by P. Snigier) in the July 1979 issue (pp. 76-79) will help readers delineate between dumb, smart and intelligent terminals. Although we agree with your comment that plasma panels have (to date) not significantly impacted the terminal market, your readers should be made aware of current developments.

Specifically, our new VuePoint terminal (Digital Design, April 1979, pg 50) offers many unique "intelligent terminal" features. The use of plasma-panel display and touch-input sensor combine to produce a terminal unit less than 3" thick – a feature that offers excellent mounting flexibility.

Other features – such as user-definable character sets, echo-mode response, selective touch sensitization, multiple (up to 51) display pages, dual blink rate, dual intensity, protected fields, right-to-left entry, cursor positioning, scrolling, character and column tabs, page copying, and keyboard and printer ports – certainly qualify such a terminal as an Intelligent Terminal with human factors performance.

Dr. Russel A. Reiss President
General Digital Corp.
E. Hartford, CT

TMS9900 A Turkey?

Dear Editor:

The TMS9900 is a turkey. I have designed and programmed with it; it has no Ret. Opcode and communicates to parallel and serial devices in serial via CRU line. Although it's available in two distinct technologies (I^2L and NMOS) and is well-suited to space and military applications (where ability to dynamically trade power for speed can be exploited), I still think you wasted good article space on it in "Microprocessor Selection: Some Do's and Don'ts" – Parts 1 and 2, by P. Snigier, April/May. By the way, whatever happened to the one-chip 9940? Shades of phantom ICs.

K. Hine
Cencom Systems, Inc.
Houston, TX

Judge By Competence

Dear Editor:

The letter from Skokie (May) on open universities points to the whole question: engineers arguing over diplomas, who is smarter and belittling the working technicians who often do the work of engineers. Engineers miss the whole point that individuals should be judged on competance – not a piece of paper they earned 20 years ago. Maybe engineers have sat behind their desks far too long, thinking that they're the top of the heap.

R. Ribkeck
PCB Piezotronics, Inc.
Buffalo, NY

Why 6502 Omitted?

Dear Editor:

In the beginning of Mr. Snigier's article, "μP Selection: Some Do's and Don'ts" (April and May), the 6502 is mentioned as a commonly-used micro. Although the 8080 and 6800 and other micros are compared, nowhere in the remainder of the article is the 6502 actually assessed. Could you expand the series?

Augustus J. Donnell
Arradcom, Inc.
Dover, NJ

AIOU Strikes Again

Dear Editor:

AIOU (Clayton University) is obviously a product of the minds of those that dwell deep in the vowels of modern society.

M. Rackin
Motorola, Inc.
Plantation, FL

Reform Possible

Dear Editor:

Wake up the IEEE members and this will make the reform possible!

Hans R. Meyer, PE
Polara Engng. Inc.
Santa Fe Springs, CA

Not From A Soapbox

Dear Editor:

I was encouraged by your Speakout, "A Question of Conviction," in the June issue. I have been working for years to reform IEEE from within, rather than from a soap box. You wouldn't have any professional activities today without polls like yours and activists working within the system, like me. Let's work together, especially if (hopefully) I am elected President for next year.

Dr. Leo Young
Executive Vice President
IEEE
345 E. 47th St.
New York, NY 10017

Proposed μP Standards

Dear Editor:

The floating point working group of the IEEE Computer Society's Microprocessor Standards Subcommittee has been working on a proposed standard for microprocessor floating point arithmetic. Several innovative and controversial proposals have been discussed but so far none has been widely circulated outside the working group. Persons interested in receiving the current working documents for the various proposals may write to: David Hough, Box 384, Wilsonville, OR 97070.

Sincerely,
David Hough

Programmable Interface ICs

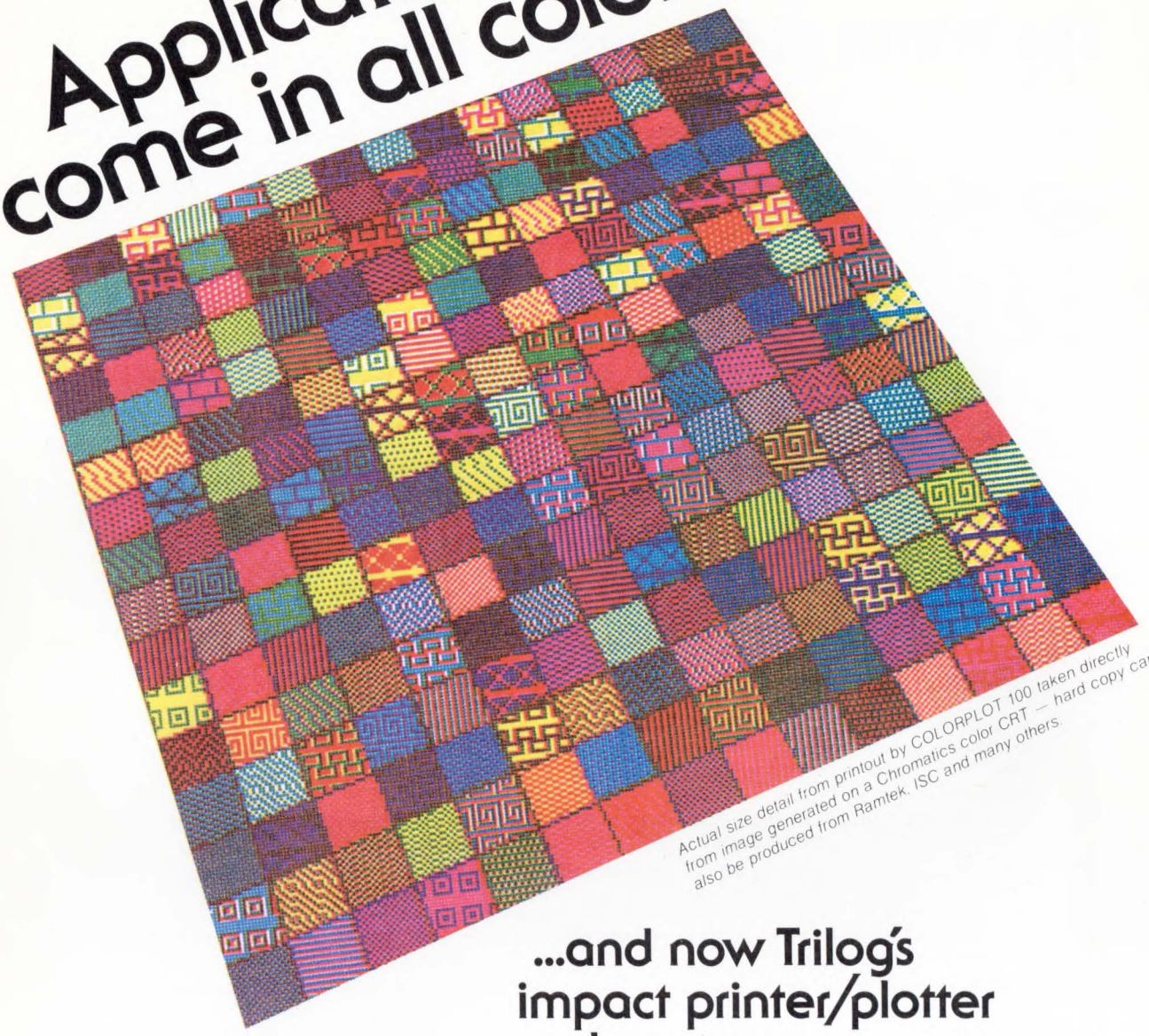
Dear Editor:

The April '79 *Software Design Series*, "Programmable Interface Chips" by Dr. Lance Leventhal and William Walsh, neglected to mention what I consider to be the worst problem in using programmable interface chips. These chips usually decrease the autonomy of software modules that use the device. Function selection, initialization, and even simple I/O for any part of a device is often so related to another part of the device that design of a module that uses the device means updating all other modules that use the device. Sometimes, a few globals will handle the problem; often not. In some multitasking applications the solution costs much, much more than the device that causes the problem.

This problem does not occur because the devices are programmable, but because they were not designed with modular software in mind. Perhaps with enough comments like this one, chip designers will take note.

Sincerely,
Darwin T. Scott
Scott Systems
Albuquerque, NM

Applications come in all colors



Actual size detail from printout by COLORPLOT 100 taken directly from image generated on a Chromatics color CRT — hard copy can also be produced from Ramtek, ISC and many others.

...and now Trilog's impact printer/plotter does, too.

COLORPLOT 100, the world's first multicolor printer/plotter, gives you super-quality full-color printouts on plain paper! Trilog has selected the industry's standard for reliability — the Printronix P-300 — and enhanced it with our own proprietary multicolor ribbon and bi-directional drive system. The result: you get high-resolution 100 x 100 dot matrix images in brilliant color for the breakthrough low price of only $9980. See for yourself — write or call today for your own COLORPLOT 100 sample packet.

TRILOG, 16750 Hale Avenue, Irvine, CA 92714
(714) 549-4079.

TRILOG **COLORPLOT 100**™

Circle 71 on Reader Inquiry Card

Speakout

Paul Snigier, *Editor*

The Winds of Change

Part One

Growing anti-IEEE sentiment among disenchanted and angry working EEs across the nation is reaching a point where the future of IEEE has become a serious concern to IEEE's hierarchy.

After examining the poll results from our readers (*A Question of Conviction?* in June's Speakout), the attitude conveyed to me was that since 96% of responding IEEE members wanted a major reform, they want a change in the way IEEE's hierarchy (all too often corporate executives or academics) run things. Most members (3.3-to-1) wanted reform efforts continued; and almost 1.3-to-1 voted for a new organization – a serious and potentially explosive situation.

Though reader comments are more subjective than our poll, they still gave strong indications of why our readers voted the way they did. Here are several major criticisms listed by our readers:

1. Feeling of exploitation was commonly expressed by readers. EEs are the hardest working of all professionals, often putting in long and uncompensated overtime and studying more on their own time than anyone else. Engineers are America's chief inflation fighters, designing products that help customers cut costs, as the products themselves drop in price. Engineers put more into the system, yet get less from it than their counterparts (with respect to intelligence and education) in every other segment of society.

2. Wage-busting tactics, with greedy contractors taking advantage of the plight of engineers. The result? Fewer jobs, lower pay, longer hours–times that could return again. Other readers asked for portable pensions.

3. Age discrimination. One issue was the forcing of older engineers out of the profession, caused in part by the plentiful supply of lower-paid recent college graduates. Members disdained IEEE's perfunctory lip-service on "over 40" legal actions and wanted less support of campaigns to recruit high-schoolers into college engineering courses.

4. Illegal (?) and surreptitious ads (both in the *Spectrum* and U.S. firms' ads in British papers) that specify age (maximum number of years experience, usually, two to three years).

5. Academics, often in secure and tenured positions, concerned more with keeping classrooms full, even if it floods the market (much to the delight of corporate executives). This over-supply builds up in good times, and then enrollments drop during mass layoffs (about every 5 years – 1952, 57, 62-64, 69-72, 74-75, 80-?).

6. "Impractical" and overly-theoretical articles in IEEE publications, written by academics more concerned with publish-or-perish dictates than aiding the working EE.

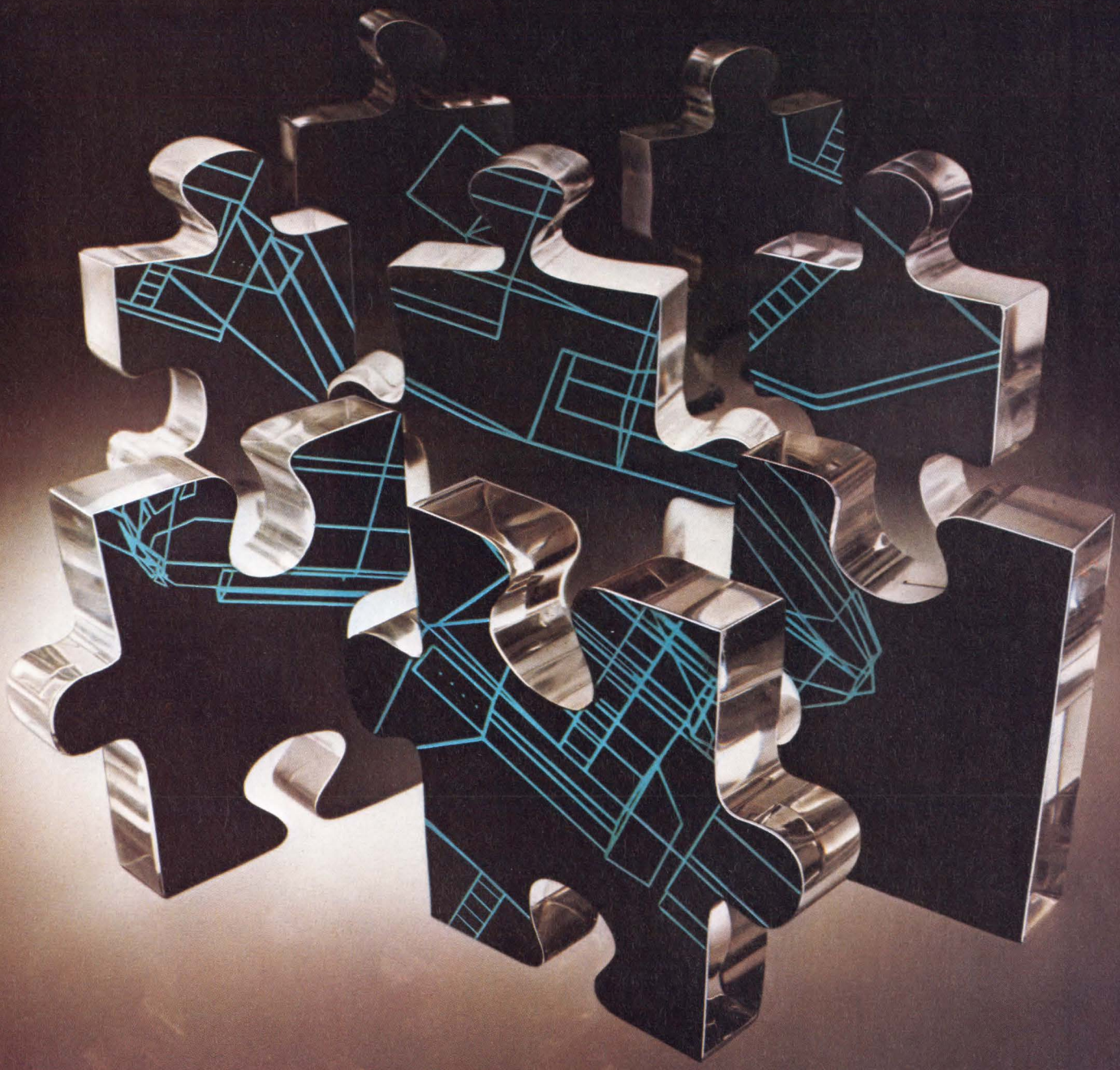
7. Readers asked for restrictions on engineering school enrollment – as done by the AMA. Doctors, lawyers and dentists through their AMA, ABA and ADA (and strong political action and lobbying) strictly control their graduates. One reader suggested that to cut medical costs, academics flood the market with MD graduates (but pointed out that unlike IEEE, the AMA has political muscle to stop any such attempt).

8. Much of the EE/technician shortage is on the West Coast, but is artificial, said one W.C. reader, since prohibitive housing costs now keep outside EEs from migrating there, unlike the 1960s. He suggested that firms double EE salaries; "then EEs would scramble to get out here, thus rapidly ending any EE 'shortage' ".

But what is the key motivational factor behind these reader inputs? One reader hit the issue succinctly with one question: "Does IEEE represent the working EE?" Answer: No. Reason: Conflict of interest. Now, would you expect a corporate executive to support a program that might just raise EEs' salaries? Or, can you imagine an academic supporting a program that limits the number of students entering his academic area – his livelihood? Not me!

IEEE has begun listening to its members – though perhaps unwillingly. Irwin Feerst started something that IEEE could not ignore forever. Two candidates for president – Leo Young and Burke Schneider – say that they both oppose IEEE policy and call for major reform. Although an IEEE Vice President for five years and a member of its Board – but accused by reformers of following the IEEE party line and becoming a mere split-the-reform-vote candidate (that is, surreptitiously sponsored by the IEEE hierarchy) – Dr. Leo Young's sudden change in views, for whatever reasons, are still a welcome sign of the growing disillusionment. Candidate Burke Schneider, who is not on the IEEE Board of Directors and is backed by Feerst (who isn't running due to his heart attack), promised that if elected, he will keep his promise to Feerst and make major reforms. Time will tell.

All these events are healthy signs of hope for IEEE. But don't expect any real reform as long as academics and corporate executives dominate IEEE hierarchy, since their interests too often conflict with those of the working EE. History shows us whose interests usually get served first.



WHY PUZZLE OVER PIECES?

See the whole picture on Sanders' Graphic 7

Sanders' Graphic 7 provides the whole picture by drawing bright, crisp vectors and symbols so rapidly that you see all the data you want. Benchmark tests with actual time measurements have proven Graphic 7 to be the refreshed cost/performance leader. This performance spells results for your application.

Convenience? Chances are the Graphic 7 will interface directly to your minicomputer's parallel DMA channel or connect to your mainframe via an RS-232 time-share link. The Graphic 7 dual microprocessors will handle the graphics and let your computer do its job more efficiently.

At Sanders we build graphic displays to tough standards and we support them. The reliability of a solid product backed by a solid organization helps keep your job on track.

To make sure you get the whole picture of performance, convenience, and reliability, call us at (603) 885-5280 and let us arrange a demonstration of the Graphic 7.

Sanders Associates, Inc., Information Products Division, Daniel Webster Highway South, Nashua, NH 03061. (603) 885-5280; TWX: 710-228-1894.

SA
SANDERS ASSOCIATES, INC.

Circle 1 on Reader Inquiry Card

IRIS and POINT 4

The Operating System for Business

Educational Data System's New Supermini

The Unbeatable Combination

A new approach to system building . . .

IRIS is used throughout the world for multi-terminal, real-time applications in business and data base management. Combined with the POINT 4, IRIS supports up to 32 terminals.

IRIS supports Business BASIC, Indexed Random Files, Editor, Assembler, Data Base Management, Report Writer, Word Processing and Business Applications, all operating simultaneously.

The POINT 4 is the perfect complement to IRIS: 400 nanosecond instruction execution; 128K bytes of directly addressable RAM; means for extending the instruction set; intercomputer communication; virtual control panel and built-in diagnostics — all on the CPU board.

The POINT 4 is compatible with a wide range of commercially available peripheral devices, including our Mighty Mux DMA channel multiplexer and Micro-N microprogrammable processor.

Get IRIS, the application software and POINT 4 from the people who created all three and support them best. Or, since they come unbundled, buy only the components you need.

For the whole story on the Unbeatable Combination, send in the coupon or call TODAY . . .

(714) 556-4242

Educational Data Systems
1682 Langley Avenue
Irvine, California 92714

CP49

Name _____ Title _____
Phone _____
Company _____
Street _____
City _____ State _____ Zip _____

Circle 67 on Reader Inquiry Card

Technology Trends

Increased Volume Won't Offset Peripheral Price Reductions

Price cuts in the 1980s in most peripherals, despite expected increases in unit shipments will not compensate for price reductions in floppies, tapes, terminals and printers.

Most types of terminals will continue rapid growth, with the rise being fueled by displacements of other keyboards (particularly keypunches and office typewriters). Demand has outstripped supply in some segments (such as teleprinters) for three or four years; but it's likely the shortage will come to an end as massive new assembly facilities are completed by such suppliers as Data General, Teletype and DEC. Some interesting opportunities will emerge in various types of specialized terminals, particularly portable terminals.

Computer Peripherals in the 1980's

Category	Strongest Sectors	Weakest Sectors
Data Entry	OCR, Sensor-Based Subsystems	Keypunches, Card Equipment
Terminals	Intelligent, Industry-Specialized	Remote Batch, "Dumb" CRT's
Disks Tapes	Floppies, Fixed-Disk Drives	Drums
Data Communications	Multiplexers	Modems
Printers, Etc.	Micro Printers, Graphics Terminals	Plotters

Reel-to-reels survive

Reel-to-reel magnetic tape drives will, ironically, be saved from virtual extinction by the spread of Winchester technology in disk drives. Users of the fixed-disk Winchester equipment will need some form of removable magnetic storage; many will opt for reel-to-reel tape. (Others will choose one of the many attractive cartridge-tape and digital-cassette-tape drives now or soon on the market.) Disk markets in general will remain strong, but skyrocketing growth of "floppy" disk drives will continue. The 8-inch hard disk drive will be used in more microcomputers (particularly 16-bit micros), minicomputers and even low-end mainframes.

"Distributed computing" will lead to a profusion of telecommunications related peripherals and devices in use, but some data communications equipment segments will be held back by availability, at reasonable prices, of services from common carriers for message editing and store-and-forward services. The proposed AT&T Advanced Communications Service (ACS) incorporates the "intelligence" in the communications network, thereby requiring no intelligence in the terminals.

"Spectacular" growth in printers

Mini and microcomputer printers will grow spectacularly, and there will be ongoing opportunities in other printer segments, although the ultra-high speed segment of the market, already occupied by Xerox (9700), IBM (3800), Siemens (ND-2) and Honeywell (Page Printer) may already be too crowded for comfort. Computer-output-to-microfilm (COM) may be at an important threshold, depending upon imminent advances in electronic storage and retrieval of COM images. Computer graphics will move closer to the executive suite due to new software and terminals which will make it easier to output business statistics in the form of graphs/diagrams.

Computer-based equipment, floppies, terminals and printers will begin their entry into new areas – the paperless electronic office and mail, the home and small business trades, and other areas – and this change will affect the electronics profession.

For more information, published in a 278-pg. report, contact IRD at 125 Elm St., Box 1131, New Canaan, CT 06840.

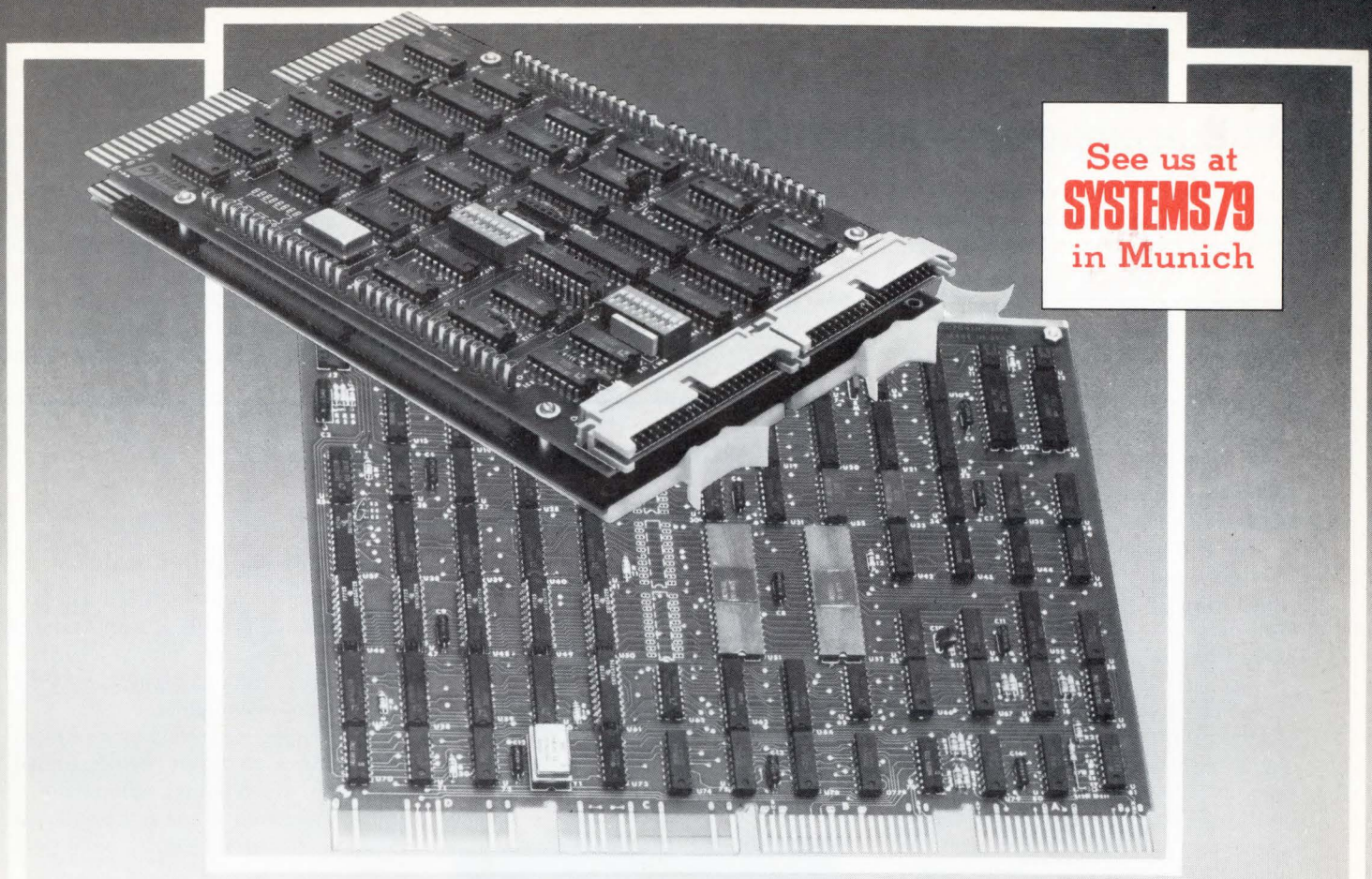
Downturn For Flexible Disk Drives?

The flexible disk drive has moved in seven years from a mere program load accessory on IBM's hard disk units to a solid position in the storage hierarchy of most systems, whether for program load functions, storage of special files on smaller systems at local sites, or backup to hard disk on larger systems.

Market demand for floppy drives in five major systems markets correlated with projected drive deliveries from major manufacturers to yield a three-years drive forecast (IDC, Waltham, MA) that projects a 31% rate of growth for 1979-1981 – certainly no downturn. The flexible disk drives' solid position in the storage hierarchy of almost all system markets yielded worldwide revenues in excess of $200 million to the US-based suppliers in 1978. Shugart is the leading independent manufacturer, while IBM manufactures more than one-half of the captive drive production.

Last year's flexible drive shipments, over 500,000 units, were dominated by 8″ single-sided drives. However, next year should see 8″ double-sided drives gaining a majority share of the 8″ market. Will 8″ single-sided drives fade from view? No, they will still be more cost effective in certain applications.

The 5¼″ drive market will keep accelerating this year, effecting a five fold increase by 1981. Although 5¼″ drives were originally designed for personal computers, 5¼″ drives are beginning to be considered for inclusion in new generation systems in some major system markets. Expect to see some 8″ drive users switch to 5-1/4″ disk drives by 1981. Despite bad experiences with the double-sided floppies, flexible disk drive growth promises to continue unabated well past the mid-1980s.



See us at SYSTEMS79 in Munich

TAPE, DISK, SMD'S...DATARAM KEEPS THEM UNDER CONTROL FOR DEC® USERS

Now you can get the industry's widest range of peripheral controllers for DEC LSI-11® and PDP®-11 from Dataram Corporation — the company that's built its reputation by delivering performance, reliability, and savings on ADD-ON/ADD-IN mini-micro memory and disk emulation systems.

In its second decade of understanding and meeting the needs of end users, OEMs and system houses throughout the world, Dataram now offers DEC users an impressive array of state-of-the-art controllers, based on efficient, high-speed bipolar microprocessors. Controllers that follow in Dataram's proven tradition of providing LSI-11 and PDP-11 users increased performance, improved reliability, denser packing, and dramatic savings.

T03 reel-to-reel/tape controller. Emulates TM11/TU10 magnetic tape system and interfaces to DEC's LSI-11 Bus. The T03 is compatible with all DEC standard operating systems and occupies two DEC dual slots. Operates NRZI, 7 track (200, 556, or 800 BPI) or 9 track (800 BPI). Tape speeds up to 75 ips.

C03 and C33 cartridge disk controllers. The LSI-11 Bus-compatible C03 and the UNIBUS®-compatible C33 emulate DEC's RK-11/RK-05 disk system, and support industry-standard 2.5, 5, 10, and 20 MB drives. Both the C03 and C33 are packaged on a single standard DEC quad board. 1500 or 2400 rpm drives accommodated.

S33 SMD controller. The industry's first single-board software-compatible SMD controller, and it's available only from Dataram. It interfaces to DEC's PDP-11 and emulates DEC's RM02. Operates with industry-standard SMDs. Up to four SMDs per S33 controller. Internal self-test, with LED error/status display, is standard.

They're all ready to plug into your LSI-11 or PDP-11 backplane...they're all totally software compatible...they're all available now...and they're offered with confidence, not promises.

Tape, disk and SMD controllers...three more reasons — with more to come! — why Dataram Corporation is the recognized innovator and leader in mini-micro memory...and its control. And the largest company in the world dedicated exclusively to this important area.

Dataram...the company to call to get your peripheral applications under control.

DATARAM CORPORATION

PRINCETON-HIGHTSTOWN ROAD CRANBURY, NEW JERSEY 08512
TEL:609-799-0071 TWX:510-685-2542

Circle 18 on Reader Inquiry Card

Microcomputer Selection Requires Care

Microcomputers are no bargain. Worse, they often don't deliver as advertised. True or false? All too often, it's true.

Theoretically, microcomputers are supposed to perform many of the same functions – such as inventory control, accounts receivable and payroll – that larger and more expensive minicomputers perform. Unfortunately, microcomputer systems too often don't deliver as advertised, and complaints are being voiced by executives and small business owners.

One complaint is hidden price tags. Microcomputer systems too often cost the buyer far more than he bargained for, and it's quite easy for him to spend several thousand dollars more on peripherals, printers, MODEMs and other accessories. And, with the relatively primitive software available, a small business owner or executive will end up calling in a consultant.

Engineers have also fallen for the siren song sung by the personal computer and small/very small business computer (S/VSBC) makers, who, after all, make their bread and butter from selling hardware; but all too often they tend to gloss over the hidden costs and inadequacies of many S/VSBC and hobbyist microcomputers.

Before you buy . . .

Can the engineer, small business owner or S/VSBC buyer protect himself? What must the S/VSBC buyer or engineer do to protect himself?

First, before buying, be sure to get a complete estimate of total costs. This includes additional equipment installation, maintenance costs, instruction costs, software and so on.

If the micro is intended for S/VSBC environments, consider the micro as only one-third of total costs; perhaps less, if in a personal computing application.

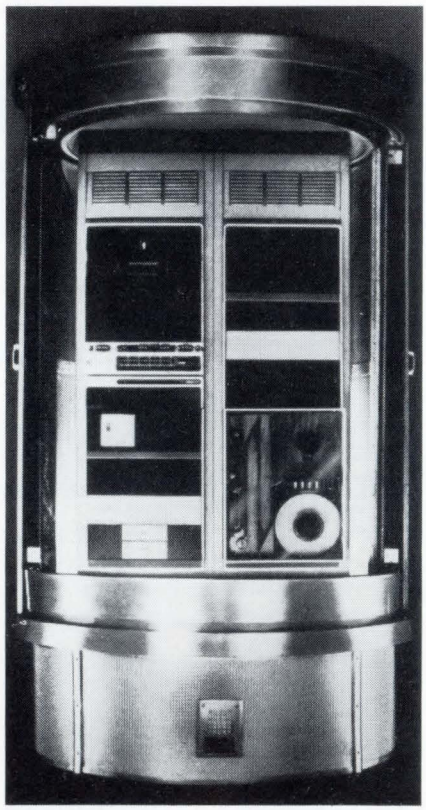
Be sure that the manufacturer is well financed (examine his financial stability) or you risk owning an unsupported system with no manufacturer to repair it, or a system that's provided with less and less support.

Examine the firm's service track record and its inventory. Is it less than illustrious? If so, when your system goes down, can you afford the long delays? Get a written guarantee of service that specifies charges, maximum time for service calls, substitutes and other factors. Check delivery times.

With Texas Instruments entering the personal computer and S/VSBC markets, and with the anticipated entry of other big names (not to mention persistent rumors of IBM's entry), some buyers have taken a wait-and-see outlook, anticipating that the new micro S/VSBC systems are bound to provide more business software packages, more reliable machines, better service and increased power. – **PGS**

Portable Computer Rooms Cut System Costs

Will the traditional computer room with all of its expense and inconvenience ever become obsolete? Perhaps not, but Transaction Security, Inc. has taken a big step in lowering environmental costs with its "Enclosure 48," that goes a long way to replacing computer rooms. It could alter our approach to computer installation, application and security.



Enclosure 48 is wide enough to hold two standard 19"-wide electronics racks. The upper part of the cylinder houses the μP controller, security controls and environmental support systems. Since Enclosure 48 maintains its own internal climate, computers and peripherals may be located in offices, outdoors or in factories.

A portable computer room?

Enclosure 48 – self-contained and prefabricated cylindrical capsule – houses operating minicomputers, tape drives, disk drives, microcomputers, ATM's and other mini equipment.

It provides controlled environment and security to assure uninterrupted operation of computer equipment – and in a fraction of the space and cost required for a traditional computer room.

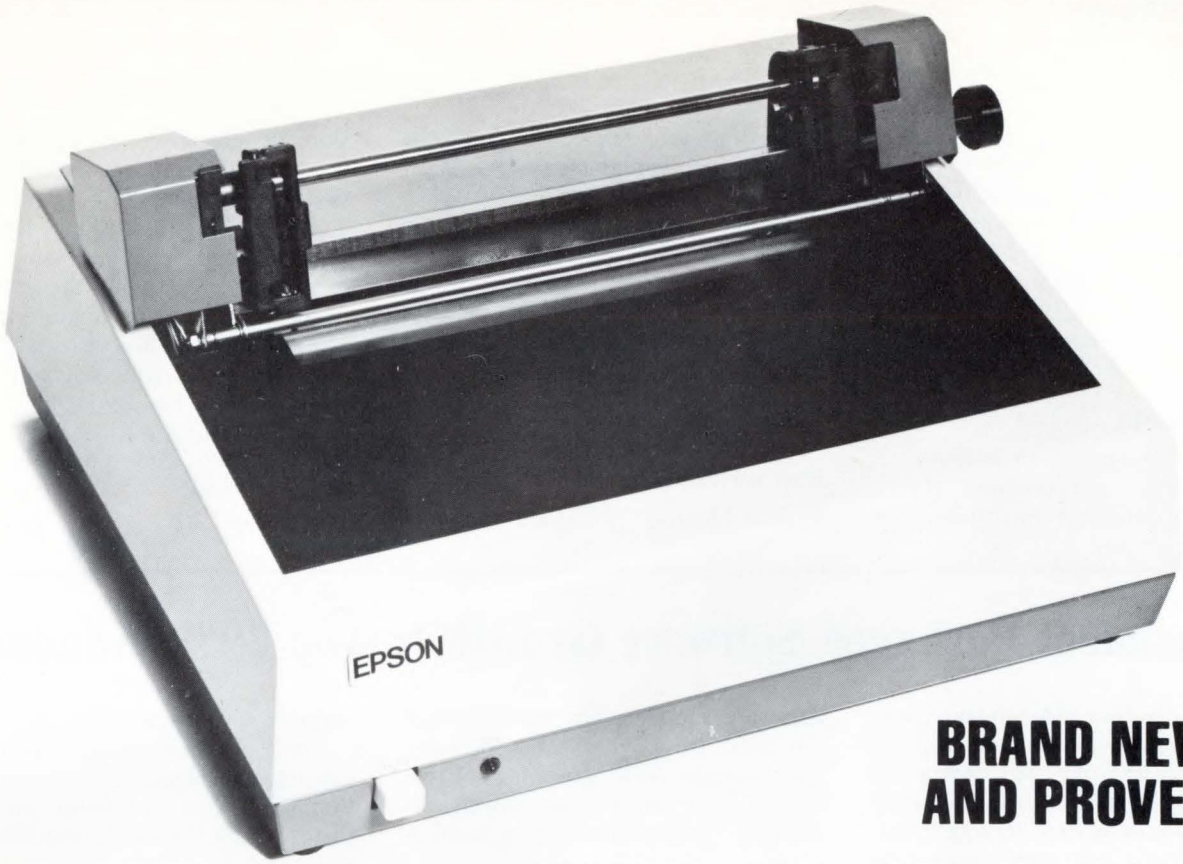
As automated systems make the transition from cloistered computer rooms to the outside world, some system security and environmental control is lost. Minicomputers, support peripherals and transaction terminals are often located in less controlled or safe surroundings.

Each cylindrical Enclosure capsule is 8' high (adjustable) and 5' wide. Its 72" internal height and 51" internal diameter allow storage of two standard, 19" wide racks or system components. A 48" turntable/floor allows equipment contained within an Enclosure to be rotated 180° in either direction for installation or servicing.

Fights fire

Two semi-cylindrical sliding glass doors help control access to equipment, maintain internal operating environment and prevent spread of fire. A transparent, impact-resistant outer door excludes dust, water and static electricity from the Enclosure interior. (When equipped with access control options, this door also excludes unauthorized personnel.) A μP-controlled inner fire door resists fire and explosion.

Under μP control, sensors watch continuously for fire or smoke inside and outside the Enclosure. The micro



BRAND NEW AND PROVEN

TX-80 DOT MATRIX PRINTER FOR OEM

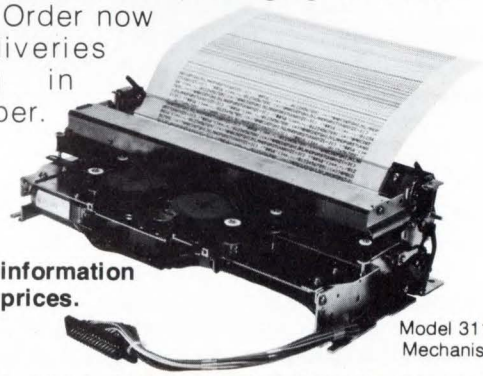
All the advantages of the proven Epson 80-column Model 3110 Dot Matrix Printer Mechanism are now available in our new complete, ready-to-go TX-80 Dot Matrix Printer.

The TX-80, complete with electronics and case, features tractor feed, a 100,000,000 character dot head, and 150 characters per second printing using 96 ASCII characters.

It comes with a connector compatible with either a Centronics plug or an EIA standard 25-pin connector.

Sold to OEM, the TX-80 fills the needs of large and small suppliers who want to avoid the costs of custom packaging and electronics. Order now for deliveries starting in September.

Write for complete information and OEM prices.



Model 3110 Mechanism

EPSON products are manufactured by SHINSHU SEIKI CO., LTD., Japan

EPSON

EPSON AMERICA, INC.

23844 Hawthorne Blvd., Torrance, CA 90505

Telephone (213) 378-2220 · TWX 910 344-7390

New York office: 98 Cutter Mill Rd., Room 350
Great Neck, N.Y. 11021 Tel. (516) 487-0660

Circle 33 on Reader Inquiry Card

monitor closes the inner fire door when fire or smoke is detected, and audible and visual alarms are triggered. If the smoke or fire is within the Enclosure, Halon 1301 fire suppressant gas is discharged within the capsule. So, whatever catastrophe befalls equipmend in one Enclosure, it doesn't spread to other Enclosures.

Self sufficient

Controlled operating environment is provided by a self-contained HVAC heating/ventiliting/air conditioning systems; however, HVAC hookups are provided to a building's system, if desired.

One or more Enclosures may be linked to a TSI Control Console that reports on up to 25 environmental parameters. The console CRT may be located remotely, tied to a hard copy printer. A Portable Remote Monitoring Console can be linked to the Control Console via modem.

Fast installation

Typical Enclosure installation, expansion, or relocation takes from 2 to 5 days vs. the 16 to 18 weeks for traditional installations.

Prices for individual Enclosure capsules and options range from $26,000 to $48,000, depending on models. Each Enclosure unit's depreciable life of at least 7 years qualifies it for a 10% investment tax credit.

Interested? For more information, contact Transaction Security, Inc., 299 Park Ave., New York, NY 10017. (212) 759-8866.

Circle 178

Independent Packaged Software Growth to Top 29% /Annum

Revenues for the independent packaged software market should top the $2 billion market by 1983, with an increase in revenues of approximately 29% per annum growth through 1983.

IBM's decision in 1969 to unbundle software opened the door to the packaged software independents, who were able to offer users not only better quality, but economy as well.

The application software segment of the market will show the greatest growth. Accounting for 47% of total packaged software revenues in 1977, this segment should capture 55% of the total revenues by 1983. But sectors of the utility software market are also showing very strong potential, most notable being report generators and job accounting software packages. Over the next six years, for these sectors, expect to see annual increases in revenues of 38% and 35%, respectively.

Systems software slowest

In general, the systems software market will show the slowest growth rate. The trend toward distributed data processing, however, will boost the demand for communications software, since an on-line, multi-user processing environment requires sophisticated communications capabilities.

Despite the enormous potential in the packaged software market, several factors could limit growth. For example, while user acceptance of packaged software is becoming more widespread, too many users are unaware of third-party alternatives – particularly for application software. Also, many hardware suppliers are waking up to the need to provide good software. For example, NCR and Wang are two in particular who are aggressively developing and/or marketing application software for various functions.

Want more information on the independent packaged software market? Contact IDC at 214 Third Ave., Waltham, MA 02254. (617) 890-3700.

Can Space Collision Experiments Create New Semiconductors?

Can colliding specially-engineered targets and "bullets" at high speeds in earth orbit to achieve pressures far greater than those possible on earth create new semiconductor materials? After completing preliminary studies for NASA, Professor of Geophysics Thomas J. Ahrens of Caltech concluded that the Space Shuttle can orbit slugs of material and targets in opposite directions, and slam them into one another at relative speeds of over 33,000 MPH!

Uses two Space Shuttles

The dynamic pressures and temperatures created – about 20 million times atmospheric pressure at sea level and one million degrees – could manufacture commercial quantities of technologically useful substances that until now have been made only in tiny quantities in laboratories or not at all.

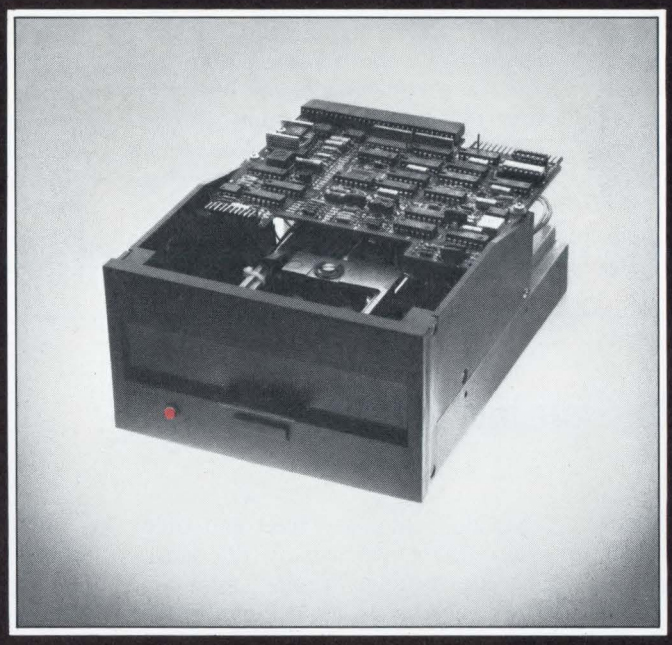
The principal factors making such a system feasible include the near-perfect vacuums available in space, the high speeds of objects in earth orbit, and the availability of the Space Shuttle to carry large payloads into the optimal orbits for collisions.

An experimental impact system in space would involve two shuttle launches, each from Vandenberg Air Force Base aimed southward into polar orbit several hundred kilometers above the earth. Because the launches would be 12 hours – or one-half earth rotation – apart, the earth would turn beneath the first orbiting vehicle, so that the second would end up in orbit in the opposite direction from the first.

From one shuttle a large tank that contains a series of targets would be released. This semi-permanent vehicle, which would remain in orbit after the flight of the shuttle vehicle, would be some 2 m in diameter and weigh several tons. The target, or impact station, would contain instruments for precisely measuring the effects of the impacts, and would be constructed so that the enormous energies of impact would be dissipated by the blasting away of materials such as water ice or dry ice.

Collision timing critical

From the other shuttle, a vehicle would be released that is designed to carry to the target a series of impac-



Simply Better.

Our MPI 52 two-headed micro floppy drive has speed, accuracy, capacity, and simplicity. It's better than any other drive.

Better because it's faster. Five times faster than the next best. Our exclusive band-positioning design ensures track to track access time of 5 milliseconds.

Better because it's bigger. 437.5K bytes per double density disk, unformatted.

And simply better because it's reliable. The MPI 52 has 1½% speed control, no mechanical switches, and comes fully burned in. There are only 10 moving parts, including our front door diskette ejector mechanism.

Order your industry-compatible MPI floppy disc drive. It's the drive for success.

MPI

MICRO PERIPHERALS INC.
21201 Oxnard Street
Woodland Hills, California 91367
(213) 999-1353

European Headquarters: Rose Industrial Estate, Cores End Rd., Bourne End, Buckinghamshire, England. Tel: (06285) 27117. Telex: 849462 TELFAC G

Circle 20 on Reader Inquiry Card

tors of various materials about 10 cm in diameter. The vehicle would alter its orbit to home in on a beacon on the impact station releasing an impactor, or slug, a fraction of a second before impact, and altering its own orbit to miss the target. After a series of such encounters a shuttle vehicle could move in to collect the material resulting from the impact, as well as collect data from the on-board instruments.

First studies prove this a promising method for achieving pressures five to ten times those available with laboratory systems on earth for 100 times longer duration. With such a space system, it would be possible to acquire ultra-high pressure data of fundamental importance to understanding the properties of matter in experimental configurations unattainable on Earth. For shockwave experiments, such a system could also achieve greater precision in producing dynamic high pressures that could earthbound systems.

High pressure forms of abundant materials on earth – including oxides of silicon, tin, germanium, titanium, boron nitride and carbon – are among the possible useful materials. Although the technological value of such minerals is hard to assess (because only small laboratory quantities have been produced), an exception is diamond structures of boron nitride and carbon, which are manufactured commercially and have high value.

Whether or not revolutionary semiconductor materials will be created – or something superior to today's semiconductors – is still unknown. In either case, one thing seems certain: space collision experiments will provide new information to aid semiconductor research.

New Static RAMs Combat Alpha Threat

Paul Snigier, *Editor*

Static RAMs have come under attack from alpha particle radiation, which had previously confined its attack to MOS dynamic RAMs. Intel's 16-bit static RAM, its first to utilize polysilicon load resistors, offers users smaller chip size and lowered power dissipation. Intel found that if the load resistor value was made too large, the ultra-low load resistor current would be affected by alpha particles, even causing the memory cells to change their states.

By limiting the load resistor values, this problem is overcome. EMM Semi, Inc., creator of polysilicon loads, designs higher-speed dynamic RAM resistors up to 1M Ω; its lower-power load resistors, up to 50 MΩ. These loads are three orders of magnitude below Mostek's 4104 4k static RAM, to take only one example, which is designed with 2 GΩ resistors (and also ran into its share of alpha troubles).

Direct solutions attempted

Semi makers are attempting direct and indirect solutions to the threats pose to RAMs by alpha particle radiation. For high-speed RAMs – more susceptible to alpha particle radiation than slower-speed versions–reducing voltage margins makes them even more susceptible to alpha particles.

The most direct approach to alpha particle radiation is to eliminate or minimize the source of radiation. Since the traditional packaging materials used do emit alpha particles in unacceptable amounts, Intel and other semi makers (particularly the Japanese) are testing "cooler" ceramics. Other approaches could minimize the chip surface area exposed to the ceramic.

In another direct solution, Bell Laboratories research showed that electron-holes generated by alpha particles recombine within 1 micrometer in heavily doped regions of semiconductor material. (As a contrast, alpha particles typically travel over 50 μm through silicon.) Bell reduced soft errors by two orders of magnitude by fabricating RAMs with an epitaxial process that places a thin p-layer over a p substrate.

Chip timing the key

Alpha particles create charges near the charge-storage capacitors, which has been known for some time, plus a more recent and annoying effect: alpha particles stopping near bit-sense lines while floating. Altering chip timing could minimize this; if bit-sense lines float for shorter times, this reduces the time during which alpha particles can cause soft errors. Unlike using "cooler " ceramics, this indirect method does not solve the problem itself. With the newer dynamic and static RAMs anticipated to enter the market, a combination of direct and indirect techniques must be utilized to minimize soft errors.

Revolutionary Flat Screen TV Uses Right-Angle Tube

A new flat screen TV, code-named TV2, will soon be manufactured in pilot production quantities. Sinclair Electronics of St. Ives, Cambridgeshire, England, just unveiled the novel flat panel screen.

The secret behind this revolutionary TV is a flat tube in which the beam comes in at right angles – not from the back as in the traditonal tube with its electron gun and electromagnetic deflection coils.

How big is Sinclair's TV? The size of a paperback. Yet with its 3″ screen, it still has better definition than a conventional screen four times the size. The patented process can be adapted to any size screen–a 40″ model could be produced in a few years–and also used for color.

Plans are to commission a highly-automated flat screen TV factory, employing several hundred workers, later this year, according to Clive Sinclair, Chairman of the firm. Although pilot production is proceeding, it won't be until late 1980 before the manufacturing operation can reach full-scale production to meet anticipated demand.–**PGS**

DILOG LSI-11* SMD CONTROLLERS... $1786†...

they interface your LSI-11 to any two removable media or Winchester drives with SMD interface . . . using ONLY ONE SLOT!

Dilog's (Distributed Logic Corp.) New Model DQ-200 Controller not only cuts your LSI-11 SMD controller cost over 40%, it also reduces your Qbus space and power requirements up to 50% or more. In addition, the DQ-200 gives you several new and/or exclusive price/performance advantages too!

QUAD SIZE INTELLIGENT CONTROLLER MODULE interfaces to one slot of your LSI-11—no external power or chassis—just SMD interface cables. And by eliminating space robbing multiple boards, you'll have more room for peripherals.

SOPHISTICATED PROPRIETARY MICRO-PROCESSOR insures long-term reliability.

SOFT SECTOR FORMAT offers you up to 20% more disc storage. That's because you decide on the sector size and number of sectors per track for highest utilization of disc storage and more convenient data base structure. You have exceptional flexibility too—up to 992 bytes per sector—and, if desired, different sector sizes on different tracks. In addition, you get write protect and "bad media" flagging on a sector-by-sector basis. Complete software support available.

AUTOMATIC SELF TEST provided by firmware diagnostics verifies controller operating condition.

ON-BOARD BOOTSTRAP LOADER gives you automatic ease of startup. The DQ-200 loader gives you 128 bytes of spare area for your additional bootstrap feature use.

LOW POWER CONSUMPTION means you have additional available power for other interfaces and expanded CPU capability.

FULL SECTOR DATA BUFFER eliminates CPU I/O bus through-put problems and data late errors.

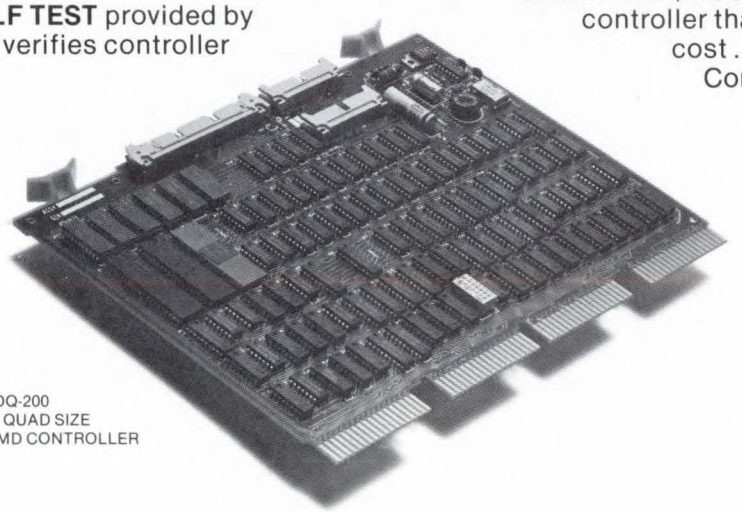
CONTROLS ANY INDUSTRY STANDARD SMD INTERFACE COMPATIBLE DRIVE including Winchester, (SMD) pack, or (CMD) cartridge type drives built by all popular manufacturers.

MIX TWO DRIVE TYPES with a single controller. The two drives may be the same, storage modules of two different capacities, storage module and Winchester, drives having different transfer rates, etc.—offering capacity combinations over 500M bytes.

DUAL PORT OPTION controllers can be used in redundant processor system applications with disc drives having dual port interface options.

ON-BOARD SWITCHES provide you with these features: BOOTSTRAP ENABLE/DISABLE, automatic READ RETRY for data reliability enhancement, and FORMAT PROTECT.

Write or call for detailed product performance data on the $1786.00 DILOG LSI-11 SMD controller that saves power, space, cost . . . ! Distributed Logic Corp. • 12800-G Garden Grove Blvd. • Garden Grove, California 92643 • Phone (714) 534-8950



DILOG DQ-200
SINGLE QUAD SIZE
LSI-11 SMD CONTROLLER

DISTRIBUTED LOGIC CORP.
DILOG

†Qty. 50

*TRADEMARK DIGITAL EQUIPMENT CORP.

Circle 36 on Reader Inquiry Card

MINI-MICRO—Anaheim

Programmable Devices:

Their Advantages and Disadvantages and Programming Equipment – Part 1

William E. Gundling and
Peter A. Schade,
International Microsystems

By selecting PROMs, EPROMs, FPGAs, PMUXs, FPLAs or other programmable logic devices and/or memories, a user can program these devices with selective bits and configure multiple logic elements for specific applications. Despite the increase in architecture being shoehorned into LSI/VLSI chips that are obsoleting large quantities of logic devices – and in fact, largely because of this – the need grows for programmable devices to bridge these large architectural chips together in systems.

In this two-part article, we will examine programming these devices and some pitfalls to avoid. In this part, we will begin by examining the various devices available.

Varying complexity

In the past few years, large numbers of user-programmable devices have flooded the semiconductor market. Users can now select PROMs, microcomputer chips with internal PROMs, programmable digital multiplexers (PMUXs) and programmable logic devices. Each type of device, which varies in complexity, presents the user with a different set of problems.

You program the least complex of these devices, the bipolar PROM, with selective bits created by an irreversible destructive process called blowing. In one product configuration, this process changes an output data bit from a ZERO to a ONE logic level, or vice versa. This is done by opening a microscopic link made from any one of a number of metals or conductive polysilicon, between a row and a column. In this, the npn transistor's collector goes to Vcc; its base, to "row", and the emitter is tied to the "column" through a fuse.

The second major configuration of the bipolar process, called avalanche-induced migration (AIM), selectively shortens transistor junctions between row and column sense lines. Before programming, this can be visualized as two diodes (anode tied to anode) with one cathode tied to the "column" and the other diode's cathode tied to "row." After programming, one diode is shorted, which may be mentally visualized as a diode with its cathode tied to "row"; its anode, to "column."

A brief listing of major bipolar technologies and the corresponding manufacturers includes: for nichrome-based devices, manufacturers are Fairchild, Harris, Monolithic Memories, and Signetics; for polycrystalline silicon, Intel and Harris; for titanium tungsten, National Semiconductor and T.I.; for platinum silicide, Advanced Micro Devices; and for avalanche induced migration, Intersil.

Bipolar PROM (dis) advantages

Bipolar PROMs offer: relatively low access times (20-80 ns for conventional types), standard pinouts for functional operation, ready availability and second sourcing for most devices, high reliability after being programmed, and low price for small configurations (i.e., 32x8, $1.50). Their short programming times permit using IC handlers during processing. Finally, they offer a large variety of configurations from 32x8 to 2kx8.

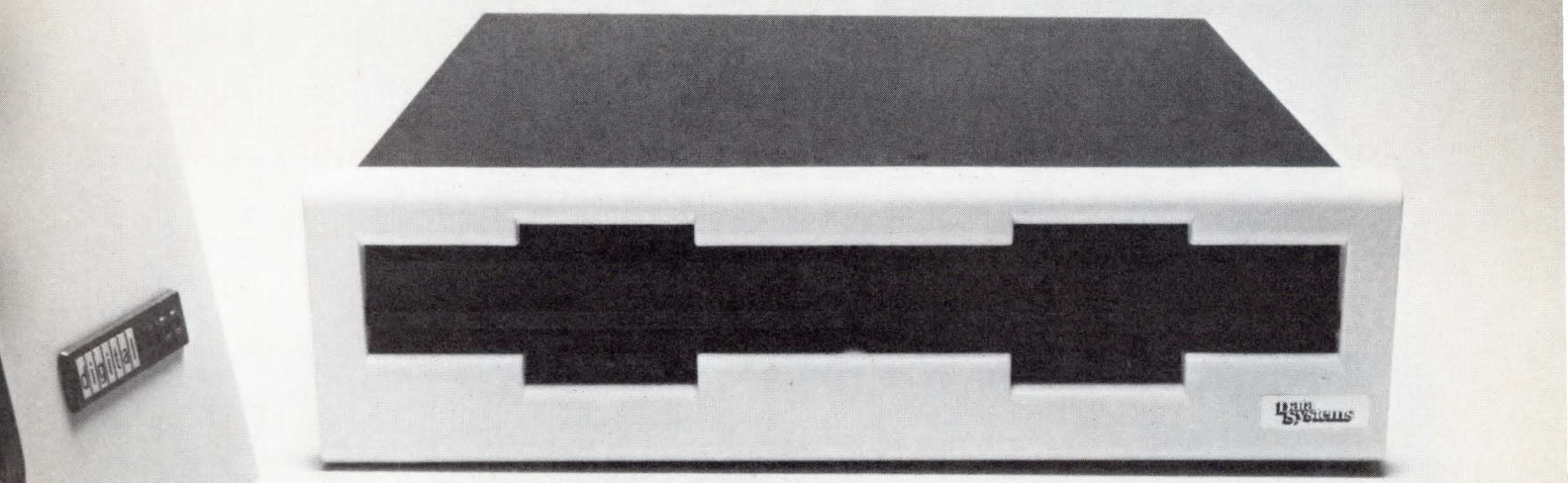
Bipolar PROMs present a number of problems, such as: they generally require complex high energy pulses which, if not properly applied, may produce partially programmed bits or unwanted altering of bits. They may create some confusion, because different manufacturers may make them pin-for-pin compatible in operation, but seldom compatible in programmability. They can fail at a high initial rate – some manufacturers quote typical failure rates of 5 to 15% (improper programming can cause higher rates) Other problems exist: bipolar PROMS are not erasable and can be programmed only once and generally operate at only high-power levels. Then, too, the manufacturer generally changes the programming algorithms frequently.

EPROMs: More complexity

UV erasable PROMs (EPROMs) present the next level of complexity. Unlike bipolar PROMs, the physical mechanism to program EPROMs is a reversible process. Storing a charge on a floating gate of MOS transistor (FAMOS) to create a ONE or a ZERO produces the selected bits to program these EPROMs. Radiation from a powerful ultraviolet light source erases the program by removing the charge, not selectively, but at all locations at once.

Of the three types of available EPROMs, PMOS (P-channel MOS) EPROMs were the earliest devices, developed

THE DSD 440. TOTAL DEC® RX02 COMPATIBILITY,



AND MORE.

The DSD 440 is the only alternative to the DEC RX02 that's 100% software, hardware and media compatible with LSI-11, PDP®-11 and PDP-8 computers, including those with extended memory. It can be configured as an RX02 for DEC double density or IBM 3740 single density recording, or as an RX01 for backward operating system compatibility.

MORE

A 512-byte hardware bootstrap is built into all PDP-11 and LSI-11 interfaces. It loads system software automatically from either single or double density diskettes. Extensive self-testing is DIP-switch selectable with the "Hyperdiagnostics" that run without being connected to a computer. The low profile 5¼-inch DSD 440 features write protection and diskette formatting.

FASTER

The optimized DSD 440 microcode increases system throughput when using the RT-11 foreground/background monitor. In particular, the DSD 440 with an LSI-11 runs fill and empty buffer operations 20% faster than an RX02.

FOR LESS

The DSD 440 is the RX02 compatible flexible disk system that combines high performance and advanced features with fast delivery... at a lower price. For further information, call or write Data Systems Design today. A data sheet and price list will be forwarded to you immediately.

® Trademark of Digital Equipment Corporation

Circle 75 on Reader Inquiry Card

Data Systems

Data Systems Design, Inc.
3130 Coronado Drive,
Santa Clara, CA 95051
(408) 249-9353
TWX 910-338-0249

Eastern Regional Sales:
(617) 329-5730
TWX 710-348-0563

Programmable Device Ratings

Device Type	Second Sourcing	Ease of Programming	Ease of Use	Reliability	Access Times
Bipolar	G	P	G	G	E
MOS PROMs					
PMOS	F	F	F	P	P
NMOS	G	G	F	F	F
CMOS	P	F	P	F	E, G
EAROM	F	F	P	F	P
Microcomputer					
With EPROM	P	F	F	F	F
Logic Devices					
PMUX	P	P	G	G	E
FPGA	P	P	G	G	E
PAL	P	P	G	G	E
FPLA	F	P	G	G	E

circa 1971 (1702), and they generally require very high programming voltages and long programming times. They tend to be leaky and drop bits. They are also quite slow, with access times as long as 1500 ns and require multiple power supplies.

In 1975, manufacturers introduced NMOS EPROMs, which provided faster access times (typically 450 ns), used less power per bit – approximately 1/4 to 1/8 of the earlier PMOS devices, and came in larger sizes (8K to 32K bits). NMOS devices also tend to be more reliable than the earlier PMOS memories. Such PROMs as the 2708 and 2716 are enjoying wide acceptance and are being used in a large range of products. When first introduced, NMOS EPROMS tended to fail at a relatively high rate, but process improvements and better testing methods, such as operating life tests in place of retention bakes, have contributed to higher quality and reliability. The major drawback of NMOS EPROMs is the relatively long programming times (2 to 4 minutes) they require.

One of the latest types of EPROMS, CMOS devices from Intersil, offer the big advantage of lower operating power (30 mW). However, their newness, lack of size selection and absence of second sourcing are the major drawbacks.

EPROM (dis) advantages

EPROMs offer these advantages: they are erasable and reusable, generally use less power than bipolar PROMs and generally available from multiple sources. Their programming algorithms, which are fairly simple, are often the same from different manufacturers.

EPROMS suffer from: long programming times (you can minimize this drawback in production quantities by usin gang PROM programmers), moderate access times and may exhibit poor reliability.

Another type of PROM that is becoming prominent is the electrically-alterable PROM (EAROM). It utilizes MNOS (metal-nitride-oxide semiconductors) technology and is similar to an EPROM, except that the interface between the gate nitride and oxide layer performs the function of a floating gate. EAROMs can be erased electrically by locations or by blocks. General Instrument, Nitron, Nippon Electric and National Cash Register currently manufacture them.

The main advantage of EAROMs lies in the ability to be selectively erased by electrical signals. Unfortunately, few parts are second sourced at the present time. They also require long program and erasure times (1 to 50 ms/word to program, and 10 to 100 ms/word to erase) and access times of 950 ns to 10 ms. Many EAROMs require nonstandard power supply voltages for operation and programming cycles.

Microcomputer chips

At the present time, the most advanced programmable devices are microcomputer chips with an internal,

WE'VE SHATTERED THE MYTH OF DOT MATRIX ALPHANUMERIC PRINTING

Full alphanumerics, without "needles"; with our line matrix impact drum printer.

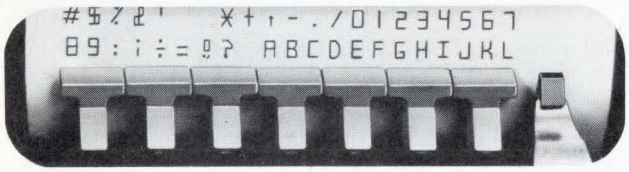
Rugged, reliable, inexpensive—our alphanumeric printer uses "spanning hammers." Each hammer impacts the steel drum to form the characters in three columns. There are no needles to bend, break or jam. Only seven hammers for 21 columns. So it's simple *and* dependable. UL-listed. And, only $140 in 100's.

54 characters, two-color printing in all columns.

Our unique line matrix permits printing of "A" to "Z", "0" to "9", and eighteen other symbols in all columns at printing speeds to 90 lines per minute. Paper feed is fast—to 10 lines per second.

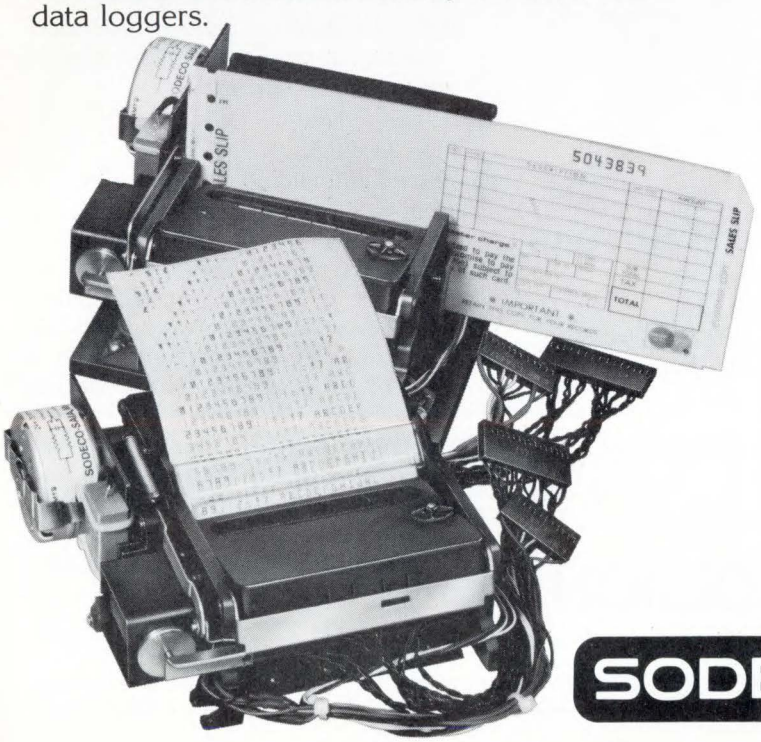
μP compatibility.

Drive the printer with our 8-bit pre-programmed μP-based interface controller. This unit accepts BCD, RS232 and parallel/serial ASCII, and provides signal conditioning, buffer storage, timing control, handshaking, character generation and solenoid drivers. Or, if you prefer, simply use the μP capability designed into your host system.



Tape, tickets, even multiple copies.

In addition to standard plain paper tape printers, we also offer ticket printing mechanisms with multiple-copy capability ideal for weighing systems, medical instruments, P.O.S. terminals, security monitors and data loggers.



Take the first step—evaluation.

For just $325, our engineering evaluation kit is yours. It includes journal printer, interface/control electronics, and custom power supply — everything you need to realize the benefits of drum printer performance in your alphanumeric application. Just return the coupon below, or write or call: SODECO, part of Landis & Gyr, 4 Westchester Plaza, Elmsford, NY 10523; (914) 592-4400.

Yes, I'd like to know more about your Alphanumeric Drum Printer

☐ Please send complete technical information

☐ I'd like a demonstration. Please have sales engineer call to arrange for an appointment.

Application _____

Estimated annual usage _____

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE _____

SODECO® LANDIS & GYR

Circle 59 on Reader Inquiry Card

conventional NMOS EPROM. The added circuitry creates problems during the programming process. Since these devices contain NMOS circuits similar to the NMOS PROMs, they share their advantages and disadvantages.

The Intel 8748 microcomputer family was the first to become available. Other manufacturers are going to make them available soon. They are the Fairchild 38E70, TI 9940 and Motorola 68701. In the 1980s, these devices will become a large part of the market. The complexity and high price of these devices makes the use of commercial PROM programmer almost mandatory.

Other programmable devices

In addition to the programmable memories and microcomputers, a wide range of other programmable logic devices are appearing. They range from the easily-understood programmable digital multiplexer (PMUX) to the highly complex field-programmable logic array (FPLA). The major problem with these programmable logic devices involves generating the program to select the correct blowing location.

PMUXs are devices in which various inputs (e.g., 10) may be routed via programming to a limited number of outputs (e.g., 4). The blowing of diode fuses which are located at the junctions of the input lines opens the bit lines connections.

Field programmable gate arrays (FPGAs) are programmable logic devices in which fuses on the inputs of an AND gate are opened to create the desired function. The major problem relates to how the user converts the Boolean equation to select the fuses to be blown.

Programmable array logic (PAL) also uses programmable AND arrays fed into fixed OR arrays. They may also incorporate additional logic, such as storage registers. The OR gates make PALs somewhat more complex than FPGA.

Field programmable logic arrays (FPLAs) are the most complex of the programmable logic devices. They contain a programmable AND and a programmable OR array. FPLAs present their biggest problem when selecting the correct lines to program from a Boolean equation.

The PMUXs, FPGAs, PALs and FPLAs use bipolar fusable link technology. Their programming algorithms are similar to those used to program bipolar PROMs.

Programmable device ratings

The table shown on page 28 contains a summary of the pluses and minuses of programmable devices.

Here's how we define the five column headings:

Second sourcing. If a type is available from only one manufacturer and if no others offer operationally pin-for-pin compatible devices, the device is rated P (poor); if available generally from two sources, an F (fair) rating; and if a multi-sourced device, G (good).

Ease of programming. If the device generally requires several different programming voltages, fast pulse rise times and parametric testing in the verify cycle, and if it is difficult to generate the data to select the locations to be programmed, the device is rated P. If the device needs only one high voltage for programming and verifying, it is rated F. If the device uses a relatively low programming and read voltage that can be easily derived from stan-


UP
DELICATE INSTRUMENT
FRAGILE - GLASS
REMEX
Peripheral Products
EX-CELL-O CORPORATION

Introducing the Data Warehouse.

Winchester disk plus floppy copy.

Big for its size.

Calling it a "warehouse" may sound like an exaggeration.

But in spite of its mini/micro size, there's room inside for 20 megabytes of fixed Winchester-disk storage with reliability sealed in.

And there's room for one or two of Remex' flexible disk drives, as well. So you can quickly transfer up to 2.5 megabytes at a time from temporary storage to permanent.

High level protocol.

Like any warehouse, it has a front office — our highly intelligent, embedded formatter. This state-of-the-art, 6800-based unit features Channel Command Control, making the Data Warehouse one of the first mini/micro disk memory systems to incorporate a high-level protocol.

40% faster throughput.

Channel Command Control gives you direct memory access, reducing communications with the computer to the extent that throughput is increased 40 percent. It also permits transfer of up to 64,000 words by a single command. And there's a built-in 2K word buffer to provide a constant transfer rate under varying CPU conditions.

Off-line copying.

Data contained on the fixed disk can be copied onto the floppy(s) off-line, without slowing CPU activity at all.

We've packed a lot of unique capabilities, along with a power supply, into a single package that provides big, reliable mass memory performance for minis and micros at an unheard-of price.

Calling it a "warehouse" may be an understatement.

Call us today for full details.
Ex-Cell-O Corporation, Remex Division,
1733 E. Alton St., P.O. Box C19533,
Irvine, CA 92713. Phone: 714/957-0039.
TWX: 910/595-1715.

Ex-Cell-O Corporation

REMEX **DIVISION**

Paper isn't the only thing we look good on.

Circle 10 on Reader Inquiry Card

dard microprocessor voltage supplies, it is rated G.

Ease of use. If the device generally requires several nonstandard voltages to operate in a circuit, it is rated P. If the device requires several standard voltages, it is rated F. If the device operates at standard TTL levels, the device is rated G.

Access times. If the access time is typically greater than 1 ms, it is rated P. If the typical access time ranges between 350 and 500 ns, the device is rated F; between 150 and 250 ns, the device is rated G. A device with a general access time between 20 and 80 ns receives an E (excellent) rating.

Reliability. If the bits in a device depend on holding a charge and the device is known to be leaky, the device is rated P. But if the device is known to be very reliable, it is rated F. If an irreversible physical change takes place to change a bit, the device is rated G.

Programming

A user may program all these devices in one of three ways. He may build his own programmer, ask the distributor or manufacturer to program the parts, or purchase a commercial PROM programmer. The complexity of a majority of the devices makes building an in-house programmer a nonrecommended option. Since allowing a distributor to program the parts is time-consuming and costly, it is recommended only for very large volume needs. If you are planning on using several types of programmable devices, purchasing a universal PROM programmer is probably a wise investment. Depending on your needs, PROM programmers can vary in price between $300 and $10,000. In general, however, most engineers choose to buy universal PROM programmers costing between $2000 and $3000.

For production quantities, an in-house system offers flexibility in programming and quality control. Several gang programmers are available for slower programming devices; several of the universal PROM programmer manufacturers offer interfaces for IC handling equipment as a cost effective means of programming fast programming devices.

Part 2 of this two-part series will discuss commercial stand-alone PROM programmers.

Rate this article: circle 1L, 1M or 1H on Reader Inquiry Card.

Tandberg Data improves the tape drive.

SO WHAT ELSE IS NEW?

Versatility. On an absolutely new level.

With the name Tandberg you expect top performance. Innovation. And versatility. And being a little ahead of the competition in certain fresh and subtle ways. Ditto our new TDI 1050 Synchronous Tape Transport.
When you're a Johnny-Come-Lately with a product line you'd *better* try harder. We did!

Your benefit? Greater reliability, maintainability, and programmability as a result of our microprocessor-based control logic. With its optional *internal* formatter, the 10-1/2-inch-reel TDI 1050 makes your interfacing task a whole lot easier, giving unprecedented flexibility and performance when controlling the reading and writing of data.

With Tandberg's dual-format tape drive, you get both 1600 cpi PE and 800 cpi NRZI at speeds of 12.5 to 45 ips, with rewind speed of 200 ips. And there's no need for customer redesign with the industry-wide compatibility of our interface.

For those who'd like multiple-drive capability in their system, our interface enables you to hook up *four* drives without the need for an outside power source.

Not only is the TDI 1050 less costly at the outset, but its built-in microprocessor is likely to reduce your operating costs. Its attractive design is another appealing plus for systems builders.

A few other goodies are our 5,000-hour MTBF, a dual ceramic-blade tape cleaner, and our proven microprocessor control system. A choice of 7 or 9 track. And IBM geometry provides minimal dynamic skew. Also, a fully documented maintenance manual with all the data and schematics necessary for easy and economical upkeep.

Ensuring you get the performance we specified for our drive, we put each unit through an exacting series of computer tests and burn-in, far tougher than any challenges it's likely to encounter on the job.

Just another tape drive? Yes and no. The task it performs has been around a while. A lot of horses ran a mile and a quarter and then along came Secretariat. Refinements count a lot, regardless of the track. Check out the TDI 1050. It'll change your ideas about what a tape transport can do.

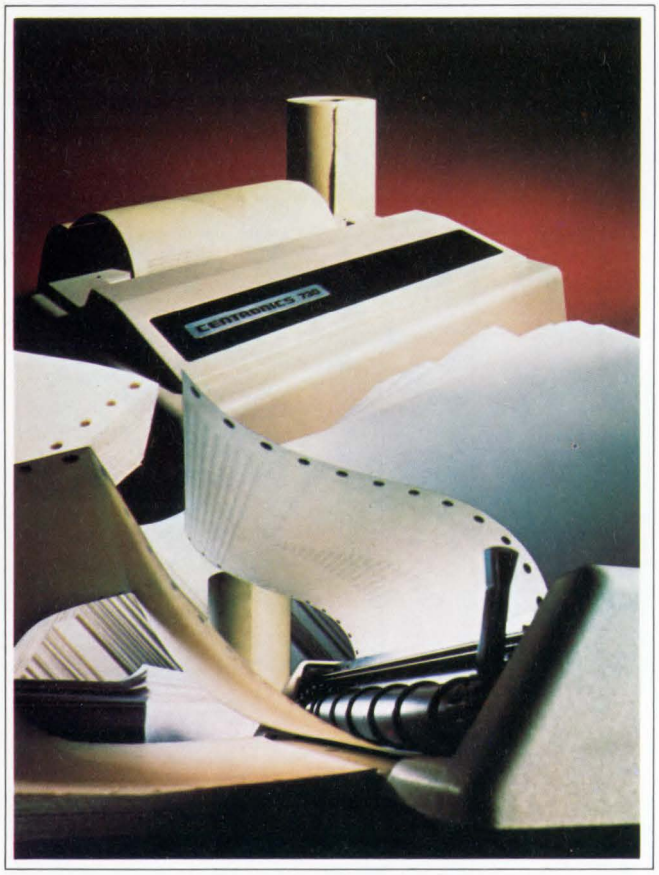
CONTACT: Gary Pyles, Sales Manager
Tandberg Data Inc., 4060 Morena Blvd.
San Diego, California 92117
Telephone (714) 270-3990

Also available now as the Model TDI 1050 Binary Data Logger (BDL), connected typically to RS-232C communication interfaces. Rugged, amazingly simple, and featuring sequenced power-fail recovery, the TDI 1050 BDL from Tandberg Data provides highly compact, non-attended 1600 cpi phase-encoded or 800 cpi NRZI digital data-logging capability suitable for communications systems activity records.

TANDBERG

Circle 17 on Reader Inquiry Card

Which Printer Should You Select?



George Rea
Centronics Data Computer Corp.

"How fast is it and what's it cost?" Although those once were the most important questions asked by everyone examining printers, today, price and speed may be secondary to other considerations.

Just an afterthought? Not today.

If printers are still an afterthought or just a peripheral to you, you won't be as successful in the years ahead. Printers aren't the same: they come in more varieties, from more sources and with more different features.

In the "old" days, systems designers looked at traditional concerns: how much does the printer cost, what is its price relative to the system, what is the potential for "value added profit," how fast is it, how good is the print quality and how long will it last. Today, printers are all of that and more.

While price is still important, an integrator cannot substitute an inexpensive 120 cps thermal printer for a 600 lpm printer just because it's cheaper! We are no longer in the era when everything was matrix and you shopped for the least expensive device. Most manufacturers are quite competitive; therefore, while prices are critical, today they are just one consideration facing you.

In terms of performance, specifically in areas of speed and print quality, you have **more options today** – and with even more tomorrow. There's matrix and fully-formed character generation, impact and non-impact, thermal, electrosensitive, laser, inkjet, chain-train, band line and many more. There are fast and slow printers, matrix and full-formed character printers. matrix printers for good quality printouts and matrix printers for near letter-quality printouts. No matter what you need, there is a printer out there specifically for that application. Be very careful to evaluate your own needs and the printers you think can help, or you may buy a printer with unnecessary capabilities that isn't up to the task or is obsolete.

New printers for new markets

Since the industry is more sophisticated, you must be more sophisticated. Consider how many markets exist today and how they changed – and change each day. A few years ago, there was no computer home/hobby market. Small businesses never considered owning or leasing a computer system until recently. And the minicomputer/microcomputer, terminal, distributed dp, text preparation, dp and other markets are relatively new. Whereas "one size fits all" once applied to this computer and printer business, today's markets and needs have drastically complicated this single-minded approach.

There are at least ten new critical areas the systems de-

The Quietype.™

Now in OEM quantities. Ten years in development. More than a year of demanding field tests by OEMs. That's the Quietype heritage. The result: a reliable easy-to-use ink-jet printer that operates at 180 cps. Silently. Quietype's simplicity has made ink-jet technology practical for a host of applications. Now you can get quick delivery of full-featured printers or mechanisms—in OEM quantities—at sizeable discounts. Call Ed Zschau, our president, for a demonstration. Or write him today. He'll prove that silence is golden. Silonics, 525 Oakmead Parkway, Sunnyvale, CA 94086. (408) 732-1650.

SILONICS
Subsidiary of System Industries

Circle 76 on Reader Inquiry Card

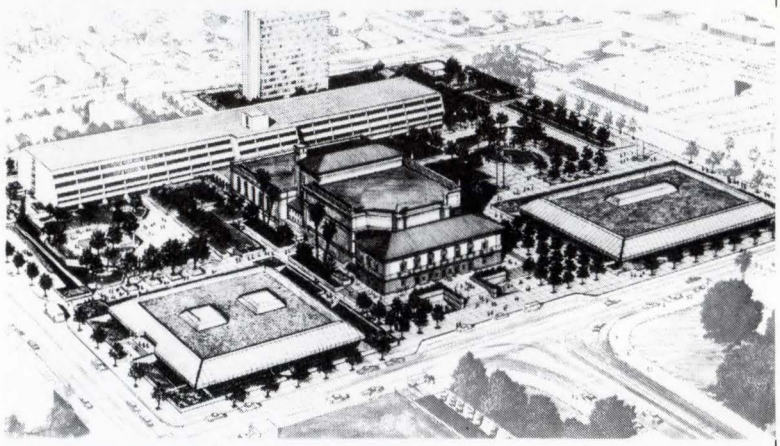
TWO UNIQUE FORUMS
designed for
TEST INDUSTRY PROFESSIONALS

ATE SEMINAR/EXHIBIT

Automated Testing for Electronics Manufacturing

Sixth semi-annual conference promotes development of testing expertise through workshops and technical paper sessions. The latest automatic test equipment from leading manufacturers will be exhibited:

- Handlers
- Burn-in equipment
- Field testers
- PCB assembly testers
- Memory testers
- Systems/bare board/ in-circuit testers
- Cable/harness/ wiring testers
- IC component testers



PLUS!

TEST INSTRUMENTS CONFERENCE

An exclusive four-day forum on the discipline of test instrument technology — the first in the U.S.

Courses, workshops and a large-scale exhibit will run concurrent with the ATE Seminar/ Exhibit at the Pasadena Convention Center. Attendees with interests in test instruments and automated test equipment may partake of the technical fare and exhibits of the ATE Seminar/Exhibit and the Test Instruments Conference. The Test Instruments exhibit will include:

- Bus analyzers
- Network analyzers
- Waveform analyzers
- Logic analyzers
- Spectrum analyzers
- Signature analyzers
- Impedance bridges
- Calibration standards
- Calibrators
- Counters/timers
- Current meters
- Decade loads
- Diode testers
- Distortion meters
- Electronic filters
- Gaussmeters
- Waveform generators
- Signal generators
- Sweep generators
- Function generators
- Pulse generators
- Insulation breakdown testers
- Logic probes
- Microprocessor evaluators
- Analog multimeters
- Digital multimeters
- Ohmmeters
- Oscilloscopes
- Phase meters
- Phase sensitive detectors
- Recorders
- Digital voltmeters
- Analog voltmeters
- Interfaces
- Test hardware
- Test hardware probes

JANUARY 7-10, 1980

Pasadena Convention Center
Pasadena, CA

INFORMATION REQUEST FORM

Please send me more information about each conference I have checked:

- ☐ **ATE Seminar/Exhibit, January 7-10, 1980, Pasadena, CA**
- ☐ **Test Instruments Conference, January 7-10, 1980, Pasadena, CA**

Name _____ Title _____

Company _____ Phone _____

Address _____

City _____ State _____ Zip _____

Principal Product of My Plant _____

Return coupon to: Sheila McDonagh, Benwill Publishing Corp., 1050 Commonwealth Ave., Boston, MA 02215. (617) 232-5470

DD

signer or integrator should carefully examine when selecting a printer today. Keep the customer's application in mind at all times and select a printer consistent with the computer. Otherwise, your system can look like a Volkswagen pulling a Winnebago.

1. Life Cycles and Reliability

How long will the printer last? While it is difficult to determine exactly how long a particular printer will operate before it needs upgrading or retrofitting, printer reliability is probably uppermost in your customer's mind. Printers are mechanical devices; they break down more frequently than completely electronic computers, and if your customer relies on hard copy output, even a temporary interruption in that operation can bottleneck the entire system and your customer's business. It is crictical that you find out all you can about a printer's reliability and expected life. Know its duty cycle. Is the printer expected to operate many hours a day, every day of the week, or will it see infrequent use? Will it be required to generate 10 pages of copy a day? Or 100? Or 1,000? Or more? By knowing the answers to these questions, you can more accurately select the printer which will live up to your customer's demands. Look into MTBF statistics and determine how much the average repair bill is. Some devices are (depending on the technology) harder to repair than others, and some repairs can be very costly.

2. Service Availability and Serviceability

What's more frustrating to a customer than a broken printer? One thing: not being able to get it fixed. Look at the printer vendor closely to see if service has its proper priority. This should influence your decision a great deal – even if you plan to provide the service yourself. Serviceability in combination with life cycles and durability should be uppermost on your mind. In fact, especially if you plan to provide your own printer service, you'll want to find out all you can about the printer's reliability track record. If you select an unreliable printer that can't be fixed quickly, you may lose a systems buyer due to peripheral equipment failures beyond your control. It's bad enough to be blamed for things that are your fault without losing business over failures that aren't your fault.

3. Size and Weight

A few years ago, whoever would've thought a few inches in cabinet dimensions could make a difference. But now that computers are quickly finding their way into the small business office, labs, homes, hotels, stores and numerous other people-oriented places, size is important.

Take, for example, the hobbyists: the part-time programmers or engineers who program their personal home computers at night at home. They want a low-cost, reliable and capable printer – but care about overall attractiveness. The entire system must look right. Hooking a 200 lb. printer to a small system won't work, no matter how inexpensive, capable or reliable. The hobbyist industry has taken note of this and is producing numerous low-cost, portable and user oriented printers.

Size and weight count if you consider walk-in service plans or walk-in service sites offered by some manufacturers. If your user can't move the printer, that's the end to walk-in service. Some sub-categories of size are the printer's styling and its noise, because these factors all are connected. In some markets noise doesn't count; in others, like modern office systems, it will make or break a sale. Never underestimate people's concerns in styling. Does the printer have a textured cabinet which resists fingerprints? With sound deadening insulation? Do these sound a little far-fetched to you? Well, it is becoming the name of the game in the small business and home markets.

4. Interfacing

Does the printer you want come with the interface you need? Will it be a costly addition or an optional extra? Can you buy the same printer with either a parallel or serial interface? Enough said. You know as much about interfacing as the manufacturers do, perhaps more, and you know the headaches it can produce if not carefully considered.

5. Forms Handling

Selection gets harder. The question: "Am I ever going to find everything I need in one printer?" Yes, if you're careful. "Hooks" are the little extras you pay for, but may not need. The trick is to find a printer that does only what you need and not pay for costly extras. You won't be impressed by the useless extras; neither will your systems buyers.

On the other hand, it is extremely difficult for you to know what your customers' needs will be in the future. While a simple forms handling capability may suit your customer's needs today, how about tomorrow? Two critical points should come to mind immediately. First, if your customers are typical, they need a printer for more than one type of output; for example, to generate payroll checks one day, inventory forms the next, and so on. Printers do exist today which take up to three different types of paper – cut sheets, fanfold and roll. Look into paper handling flexibility so you can offer customers the forms handling they want. Second, printer upgradeability is important (more about that later).

Aside from a printer's form handling capabilities, look at its ability to take plain paper; a user can spend more on paper during a printer's lifetime than was originally spent for the printer itself. Special papers are costly and sometimes hard to obtain. There's no substitute for plain paper which is readily available, inexpensive and supplied by numerous competitive sources.

6. Upgradeability

With many small companies emerging today that manufacture printers, keep the future in mind. Systems users today outgrow their computers' capabilities and printers. Just as a small business may begin with a small van for local deliveries and wind up with its own fleet of trucks, these same businesses also start out with small systems and build themselves into bigger, more costly and more capable systems. When the computer becomes more powerful, the printer either must grow with the need or be replaceable easily with a more powerful one. If the printer you select comes from a broad product family which contains several members of varying speed and performance, you can upgrade quickly and inexpensively – without searching out a new printer supplier, learning about a whole new device, re-stocking your spares department and retraining the end user and your salesmen on how to operate a new printer from a different source.

7. Commonality

Must you integrate numerous printers into various systems? For example, you buy three different printers from one manufacturer's family of printers. Or even worse, you buy three different printers from three different manufac-

turers. The critical question is: do these printers share a high commonality of parts? Or, will you be forced to stock three different head spares, maintain three separate service manuals and run three different training sessions for the equipment. Everyone's had a relative, for example, who only bought black socks because he didn't want to worry about pulling out a perfect match from the drawer early in the morning. There's no need to go that far and sacrifice needs for convenience. But do try to keep your inventory lists to a minimum.

8. Availability

It can be the best printer ever seen, but if it isn't readily available, you'll lose systems business. Be careful: look at each manufacturer and ask yourself, "If my business doubles, will this supplier be capable of doubling its printer deliveries to me?" Pay close attention to their manufacturing capabilities, lead times and delivery reputation. Always look into any manufacturer's ability to deliver the product as promised.

9. Distribution Systems

Tied in with availability is the supplier's ability to distribute his product. If you purchase printers in small and irregular quantities, for example, does the vendor have regional stocking distributors with on the shelf printers? If not, do you want to wait for the manufacturer to build the product for you? Very often, through regional distributors, you get fairer and more personal treatment, better credit understandings and improved spares availability.

10. Manufacturer's overall reputation

Never underestimate your supplier's reputation; if it's good, it's an invaluable plus: good reputations are hard to develop. If a vendor has a good reputation, it generally means the company has tried very hard to help its customers. If you consider a printer manufacturer, ask others their opinion of the company. Is it fair and honest? Can the company produce as promised and are the statistics accurate?

Printer complexity grows

When it comes to selecting a printer, you can never do enough homework. Your selection is critical and becoming more so each year as printers become more common, capable and sophisticated. As for the future, your job won't get any easier. If you start your work now, you will be that much ahead of the game as the future unfolds.

Rate this article: circle 2L, 2M or 2H on Reader Inquiry Card.

Buyers Guide to Printer Manufacturers

For information on printers, circle the desired numbers listed here on the reader service card.

Addmaster Corp.
416 Juipero Serra Dr.
San Gabriel, CA 91776
(213) 285-1121
Circle 201

Amperex Electronic Corp.
230 Duffy Ave.
Hicksville, NY 11802
(516) 931-6200
Circle 202

Anadex Instruments, Inc.
9825 De Soto Ave.
Chatsworth, CA 91311
(213) 988-8010
Circle 203

Anderson Jacobson, Inc.
1065 Morse Ave.
Sunnyvale, CA 94086
(408) 734-4030
Circle 204

Applied Computer Systems
248 Sovante Way
Sunnyvale, CA 94086
(408) 733-3733
Circle 205

Applied Computer Technology
1796 F Sky Park Circle
Irvine, CA 92707
(714) 557-9972
Circle 206

Axiom Corp.
5932 San Fernando Rd.
Glendale, CA 91202
(213) 245-9244
Circle 207

Bowmar Instruments
8000 Bluffton Rd.
Ft. Wayne, IN 46809
(219) 747-3121
Circle 208

Business Systems Technology
3015 Daimler St.
Santa Ana, CA 92705
(714) 549-9961
Circle 209

Centronics Data Computer Corp.
One Wall St.
Hudson, NH 03051
(603) 883-0111
Circle 210

Clary Corp.
320 W. Clary Ave.
San Gabriel, CA 91776
(213) 287-6111
Circle 211

ComData
8115 N. Monticello Ave.
Skokie, IL 60076
(312) 677-3900
Circle 212

Computer Devices, Inc.
9 Ray Ave.
Burlington, MA 01803
(617) 273-1550
Circle 213

Computer Terminal Systems
52 Newton Plaza
Plainview, NY 11803
(516) 293-6611
Circle 214

Computer Transceiver Sys. (CTSI)
317 Rte. 17,
Paramus, NJ 07652
(201) 261-6800
Circle 215

Control Data Corp.
1480 N. Rochester Rd.
Rochester, MI 48063
(313) 651-8810
Circle 216

Data Access Systems
100 Rte. 46
Mountain Lakes, NJ 07046
(201) 335-3322
Circle 217

Data 100 Corp.
25 Graystone St.
Warwick, RI 02886
(401) 738-9500
Circle 218

Data General Corp.
Rte 9
Westboro, MA 01581
(617) 366-8911
Circle 219

Data Printer Corp.
600 Memorial Dr.
Cambridge, MA 02139
(617) 354-4700
Circle 220

Data + Technik Corp.
24 Avon Circle
Needham Heights, MA 02194
9617) 444-8360
Circle 221

Data Terminals & Comm.
1190 Dell Ave.
Campbell, CA 95008
(408) 378-1112
Circle 222

Data Test Corp.
2450 Whitman Rd.
Concord, CA 94518
(415) 689-3583
Circle 223

Datadyne Corp.
Bldg. 37A, Valley Forge Ctr.
King of Prussia, PA 19406
(215) 265-1793
Circle 224

Continued on page 42

C. Itoh's Model 8300 printer looks superb.

It works even better.

C. Itoh offers you the perfect OEM printer for general purpose computers, communication terminals, data loggers and micro computers: the Model 8300. This quiet and low-cost unit features a straightforward, reliable design and a continuous-duty 7-wire head with a life expectancy of 100 million characters. Designed with a 7-bit parallel interface, the 80-column, dot matrix Model 8300 prints bi-directionally at 125 CPS. Its sprocket paper feed mechanism accepts multi-ply pin-feed paper in any width from 4.5″ to 9.5″; paper can be loaded from the bottom or rear; and print line position is readily adjustable. The Model 8300 works even better than it looks. Would you expect anything less from C. Itoh? Write today for detailed specifications.

C. Itoh Electronics, Inc.

C. Itoh means excellence in printers.

5301 Beethoven Street, Los Angeles, CA 90066
Call: (213) 390-7778 • Telex: WU 65-2451
East Coast
280 Park Avenue, New York, NY 10017
Call: (212) 682-0420 • Telex: WU 12-5059

C. Itoh Electronics is part of the 119-year-old C. Itoh & Co., Ltd., world-wide trading organization.

Circle 44 on Reader Inquiry Card

Buyers Guide continued

Dataproducts Corp.
6219 De Soto Ave.
Woodland Hills, CA 91364
(213) 887-8000
Circle 225

Dataroyal, Inc.
235 Main Dunstable Rd.
Nashua, NH 03060
(603) 883-4157
Circle 226

Datel Systems, Inc.
1020 Turnpike St.
Canton, MA 02021
(617) 828-8000
Circle 227

Decision Data Corp.
100 Witmer Rd.
Horsham, PA 19044
(215) 674-3300
Circle 228

Diablo Systems (Xerox)
24500 Industrial Blvd.
Hayward, CA 94545
(415) 786-5000
Circle 229

Diamond Engineering
3635 150th NE
Redmond, WA 98052
(206) 883-1071
Circle 230

Di/An Controls, Inc.
944 Dorchester Ave.
Boston, MA 02125
(617) 288-7700
Circle 231

Digital Associates
24 Old Kings Highway S.
Darien, CT 06820
(203) 327-9210
Circle 232

Digital Computer Controls
12 Industrial Rd.
Fairfield, NJ 07006
(201) 575-9100
Circle 233

Digital Equipment Corp.
One Iron Way
Marlborough, MA 01752
(617) 481-7400
Circle 234

Digitec (United Systems)
918 Woodley
Dayton, OH 45403
(513) 254-6251
Circle 235

Documation, Inc.
Box 1240
Melbourne, FL 32901
(305) 724-1111
Circle 236

Electronic Product Assoc.
1157 Vega St.
San Diego, CA 92110
(714) 276-8911
Circle 237

Epson America, Inc.
23844 Hawthorne Blvd.
Torrance, CA
(213) 378-2220
Circle 238

Expandor, Inc.
612 Beatty Rd.
Monroeville, PA 15146
(412) 373-0300
Circle 239

Extel Corp.
310 Anthony Trail
Northbrook, IL 60062
(312) 564-2600
Circle 240

Facit-Addo Corp.
501 Windsor Dr.
Seacaucus, NJ 07094
(201) 886-5111
Circle 241

Florida Data Corp.
3308 New Haven Ave.
W. Melbourne, FL 32901
(305) 724-6088
Circle 242

GenCom Systems, Inc.
2306 Cotner Ave.
Los Angeles, CA 90064
(213) 478-6087
Circle 243

General Electric Co.
Data Comm. Div.
Waynesboro, VA 22980
(703) 942-8161
Circle 244

Genesis One Computer Corp.
300 E. 44th St.
New York, NY 10017
(212) 557-3500
Circle 245

Gould Inc.
20 Ossipee Rd.
Newton, MA 02164
(617) 969-6510
Circle 246

Gulton Industries (MCS Div.)
Gulton Industrial Park
East Greenwich, RI 02818
(401) 884-6800
Circle 247

Hecon Corp.
31-45 Park Rd.
Tinton Falls, NJ 07724
(201) 542-9200
Circle 248

Hewlett-Packard Co.
1501 Page Mill Rd.
Palo Alto, CA 94304
(415) 493-1501
Circle 249

Houston Instrument
8500 Cameron Rd.
Austin, TX 78753
(512) 837-2820
Circle 250

Hycom, Inc.
16841 Armstrong Ave.
Irvine, CA 92795
(714) 557-5252
Circle 251

Hydra Corp.
2218 Middlefield Way
Mountain View, CA 94043
(415) 964-9135
Circle 252

Inforex
21 North Ave.
Burlington, MA 01803
(617) 272-6470
Circle 253

Integral Data Systems
5 Bridge St.
Watertwon, MA 02172
(617) 926-1011
Circle 254

Interdata
(Perkin-Elmer Data Systems)
1 Ocean Place
Oceanport, NJ 07757
(201) 229-4040
Circle 255

C. Itoh Electronics
5301 Beethoven St.
Los Angeles, CA 90066
(213) 390-7778
Circle 256

Juki Machinery Corp.
3186-G Airway Ave.
Costa Mesa, CA 92626
(714) 540-4533
Circle 257

Lear Siegler, Inc.
714 N. Brookhurst St.
Anaheim, CA 92803
(714) 774-1010
Circle 258

Litton Datalog
1770 Walt Whitman Rd.
Melville, NY 11746
(516) 694-8300
Circle 259

LogAbax, Inc.
10889 Wilshire Blvd.
Los Angeles, CA 90024
(213) 477-0494
Circle 260

Logicon/Intercomp
24225 Garnier St.
Torrance, CA 90505
(213) 542-7313
Circle 261

LRC Inc.
Technical Industrial Park
Riverton, WY 82501
(307) 856-4821
Circle 262

Macro Products
3110 Willow St.
Long Beach, CA 90806
(213) 595-6337
Circle 263

Media III
2259 Via Burton
Anaheim, CA 92806
(714) 870-7660
Circle 264

Memorex Corp.
3015 Daimler St.
Santa Ana, CA 92705
(714) 854-3111
Circle 265

Mesa, Inc.
11900 Parklawn Dr.
Rockville, MD 20852
(301) 881-8430
Circle 266

MFE Corp.
Keewaydin Dr.
Salem, NH 03079
(603) 893-1921
Circle 267

Microdata Corp.
17481 Red Hill Ave.
Irvine, CA 92750
(714) 540-6730
Circle 268

Miltope Corp.
532 Broad Hollow Rd.
Melville, NY 11746
(516) 938-9500
Circle 269

MI^{2}Data Systems
1356 Norton Ave.
Columbus, OH 43212
(614) 481-8881
Circle 270

Moxon, Inc.
2222 Michelson Dr.
Irvine, CA 92715
(714) 833-2000
Circle 271

NCR Corp.
Box 627
Ithaca, NY 14850
(607) 273-5310
Circle 272

NCR Corp. (EDP Products)
Dayton, OH 45409
(513) 449-2041
Circle 273

NEC Systems Labs, Inc.
5 Militia Dr.
Lexington, MA 02173
(617) 862-6415
Circle 274

Okidata Corp.
111 Gaither Dr.
Moorestown, NJ 08057
(609) 235-2600
Circle 275

Olivetti Corp. of America
500 Park Ave.
New York, NY 10022
(212) 826-1200
Circle 276

Panasonic Electronic Components
Box 1503
Secaucus, NJ 07094
(201) 348-7000
Circle 277

Perkin-Elmer Data Systems
Rte. 10 & Emory Ave.
Randolph, NJ 07801
(201) 336-5350
Circle 278

Potter Instruments Co., Inc.
45 Executive Dr.
Plainview, NY 11803
(516) 681-3200
Circle 279

Continued on page 44

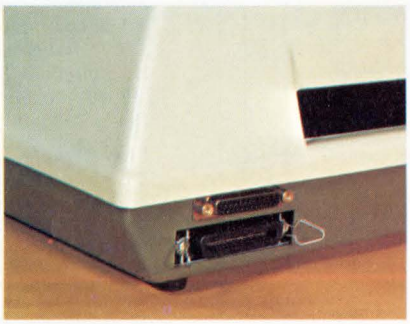
The Anadex 80 Column Printer.

First check the specs. Then check the price.

Our new 80-column dot matrix line printer – the DP-8000 – combines high performance and operating convenience with a low price that's worth checking into.

Check Performance
The DP-8000 features a precision engineered, heavy duty printing mechanism that can print the complete 96 ASCII character set, bi-directionally, at 84 LPM.

Check the Interface
Included at no extra cost, are two input connectors (see photo) that provide three basic ASCII compatible interfaces: EIA Std. RS232C, for interfacing at up to 9600 Baud with most mini-computers and modems; the 20/60 ma current drive mode required by Teletype® ASR33-35 printers; and the parallel-bit, serial character synchronous Centronics compatible interface.



The DP-8000 includes 12 lines of internal FIFO buffer storage and can accept data continuously or in bursts. Optionally, increased buffer storage of 2048 characters can be supplied for CRT dump and similar applications.

Check Printer Quality
A 9 × 7 character font provides virtually half-dot resolution for clean crisp print quality on the original plus three copies.

Precise paper positioning is ensured by a sprocket-feed paper advance, user-programmable Top of Form control, and up to 8 vertical tab positions.

Check Convenience
For operating ease, the DP-8000 accepts paper through the rear or bottom of the unit, provides programmable Skip Over Perforation control, and Out of Paper indication and logic signal. And movable sprockets allow the use of forms or paper from under 3 inches to 9½ inches wide.

Check the low Price
The best news is the price. A complete DP-8000 is unit-priced at under $1000, with substantial discounts in larger quantities.

Once you've checked out the performance and price, we think you'll agree that the DP-8000 is definitely worth checking into. Contact us today for complete details and a demonstration.

Anadex®

ANADEX, INC. • 9825 DeSoto Avenue • Chatsworth, CA 91311, U.S.A. • Tel: 213/998-8010 • TWX 910-494-2761
ANADEX, LTD • Dorna House, Guildford Road • West End, Woking, Surrey GU24 9PW, England • Tel: Chobham (09905) 6333 • Telex: 858762 ANADEX G

Buyers Guide continued

Practical Automation
Trap Falls Rd.
Shelton, CT 06484
(203) 929-5381
Circle 280

Printec Co.
8 Gill St.
Woburn, MA 01801
(617) 935-4246
Circle 281

Printronix
17421 Derian Ave.
Irvine, CA 92714
(714) 549-8272
Circle 282

Qualterm Terminals
227 Humboldt Ct.
Sunnyvale, CA 94086
(408) 734-5610
Circle 283

Qume Corp.
2323 Industrial Parkway W.
Hayward, CA 94545
(415) 783-6100
Circle 284

Randal Data Systems
2807-F Oregon Court
Torrance, CA 90503
(213) 320-8550
Circle 285

SCI Systems
8600 S. Memorial Pkwy.
Huntsville, AL 35802
(205) 881-1611
Circle 286

Sanders Technology Systems
5 Tinkham Ave.
Derry, NH 03038
(603) 434-1571
Circle 287

SCM/Kleinschmidt
Lake Cook Rd.
Deerfield, IL 60015
(312) 945-1000
Circle 288

Scope Data, Inc.
3728 Silver Star Rd.
Orlando, FL 32808
(305) 298-0500
Circle 289

Selecterm, Inc.
2 Audobon Rd.
Wakefield, MA 02143
(617) 623-7800
Circle 290

Sheldon-Sodeco
4 Westchester Plaza
Elmsford, NY 10523
(914) 592-4400
Circle 291

Siemens
186 Wood Ave.South
Iselin, NJ 08830
(201) 494-1000
Circle 292

Continued on page 46

VERSATILITY: STANDARD.

Why buy two printers, when one Malibu may be all you will ever need?

That's right, the Malibu 165 doesn't force you to make a choice between speed, letter quality or graphics. The 165 has the capability to operate as a high speed (165 cps) dot matrix line printer, a reduced speed (90 cps) letter quality dot matrix printer, or a full graphics dot matrix printer.

HIGH SPEED PRINTING

The Malibu 165 prints its standard character set at 165 characters per second. High throughput is assured by full logic printing and high speed horizontal tabbing. Other significant features include underlining, programmable horizontal and vertical tabs, expanded characters, and the option to program one's own character set through a standard ASCII port.

Circle 50 on Reader Inquiry Card

LETTER QUALITY PRINTING

The Malibu 165 features a high density, high resolution character set which provides the dot matrix user letter quality print. In this mode the print speed is reduced to 90 cps, still considerably faster than most daisywheel printers. All the features of the high speed printing are retained.

GRAPHICS PRINTING

The Malibu 165 provides two means to implement graphics printing. One is through the use of the user programmable character set. By programming a graphic character set into the printer and enabling the "characters touching" feature of the printer, a wide range of graphics is possible. If more sophisticated graphics are desired the user may enter the "Direct Graphic Control" mode of the Malibu 165. In this mode, 6-bit data bytes representing actual dot data are transmitted to the printer over ASCII lines. In this way unlimited graphics (60 x 72 dots/inch) are possible.

For detailed specifications, pricing and delivery, write or call today.

malibu
Design Group Inc.

8900 Eton Avenue Suite G, Canoga Park, CA 91304 ✱ (213) 998-7694

Buyers Guide continued

Silonics
525 Oakmead Parkway
Sunnyvale, CA 94086
(408) 732-1650
Circle 293

Southern Systems, Inc.
3000 Northeast 30th Pl.
Fort Lauderdale, FL 33306
(305) 561-5226
Circle 294

Southwest Tech Products
219 Rhapsody
San Antonio, TX
(512) 344-0241
Circle 295

Sperry Univac
Box 500
Blue Bell, PA 19422
(215) 542-4011
Circle 296

Sweda International
34 Maple Ave.
Pine Brook, NJ 07058
(201) 575-8100
Circle 297

Sycor, Inc.
100 Phoenix Dr.
Ann Arbor, MI 48104
(313) 971-0900
Circle 298

Tally Corp.
8301 South 180th St.
Kent, WA 98031
(206) 251-5500
Circle 299

Telespeed Communications
Box 647
Syosset, NY 11791
(516) 364-0777
Circle 300

Telpar, Inc.
4132 Bill Mitchell Rd.
Addison, TX 75001
(214) 233-6631
Circle 186

Teletype Corp.
5555 Touhy Ave.
Skokie, IL 60076
(312) 982-2000
Circle 187

Telex Terminal Comm.
Box 27228
Raleigh, NC 27611
(919) 834-5251
Circle 188

Texas Instruments
12202 Southwest Freeway
Stafford, TX 77477
(713) 494-5115
Circle 189

TL Industries
6061 Telegraph Rd.
Toledo, OH 43612
(419) 478-7564
Circle 190

Trendata Computer Sys.
610 Palomar Ave.
Sunnyvale, CA 94086
(408) 732-1790
Circle 191

Triformation Systems
Box 2433
Stuart, FL 33494
(305) 283-4817
Circle 192

Tri-Star Computer Systems
304 Harper Dr.
Moorestown, NJ 08057
(609) 234-6661
Circle 193

Tycom Systems Corp.
26 Just Rd.
Fairfield, NJ
(201) 227-4141
Circle 194

Varian Data Machines
611 Hansen Way
Palo Alto, CA 94303
(415) 493-4000
Circle 195

Versatec Inc.
2805 Bowers Ave.
Santa Clara, CA 95051
(408) 988-2800
Circle 196

Victor Comptometer
3900 N. Rockwell St.
Chicago, IL 60618
(312) 539-8200
Circle 197

Vogue Instrument Corp.
131st St. & Jamaica Ave.
Richmond Hill, NY 11418
(212) 641-8800
Circle 198

Wang Laboratories
One Industrial Ave.
Lowell, MA 01851
(617) 851-4111
Circle 199

Xerox Corp.
701 S. Aviation Blvd.
El Segundo, CA 90245
(213) 679-4511
Circle 200

Microprogramming? STEP on it!

Powerful Step 2 Instrument

Microprogramming design problem? Step on it fast with STEP ENGINEERING's "Step 2 Instrument". The most powerful development system for fast firmware debugging and system testing.

CHECK THESE FEATURES!

1. Step 2 is the only instrument that spans the complete spectrum of uses: ROM logic, controllers, 2900 bit-slice, and fourth generation mainframes.

2. Step 2 configures to match your system—not the reverse. We even plug into your ROM sockets.

3. Step 2 has real-time memory simulation—as fast as 50 ns in your system.

4. Step 2's microcode editor makes machine-code manipulation a snap—regardless of word length (8 to 192 bits) or field structure.

: Send the reply card, below.

16. Step 2 is compatible with your existing software, and supported by our user definable assembler, TMA.

Get the most powerful development system available today: combine your computer, an assembler (yours or ours), and Step 2. Our low-cost version with full capability starts at $4950. That's cost effective, even for small projects, and all Step systems will more than pay for themselves. If you've got a problem, "step on it—fast." Call Steve Curtis at (408) 733-7837, or send for data.

Name: _____

Title: _____

Company: _____

Address: _____

City _____ State _____ Zip _____

Phone: (_____) _____

- ☐ Send me all the features, 1 through 16.
- ☐ Send me Step 2 "Justification Chart." Compares time, costs, and results for different development methods.
- ☐ Send me Step 2 data sheets.
- ☐ Send me the impressive Step 2 "Customer List."

Send coupon to:

STEP ENGINEERING
714 Palomar Ave.
Sunnyvale, CA 94086
(408) 733-7837

Circle 35 on Reader Inquiry Card

New Digital Hard Copy Technologies

Alan Dawes
Versatec, Santa Clara, CA

Ideally, a digital hard copy device should conserve the versatility of handwriting. That is, be able to draw any image on a substrate with one recording instrument. It must also be fast, which carries the implication that no mass moves with the information. Further, it must be reliable, reasonably priced and quiet in operation.

Many new and innovative technologies – electrostatic, thermal, ink-jet, xerography, film and conventional impact printers and pen plotters – have been developed to answer these needs. None appear to offer a comprehensive solution for all applications, but each offers its own set of benefits.

Image dissection

Image dissection is a concept employed by all non-impact and some impact writing devices to achieve versatility of display. The image to be displayed, letters or graphics, is dissected into a number of common elements. We can call them dots. By selectively placing dots of contrasting color on a substrate, one can display any kind of information with one writing instrument. The principle works in a fashion similar to a television display where the scanning beam is turned on and off, thus producing the desired image when the eye integrates the detail.

With dissection of an image, the concept of resolution arises. Resolution can be defined as a measure of the detail present per a given square area. It is a function of the density of dots per square inch or per image. In the early applications of this technique, less than 100 dots per linear inch were used. This matrix printing, although very legible, lacked the quality of a typewritten page. Now, however, some matrix devices display 200-300 dots per inch resolution. This results in a high quality image approaching the appearance of typewriting. In the near future, resolutions of up to 400 dots per inch will be common.

Dissection of the image makes it possible to program the dots at will, using any acceptable storage device, such as ROM, to display many different fonts. Any graphic information, including dense black areas, can be displayed using only one writing instrument. The result: total versatility of display.

Writing techniques

Of the many processes available for putting permanent marks on paper, one is believed to hold special promise because of its inherent simplicity – electrostatic writing. Others, such as thermal and ink-jet printing, offer benefits of a unique nature in some applications. Conventional impact printing and pen plotters will also continue to serve special applications. Brief descriptions of these various techniques reveal some important differences.

Electrostatics

Electrostatic Writing employs a slightly conductive paper (approximately 20 megohms per square) coated with a micron-thin dielectric film. This allows retention of an electric charge. A conductive stylus is placed on top of the dielectric surface, a rear electrode is placed behind the paper, and a voltage difference is applied above 300V, some charge transfer takes place. When the stylus is removed, the area remains charged for some time. Using a recording head carrying an array of embedded nibs, and addressing those nibs in an appropriate manner, charged dots can be selectively deposited on the surface of the dielectrically coated paper. This electrostatic disturbance is not visible. As soon as the paper passes the recording head, its dielectric surface is brought in contact with a developing liquid called toner. This liquid is typically a colloidal suspension of carbon. The black particles migrate to the charged areas where they are deposited and permanently fixed as the paper dries. The resins contained in the toner fix the particles after the charge is neutralized.

The paper supply can be either fanfold or roll paper. The

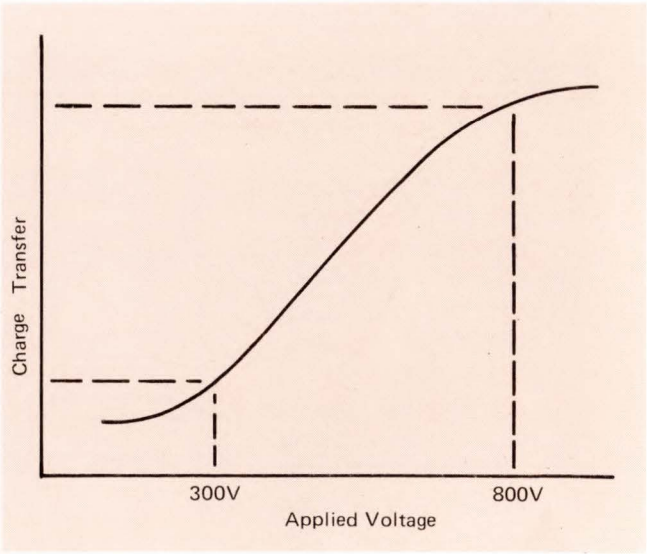


Fig 1. Electrostatic charge transfer as a function of applied voltage shows how no significant charge transfer occurs below 300V.

When you're ready to step up, call Logic Systems for your next plotter.

We're introducing a new series of computer output plotters because we know what you need. We've been providing plotter supplies since 1968 and have studied your graphics requirements for a long time. We know that your plotter must be fast and flexible for your applications. And we noted that other plotter manufacturers—especially the leaders—are not meeting your current needs. There's a spot for a new number one, and we're plotting to get there.

That's why we're introducing the new Logic-L Plotter Series.

It will accept your data format no matter what computer you're using. We've added intelligence to our controller. So whether your interface is RS-232-C, IEEE-488 or whether you're talking Fortran, Cobol, Basic, our plotter is compatible.

The new curvilinear function on our Logic-L Series draws precision curved lines, instead of jagged (and noisy) approximations. And it requires less data than vector approximations, so it's faster (and lots quieter) than other plotters. We've even priced it less than the competition.

Logic Systems:

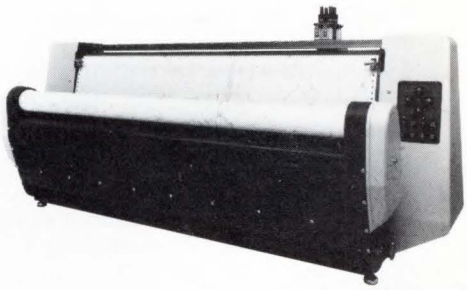
Plotting to be number one.

In addition to a built-in character set, you can create any symbol by downloading to the plotter. And for more flexibility in manipulating a variety of drawing media, our controller allows you to adjust the pen velocity.

Logic Systems' plotters accept both roll and fanfold paper and range in width size from 15 to 48 inches.

Call us for more information about our flexible Logic-L Plotter Series. We'll show you how we're plotting to be number one.

Logic Systems
437A Aldo Avenue
Santa Clara, California 95050
(408) 988-3911



Circle 54 on Reader Inquiry Card

dielectric side passes the writing head, establishes intimate contact with it and charging takes place. Immediately, the charged paper enters the toner applicator and the image is developed. As it emerges, it is either air and/or vacuum dried to deliver a dry, permanent copy.

To limit the number of transistor drivers used to address the recording head, and thus the cost of the machine, a multiplexing scheme is used. The rear electrode is segmented and, because no appreciable charge transfer occurs below 300V as shown in Fig 1, one can address several nibs at the same time. The nib that writes will coincide with the rear electrode whose potential is uniquely different and higher than the others.

In later models of electrostatic printer/plotters, the recording nibs in the head are staggered. Information is appropriately displayed from row to row so that the dots become contiguous. In this way, better quality images are achieved.

In addition to driving circuits and high voltage power supplies, a typical electrostatic printer/plotter also includes a logic section that controls the system and handles incoming data. Most machines can accept ASCII coded information and plotting information at the same time. This is done by using two separate buffers, one for plotting and one for alphanumeric information. When the buffered line is translated to voltage fluctuations on the nibs, the printing and plotting information is simultaneously applied to the paper.

Electrostatic plotters are raster output scan devices. As such, they demand significant amounts of data (7×10^6 bits for a 22 x 34 inch D-size drawing at 100 nibs per inch resolution). To reduce the burden on the host CPU, most controllers for electrostatic plotters contain enough intelligence to do the rasterization task. Input to such systems is in the form of vector files that describe the image. Thus, computation time, I/O time and storage requirements are comparable to pen plotters.

Electrostatic printers and plotters, in contrast to other devices, exhibit these advantages:

Versatility of display. Due to the "dissection of image" technique, these printers and plotters can display any kind of graphic and alphanumeric information. This is very useful when the machine must write several languages, draw dense black areas or create fine line graphics.

Speed. The time required to charge the paper is a few microseconds. Existing machines can plot a 22 by 34″ engineering drawing (D-size) in thirty seconds at 100 nibs/in. resolution or under 60 sec at 200 nibs/in. resolution. Laboratory models have demonstrated speeds of over 20,000 lines per minute with paper speeds exceeding 30 ips.

Reliability. No parts move in the writing process except for a simple paper transport that delivers uniform motion of the paper, and a small toner pump that circulates the liquid toner. No object having mass moves with the information. Without impact, there is almost no wear on the writing element. The 10,000 units installed to date have demonstrated excellent reliability.

Low noise. Free from impact, the devices are quiet. They can be used in any office environment.

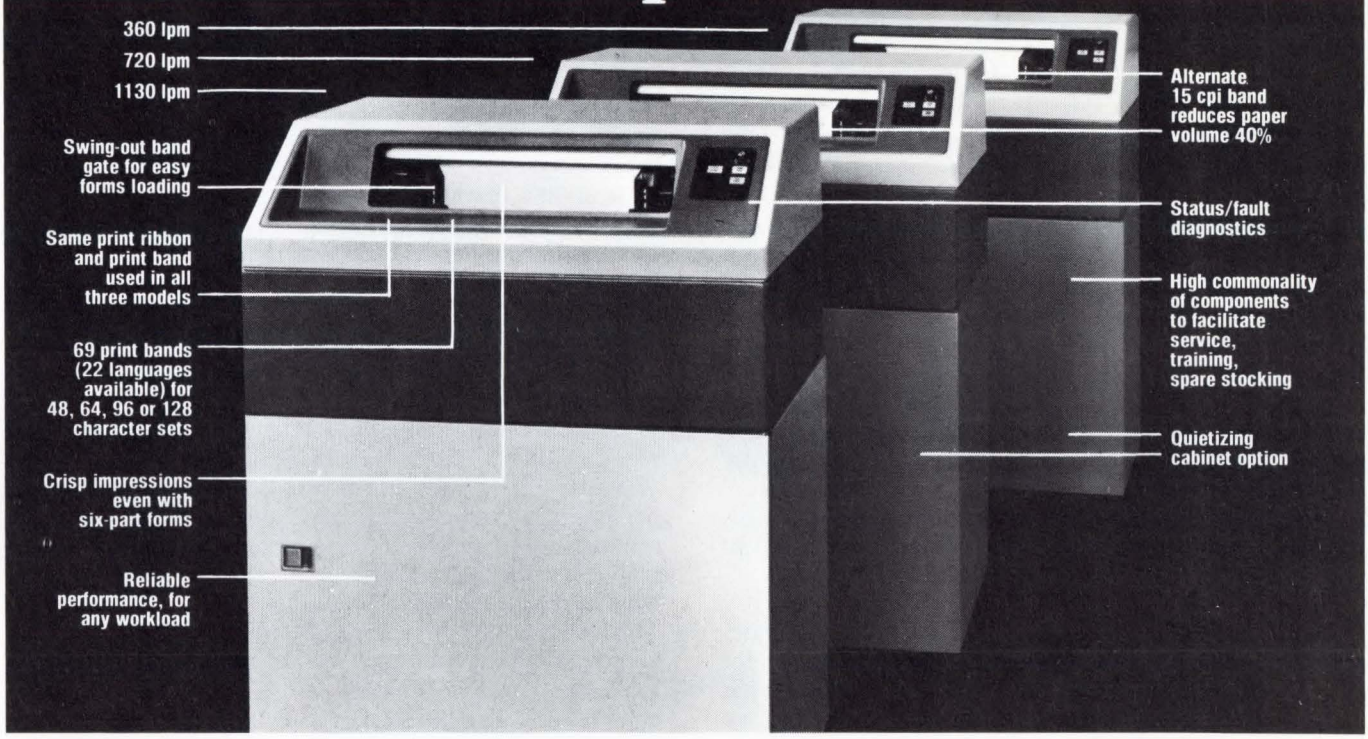
Size. Paper width is not a practical limitation. Electrostatic plotters are available in paper widths from 8.5″ up to 72″.

Cost. The simplicity of the technique makes it possible to produce reliable, high speed devices at a low cost. For example, printers and plotters that display information at a rate of 1000 lines per minute (800 characters per second) or plot at two inches per second, are priced from $5,000 to $8,000.

			NON-IMPACT				
Price/ Performance	**Impact Printers**	**Pen Plotters**	**Electrostatic**	**Thermal**	**Ink-Jet**	**Electro-Photographic**	**Film**
Speed: Print	30CPS-1000 LPM	----------	1000 LPM	100 CPS	92 CPS	13,000 LPM	----------
Plot	----------	Up to 40 in/ (pen travel)	2 in/sec (paper travel)	20 sec/page	104 in/sec	17 in/sec	200in/sec
Resolution (points/inch)	100	500	100 & 200	50	127 Plot 250 Print	300	2000
Quality	Fair	Excellent	Good	Fair	Good	Good	Excellent
Reliability	Fair	Fair	Excellent	Good	Unknown	Fair	Good
Versatility:							
Image	Limited	Line graphics, color	Any B/W inc. halftones	Limited	Any	B/W line graphics	Any
Substrate	Stock & custom forms	Any	Bond & translucent paper	Thermal paper	Any	Plain paper	Film
Color	No	Yes	No	No	Yes	No	Yes
Gray scale	No	No	Yes	No	Yes	----------	Yes
Cost:							
System ($K)	1-100	22-40*	30-50*	1-5	45K*	100-300	150
Consumables	1/2¢/ft^2	1/2¢/ft^2	2¢/ft^2	1.7¢/ft^2	1/2¢/ft^2	1/2¢/ft^2	50¢/ft^2

*Comparisons are for 22 by 34 inch (D-size) drawing capability.

Quality impressions are made easily with OEM band printers from CDC



If you're an OEM, you already know what Control Data has done for disk technology. Now we're determined to earn the same reputation for excellence in band printer technology. By giving *you* versatility and maintainability. By giving *your customer* reliability, superior print quality and economical operation.

Engineered for component commonality

All three members of our 9380 family of band printers look pretty much alike. Inside and outside. So your servicing, training and inventory requirements are simplified. Yet you can choose from three print speeds, 69 print bands and lots of other options.

Built with the features and economy to attract end-users

Our 360/720 lpm models offer a compressed pitch option. That saves your customer money in paper expense. And gives him the capability to print 132 columns on standard 8½ by 11 inch paper. Bands switch in seconds. Paper loading is easier. Operator controls and adjustments are minimal. And your customer will like the clean, crisp impressions delivered by our proven hammer technology.

Put quality behind your nameplate. Let us send you data sheets and print samples. Call us at 313/651-8810 or if in Europe, contact one of our European representatives. Or return coupon to:

Richard Burt, Product Sales Manager **DD-99**
Control Data Corporation
1480 N. Rochester Road, Rochester, MI 48063

Please send literature and sample printouts on your band printers.

Name_____ Title_____

Company_____ Phone_____

Address_____

City_____ State_____ Zip_____

CONTROL DATA CORPORATION

More than a computer company

Circle 38 on Reader Inquiry Card

Other non-impact printing techniques

Thermal printers also use a treated paper. Total versatility of display is possible by exploiting image dissection and imaging with one writing element. Heads can be small arrays mechanically traversing the page to form a low cost, 100 character-per-second serial printer. Full page width arrays are possible to create low cost line printers or CRT hard copy devices. Typically, an 80-column, 24-line image can be printed in twenty seconds. Resolution of thermal printers is usually less than 100 dots per inch.

The interest in **Ink-Jet** printers and plotters has been revived with the introduction of equipment from IBM. The most important benefit of ink-jet devices is their ability to write on any substrate – from letterhead bond to carpets. Reliability at reasonable cost has not been established.

Speed has an upper bound with ink-jet printing because mass (ink droplets) move with the information. Synchronous systems that create images by selecting droplets from a continuous stream have an upper limit of about 100,000 droplets per second. The IBM 6640 document printer uses a synchronous system having one jet. It is limited to 92 characters per second. The Applicon Color Plotting System is said to produce a 22 x 34″ image at 127 points/in. resolution, in color, within 8-1/2 minutes. Asynchronous systems, imaging with drops-on-demand, are slower and limited to about 20,000 droplets/sec. In addition to color, asynchronous ink-jet systems can modulate droplet size to reproduce continuous tone images.

Very high speed is possible with multiple ink-jet arrays. Implementation of such devices today is expensive and of uncertain reliability. However, as cost/performance is improved, they will become a factor in some applications.

Electrophotographic systems for high speed computer printing dissect images and reconstruct them in digital dot matrix form. The IBM 3800 (resolution: 180 dots per inch) and the Xerox 9700 (resolution: 300 dots/in.) are typical examples. Both machines have the potential to merge graphics with text, both digitally and optically, with a forms flash. Their graphics capability is oriented toward forms creation and special characters, but they could reproduce highly versatile graphics.

Film is used in several ways for digital hard copy. Photoplotters, both small and large, serve specialized applications like data logging and seismic plotting. Their advantages are speed and an ability to create dense black areas and variable widths. They tend to be expensive, both in terms of initial system cost and consumables.

Film is also used extensively for capturing digital images from CRT displays. Polaroid and multiformat 70mm cameras are a cost-effective means of reproducing continuous tone digital images.

Pen plotters, both flatbed and drum, are highly accurate and can write on a variety of substrates. Their principle disadvantage is low speed. They come in a wide variety of configurations.

Video hard copy devices, like those offered by Tektronix, are a common way to render digital graphics visible in hard copy form. A single thermal or electrostatic hard copy system can print, plot and produce video hard copy.

Impact Printers

Impact printers offer a means to create plots for the occasional graphics user unable to justify the cost of a plotting system. Useful plots can be created on an IBM 1403 line printer using "I", "-" and x's. Even complex graphics, like electron trajectories in an electromagnetic field, can be interpreted in this way.

Many simple business graphs, bar charts, scatter diagrams, etc., can be produced on low speed daisy wheel printers. As applications for business graphics expand, traditional printing devices will be required to offer graphics capability. Many wire matrix impact printers, thermal and electrostatic printers already offer this capability.

Applications

Computer Aided Design. High speed digital plotters give computer-aided designers a new tool that improves productivity. Design sessions are typically interactive via a CRT display. Traditionally, output has been limited to video hard copy or a pen plot. Usually, a pen plot is required for large or complex drawings. When it takes hours to get a plot, the design function is interrupted. This means that designers must spend more time at the terminal. Electrostatic plots, received in a few minutes, encourage faster, more cost-effective design sessions. In some cases, high speed plotting has improved computer-aided design productivity by more than 50%.

Although paper cost was an early concern of users in computer-aided design, it has not been a problem. Consumables cost for an electrostatic plot is approximately 40¢ for a D-size drawing and 60¢ for E-size.

Problem Solving Applications. The experimental environment provides a diverse range of applications requiring a fast versatile plotter. A few examples: ink blots, computer aided composition (music, atomic structures), three-dimensional representations, graphs, histograms, bar charts, Gannt charts and scientific character sets.

Printing and Publishing. For several years, photocomposition systems have been using electrostatic printers as high speed proofing devices. High resolution film plotters (phototypesetters) have consumable costs as high as 20¢ per page and are slow. In contrast, electrostatic proofs cost only 2¢ and are available in seconds.

Other plotters are producing interactive ad make-up and full page proofs, including line drawings and halftone photographs. Rendition of continuous tone pictures is possible with digital plotters and software packages that emulate lithographic halftone processes.

Medical Systems. Computer aided tomography (CAT) and ultra-sound scanners are digital image processing systems requiring hard copy output. Film has been the traditional medium for recording CRT images in hard copy form. Electrostatic printers have been used extensively for test calibration and treatment planning (line graphics). Gray scale software provides halftone rendition of continuous tone images.

Many distributed hospital terminals require reliable, fast output devices that are silent. Plotting capability is often required for display of vital graphics data with alphanumeric printing.

Energy. Electrostatic plotters are used for displaying records of seismic data collected during geophysical exploration. In many applications, this method has replaced the use of expensive photographic film.

Weather. Electrostatic printer/plotters have been selected for use in AFOS, a nationwide computer-based weather system. Speed, reliability and multi-function output capability were the primary criteria.

Patterns. Wide plotters, in paper widths up to 72″, are being used in the garment industry for pattern-making. Output speed is a major benefit where long, 72-inch wide patterns are generated interactively on a computer system.

Electrostatic plotters are used in other applications in-

A Beautiful Way To Interface

IQ 140

SOROC's first and foremost concern, to design outstanding remote video displays, has resulted in the development of the IQ 140. This unit reflects exquisite appearance and performance capabilities unequaled by others on the market.

With the IQ 140, the operator is given full command over data being processed by means of a wide variety of edit, video, and mode control keys, etc.

The detachable keyboard, with its complement of 117 keys, is logically arranged into 6 sections plus main keyboard to aid in the overall convenience of operation. For example, a group of 8 keys for cursor control / 14 keys accommodate numeric entry / 16 special function keys allow access to 32 pre-programmed commands / 8 keys make up the extensive edit and clear section / 8 keys for video set up and mode control / and 8 keys control message and print.

Two Polling options available: 1) Polling compatible with Lear Siegler's ADM-2. 2) Polling discipline compatible with Burroughs.

IQ 120

The SOROC IQ 120 is the result of an industry-wide demand for a capable remote video display terminal which provides a multiple of features at a low affordable price. The IQ 120 terminal is a simple self-contained, operator / computer unit.

The IQ 120 offers such features as: 1920 character screen memory, lower case, RS232C extension, switch selectable transmission rates from 75 to 19,200 bps, cursor control, addressable cursor, erase functions and protect mode. Expansion options presently available are: block mode and hard copy capability with printer interface. The IQ 120 terminal incorporates a 12-inch, CRT formatted to display 24 lines with 80 characters per line.

SOROC TECHNOLOGY, INC.

165 FREEDOM AVE., ANAHEIM, CALIF. 92801

(714) 992-2860 / (800) 854-0147

Circle 29 on Reader Inquiry Card

Paper Problems Still Limit Electrostatic Printer Applications

Anyone investigating present-day small printer technologies quickly finds that each type best fits a specific group of applications, according to Richard B. Trembly, Hycom's special products marketing manager. For engineers looking for a cost-effective way to produce hard copy, electrostatic printing is raising greater interest than it has in the past.

Although some may call it an "aluminum paper" technology, it does possess some distinct major advantages over impact and thermal printing, continued Trembly. Using only about one-tenth the power at its head as it prints twice as fast as its competitive technologies, electrostatic printing requires low-power head driving circuitry. This circuitry provides greater reliability at lower cost. Head replacement costs are substantially lower, too. For example, an impact print head can cost 5 times as much as its electrostatic counterpart.

While most electrostatic printers provide the just-mentioned benefits, each maker of these products markets a somewhat different piece of equipment. Although the typical electrostatic printer operates at from 1-6 lines per second, SCI Systems has recently introduced a unit that produces 90 lines of copy per second on 4-inch wide paper that passes through it in a curved path. This machine prints the copy lengthways on the strip, not across it, as is common.

Electrostatic technology also provides a very small low-priced printer. It is unusual to find any type of printer that sells for $52.00 in lots of 100. This 12- to 15-column printer, marketed by Hycom, uses a very small frame to produce 7 dot matrix characters. According to Trembly, this printer is one of several used in Sharp hand-held calculators that have recently become popular in the U.S.

Aluminum Paper

In spite of electrostatic printer cost-effectiveness, many potential users worry about the aluminum paper. Although the electrostatic process etches the aluminum coating to produce copy of almost archival quality, the paper's non-white color and its tendency to show fingerprints has held back wider adoption of electrostatic printing in consumer applications. Also, the process produces some RFI.

But that's for the present time. What does the future hold for efficient electrostatic printing? "Our best hope lies with the development of a new paper or, perhaps, with somewhat modified electrostatic printing technology," said Trembly.

In the past, many paper manufacturers have offered "white" (zinc oxide coated) paper without a sufficiently clear measure of success. Whereas aluminum coated exhibits a mild tendency to show fingerprints, the usual zinc oxide coated white tends to fingerprint more strongly; it is also subject to fuming. The best compromise to date, an aluminum coated paper, provides a rougher buff surface in place of a shiny one. Nicolet Paper and Dennison Manufacturing have been marketing this paper, whose rougher surface wears the print head faster than the smooth shiny finish on the original aluminum coated stock. A tradeoff is necessary between paper appearance and head wear.

A better paper may be available, according to the claims of a New York company which has developed a new white paper. Since no samples for testing are available at the moment of publication, it is too early to tell whether this product can eliminate the weak link in electrostatic printing. But the new paper surely interests the makers of electrostatic printers.

At least for the time being, much of the application of electrostatic printers will remain in the logging of data in the laboratory, in medicine and in the field, and in other non-consumer related work, concluded Dick Trembly.

volving computerized design or the display of complex graphic information on large sheets of paper. For example, utility and communications companies use them to produce dynamic records of networks throughout a city.

Military. The simplicity of electrostatic devices makes it possible to design high speed, versatile output devices for hostile environments. Multi-function output (print, plot, CRT copy) saves critical space.

Electronic Mail. One of the latest applications of the electrostatic writing technique is development of a high speed printer/plotter for electronic mail. The device will print and/or plot four 8-1/2 x 11″ documents/second with complete versatility of display.

Facsimile. Special machines produce remote facsimile in an electrostatic plotting mode. These hard copy output devices display high quality, high resolution information received via telephone lines.

Mapping. Plotters, in paper widths up to 72 inches wide, produce computer-generated maps in a matter of minutes. Smaller machines provide a cost-effective way to produce maps at remote sites via communications networks.

Business Graphics. PERT/CPM and other business graphic systems are powerful tools for project management, but timely preparation of graphics is very important. High speed electrostatic plotters can reproduce large format charts in minutes rather than the hours required by conventional techniques. As new software makes graphics easier to implement, business graphics use will expand rapidly.

Summary

As computers proliferate, so will digital hard copy devices. Because of their inherent versatility, non-impact devices will grow rapidly in popularity, especially when graphics can be used to advantage. While thermal, ink-jet, electro-photographic and film technologies all have application, the electrostatic technique offers the simplicity, versatility and cost/performance advantages necessary to dominate the computer-based hard copy printing market. It is the most promising technology now available for rendering original information visible.

Rate this article: circle 3L, 3M or 3H on Reader Inquiry Card.

Lots of people talk.

The talk is thick and fast. Yet the truth is simple. IMI and only IMI can deliver proven production unit 8″ Winchester disk drives. We began volume delivery the first of the year, and we'll deliver 5,000 drives by year-end.

Another fact. Despite all the hoopla at this year's NCC, only IMI showed an 8″ Winchester disk drive in actual operation. A drive that uses well-proven technology and conservative design to ensure maximum reliability in environments outside the computer room.

Only IMI delivers 8" Winchester disk drives today!

Why wait? Join the OEM's getting off-the-shelf delivery of production quantities. Evaluate an IMI production unit (not a prototype) and hasten the day you'll be using 8″ Winchester technology in your system.

IMI INTERNATIONAL MEMORIES, INCORPORATED

10381 Brandley Drive, Cupertino, CA 95014
(408) 446-9779

Circle 48 on Reader Inquiry Card

Robert Klatt
Electro-Optical Products
Information Control Corp.
Los Angeles, CA

CRT Light Pen Technology and Design

Light pens are hand-held electro-optical devices used to select data or indicate a location for new data on a CRT terminal. They typically consist of a cylindrical pen body about 1.25cm in diameter and 15cm long, connected by a flexible cable to the terminal or supporting computer. Light pen operation is possible because a CRT is a serial input device, with a specific instant in time associated with each position on the screen. At the time a point on the screen is addressed, and beam current is turned on, a rapid increase in brightness occurs at the point addressed. A light pen aimed at this point detects the increase in brightness and generates an output pulse. This pulse is used to strobe a counter or register and locate the position of the aiming point.

Most light pens also provide a second output signal called a "switch" or "actuation" signal. This signal is generated at the discretion of the operator and used for control functions, such as indicating to the computer that the next light pulse should be accepted.

The major advantage of a light pen is that it requires no new skills be developed by the operator. The hand-eye coordination required is the same used in writing or drawing with a pencil or pen. The light pen provides a simple, reliable and economical method for operator interaction with a CRT terminal.

Early light pens used a fiber-optic cable to transmit light down to an assembly containing a photo-multiplier tube, power supply and associated signal processing. Most modern light pens use a silicon photo-detector and solid-state signal processing electronics contained within the pen body. The pen is supplied with +5 VDC and provides two TTL-compatible output signals -- a pulse when light is detected and a level shift when the switch is actuated. A block diagram of a typical light pen with CRT is shown in **Fig 1.**

The light emitted by the phosphor, when the electron beam addresses a point within the light pen's field-of-view (FOV), illuminates the detector and generates an increase in signal current. The FOV is a function of the size of the detector element, any lenses or apertures in the optical path, and the distance of the pen to the phosphor. The effect of these parameters on the operation of the light pen system will be discussed in detail later in this article. The output of the detector is amplified by a video amplifier and differentiated to emphasize the increasing signal when the point is addressed. The differentiated output is compared to a threshold voltage, and when the threshold is exceeded a light pulse is generated. The significant design goals

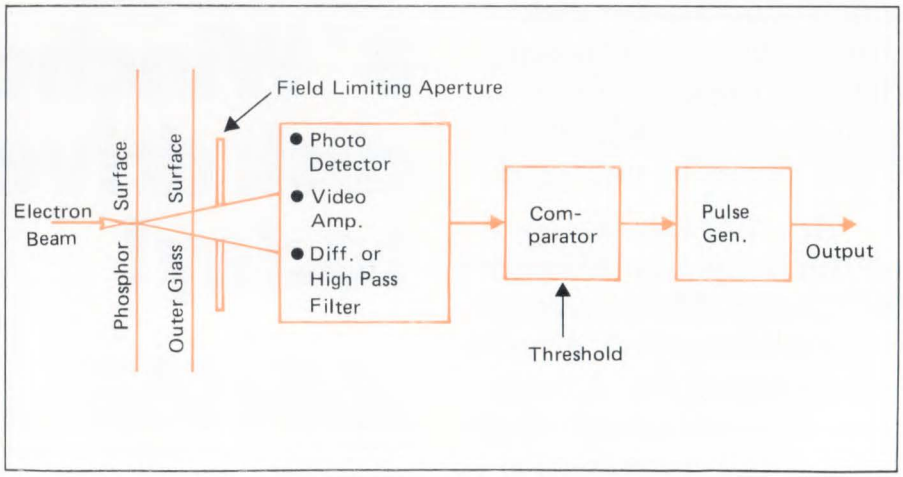


Fig 1 Light pen block diagram shows a typical lightpen with CRT.

ANOTHER FIRST FROM First™

SALE EXTENDED THRU OCTOBER 31st.

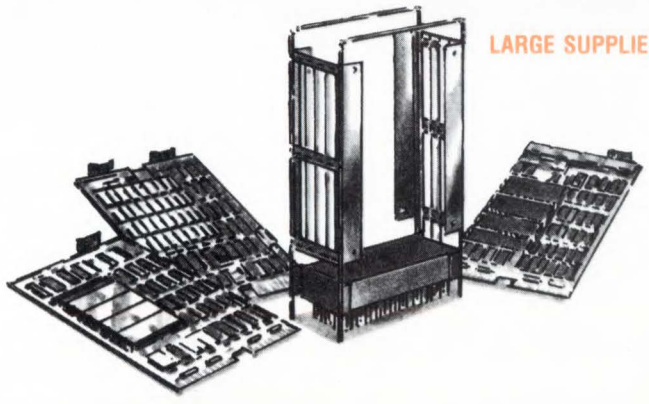
MILLION DOLLAR $$$ SALE $$$

Here's a "ONE IN A MILLION" opportunity to buy

LSI-11/2 CPU's at 30% OFF...

First's MILLION DOLLAR September SALE
Selling One Million Dollars worth of LSI-11/2® CPU'S
at 30% OFF. . . During SEPTEMBER ONLY!

Don't let this "ONE IN A MILLION" opportunity pass you buy!



LARGE SUPPLIES "IN STOCK" FOR IMMEDIATE DELIVERY

	DEC® List Price	Our Price
KD11-HA LSI11/2 Microcomputer	$695	$487
KD11-HB KD11-HA Plus 8K Word RAM Memory	1290	903
KD11-HC KD11-HA Plus 16K Word RAM Memory	1490	1043
KD11-HD KD11-HA Plus 32K Word RAM Memory	1690	1183

MD-1

First computer corporation

TWX NUMBER 910-651-1916

corporate square/825 north cass avenue/westmont, illinois 60559/(312) 920-1050

® Registered trademark of Digital Equipment Corporation, Maynard, Mass. ™ Registered trademark of First Computer Corporation

Circle 53 on Reader Inquiry Card

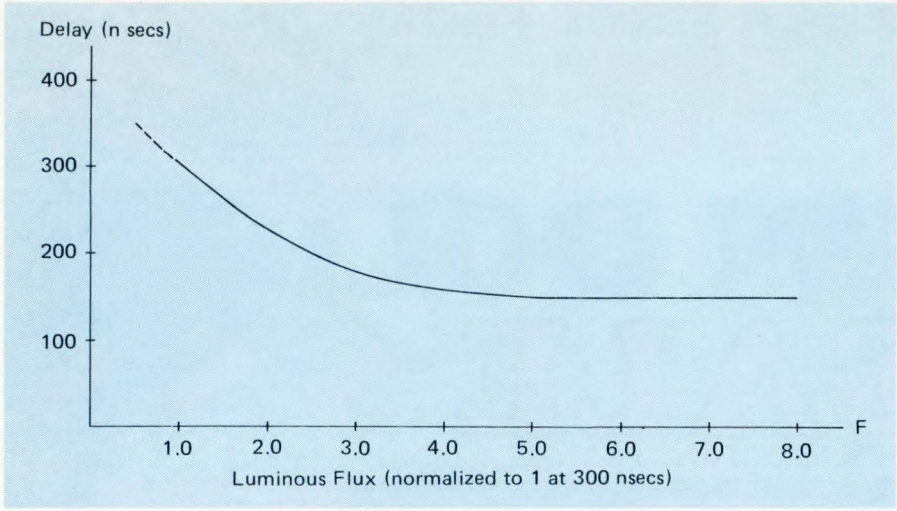


Fig 2 Delay vs. luminous input. Threshold is set to yield a low false alarm rate, determining this curve.

for the light pulse circuitry are low noise, to make possible the detection of small brightness increases, and fast response time to minimize the delay between the addressing of a point and the generation of the output pulse.

The threshold setting determines the false alarm rate, the sensitivity, and the response time (or delay). The threshold is usually set to yield an acceptably low false alarm rate and determines a curve, as typically shown in **Fig 2**, for delay as a function of luminous flux (F). For a typical CRT display, unity on the F coordinate corresponds to a photometric brightness of about 1 Foot Lambert, which is barely visible in a well-lighted room. At display brightness more typical of actual applications, the delay approaches 150 nanoseconds and becomes relatively constant.

It is advantageous to have the delay curve relatively flat in the range of brightness normally used so that changes in brightness due to different room ambients or operator preference will not cause delay variations large enough to affect system operation.

Short delays may simplify system hardware or software design since delay jitter is often proportional to the delay. A large delay must be compensated for in order to properly identify the selected address and a large amount of jitter may require averaging the input of several frames to correctly identify the selected point.

Averaging or comparing the results of two or more frames is a useful technique in high-noise environments. If the noise is not correlated with the CRT deflection signals, then requiring two hits at the same address will sharply reduce the probability of false output.

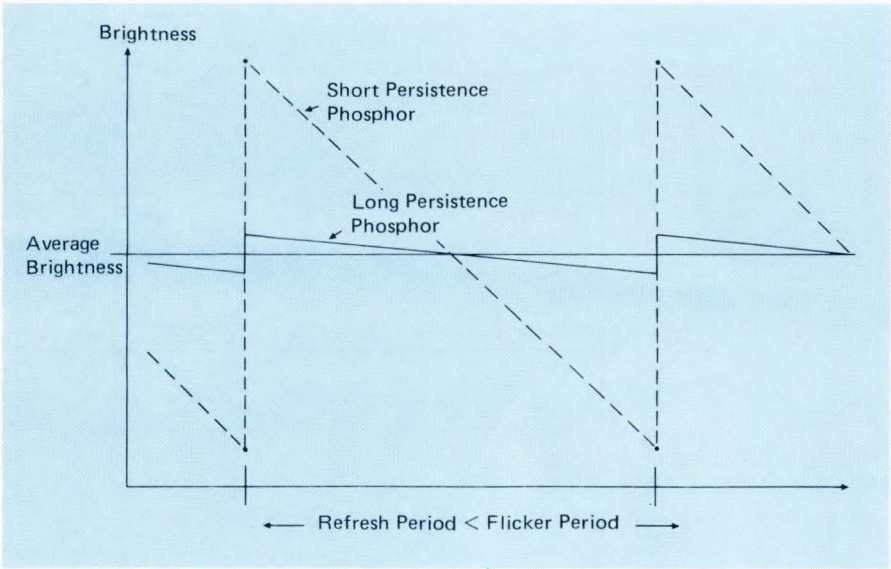


Fig 3 Fast and slow phosphors. A pair of phosphors produce identical average brightness and appear identical.

The major consideration in designing a light pen system – the light pen and CRT terminal – is the conflicting requirement between the light pen and the operator. Avoidance of operator fatigue requires that the display provide apparently constant brightness. This can be accomplished either by using a long-persistence phosphor, whose brightness does not appreciably decrease during the refresh period, or by taking advantage of the averaging characteristics of the human eye, and using a refresh frequency above the "flicker rate". Use of a long persistence phosphor is not recommended for light pen systems because the p-p brightness, which the light pen detects, can be quite small. The situation is shown in **Fig 3**, where two hypothetical phosphors are producing the same average brightness and could look identical to the operator, but one is producing 10X the useful light pen signal of the other.

To use real phosphors as an example, the P-31 is a good light pen phosphor and under typical operating conditions will provide roughly 100 times the light pen signal of the P-39, a very poor light pen phosphor.

If a slow phosphor, such as P-39, must be used at refresh rates which do not allow high peak brightness, operation of a light pen is possible by doping the slow phosphor with a fast phosphor. The fast phosphor can either emit in the visible spectral region (preferably the same wavelength as the slow phosphor) or it can take advantage of the silicon detectors peak response in the near I-R region and use I-R doping.

A good example of visible doping is the combination of P-46 with P-39. Experiments have shown 5% to 10% of P-46 added to P-39 to be effective at an average display brightness of less than 3 Ft.L. I-R doped phosphors, such as P-451 (15% I-R doping) can be useful, but care must be taken that any material between the phosphor and the light pen, such as a contrast enhancement filter, is transparent at the wavelength of the I-R emission. Of course, with reference to light pen applications, short persistence means short compared to the refresh period, but few displays have refresh rates high enough to cause trouble.

The other major phosphor characteristic, Spectral Energy Distribution (SED) is not as significant to light pen operation as is persistence. The display phosphor will always be chosen to emit most of its energy within the visible spectral region. Within this

range the light pen sensitivity will vary almost linearly from 20% (for blue), to 80% (for red) of its peak response at 800nm.

Other significant display related parameters are spot size and the distance from the phosphor to the outermost surface. This follows from the simplified equation for luminous flux (F) incident on the detector: $F = B (A_E A_R / D^2)$, where B is the photometric brightness, A_E is the emitting area, A_R is the receiving area, and D is the distance from the phosphor to the aperture defining the receiving area.

Brightness will be primarily determined by the ambient light level at the user's location. It should be noted that the primary concern of the operator is contrast, the ratio of the line brightness to the background. The light pen signal processor, however, has a high pass filter characteristic and responds only to the CRT output. Therefore, two displays set for the same contrast in different ambient light environments may produce different light pen results.

The emitting area (A_E) is the area of the CRT spot. Spot diameter will vary from about 0.25mm for a high resolution display to about 0.75mm. This represents an almost 10X variation in detector luminous input, and display resolution can affect light pen performance.

The large majority of CRT terminals use bonded implosion shields and the distance from the outer glass surface to the phosphor is about 1cm. Terminals of this type, with spot size of about 0.5mm and operated with adequate brightness for comfortable viewing in a normal office environment work well with relatively simple light pens. The receiving area of these pens is defined by a small aperture in near-contact with the screen. This aperture may be open or may use a light pipe to transmit light back to the photo-detector. In either case the small size of the receiving area and its proximity to the phosphor result in an acceptably small field-of-view at the phosphor, typically about 2.5mm. With this simple optical system, sensitivity, field-of-view and phosphor distance are interdependent. If phosphor distance is increased, both sensitivity and FOV will suffer. If higher resolution is required, FOV can only be reduced at the cost of lower sensitivity.

An example of a system that exceeds the capabilities of a simple light pen is a terminal with a large, curved CRT faceplate covered by a flat panel. One terminal of this type has a phosphor distance which varies from 1.5cm at the center to over 4cm at the corners. The solution to this problem requires increasing the receiving area by use of a lens system. The FOV is controlled by choosing the lens, detector size, and lens-to-detector distance so that the image of the detector element on the phosphor gives the desired FOV at the maximum phosphor distance. Two problems are inherent in this type of pen depth-of-focus and aiming. At distances much different from the design distance the optical system will defocus, and the field-of-view and sensitivity will degrade. Aiming at a distance of several centimeters through a number of glass layers can also present a problem. This is remedied by generating a ring of light within the pen and projecting its image through the light pen optical system. The image on the phosphor is sharply focused at the design distance and exactly defines the size and location of the FOV.

Another method of providing aiming information is quite simple and is used in many terminals. This technique provides feedback to the operator by intensification of the point or symbol that the light pen detects. In

an alpha-numeric system the character selected (or picked) would be intensified. This also provides an example of the use of the light pen switch or actuation output. The operator points the pen at the desired symbol and the symbol is intensified, showing the operator the symbol picked. If the desired symbol has been selected the operator signals the computer to accept the data by operating the switch.

There are at least three types of light pen switches. The most popular is the push tip switch. The operator picks the desired symbol with the pen tip in light contact with the screen and operates the switch by the application of light pressure. Force required is typically 2 to 5 oz, and movement is typically 1 to 2mm. Other methods are, of course, necessary when the pen does not contact the screen. One of these is the push-button (on a pen designed to operate several inches from the screen). Another is the Touch-Tip, which has no moving parts. The switch is operated by using a finger to close a circuit between the main body of the pen (in contact with the hand) and an isolated ring or tip. A few μA is sufficient for operation.

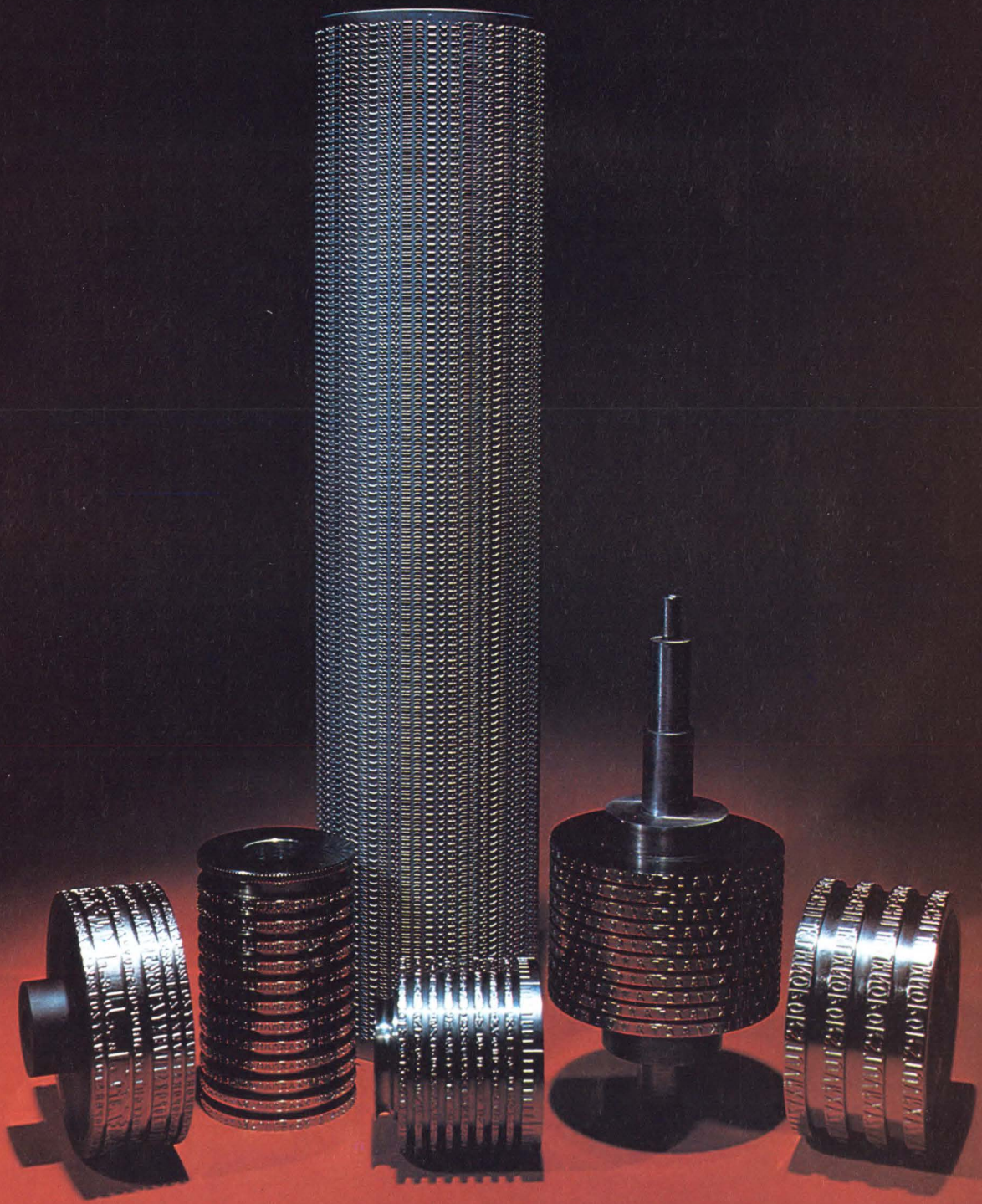
Another example of the use of the switch is in drawing a line started on a dark screen. Since a dark screen can provide no input to the light pen, the drawing is started by the operation of the switch which causes the display screen to be totally illuminated for one frame. Of course, extending the line, once the starting point is established, also requires extracting information from a dark screen. This could be accomplished by repetitive brightening of the entire screen, but the effect would be unpleasant, and for random scan systems, inefficient.

A better solution is to use a "track" mode of operation, rather than a "pick" mode. In the track mode, a tracking target – a pattern of points or addresses – is generated and displayed with its center located at the last point drawn. As the pen is moved, each point detected within the tracking target is retained as part of the line and the target location is kept centered at the last point detected. If several frames go by without the pen detecting the signal and without an end-of-line command being given, the program can initiate two courses of action. First, the size of the target can be increased (effectively a search procedure) and second, if this is unsuccessful, the entire screen can be flashed.

Flashing the screen for one frame can also solve another problem. Color CRT's are finding increasing use in terminals. Many of the newer color CRT's use a red phosphor which has long persistence. Depending on the other factors previously discussed, light pen operation with this red phosphor may be marginal. This may be solved by using the first switch closure to write all data in white (a white flash) for one frame. Then, if desired, the point or symbol picked could be intensified and the second switch closure used to accept data. Alternatively, light pens are available with dual switches (push-tip and push-button) producing independent outputs. One switch could be used to generate the "white flash" and the second to accept data.

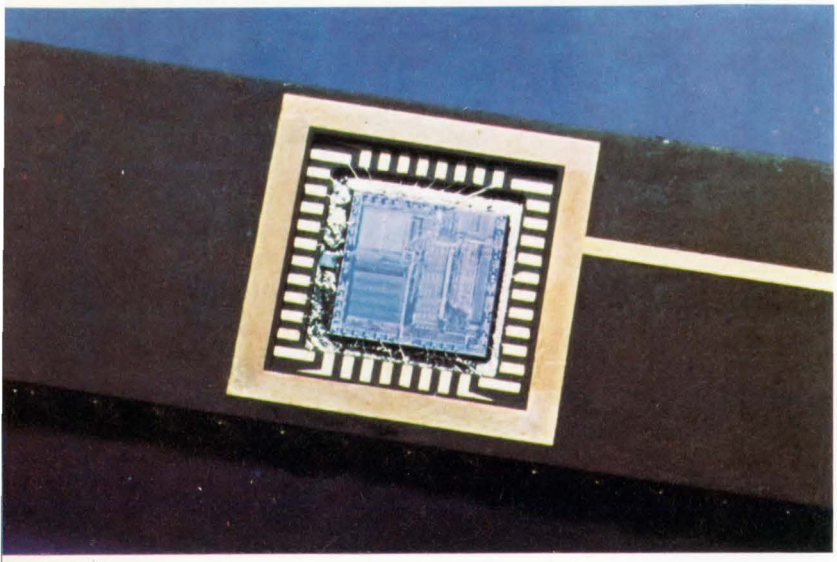
Rate this article: circle 4L, 4M or 4H on Reader Inquiry Card.

PRINT DRUMS AND TYPE WHEELS YOU CAN COUNT ON



DATA CARD CORPORATION • TROY DIVISION

2320 SOUTH PULLMAN ST. • SANTA ANA, CALIFORNIA 92705 • (714) 540-8565



Single-Chip 6801 Offers Increased Versatility –Part 1

James J. Farrell III
Motorola Semiconductor Product Inc.
Austin, TX

The newest member in the compatible evolutionary expansion of the M6800 family, Motorola's MC6801 microcomputer follows the pioneering +5V- only, MC6800 microprocessor in family compatibility as a prime design criteria.

MC6801 advantages

From a hardware standpoint, what is a MC6801? **Fig 1** shows the existing MC6800 family consisting of the MC6800, the clock and all of its compatible peripheral parts. In order to virtually duplicate in hardware the functions on-board the MC6801, all the parts enclosed by the thick black border have to be used. Even using the 9 chips required to replace the single MC6801 may not be adequate. The enhanced instruction set of the MC6801 (such as a hardware multiply) will cause the same programs used in the 9-chip system to be much longer (performing the multiply in software). The 9-chip system may have to become an 11-chip system, adding an additional ROM and RAM in order to be functionally equivalent to the single MC6801. Even with all this, the single MC6801 will execute its program more quickly than the multi-chip system.

Replacing an 11-chip system with the single-chip MC6801 provides:

(1) Reduced PC board Real Estate – The MC6801 will require only about 12% of the printed circuit board area used by the 11-chip system.

(2) Greatly reduced power consumption – Typically, the MC6801 will require less than 20% of the power used in the 11-chip system.

(3) Enhanced Reliability – The Mean Time Between Failure (MTBF) calculation includes several factors including part count. MC6801 has a greatly improved MTBF over the multi-chip system.

(4) A smaller and lighter system, since the smaller MC6801 supply and PC board reduce system size and weight. This means lower shipping costs and ultimately less floor space occupied in end-user facilities.

(5) Greatly reduced manufacturing costs, with fewer parts to handle, stock, insert in PC boards, QC, QA and so on.

(6) Reduced design-in time, since probability of design-in errors and initial copper lay-out errors is reduced.

Fig 2 describes MC6801 family evolution. The "vanilla" MC6800 requires five chips in its minimum configuration to operate in a viable system. Three years ago Motorola introduced the MC6802, which is essentially a MC6800 with a clock oscillator and 128 bytes of RAM – all on the same chip. The newer MC6801 contains 39,000 devices on a single chip, and operates in eight basic modes. Let's look at MC6801 features first, and then describe how it operates in the eight basic modes.

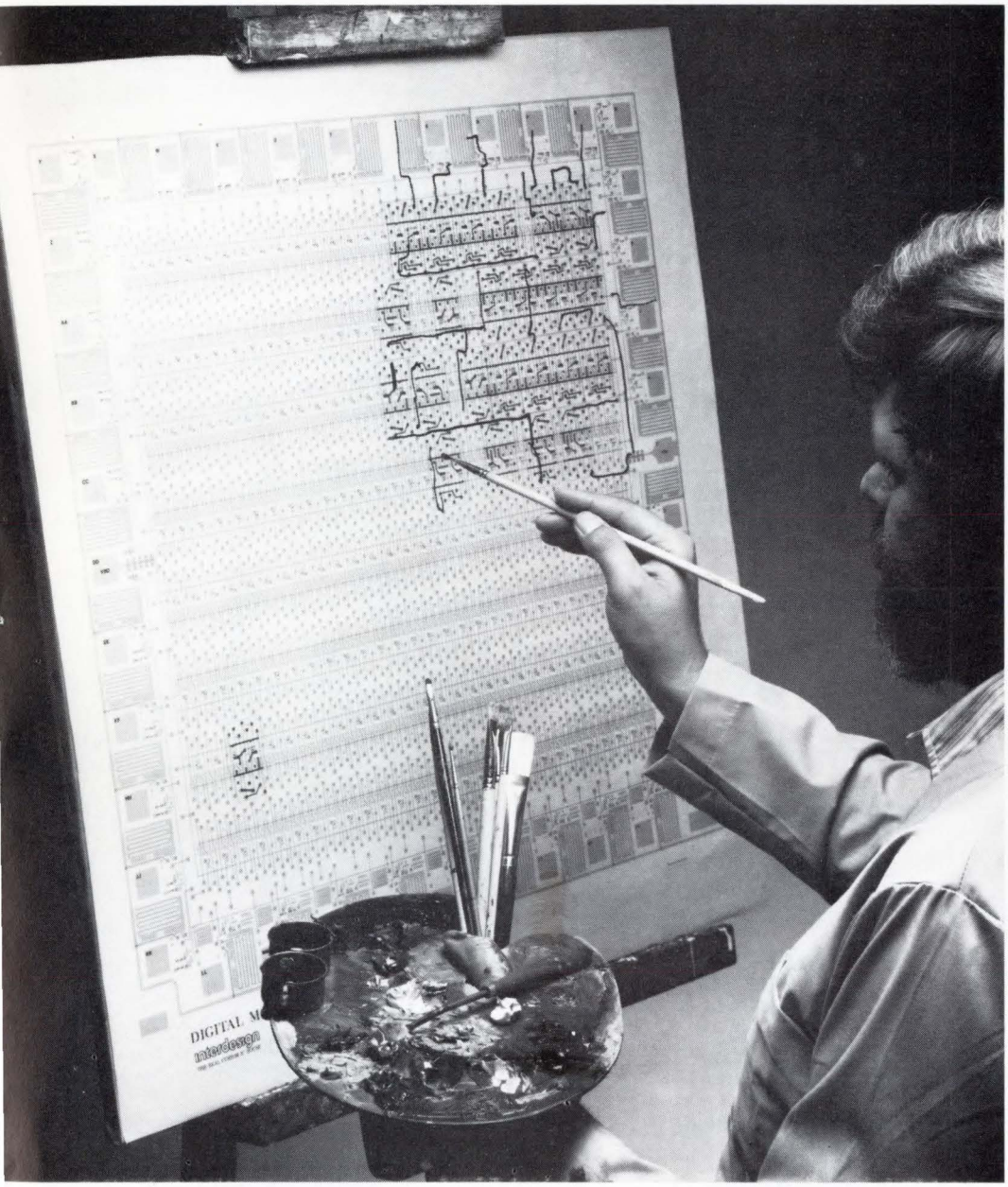
On-chip clock

For this one-chip system, an on-chip clock performs the system clock function. A divide-by-four circuit, included with the internal clock, uses a 4-MHz crystal to run the system at 1 MHz. This circuitry allows the chip to use an inexpensive 3.58-MHz color TV crystal for noncritical timing applications. Two 27 pF capacitors which connect the two crystal pins to ground ensure reliable operation. An external clock source may drive the oscillator at a 4-MHz rate to run at 1 MHz. The system is not restricted to 4 MHz, because it will divide-by-4 any frequency less than or equal to 4 MHz; the minimum rate is 400 kHz. Pin 2 must be grounded if an external clock is used.

The following crystal parameters are recommended: AT-Cut Parallel Resonance Crystal, C_o = 7 pF Max, FREQ = 4.0 MHz @ C_L = 24 pF, R_s = 50 ohms Max, frequency tolerance – ±5% to ± 0.02%.

The best E output for worst case design tolerance is ± 0.05% (500 ppM) with an A ± 0.02% crystal.

Your creativity and our Monochip: all you need to design your own NMOS IC.



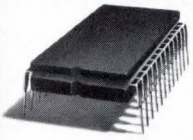
With your creativity and our semi-custom Monochip,™ you can have the advantages of NMOS without the high cost and long lead-time of full-custom development.

The logic elements are already in place on our Monochip—just waiting for you to design the interconnections to create the circuit you need for your application. After you do that, we'll etch the last layer of the wafer and deliver prototypes in 8 weeks for $5000 or less. And then we'll make production runs of 5000 to half a million parts.

Our $59. Design Kit makes it easy. And personal help from our NMOS experts costs nothing.

Call or write today for more information. Interdesign, 1255 Reamwood Avenue, Sunnyvale, CA 94086. (408) 734-8666.

interdesign



Monochip.™
the semi-custom IC.

Our NMOS Monochip Design Kit has everything you need to design and lay out your NMOS Monochip. $59.

Applications	Features
☐ Microprocessor interface	☐ Proven NMOS technology
☐ Data terminal keyboard encoders	☐ 224 logic cells
☐ Binary rate multipliers	☐ 38 I/0 cells
☐ Teletype interface logic	☐ Internal toggle rates greater than 3 MHz
☐ Multiplexers	☐ Three-state, inverter, open drain, and push-pull outputs
☐ Counters	☐ 10 mA sink capability
☐ Timers	☐ CMOS and TTL compatible
☐ Digital panel meters	
☐ Auxiliary arithmetic and logic units	
☐ General I/O interfaces	

Interdesign is a Ferranti Company.

Circle 60 on Reader Inquiry Card

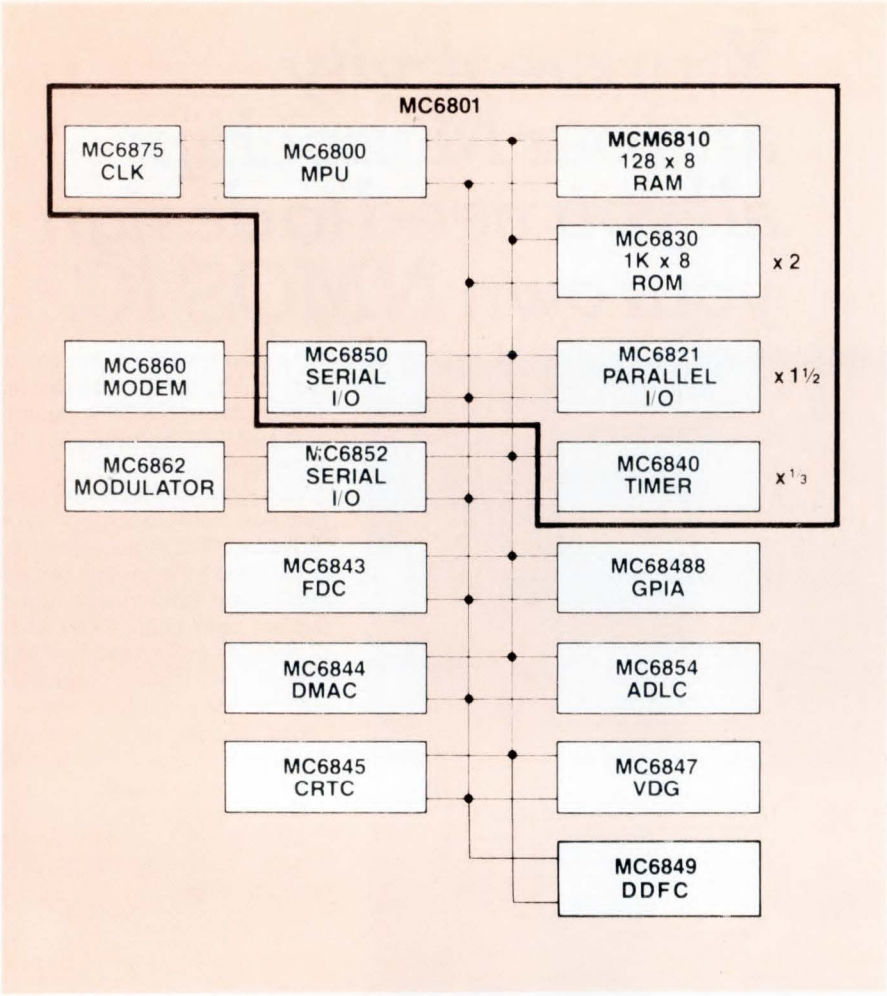


Fig 1 MC6801 single-chip microcomputer family.

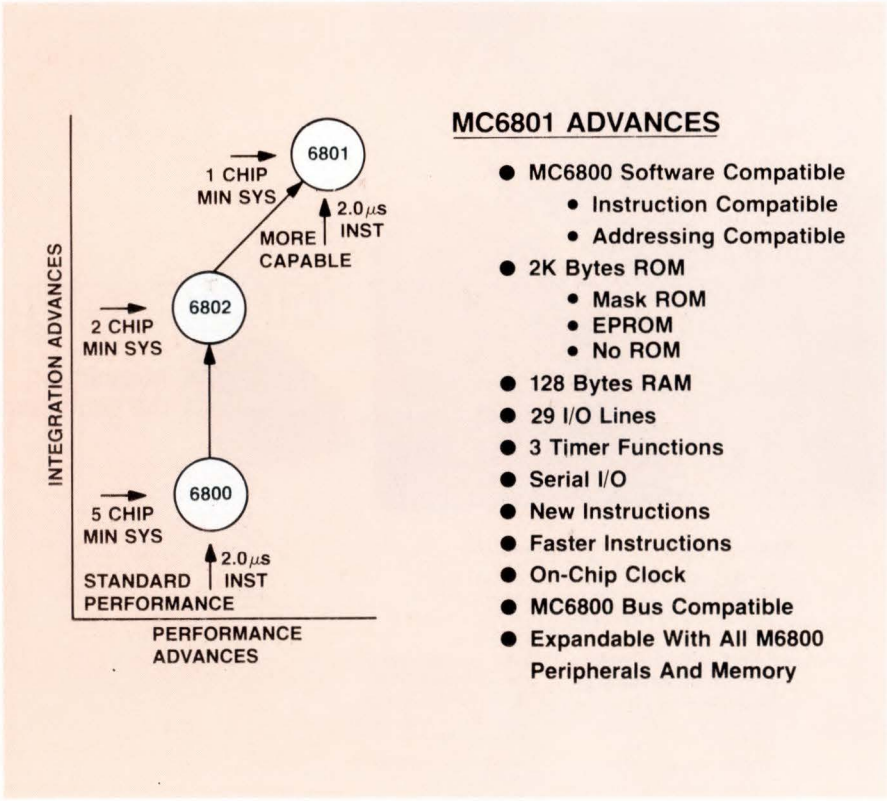


Fig 2 M6800 microprocessor/microcomputer family evolution.

On-board RAM

When selected, the on-board RAM occupies the position shown in the memory map in **Fig 3**. This RAM contains 128 bytes, of which 64 bytes are "retainable." That is, they may be saved in a power down condition, with the clock disabled, by using the low-power V_{CC} standby pin. This arrangement permits efficient battery backup operation during a main-line power failure condition; it saves 64 bytes of RAM for use when operations resume. Of course, a design may also use this feature at other times at his discretion.

On-board ROM

The MC6801 also contains 2048 (2K) bytes of on-board ROM. At the time of manufacture, Motorola places the user's program into the ROM. To facilitate designing the MC6801, Motorola is presently offering a MC6801L1 in kit form. It contains a monitor program in the on-board ROM. A software manual, "Lil Bug", explains this monitor.

To facilitate the development of the user programs further, Motorola offers a MC68701, which is a variation of the MC6801 and contains a UV-erasable, programmable ROM (EPROM). The MC68701 user may develop the ROM program for the MC 6801 or employ it in the final product, when production quantities do not justify the mask programmed ROM.

As already noted, the MC6801 ROM occupies the space shown on the memory map (**Fig 2**). The MCU (microcomputer unit) may select and access its internal ROM or RAM or may access these locations (independently) off-board – a topic discussed in the section on mode selection. The MC 6803, which is a MC6801 with no ROM on-board, and the MC6803, which has no ROM and no RAM. Otherwise, these parts are functionally identical to the MC6801. **Fig 4** shows the MC6801 family.

Interrupt structure

The operation of the MC6801 interrupts is similar to the MC6800 interrupts except that additional interrupt memory assignments have been made for the interrupts that the on-board timer and the SCI (Serial Communications Interface) can initiate. Before describing the MC6801 SCI and timer, let's note the additions to the MC6800 interrupt structure. **Table 1** makes a side-by-side comparison of the MC6800 and MC6801.

An Elgar AC Power Source lets you tap into all kinds of unusual powers—from 120 VA to 27 KVA. A single model lets you choose from 50 available plug-in oscillators for variable or fixed frequencies from 15 Hz to 10 KHz. Anything they can't provide, our programmable oscillator can. You can even order Elgar Power Sources with two- and three-phase outputs. So if you're in the market for power, come right to the source. Elgar is also a leading producer of High Isolation Transformers, AC Line Conditioners, and Uninterruptible Power Systems.

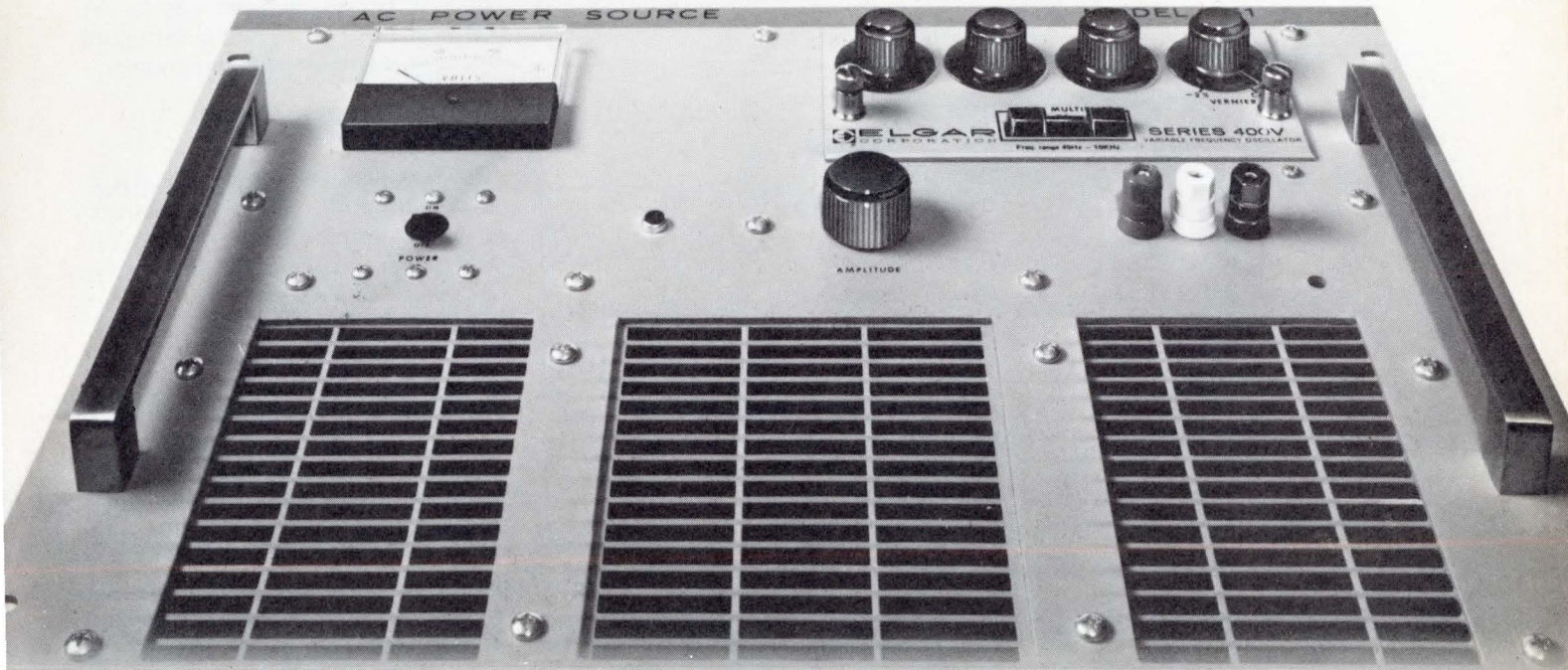
ELGAR®

8225 Mercury Ct., San Diego, CA 92111. Phone (714) 565-1155.

Circle 61 on Reader Inquiry Card

See us at Wescon Booth #1855/1857

You can have all the power in the world.



Right from the source.

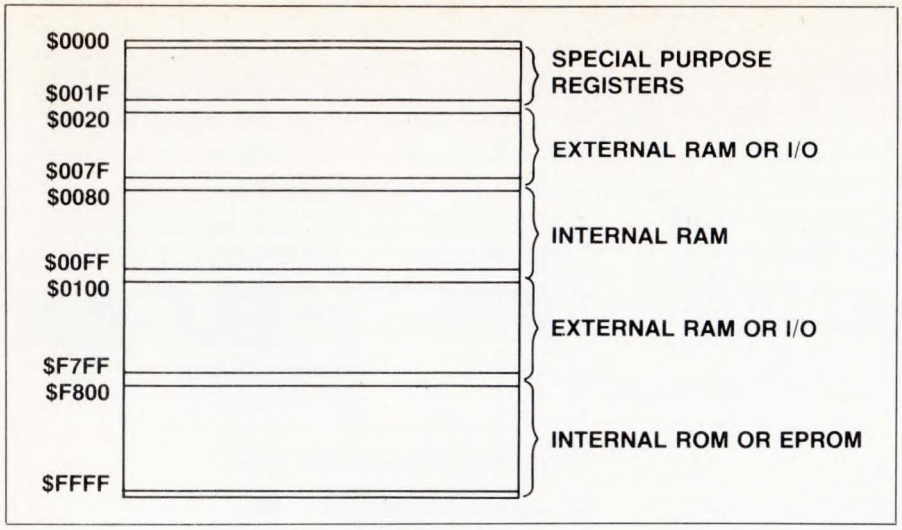


Fig 3 Memory map.

Table 1. MC6801 Vs. MC6800 Interrupt Structures

	Vector MS LS	MC6801 Description	MC6800
Highest	FFFE, FFFF	Restart	Restart
Priority	FFFC, FFFD	Non-Maskable Interrupt	Non-Maskable Interrupt
	FFFA, FFFB	Software Interrupt	Software Interrupt
	FFF8, FFF9	IRQ1/Interrupt Strobe 3	Hardware (IRQ) Interrupt
	FFF6, FFF7	IRQ2/Timer Input Capture	User
	FFF4, FFF5	IRQ2/Timer Output Compare	User
	FFF2, FFF3	IRQ2/Timer Overflow	User
Lowest	FFF0, FFF1	IRQ2/Serial I/O	User
Priority		Interrupt	

Table 2. Special-Purpose Registers

Hex Address	Register
00	Data Direction Port 1
01	Data Direction Port 2
02	I/O Port 1
03	I/O Port 2
04*	Data Direction Port 3
05**	Data Direction Port 4
06*	I/O Port 3
07**	I/O Port 4
08	Timer Control and Status Register
09	Counter High Byte
0A	Counter Low Byte
0B	Output Compare High Byte
0C	Output Compare Low Byte
0D	Input Compare High Byte
0E	Input Capture Low Byte
0F*	I/O Port 3 Control/Status
10	Serial Rate and Mode Register
11	Serial Control and Status Register
12	Serial Receiver Data Register
13	Serial Transmit Data Register
14	RAM Control Register
15-1F	Reserved

On-board timer

The fully functional on-board timer enables the programmer to measure and generate various timing functions. **Fig 3** and **Table 2** show the memory map register allocation of the timer Special Reserved Register. The timer hardware consists of an 8-bit control and status register, a 16-bit free running counter, a 16-bit output compare register and a 16-bit input capture register. **Fig 5** contains a block diagram of the timer registers and refers to the hardware and software descriptions of the timer. The first 32 bytes are for the special-purpose registers appearing in **Table 2**.

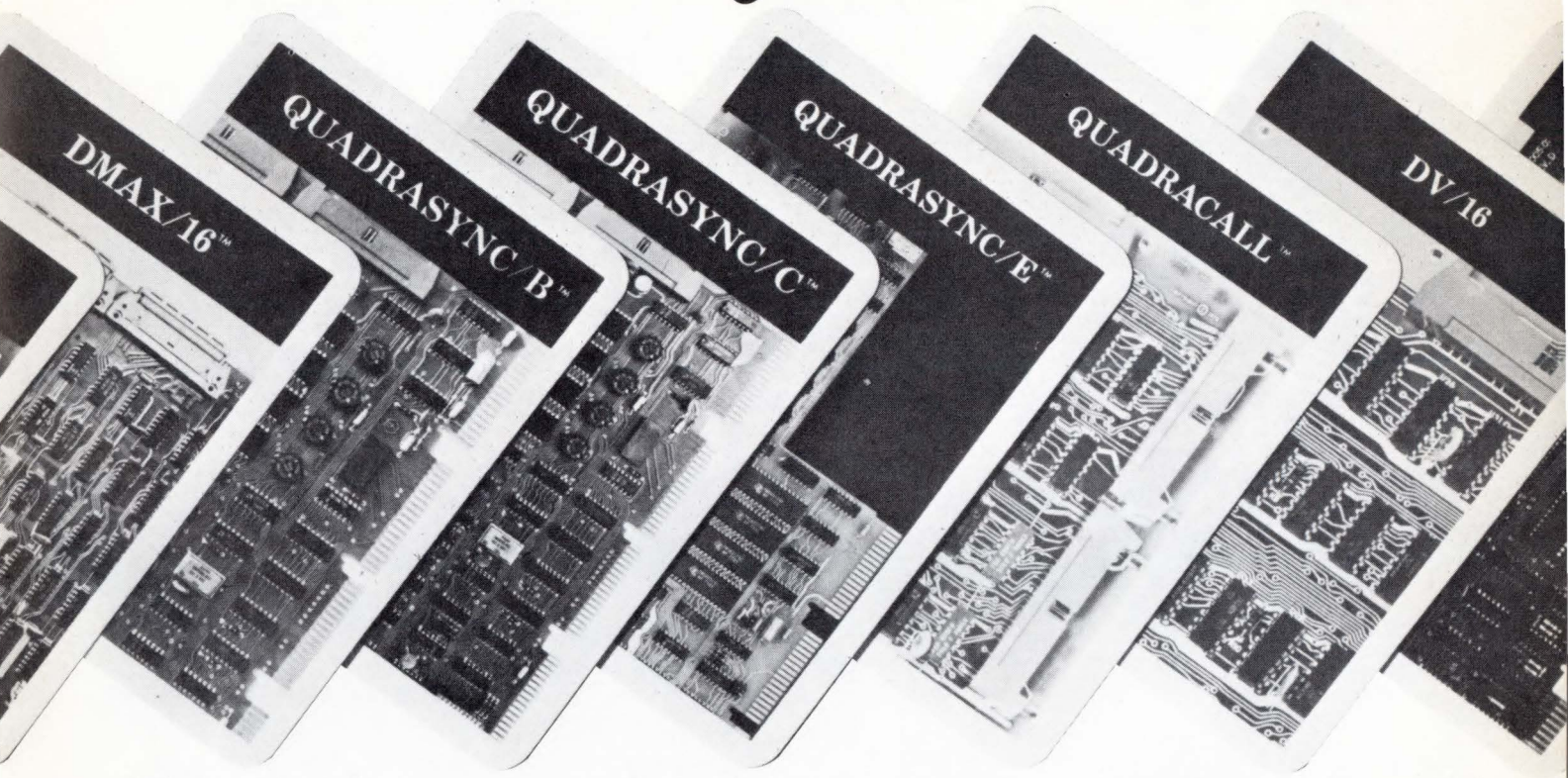
Free-running counter ($0009:000A)

The key element in the programmable timer is a 16-bit free-running counter which the MCU E-clock (crystal frequency divided by 4) increments. The MCU software may read the value at any time. The counter is cleared to read-only register with one exception. Any MCU write to the counter's address ($09) always results in a preset value of $FFF8 being loaded into the counter regardless of the value involved in the write. Although the preset operation is intended for operational testing of the part, it may be of value in some applications. It may also result in an erroneous SCI (Serial Communications Interface) character transfer, because the SCI baud rate is derived directly from the free-running counter.

Output compare register ($000B:000C)

The Output Compare Register (OCR) is a 16-bit R/W register that controls an output waveform or provides a time-out flag. The contents of this register are compared with the current value of the free-running counter on each E-cycle. When a match is found, a flag is set (OCF or Output Compare Flag) in the Timer Control and Status Register (TCSR) and the current value of the Output Level bit (OLVL) in the TCSR is clocked to the output level register. If Data Direction Register for Port 2, Bit 1 contains a "1" (output), output level register value appears on the pin for Port 2, Bit 1. Values in OCR and output level bit may be changed to control output level on the next com-value. OCR is set to $FFFF at Reset. Compare function is inhibited for one cycle following a write to the high byte of the OCR to insure a valid 16-bit value is in the register before a compare is made.

Hotline to your PDP-11



Able deals a powerful data-communications hand

We've moved well into data communications and already have a fist full of cards that sell for less than the competition but do a lot more. They all will save you space, power, bus loading and money while giving better performance, reliability, flexibility, and convenience. Take a look at the facts, then decide for yourself.

DMAX/16™
(16-LINE DH11 REPLACEMENT)

INSTALLS IN: <half DH11 space. **DATA RATES:** All standard baud rates **plus** 19.2K baud and one user programmable rate (16 baud rates). **PROCESSING ADVANTAGES:** Word transfers (in lieu of byte DMA) cut processing overhead by half! **OPERATING MODES:** Full or half duplex with full modem control via DM/16 option. **CAPACITY:** Up to 256 lines on a single PDP-11 at 2 bus loads per 16-lines.

QUADRASYNC/B™
(4-LINE DL11 REPLACEMENT/EIA)

INSTALLS IN: 1 SPC slot, 4 lines at 1 bus load. **DATA RATES:** 7 selectable rates for any of the 4 lines (150-9600). **ELECTRICAL:** EIA standard RS232C (Modem control not supported). **VECTOR/ADDRESS SELECTION:** Vector and address values to be set on boundaries of 00s to 40s. 16 continuous word address for Vector or Address.

QUADRASYNC/C™
(4-LINE DL11 REPLACEMENT/CL)

INSTALLS IN: 1 SPC slot, 4 lines at 1 bus load. **DATA RATES:** 7 selectable rates for any of the 4 lines (150-9600). **ELECTRICAL:** 20MA current loop (Send : Receive). **VECTOR/ADDRESS SELECTION:** Vector and address values to be set on boundaries of 00s to 40s. 16 continuous word address for Vector or Address.

QUADRASYNC/E™
(4-LINE DL11-E REPLACEMENT)

INSTALLS IN: 1 SPC slot, 4 lines at 1 bus load. **DATA RATES:** 7 selectable rates for any of the 4 lines (150-9600). **ELECTRICAL:** EIA standard RS-232C with modem control. **VECTOR/ADDRESS SELECTION:** 16 continuous word address for Vector or Address—starting values selected on any boundary.

QUADRACALL™
(4-LINE DN11 REPLACEMENT)

INSTALLS IN: 1 SPC slot, 4 lines at 1 bus load. **PERFORMANCE:** Interfaces up to 4 Bell 801 ACU's with Unibus for autodial link-ups. **INPUT/OUTPUT:** 5-input signals from ACU are handled by EIA RS-232 receivers. 6-output signals are transmitted using EIA RS232 drivers. **VECTOR/ADDRESS SELECTION:** Allows selection of device address and vector by use of pencil switches.

DV/16
(8, 16, 24 or 32-LINE DV11 REPLACEMENT)

INSTALLS IN: <half DV11 space providing byte protocol handling for sync/async communications such as DEC DDMCP, IBM BISYNC, etc. **OPERATING ADVANTAGE:** User may mix sync and async lines in combinations of 4 or 8 lines by on-board switch selection with modem control. Fully software compatible with all DV11 performance features.

Along with our powerful communication package and world-wide product support we have a complete selection of cache buffer memories, Fastbus memories, DMA interfaces, PDP-11 bus repeaters and LSI Q-bus adaptors. Write for details. You'll find out why our customers consider us the leader among manufacturers of PDP enhancements.

Able Computer. 1751 Langley Avenue. Irvine, California 92714.
(714) 979-7030.
TWX 910-595-1729.

Able, the computer experts

Circle 62 on Reader Inquiry Card

'Power Misers.'

Adtech Power's new high efficiency linear DC Power Supplies.

30-40% more efficient and 30-45% smaller than series regulators.. half the cost of less reliable switchers!

TRANSFORMER SIZE AND WEIGHT ARE REDUCED because of the higher efficiency of the components and circuits developed.

TRANSFORMER LOSSES HAVE BEEN REDUCED 13% through the use of higher grade steel and square copper magnet wire.

50% MORE FILTER CAPACITANCE REDUCES RIPPLE BY 33% reducing the D.C. input voltage required to offset the ripple.

THE EMPS 5-18 (5V/18A) PICTURED IS THE SAME SIZE AS A CONVENTIONAL 5V/12A SERIES REGULATED UNIT.

HIGHER POWER, LOWER SATURATION VOLTAGE SERIES TRANSISTORS reduce saturation voltage drop dissipation by 40%.

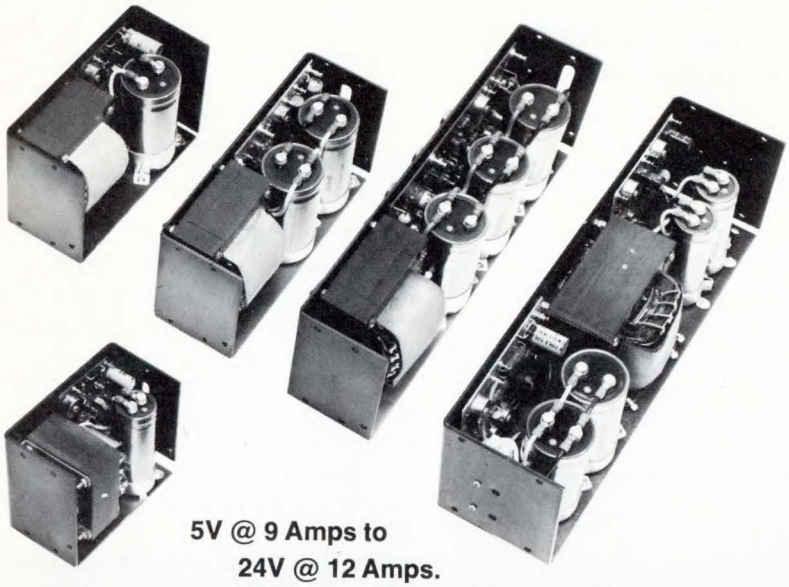
TYPICAL RECTIFIER LOSSES OF 20-25% ARE REDUCED 50% by the use of more expensive, high powered Schottky rectifiers conservatively derated 50% in both current and voltage.

*** Comparison of your three alternatives.**

Type*	Cost Per Watt Out	Efficiency	Volume Per Watt Out	Power Density Per Watt Out
Conventional Linear Series Regulator	$1.20	33-43%	3.74 Cu. In./W.	0.27 W/Cu. In.
Hi-Efficiency "Power Miser" EMPS Series	$1.35	53-56%	1.91 Cu. In./W.	0.52 W/Cu. In.
High-Frequency Switching Regulator	$2.20	65-71%	1.34-1.62 Cu. In./W.	0.61-0.74 W/Cu. In.

*Data based on 5 Volt, 25 Amp D.C. Output Rating.

A complete series of 18 Single Output, Dual Output and Triple Output Microprocessor Models with no EMI problems...an MTBF of 60,000 to 80,000 hours...backed by a 6-year guarantee!



5V @ 9 Amps to 24V @ 12 Amps.

18 Models/ 7 Configurations

D.C. RATING	EFFICIENCY	MODEL NO.	POWER SUPPLY PRICES				
			1-9	10-24	25-49	50-99	100-249
Single Output Models							
5V @ 9A	54% ±2%	EMPS 5-9	99.00	94.00	90.30	87.60	85.80
5V @ 12A	54% ±2%	EMPS 5-12	109.00	103.55	99.40	96.40	94.50
5V @ 18A	54% ±2%	EMPS 5-18	135.00	127.95	122.80	119.15	116.75
5V @ 25A	54% ±2%	EMPS 5-25	180.00	171.00	164.00	159.25	156.00
5V @ 40A	54% ±2%	EMPS 5-40	220.00	209.00	200.60	194.60	190.00
12V @ 12A	59% ±1%	EMPS 12-12	170.00	161.00	154.00	149.25	146.00
12V @ 18A	59% ±1%	EMPS 12-18	210.00	199.00	190.00	184.60	180.00
15V @ 11A	65% ±1%	EMPS 15-11	170.00	161.00	154.00	149.25	146.00
15V @ 16A	65% ±1%	EMPS 15-16	210.00	199.00	190.60	184.60	180.00
24V @ 8A	68% ±1%	EMPS 24-8	170.00	161.00	154.00	149.25	146.00
24V @ 12A	68% ±1%	EMPS 24-12	210.00	199.00	190.60	184.60	180.00
Dual Output Models							
±12V @ 6A	OVER 50%	DEMPS 12-6	190.00	188.10	180.60	175.15	171.65
±15V @ 5.5A	OVER 50%	DEMPS 15-5.5	190.00	188.10	180.60	175.15	171.65
Triple Output Microprocessor Models							
5V @ 12A ±12V @ 2A	OVER 50%	TEMPS-3	185.00	175.75	168.70	163.65	160.40
5V @ 18A ±12V @ 3A	OVER 50%	TEMPS-4	230.00	218.50	209.75	203.50	199.40

*For +15V add "-2" suffix to model no.
Overvoltage protection standard on TEMPS-3 & 4, 5V. output

Specifications: All Models

A.C. Input:
5 V.D.C. OUTPUT UNITS: 105-125 Vac. 47-440Hz (derate 10% for 50Hz operation)
ALL OTHERS: 105-125/210-250 Vac, 47/440Hz

Extended A.C. Input: 100-130 Vac (derate 20%)

D.C. Outputs: See Tabulation of Models

Control: ± 5% Voltage Adjustment (Screwdriver adjust pot.)

Regulation: ± 0.05% Line or Load

Remote Sensing:
Standard on all models, (includes open sense lead protection.)

Ripple: 5mV Peak to Peak

Reserve Power:
+5% of output available for external load line drop on 5V. and 12V. units; +0.6V. on all others.

Temperature Coefficient: 0.02%/°C.

Stability:
± 0.1% for 24 hour period after 30 minute warmup

Overshoot:
No turn-on, turn-off or power failure overshoots.

Transient Response:
Output recovers to regulation band within 50 microseconds after an instantaneous load change of 50 to 100%.

Operating Temperature:
-25° to +70°C. (derate linearly above +50°C. to 40% at +70°C.; derate linearly below -5°C. to 70% at -25°C.)

Cooling:
Convection cooled for full power rating at 50°C. ambient. Forced air cooling extends full power rating to 60°C.

Protection:
Overload and short circuits: Automatic recovery foldback current limiting fully protects against overloads and short circuits.
Reverse Polarity Protection: Prevents damage from reverse voltage swings.
Inductive Load Protection: Prevents damage due to inductive voltage swings.

Overvoltage:
Optional crowbar overvoltage protection. (Standard on 5V. output TEMPS)

Transformer:
Electrostatically shielded for better line noise immunity.

All Models Meet U.L. Recognition Requirements.

CALL OUR ENGINEERING SALES OFFICE IN YOUR AREA FOR COMPLETE DATA AND PRICES

Arizona, Phoenix
Phone: (602) 894-2335

California, Anaheim
Phone: (714) 634-9211

California: Long Beach
Phone: (213) 426-7375

California, Los Gatos
Phone: (408) 354-6496

California, San Diego
Phone: (714) 560-1009

Colorado, Denver
Phone: (303) 688-4154

Connecticut, Meriden
Phone: (203) 237-9232

Florida, Coral Springs
Phone: (305) 752-7520

Florida, Largo
Phone: (813) 536-8536

Georgia, Atlanta
Phone: (404) 233-6679
(404) 981-9753

Illinois, Chicago
Phone: (312) 437-2700

Indiana, Indianapolis
Phone: (317) 844-2800

Iowa, Cedar Rapids
Phone: (319) 362-9177

Kansas, Kansas City
Phone: (913) 381-0004

Kansas, Wichita
Phone: (316) 264-2662

Massachusetts, Boston
Phone: (617) 245-0250

Michigan, Detroit
Phone: (313) 576-4706

Minnesota, Minneapolis
Phone: (612) 861-3343

Missouri, St. Louis
Phone: (314) 569-1220

New Mexico, Albuquerque
Phone: (505) 294-8408

New Mexico, Las Cruces
Phone: (505) 524-0126

New York, Albany
Phone: (518) 456-6667

New York, Buffalo
Phone: (716) 632-7880

New York, New York
Phone: (516) 487-3966

New York, Rochester
Phone: (716) 482-3000

New York, Syracuse
Phone: (315) 637-9383

North Carolina, Hayesville
Phone: (704) 389-8850

Pennsylvania, Philadelphia
Phone: (215) 825-9515

Pennsylvania, Pittsburgh
Phone: (412) 961-0414

Texas, Dallas
Phone: (214) 387-2489

Texas, Houston
Phone: (713) 988-0991

Washington, Seattle
Phone: (206) 641-3535

Washington, D.C.
Phone: (202) 363-9417

Wisconsin, Milwaukee
Phone: (414) 527-1500

ADTECH POWER

Europe: ADTECH INTERNATIONAL, Subsidiary of Adtech Power, 46 BD, Roger Salengro, 78200 Mantes La Ville, France. Tel. 4775301+

DISTRIBUTORS: Call Kathy Nelson, Distributor Products Group, (714) 634-9211, for the name of a distributor near you.

Power Misers are also manufactured in Europe.

ADTECH POWER, INC., 1621 S. SINCLAIR ST., ANAHEIM, CA 92806. (714) 634-9211 ● TELEX 68-1498

Circle 64 on Reader Inquiry Card

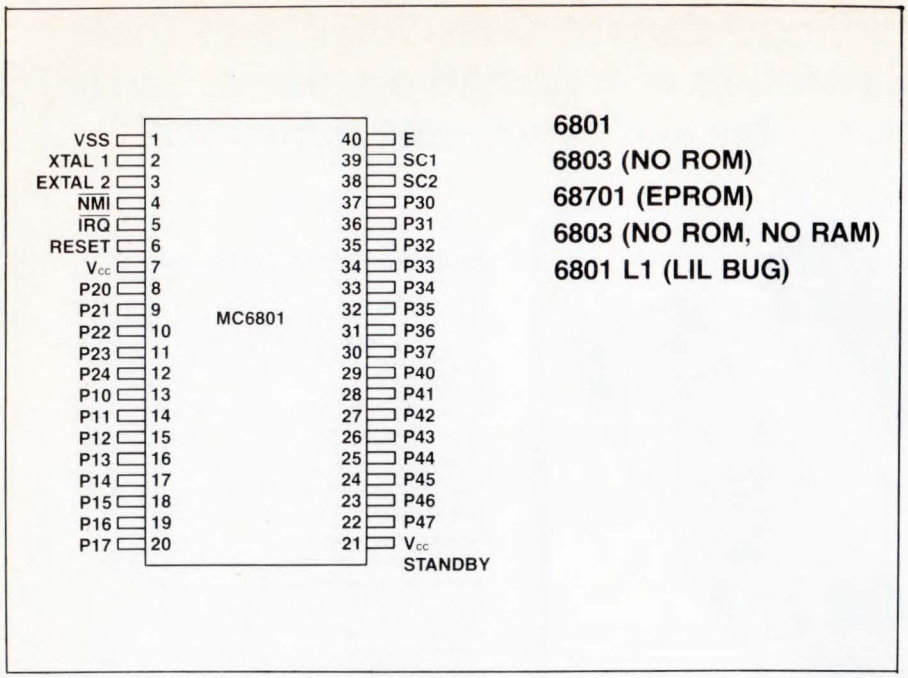


Fig 4 M6801 footprint and family.

Input capture register ($000D:000E)

The 16-bit input capture register is a read-only register that stores the current value of the free-running counter when the proper transition of an external input signal occurs. The input transition change required to trigger the counter transfer is controlled by the Input Edge bit (IEDG) in the TCSR.

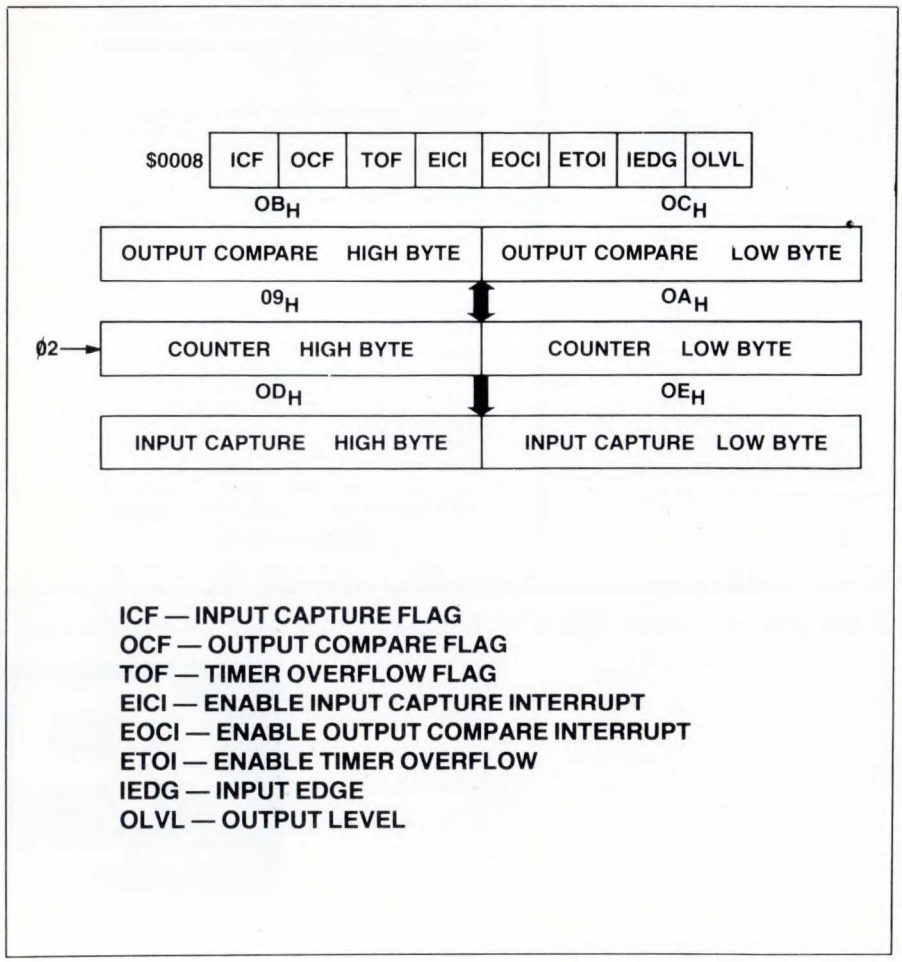


Fig 5 Timer control/status register.

The Data Direction Register bit for Port Bit 0 should be cleared (zero) to gate in the external input signal to the edge detect unit in the timer. (With Port 2, Bit 0 configured as an output and set to "1", the edge detect unit still sees the MCU data bit changes.) The timer input signal must maintain its logic level for at least 2 MCU E-cycles after transition to insure an input capture under all conditions.

Timer control and status register (TCSR) ($0008)

The TCSR consists of an 8-bit register. Bits 0-4 are read and write, Bits 5-7 are read-only. The upper three bits contain read-only timer status information and indicate that:

- A proper transition has taken place on the input pin (TCSR bit 7)
- A match has been found between the value in the free running counter and the output compare register (TCSR bit 6)
- The free running counter has rolled over from $FFFF to $0000 (TCSR bit 5) (IRQ2) with an individual Enable bit in the TCSR. If the I-bit in the MC 6801 Condition Code Register is clear, a priority vectored interrupt occurs and corresponds to the flag bit(s) set.

A description of each bit in the Timer Control/Status Register **(Fig 5)** follows:

Bit 0 OLVL Output Level: This value is clocked to the output level register by an output compare. If the DDR for Port 2 bit 1 is set, the value will appear on the output pin.

Bit 1 IEDG Input Edge: This bit controls which transition of an input will trigger a transfer of the counter to the input capture register. The DDR for Port 2 bit 0 must be clear for this function to operate.

IEDG = 0 Transfer takes place on a negative (high-to-low) transiton*.

IEDG = 1 Transfer takes place on a positive edge (low-to-high) transition*.

The timer input signal must maintain its logic level for at least 2 MCU cycles after transition in order to generate an input capture under all conditions.

Bit 2 ET01 Enable Timer Overflow Interrupt: When set, this bit enables an IRQ2 interrupt for a Timer Overflow, when clear, the interrupt is inhibited.

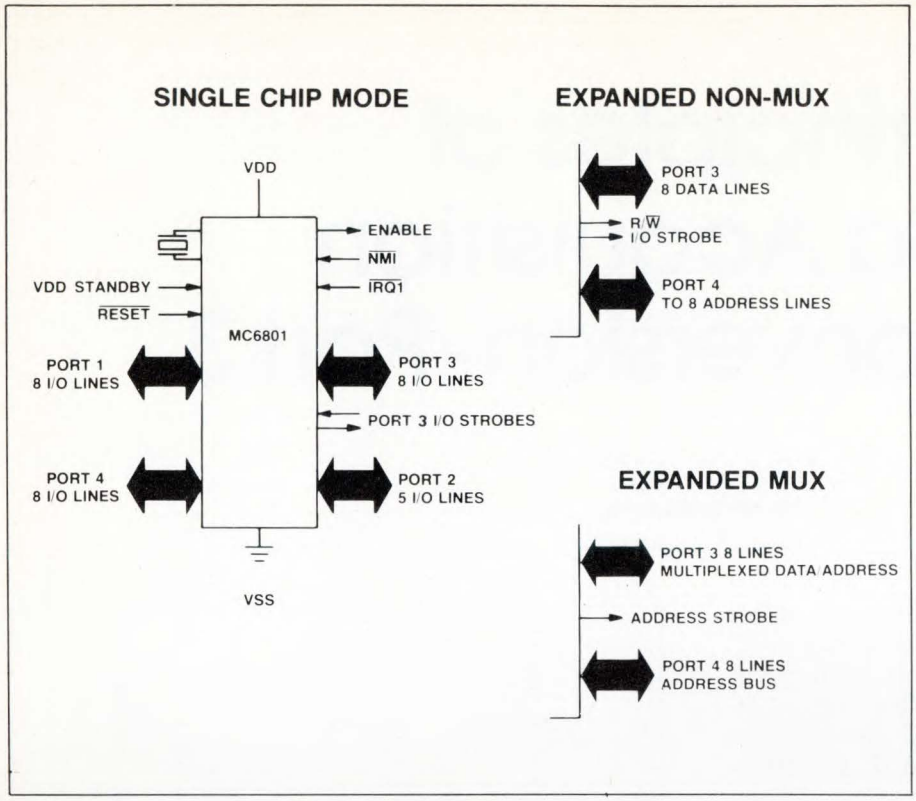


Fig 6 Three external configurations.

Bit 3 EOCI Enable Output Compare Interrupt: When set, this bit enables an IRQ2 interrupt for an output compare; when clear, the interrupt is inhibited.

Bit 4 EICI Enable Input Capture Interrupt: When set, this bit enables an IRQ2 interrupt for an input capture; when clear, the interrupt is inhibited.

Bit 5 TOF Timer Overflow Flag: This read-only bit is set when the counter overflows from $FFFF to $0000. It is cleared by a read of the TCSR (with TOF set) followed by a MCU read of the counter high-byte ($09).

Bit 6 OCF Output Compare Flag: This read-only bit is set when a match is found between the output compare register and the free running counter. It is cleared by a read of the TCSR (with OCF set) followed by an MCU write to the output compare register ($0B or $0C).

Bit 7 ICF Input Capture Flag: This read-only status bit is set by a proper transition on the input to the edge detect unit; it is cleared by a read of the TCSR (with ICF set) followed by a MCU read of the Input Capture Register High Byte ($0D).

*See Input Capture Register.

Parallel port operation

Pins 8 through 20 and pins 22 through 37 of the footprint in **Fig 3** describe the four ports of the MC6801. **Fig 6** demonstrates the three external configurations and the differing functions of the parallel ports in the 8 modes. The port may be initialized in the Single Chip Mode, Expanded Non-Multiplexed Mode or Expanded Multiplexed Mode. Breaking the code or port nomenclature is easy: P32 means Port 3, bit 2; P10 means Port 1, bit 0 and so on. Each individual bit in each port may individually be programmed as an input or an output.

Fig 7 (in Part 2) demonstrates a parallel interface between two MC6801's. Since the MC6801's are in asynchronous operation (each operating off its own crystal), port 3 handshake implements the data transfer between the MCUs.

The second part will examine the MC6801 full-duplex asynchronous serial communication interface, programmable options and other features of the MC6801.

Rate this article: circle 5L, 5M or 5H on Reader Inquiry Card.

Principles of Data Acquisition and Conversion - Part 3

Eugene L. Zuch
Datel Systems, Inc.

Digital-to-analog converters (DACs or decoders) enable computers to communicate with the outside analog world. They are used in CRT display systems, voice synthesizers, automatic test systems, digitally controlled attenuators, process control actuators and other applications. They are also key components inside most A/D converters.

Most DACs are parallel types

The transfer function of an ideal 3-bit A/D converter is shown in **Fig 1**. Each input code word produces a single, discrete analog output value, generally a voltage. Over the output range of the converter 2^n different values are produced including zero; and the output has a one-to-one correspondence with input, which is not true for A/D converters.

There are many different circuit techniques used to implement D/A converters, but a few popular ones are widely used today. Virtually all D/A converters in use are of the *parallel type* where all bits change simultaneously upon application of an input code word; *serial type* D/A converters, on the other hand, produce an analog output only after receiving all digital input data in sequential form.

The most popular D/A converter design in use today is the weighted current source circuit illustrated in **Fig 2**. An array of switched transistor current sources is used with binary weighted currents. The binary weighting is achieved by using emitter resistors with binary related values of R, 2R, 4R, 8R, . . . 2^nR. The resulting collector currents are then added together at the current summing line.

The current sources are switched on or off from standard TTL inputs by means of the control diodes connected to each emitter. When the TTL input is high the current source is on; when the input is low it is off, with the current flowing through the control diode. Fast switching speed is achieved because there is direct control of the transistor current, and the current sources never go into saturation.

To interface with standard TTL levels, the current sources are biased to a base voltage of +1.2V. The emitter currents are regulated to constant values by means of the control amplifier and a precision voltage reference circuit together with a binary transistor.

The summed output currents from all current sources that are on go to an operational amplifier summing junction; the amplifier converts this output current into an out-

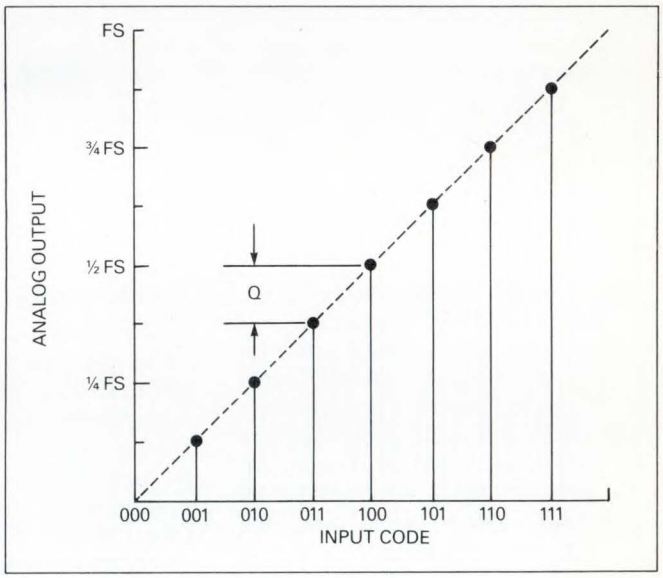


Fig 1 Transfer function of ideal 3-bit D/A converter.

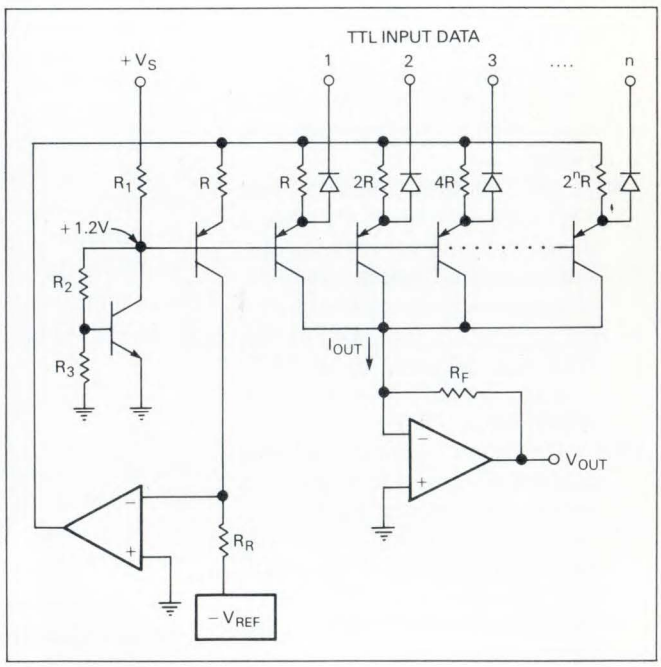


Fig 2 Weighted current source D/A converter

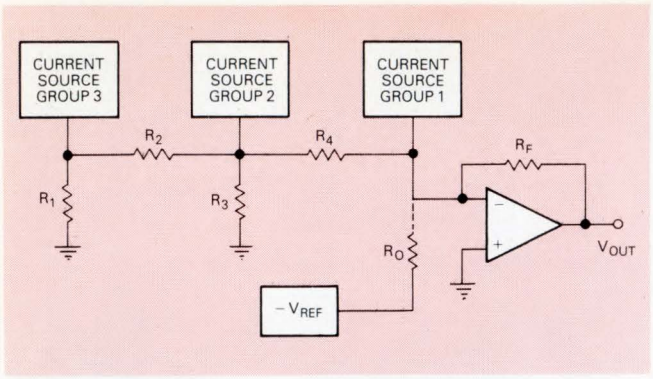


Fig 3 Current dividing the outputs of weighted current source groups.

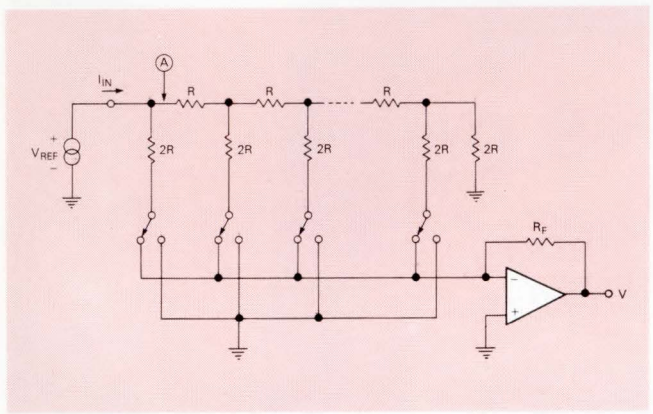


Fig 4 R-2R Ladder D/A Converter.

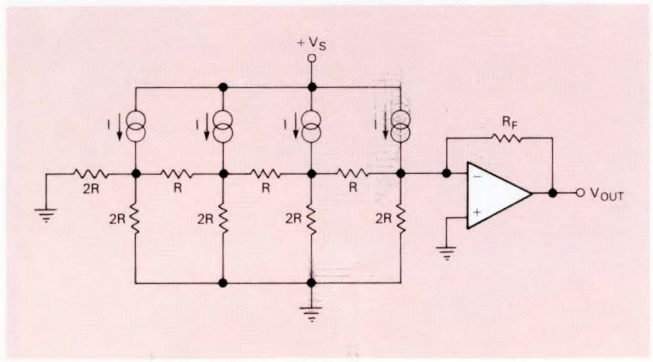


Fig 5 D/A Converter employing R-2R Ladder with equal value switched current sources.

put voltage. In some D/A converters the output current is used to directly drive a resistor load for maximum speed, but the positive output voltage in this case is limited to about +1V.

The weighted current source design has the advantages of simplicity and high speed. Both PNP and NPN transistor current sources can be used with this technique although the TTL interfacing is more difficult with NPN sources. This technique is used in most monolithic, hybrid, and modular D/A converters in use today.

Weighted current sources

A difficulty in implementing higher resolution D/A converter designs is that a wide range of emitter resistors is required, and very high value resistors cause problems with both temperature stability and switching speed. To overcome these problems, weighted current sources are used in identical groups, with the output of each group divided down by a resistor divider as shown in **Fig 3**.

The resistor network, R_1 through R_4, divides the output of Group 3 down by a factor of 256 and the output of Group 2 down by a factor of 16 with respect to the output of Group 1. Each group is identical, with four current sources of the type shown in **Fig 2**, having binary current weights of 1, 2, 4, 8. Figure 3 also illustrates the method of achieving a bipolar output by deriving an offset current from the reference circuit which is then subtracted from the output current line through resistor R_0. This current is set to exactly one half the full scale output current.

A second popular technique for D/A conversion is the R-2R ladder method. As shown in **Fig 4**, the network consists of series resistors of value R and shunt resistors of value 2R. The bottom of each shunt resistor has a single-pole double-throw electronic switch which connects the resistor to either ground or the output current summing line. As in the previous circuit, the output current summing line goes to an operational amplifier which converts current to voltage.

The operation of the R-2R ladder network is based on the binary division of current as it flows down the ladder. Examination of the ladder configuration reveals that at point A looking to the right, one measures a resistance of 2R; therefore the reference input to the ladder has a resistance of R. At the reference input the current splits into two equal parts since it sees equal resistances in either direction. Likewise the current flowing down the ladder to the

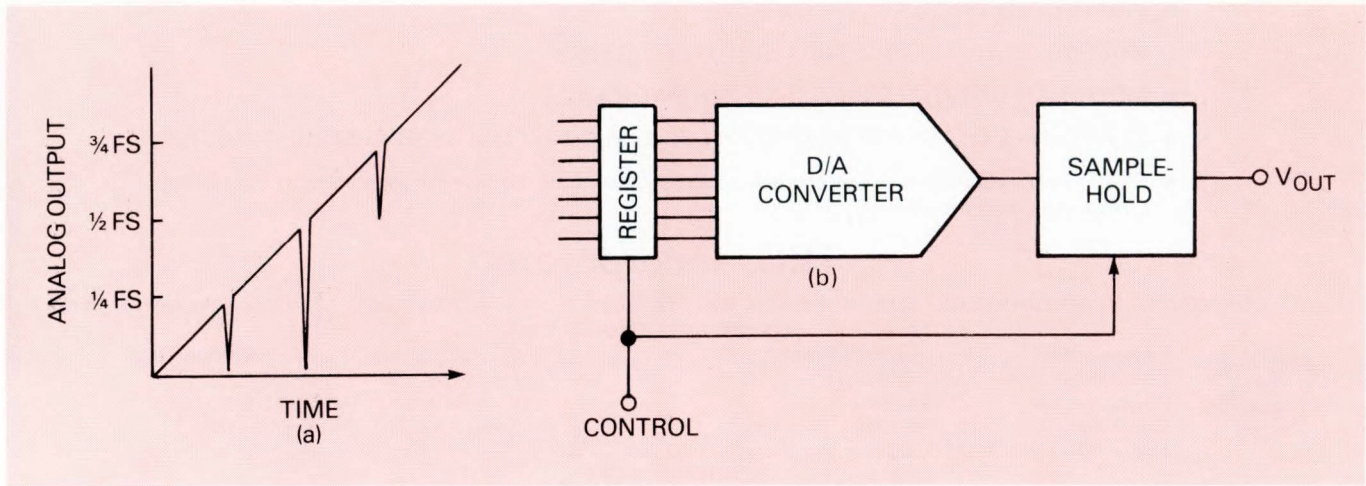
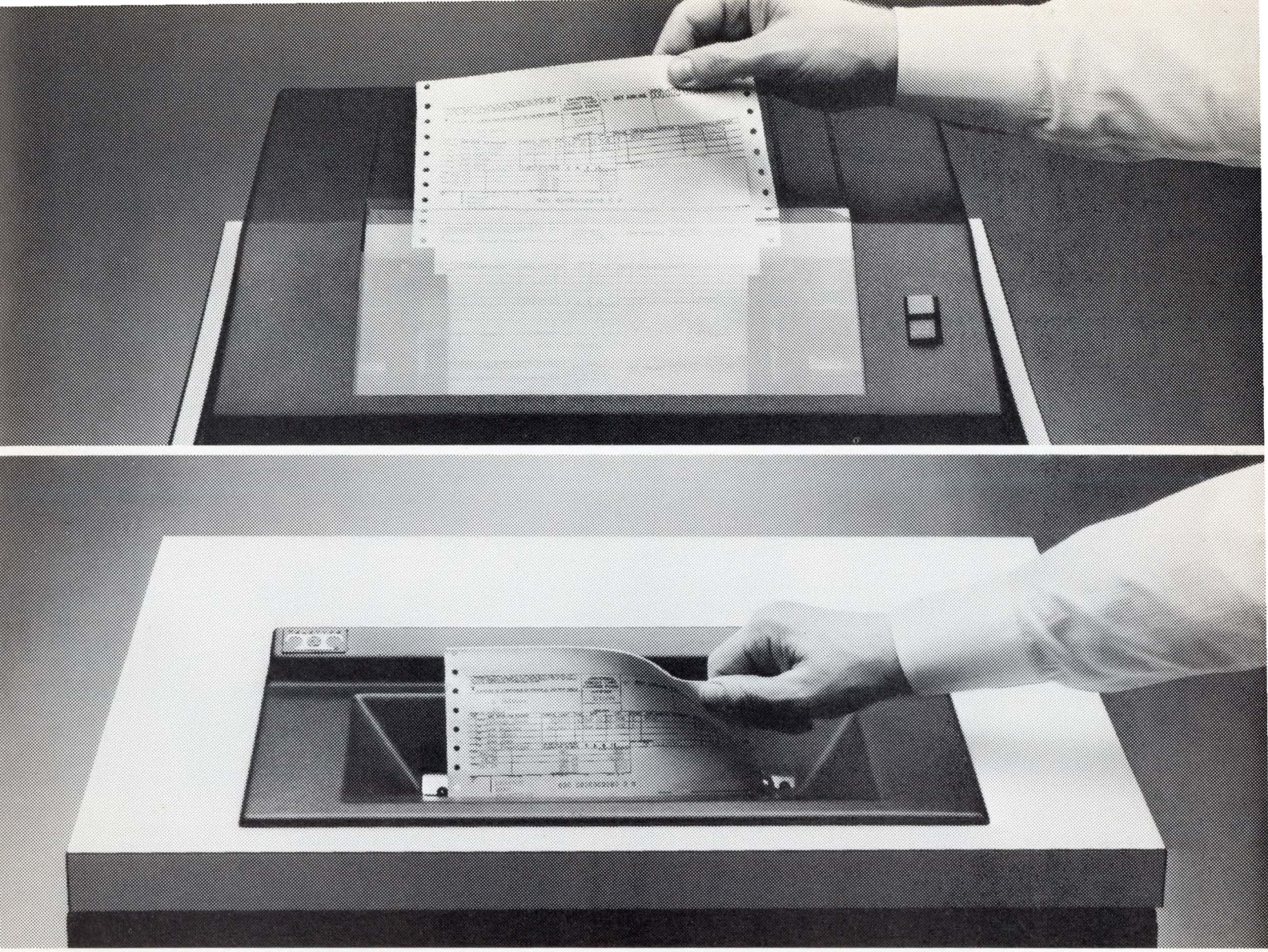


Fig 6 Output glitches (a) and deglitched D/A Converter (b).



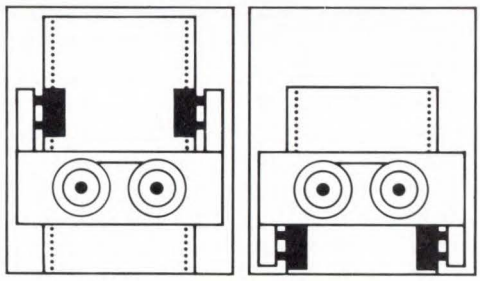
THE BOTTOM LINE ON FORMS ACCESS PRINTERS.

Why can the Teletype* model 40 printer give you the bottom line when most other printers can't?

Because with the Teletype model 40 printer, you can print from the very top to the very bottom line of any form, tear it off, and never waste or destroy the next form.

It saves paper.

We designed our Forms Access printer with the tractor feed mechanism mounted below the print line. The paper is pushed up through the printer, so you never have to feed a second form through to get at the one you just printed.



Theirs. Ours.

It makes money.

And, while your customers save paper, you make money. Teletype Corporation's low price on the remarkable model 40 makes it extremely cost efficient. Plus our proven LSI circuitry assures you of high reliability.

And it's ready to go to work now.

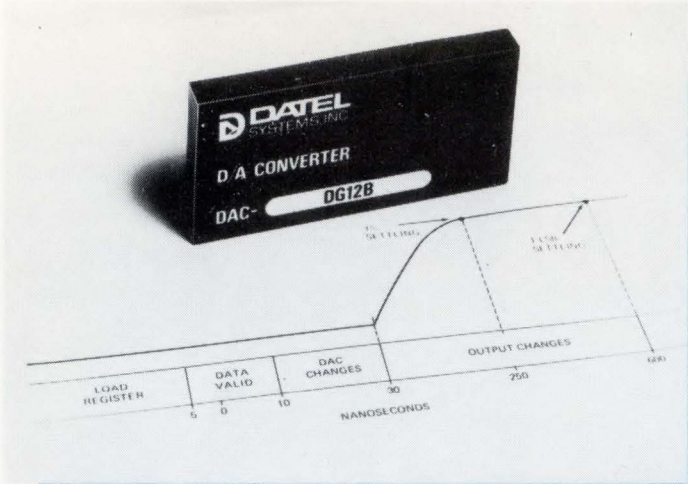
The model 40 unit includes everything you need to go on-line right now. There's also handsome cabinetry or modification kits available to make packaging quick and simple. Plus technical assistance if you need it.

And that's the bottom line on the Forms Access printer. No wonder we're getting a reputation as the printer people.

Teletype Corporation
5555 Touhy Avenue, Dept. 3185, Skokie, IL 60076.
Telephone (312) 982-2000.

Circle 52 on Reader Inquiry Card

*Teletype is a trademark and service mark of the Teletype Corporation.



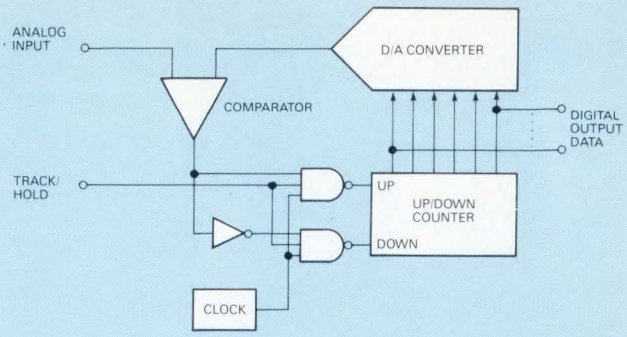


Fig 8 Successive approximation A/D Converter.

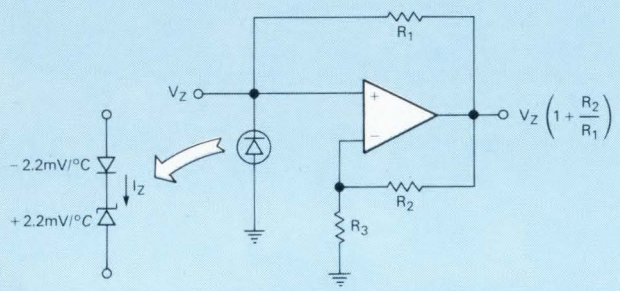


Fig 7 Tracking type A/D Converter.

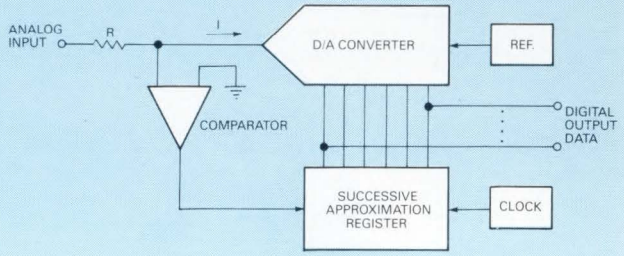


Fig 9 Successive approximation A/D Converter.

right continues to divide into two equal parts at each resistor junction.

The result is binary weighted currents flowing down each shunt resistor in the ladder. The digitally controlled switches direct the currents to either the summing line or ground. Assuming all bits are on, as shown in the diagram, the output current is: $I_{OUT} = V_{REF}/R)\ (1/2 + 1/4 + 1/8 + \ldots 1/2^n)$, which is a binary series. The sum of all currents is then: $I_{OUT} = (V_{REF}/R)\ (1-2^{-n})$. The 2^{-n} term physically represents the portion of input current flowing through the 2R terminating resistor to ground at far right.

The advantage of the R-2R ladder technique is that only two values of resistors are required, with the resultant ease of matching or trimming and excellent temperature tracking. In addition, for high speed applications relatively low resistor values can be used. Excellent results can be obtained for high resolution D/A converters by using laser-trimmed thin film resistor networks.

The R-2R ladder method is specifically used for *multiplying type* D/A converters. With these converters, the reference voltage can be varied over the full range of $\pm V_{max}$ with the output the product of the reference voltage and the digital input word. Multiplication can be performed in 1, 2 or 4 algebraic quadrants.

If the reference voltage is unipolar, the circuit is a one-quadrant multiplying DAC; if it is bipolar the circuit is a two-quadrant multiplying DAC. For four-quadrant operation the two current summing lines shown in **Fig 4** must be subtracted from each other by operational amplifiers.

In multiplying D/A converters, the electronic switches are usually implemented with CMOS devices. Multiplying DAC's are commonly used in automatic gain controls, CRT character generation, complex function generators, digital attenuators, and divider circuits.

Another important D/A converter design takes advantage of the best features of both the weighted current source technique and the R-2R ladder technique. This circuit, shown in **Fig 5**, uses equal value switched current sources to drive the junctions of the R-2R ladder network. The advantage of the equal value current sources is obvious since all emitter resistors are identical and switching speeds are also identical. This technique is used in many ultra-high speed D/A converters.

One other specialized type D/A converter used primarily in CRT display systems is the *deglitched* D/A converter. All D/A converters produce output spikes, or *glitches*, which are most serious at the major output transitions of 1/4 FS, 1/2 FS, and 3/4 FS as illustrated in **Fig 6a**.

Glitches are caused by small time differences between some current sources turning off and others turning on. Take, for example, the major code transition at half scale from 0111 . . . . 1111 to 1000 . . . . 0000. Here the MSB current source turns on while all other current sources turn off. The small difference in switching times results in a narrow half scale glitch. Such a glitch produces distorted characters on CRT displays.

Glitches can be virtually eliminated by the circuit shown in **Fig 6b**. The digital input to a D/A converter is controlled by an input register while the converter output goes to a specially designed sample-hold circuit. When the digital input is updated by the register, the sample-hold is switched into the hold mode. After the D/A has changed to its new output value and all glitches have settled out, the sample-hold is then switched back into the tracking mode. When this happens, the output changes smoothly from its previous value to the new values with no glitches present.

Seven Reasons Why PDP*-11 Computer Users Prefer MDB Interface Products:

1. Superior Performance
2. Quality Workmanship
3. Comprehensive Product Mix
4. Competitive Pricing
5. Better Delivery
6. One-Year Unconditional Warranty
7. Worldwide Sales

Find your reason here!

■ PERIPHERAL DEVICE CONTROLLERS

MDB-LP11 Line Printer Controller (high speed)
MDB-LS11 Line Printer Controller (slower speed) These will accommodate most major manufacturers' models
New! MDB-LV11 High Speed Electrostatic Printer/Plotter Controller
MDB-CR11 Card Reader Controller (most popular models)
MDB-PC11 Paper Tape Reader/Punch Controller (controllers above include 15 foot cable)
MDB-XY11 Incremental Plotter Controller

■ SYSTEMS MODULES

MDB-DR11B Direct Memory Access Module (single quad board)
MDB-DR11C General Purpose Interface Module
MDB-TA528 Digital I/O Module
MDB-UT/930 Unibus Terminator
MDB-DT1711 Data Acquisition I/O Subsystem

■ COMMUNICATIONS/TERMINAL MODULES

MDB-MDL11 Asynchronous Serial Line Adapter
MDB-MDL11W Same, with Line Frequency Clock
MDB-MDU11 Synchronous Serial Line Adapter
New! MDB-DUP11 Synchronous Serial Line Adapter for bit or byte oriented protocols (quad board) (modules above include choice of cable)
New! MDB-DZ11AC Eight Line Asynchronous Multiplexor
New! MDB-PDI-11 Byte Parallel DMA Terminal Interface

■ INTERPROCESSOR LINK SUBSYSTEMS

New! MDB-DA11BJ Parallel DMA Interprocessor Link between two PDP-11 computers; with differential receivers & drivers
New! MDB-DA11BOI Parallel DMA Interprocessor Link between two PDP-11 computers; with differential drivers, optically isolated receivers
New! MDB/MLSI-DA11BOI Parallel DMA Interprocessor Link between PDP-11 and LSI-11 computers, differential drivers and optically isolated receivers
New! MDB-DA528 Programmable Buffered Parallel Interprocessor Link between PDP-11 computers (subsystems above include 50 foot cables)

■ (P)ROM MEMORY MODULES

New! MDB-MR11A (P)ROM Bootstrap Loader/Restart Module (quad board)

ROM Modules, no memory:

New! MDB-MR-004 For 2716 or 2758 PROMS with on-board PROM programmer
New! MDB-MR-005 For 2704, 2708, 3624, 2716, 2732, 2758 or similar devices

■ GENERAL PURPOSE/FOUNDATION MODULES

MDB-11B General Purpose DMA Foundation Module; 12 user IC positions
MDB-11C General Purpose Bus Foundation Module, 16 bit input and output registers; 20 user IC positions
MDB-1710 General Purpose Bus Foundation Module; 40 user IC positions, sockets optional
MDB-11WWB Quad Wire Wrap Module; 70 user IC positions, sockets optional
New! MDB-W9501 Universal Quad Wire Wrap Module
New! MDB-9500 Universal Hex Wire Wrap Module; sockets optional
MDB-WWB1 Dual Wire Wrap Module
New! MDB-M91WW Dual Wire Wrap I/O Coupler Module (all modules above have pins inserted in the wire wrap portion)

MDB interface products always equal or exceed the host computer manufacturer's specifications and performance for a similar product. MDB interfaces are completely hardware compatible and software transparent to the host computer. MDB products are competitively priced, delivery is 30 days ARO or sooner. MDB places an unconditional one-year warranty on its controllers and tested products.

MDB also supplies similar interface modules for DEC LSI*-11, Data General**, Perkin-Elmer (Interdata) and IBM Series/1 computers. Product literature kits are complete with data sheets, pricing and discount schedules.

*TM Digital Equipment Corp. **Data General is a computer manufacturer not related to MDB

MDB SYSTEMS INC.
1995 N. Batavia Street
Orange, California 92665
714-998-6900
TWX: 910-593-1339

Northern California 408/733-3950 □ **Mid-Atlantic:** 301/652-2173 □ **New England:** 617/444-1800 □ **Mid-Western:** 312/266-1032 □ **Southeastern:** 305/254-2511
Southwestern: 713/438-1238 □ **Australia & New Zealand:** (03) 543 2077 □ **Belgium & Luxembourg:** 02-720.90.38 □ **Canada:** 416/625-1907 □ **France:** 956.81.42
Greece: 9514.944 9520.589 □ **Hawaii:** (808)524-8633 □ **Hong Kong:** 5-771768 □ **India:** 234343 □ **Japan:** 03-437-5371 □ **Malaysia:** 944 404 □ **Netherlands:** 03404-21344
Philippines: 89-10-96 □ **Singapore:** 295-2381-2389 □ **Sweden, Norway & Finland:** 08/94 04 90 □ **Switzerland & Liechtenstein:** 01/730 48 48 **W. Germany:** 0 89/80 60 61-62

Circle 93 for PDP; 94 for LSI; 95 for DG; 96 for P-E; 97 for IBM.

See us at Wescon MINI/MICRO Systems 79

Voltage reference circuits

An important circuit required in both A/D and D/A converters is the voltage reference. The accuracy and stability of a data converter ultimately depends upon the reference; it must therefore produce a constant output voltage over both time and temperature.

The compensated zener reference diode with a buffer-stabilizer circuit is commonly used in most data converters today. Although the compensated zener may be one of several types, the compensated *subsurface*, or *buried*, zener is probably the best choice. These new devices produce an avalanche breakdown which occurs beneath the surface of the silicon, resulting in better long-term stability and noise characteristics than with earlier surface breakdown zeners.

These reference devices have reverse breakdown voltages of about 6.4 volts and consist of a forward biased diode in series with the reversed biased zener. Because the diodes have approximately equal and opposite voltage changes with temperature, the result is a temperature stable voltage. Available devices have temperature coefficients from 100 ppm/°C to less than 1 ppm/°C.

Some of the new IC voltage references incorporate active circuitry to buffer the device and reduce its dynamic impedance; in addition, some contain temperature regulation circuitry on the chip to achieve ultra-low tempcos.

A popular buffered reference circuit is shown in **Fig 7**; this circuit produces an output voltage higher than the reference voltage. It also generates a constant, regulated current through the reference which is determined by the three resistors.

Some monolithic A/D and D/A converters use another type of reference device known as the *bandgap reference.* This circuit is based on the principle of using the known, predictable base-to-emitter voltage of a transistor to generate a constant voltage equal to the extrapolated bandgap voltage of silicon. This reference gives excellent results for the lower reference voltages of 1.2 or 2.5 volts.

Few ADCs are widely used

Analog-to-digital converters (ADCs or encoders) use many circuit techniques to implement the conversion function. As with D/A converters, however, relatively few of these circuits are widely used today; the choice depends on the resolution and speed required.

One of the simplest A/D converters is the *counter*, or *servo*, type. This circuit employs a digital counter to control the input of a D/A converter. Clock pulses are applied to the counter and the output of the D/A is stepped up one LSB at a time. A comparator compares the D/A output with the analog input and stops the clock pulses when they

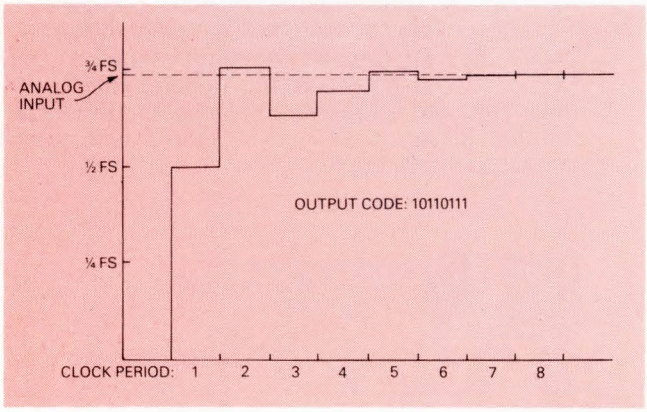


Fig 10 D/A output for 8-bit successive approximate conversion

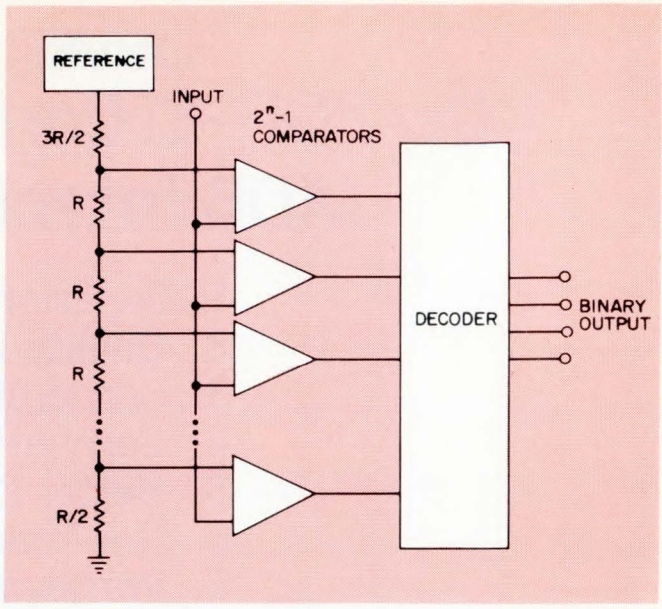


Fig 11 4-Bit Parallel A/D Converter

are equal. The counter output is then the converted digital word.

While this converter is simple, it is also relatively slow. An improvement on this technique is shown in **Fig 8** and is known as a *tracking* A/D converter, a device commonly used in control systems. Here an up-down counter controls the DAC, and the clock pulses are directed to the pertinent counter input depending on whether the D/A output must increase or decrease to reach the analog input voltage.

The obvious advantage of the tracking A/D converter is that it can continuously follow the input signal and give updated digital output data if the signal does not change too rapidly. Also, for small input changes, the conversion can be quite fast. The converter can be operated in either the track or hold modes by a digital input control.

By far, the most popular A/D conversion technique is general use for moderate to high speed applications in the *successive-approximation* type A/D. This method falls into a class of techniques known as *feedback type* A/D converters, to which the counter type also belongs. In both cases a D/A converter is in the feedback loop of a digital control circuit which changes its output until it equals the analog input. In the case of the successive-approximation converter, the DAC is controlled in an optimum manner to complete a conversion in just n-steps, where n is the resolution of the converter in bits.

The operation of this converter is analogous to weighing an unknown on a laboratory balance scale using standard weights in a binary sequence such as 1, 1/2, 1/4, 1/8, . . .1/n kg. The correct procedure is to begin with the largest standard weight and proceed in order down to the smallest one.

The largest weight is placed on the balance pan first; if it does not tip, the weight is left on and the next largest weight is added. If the balance does tip, the weight is removed and the next one added. The same procedure is used for the next largest weight and so on down to the smallest. After the nth standard weight has been tried and a decision made, the weighing is finished. The total of the standard weights remaining on the balance is the closest possible approximation to the unknown.

In the successive-approximation A/D converter illustrated in **Fig 9**, a successive-approximation register (SAR) controls the D/A converter by implementing the weighing logic just

described. The SAR first turns on the MSB of the DAC and the comparator tests this output against the analog input. A decision is made by the comparator to leave the bit on or turn it off after which bit 2 is turned on and a second comparison made. After n-comparisons the digital output of the SAR indicates all those bits which remain on and produces the desired digital code. The clock circuit controls the timing of the SAR. **Fig 10** shows the D/A converter output during a typical conversion.

The conversion efficiency of this technique means that high resolution conversions can be made in very short times. For example, it is possible to perform a 10-bit conversion in 1 μsec or less and a 12-bit conversion in 2 μsec or less. Of course the speed of the internal circuitry, in particular the D/A and comparator, are critical for high-speed performance.

For ultra-fast conversions required in video signal processing and radar applications where up to 8 bits resolution is required, a different technique is employed; it is known as the *parallel* (also *flash*, or *simultaneous*) method and is illustrated in **Fig 11**. This circuit employs 2n−1 analog comparators to directly implement the quantizer transfer function of an A/D converter.

The comparator trip-points are spaced 1 LSB apart by the series resistor chain and voltage reference. For a given analog input voltage all comparators biased below the voltage turn on and all those biased above it remain off. Since all comparators change state simultaneously, the quantization process is a one-step operation.

A second step is required, however, since the logic output of the comparators is not in binary form. Therefore an ultra-fast decoder circuit is employed to make the logic conversion to binary. The parallel technique reaches the ultimate in high speed because only two sequential operations are required to make the conversion.

The limitation of the method, however, is in the large number of comparators required for even moderate resolutions. A 4-bit converter, for example, requires only 15 comparators, but an 8-bit converter needs 255. For this reason, it is common practice to implement an 8-bit A/D with two 4-bit stages as shown in **Fig 12**.

The result of the first 4-bit conversion is converted back to analog by means of an ultra-fast 4-bit D/A and then subtracted from the analog input. The resulting residue is then converted by the second 4-bit A/D, and the two sets of data are accumulated in the 8-bit output register.

Converters of this type achieve 8-bit conversions at rates of 20 MHz and higher, while single stage 4-bit conversions can reach 50 to 100 MHz rates.

Integrating type A/D converters

Another class of A/D converters, known as integrating type, operates by an indirect conversion method. The unknown input voltage is converted into a time period which is then measured by a clock and counter. A number of variations exist on the basic principle such as *single-slope, dual-slope,* and *triple-slope* methods. In addition there is another technique – completely different – which is known as the *charge-balancing* or *quantized feedback* method.

The most popular of these methods are dual-slope and charge-balancing; although both are slow, they have excellent linearity characteristics with the capability of rejecting input noise. Because of these characteristics, integrating type A/D converteres are almost exclusively used in digital panel meters, digital multimeters and other slow measurement applications.

The dual-slope technique, shown in **Fig 13**, is perhaps

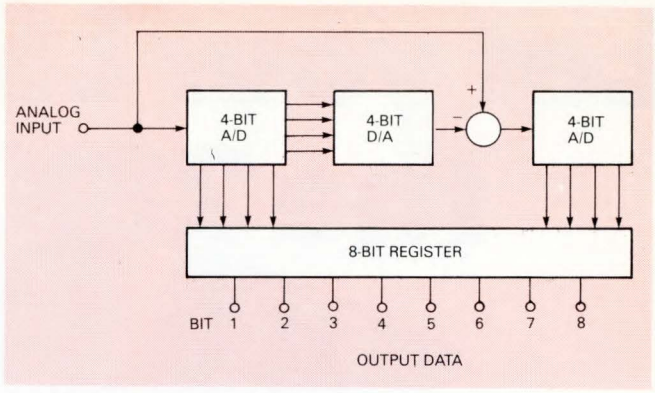


Fig 12 Two-stage parallel 8-bit A/D Converter.

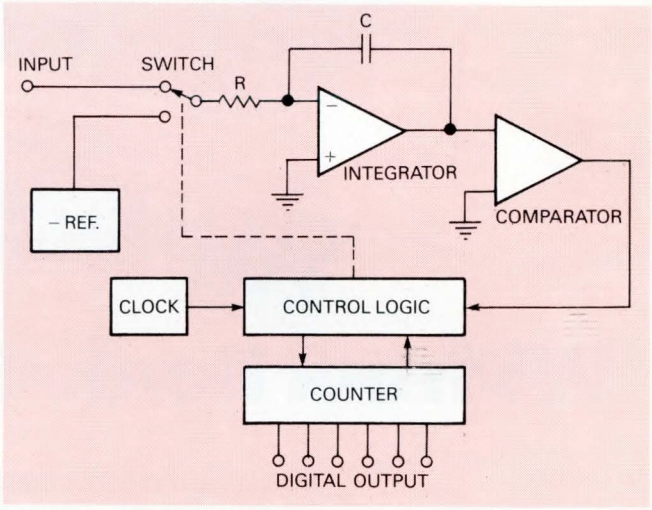


Fig 13 Dual slope A/D Converter.

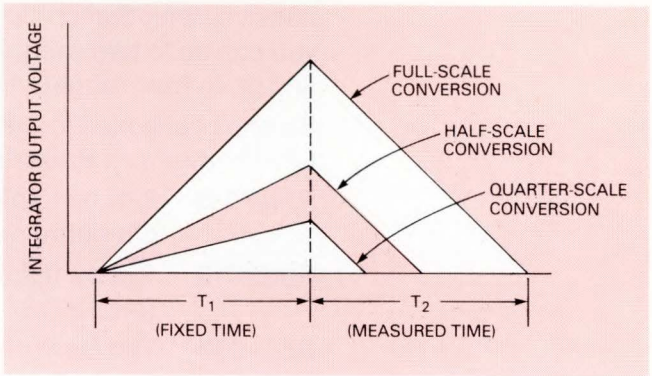


Fig 14 Integrator output waveform for dual slope A/D Converter.

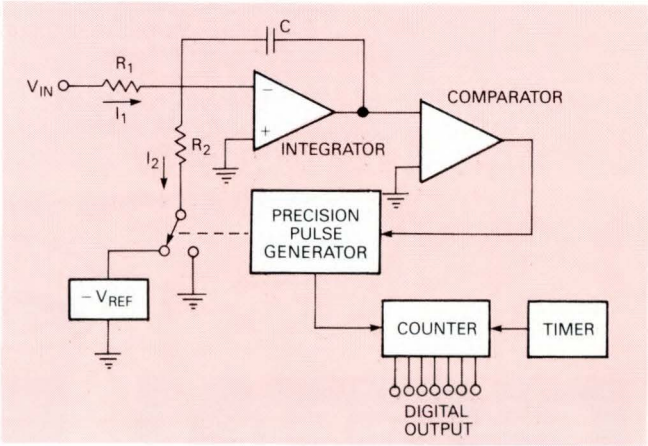
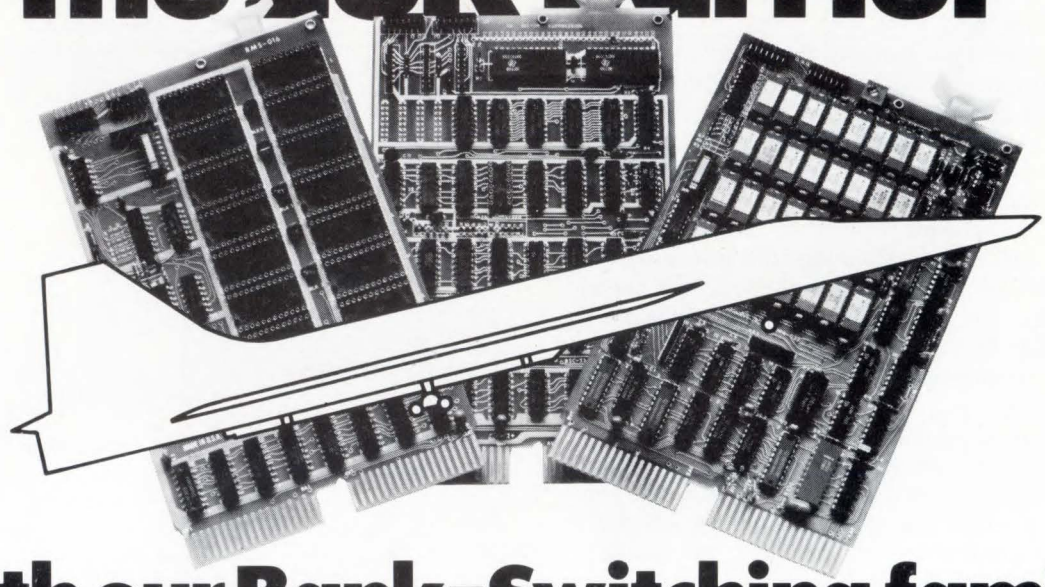


Fig 15 Charge-balancing A/D Converter.

Let your LSI-11* break the 28K barrier



With our Bank-Switching family

In LOCAL mode our memory is functionally just like DEC memory. But when you run out of memory space you're not lost. Add an inexpensive Bank-Switch Controller (BSC-256) and you can go to **two megabytes.** Add another and go to **four megabytes.**

So don't get boxed in with other brands of LSI-11* memory. Break free. Join the family:

RMA-032	32K by 16 bit RAM. On-board refresh	$1200 (Single qty.)
RMS-016	16K by 16 bit ROM. (Intel 2716)	$300 (Single qty.)
BSC-256	The Bank-Switch Controller	$300 (Single qty.)

Substantial quantity discounts are available. For a free copy of our Bank-Switching manual, call or write on your company letterhead.

Digital Pathways Inc.
4151 Middlefield Road
Palo Alto, CA 94306
(415) 493-5544

**Registered trademark of Digital Equipment Corporation*

DIGITAL PATHWAYS

Circle 30 on Reader Inquiry Card

best known. Conversion begins when the unknown input voltage is switched to the integrator input; at the same time the counter begins to count clock pulses and counts up to overflow. At this point the control circuit switches the integrator to the negative reference voltage which is integrated until the output is back to zero. Clock pulses are counted during this time until the comparator detects the zero crossing and turns them off.

The counter output is then the converted digital word. **Fig 14** shows the integrator output waveform where T_1 is a fixed time and T_2 is a time proportional to the input voltage. The times are related as follows:

$$T_2 = T_1 E_{IN}/V_{REF}.$$

The digital output word therefore represents the ratio of the input voltage to the reference.

Dual-slope conversion has several important features. First, conversion accuracy is independent of the stability of the clock and integrating capacitor so long as they are constant during the conversion period. Accuracy depends only on the reference accuracy and the integrator circuit linearity. Second, the noise rejection of the converter can be infinite if T_1 is set to equal the period of the noise. To reject 60 Hz power noise therefore requires that T_1 be 16.667 msec.

The charge-balancing, or quantized feedback, method of conversion is based on the principle of generating a pulse train with frequency proportional to the input voltage and then counting the pulses for a fixed period of time. This circuit is shown in **Fig 15**. Except for the counter and timer, the circuit is a *voltage-to-frequency* (V/F) converter which generates an output pulse rate proportional to input voltage.

The circuit operates as follows. A positive input voltage causes a current to flow into the operational integrator through R_1. This current is integrated, producing a negative going ramp at the output. Each time the ramp crosses zero the comparator output triggers a precision pulse generator which puts out a constant width pulse.

The pulse output controls switch S_1 which connects R_2 to the negative reference for the duration of the pulse. During this time a pulse of current flows out of the integrator summing junction, producing a fast, positive ramp at the integrator output. This process is repeated generating a train of current pulses which exactly balances the input current — hence the name charge balancing. This balance has the following relationship:

$$f = 1/\tau(V_{IN}/V_{REF})(R_2/R_1),$$

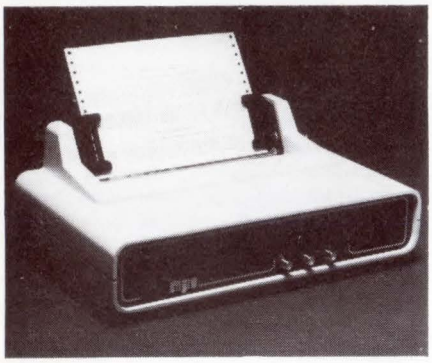
where τ is the pulse width and f the frequency.

A higher input voltage therefore causes the integrator to ramp up and down faster, producing higher frequency output pulses. The timer circuit sets a fixed time period for counting. Like the dual-slope converter, the circuit also integrates input noise, and if the timer is synchronized with the noise frequency, infinite rejection results. The noise rejection characteristic of all integrating-type ADCs with rejection plotted against ratio of integration period to noise period reaches infinite rejection at even T/T^n values.

Rate this article: Circle 6L, 6M or 6H on Reader Inquiry Card.

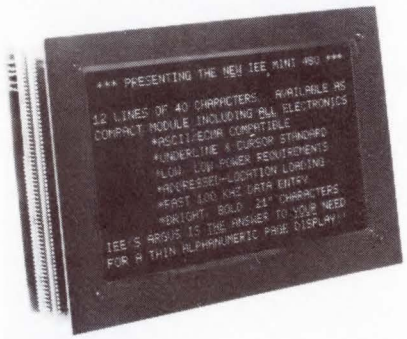
New Products

THE 88T IMPACT PRINTER features 100 cps bi-directional printing and print line formats of 80, 96 or 132 columns. A full upper and lower case 96 character ASCII set is printed in a 7x7 matrix for crisp, clear printing on the original plus two copies. Double wide characters are software selectable and can be intermixed on any line for message high-lighting. Forms handling is implemented with a stepper-motor



driven tractor paper feed system that can be adjusted to accept fan-fold forms varying from one to 9.5 inches in width. The microprocessor controlled interface can accept either serial RS232/CL or parallel data. A two line buffer is standard, with 1K and 2K data buffers available as options to allow CRT screen dumps. $560. **MPI** 2099 West 2200 South, Salt Lake City, UT 84119. **Circle 149**

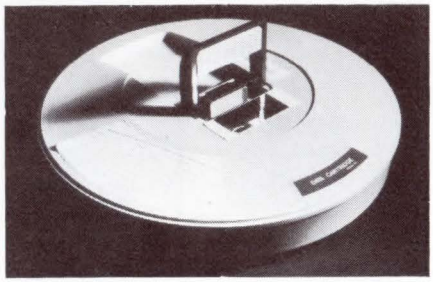
FLAT PANEL DISPLAY provides 480 alphanumeric characters (12 lines of 40) and is one of a pair of displays with 40 characters per line, the other being a 320-character (8x40) model. Both Argus units provide .21" (5.3mm) characters in the familiar 5x7



dot matrix and present a neon-orange (or red) display. A standard editing cursor is featured along with high (100KHz) data loading rates, low power, extremely wide (120°) viewing angles, and jitter-free appearance of DC plasma displays. $945. **IEE**. 7740 Lemona Ave., Van Nuys, CA 91405. **Circle 155**

GRAPHIC OPTION for the micro-processor-controlled T-80 thermal-matrix printer permits interspersed graphics and text. The T-80 is a 5 x 7 dot-matrix printer which operates at 80-char. per second. When graphing, it employs a raster scan technique sequentially energizing any of the seven vertical dots. Both vertical and horizontal spacing is 70 dots per inch giving 4900 points per square inch. Headings, legends, values or any other text may be printed simultaneously with graphing. A standard 96-character ASCII character set is contained in ROM. Character spacing is ten per inch with six horizontal lines per inch. $1330. **DAtaproducts Corp.**, 6219 DeSoto AVe., Woodlawn Hills, CA 91364. **Circle 176**

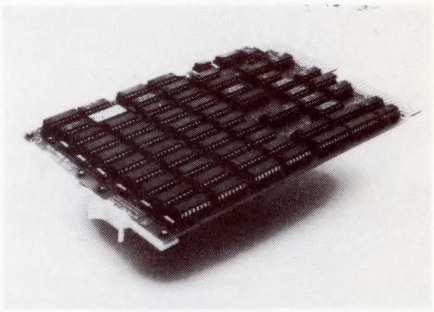
DEC RK06, RD07 AND RL01 disk cartridges are available on same day shipment. These three DEC disk cartridges are certified to read and write 100% error-free and are guaranteed by Inmac for three years. A 70-page catalog offers in addition the minicom-



puter and word processing user an extensive line of magnetic media, cables, racks, connectors, computer-room furniture, supplies and accessories. . . a total of more than 1,000 products. **Inmac**, 2465 Augustine Drive, Santa Clara, CA 95051. **Circle 150**

MODEM. Facom 1921B, a 9,600 bps modem coupled with an 8-channel multiplexer, operates in any of the CCITT V.29 9,600, 7,200 and 4,800 bps modes – and also in CCITT V.27 bis 4,800 and 2,400 bps modes. The muxer accommodates asynchronous 200, 300 and 1,200 bps channels and synchronous 1,200, 2,400, 4,800, 7,200 and 9,600 bps channels. Can modes and speeds be changed quickly? Yes, as front panel switches permit this. Automatic adaptive equalizer and unique phase jitter tracking insure high performance – even if there are distortions or phase instability. 17.20 x 5.88 x 21.40". 39.68 lbs. **Fujitsu America, Inc.**, 2945 Oakmead Village Court, Santa Clara, CA 95051. **Circle 121**

LSI 11/2 MEMORY does more than store: its 32K-word storage capability is enhanced with a systems bootstrap and diagnostics PROM. The PROM has memory sizing and diagnostics, and RX-01 floppy disk bootstrap, an absolute binary loader, and a synchronous



modem downline loader. Other features include: 18-bit memory addressing; independent automatic refresh; switch-selectable memory size (16K to 32K); and IC sockets. **Standard Engineering Corp.** 44800 Industrial Dr., Fremont, CA 94538. **Circle 154**

A MODEM TEST SET is capable of performing bit error rate tests (BERT) on synchronous and asynchronous EIA data communication links. The unit provides a hand-held, battery-powered unit for testing and monitoring data communication systems at the EIA RS-232/CCITT V.24 modem-terminal interface. **International Data Sciences, Inc.**, 7 Wellington Rd., Lincoln, RI 02865. **Circle 141**

MINIATURE PRINTER. Low-cost, serial-matrix printer Microline 80 features program-controlled font selection, a 200 million char. head warranty and μP-controlled interfaces. The 14lb., 4" H x 13.4"W x 9.4"D operates continuously at 80 cps with no duty cycle limitations, producing 9 x 7 uc &

lc characters across an 80 col. page. It prints condensed char. at 16.5 cpi, accommodating 132 col. formats. Line spacing at 6 or 8 lpi, char. spacing and font selection are under program control. **Okidata Corp.**, 111 Gaither Dr., Mount Laurel, NJ 08054. **Circle 122**

CALL FOR PAPERS

for presentation at . . .

Design Technology for Computers & Datacomm Systems '80

March 19, 20, 21, 1980

Disneyland Hotel Convention Center, Anaheim, California

The ONLY U.S. Exhibition and Conference for the engineers and specialists who design, implement, and test computers and data communications systems

YOU ARE INVITED TO SUBMIT AN ABSTRACT FOR CONSIDERATION

Fundamental or applied papers are requested in the following areas:

- Multiprocessor Architectures
- Communication Controllers
- Control of Noise within Digital Systems
- Microprocessor Technology
- Solid State Bulk Memories
- Data Communication Networks
- Effective Power Distribution
- Nonvolatile Storage for Small Processors
- Microprocessor Peripherals
- Custom vs. Master Slice Circuits
- Effective Design with Logic Arrays
- Data Encryption for Data Communication
- Memory and Microprocessor Testing
- Design Methodology for Distributed Processing
- Applying Voice Interface to Microprocessors
- Designing with Analog to Digital Converters
- Interprocessor Communication
- Adaptive Computer Organizations
- Packaging High Speed Circuits
- Fiber Optics Communications
- Telecommunication Circuit Techniques
- Methods in Digital Signal Processing
- Interfacing Displays and Keyboards
- Data Comm Circuit Testing

TO SUBMIT YOUR ABSTRACT:

Use the reverse side of this notice to describe the contents of your proposed paper in 100-200 words. Mail this form as soon as possible.

ABSTRACT DEADLINE IS 15 OCTOBER 1979

Announcement of selected papers will be made early in January 1980.

MAIL YOUR ABSTRACT TO:

Mr. William D. Ashman
Program Coordinator
Industrial & Scientific Conference Management, Inc.
222 West Adams Street
Chicago, Illinois 60606

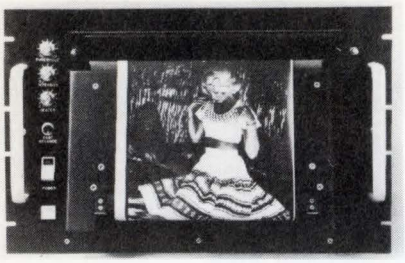
Show Your Colleagues This Notice!

They May Duplicate It If They Wish To Submit Abstracts.

Co-Sponsored by:
DIGITAL DESIGN MAGAZINE
MINICOMPUTER NEWS

Organized by
Industrial & Scientific Conference Management, Inc.
Chicago • Tokyo • Hong Kong • Singapore • London

New Products



FIBER OPTIC GRAPHIC RECORDERS differ from standard plotters in that they offer resolution of up to 400 lines per inch and consistently print up to 32 varying shades of grey. The device will also produce graphics and alpha/numerics on several different paper and film types at varying speeds. **EDO Western Corp.** 2645 South 300 West, Salt Lake City, Utah 84115.
Circle 140

FULL-COLOR RASTER DISPLAY. Higher clarity and more concise color delineation via computer generated raster-scan display is achieved through the 1,048,576-pixel resolution (1024 pixels/line x 1024 lines) full-color Model GCT-3500. A unique monitor control module board handles up to 8 memory planes and displays 256 different colors from a selection of 4096 values. Other monitor control systems are optionally available that accommodate up to 12 memory planes and display up to 4096 colors from an over 16-million color-shade selection. GCT-3500 comes with a choice of 19″ or 25″ high-resolution color CRT monitors. **Genisco Computers,** 17805 Sky Park Circle Dr., Irvine, CA 92714.
Circle 120

MONITOR/KEYBOARD CONTROLLERS, designated the BLC-8228 and the BLC-8229, provide an 80 by 24 display and a full 128 ASCII character set. Both boards have full software cursor control and programmable character display for blinking, inverse video or alternate character. Standard control functions include editing by character or by line, formatting, and software-selectable scrolling for each line. The BLC-8288 provides a 5 by 7 display matrix, $927. The BLC-8229 provides a 7 by 9 matrix, has special display options available and costs $1133. **National Semiconductor,** 2900 Semiconductor Dr., Santa Clara, CA 95051.
Circle 158

MG 30/30 TEST SYSTEM is designed primarily for production testing of semiconductor memory devices, boards, or systems. All operator interactions are provided via a CRT using a version of MTS Basic, Microgamma's high level, interpretive language used in all of the standard memory test systems. This single board computer can be interfaced to device handlers or other peripheral equipment. The single board computer contains a software package that allows for board error mapping, software calibration of all programmable clocks and several other features previously found only on high priced testers. $15,000. **Microgamma Systems Inc.,** 950 Benicia, Sunnyvale, CA.
Circle 160

X.25 PROTOCOL TESTER for users and developers of X.25 software and hardware is a development/debugging aid and diagnostic tool set up in an intelligent, stand-alone unit that serves as a network terminal simulator, line monitor, and protocol validator. It supports multiple line speeds with a complete hardware/software package and has interactive control via Tran's video or TTY console. A table-top microprocessor-based device, XPRT tests X.25 data terminal equipment and networks at each of the three defined X.25 levels - electrical, link control, and data packet - by generating, displaying, and validating X.25 traffic.

Tran Telecommunications Corp., 2500 Walnut Ave., Marina del Rey, CA 90291. **Circle 130**

600 CPS MATRIX PRINTER offers 600 cps with 7x8 matrix, 132 character lines and over 1000 lpm for short lines. The BNY printer can select under program control one of 3 different 7x8 character fonts with true underlining and elongated characters. The BNY can also select one font of a 15x16 matrix. No duty cycle or page density restrictions means continuous printing. Open binary interface allows for 128x 128 dots per inch graphics and plotting. A large 890 character buffer is standard. Expanded characters for labeling and other special requirements include twice, four times, and eight times normal character size. **Florida Data Corp.**, 3308 New Haven Ave., W. Melbourne, FL 32901. **Circle 131**

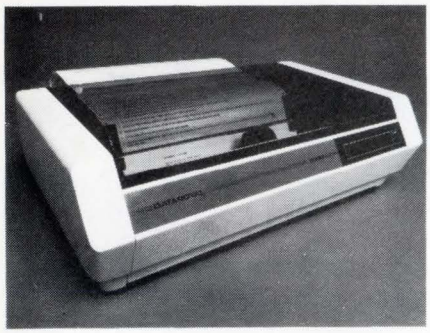
DISPLAY GENERATOR CHIP, a mask-programmable 11,648-bit device provides a 10 x 9 matrix for 128 char. in a 10 x 16 field. The 8-bit character code can also be translated into 256 additional possible graphic patterns, for 384 distinct patterns. Other features include character and line address latches, a thin graphics option which generates 15 special characters for forms applications, and internal shift capability that lowers the matrix to provide descenders on characters such as j, y, g, t, and q, and selective blanking of data output for ASCII control characters. $6.90 (100). **Signetics**, 811 E. Arques Ave., Box 9052, Sunnyvale, CA 94086. **Circle 126**

AN 8080A COMPUTER is designed especially for the dedicated control and processing applications. Designated the BLC-80/07, the board has an 8080A CPU, a system clock, 24 programmable parallel I/O lines, 512 bytes of static RAM, and sockets for 4K bytes of PROM. The BLC-80/07 can address 64K bytes of memory and has an access time of less than 500 nanoseconds. **National Semiconductor**, 2900 Semiconductor Dr., Santa Clara, CA 95051. **Circle 138**

SINGLE BOARD COMPUTER. The 6800 based micro module comes on a 4½" x 6½" G-10 PCB with industry standard 22/44 pin gold plated edge connector. In addition to the 6800 MPU, the module has a 1 MHz clock, baud rate generator for all rates to 9600, 128 bytes RAM, a socket for a 2758 or 2716 or 2732 EROM, and customers choice of one serial or two parallel I/O ports. $125. **Wintek Corp.**, 902 N. 9th Street, Lafayette, IN 47904. **Circle 163**

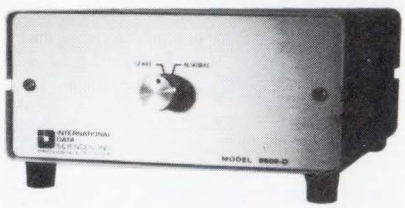
New Products

MICRO-BASED IMPACT PRINTERS, called the IPS-5000, are built for heavy duty cycles, yet are quiet enough for office operation. They operate at 150 cps in a 9x9 dot matrix. The IPS-5000 can generate a 96 ASCII character set with true lower case descenders bi-directionally. It features a 256 character buffer, tractor feed, ribbon cartridge, short line capability, and six-



part form capability. Standard features include top-of-form control and selectable expandable characters. Optional features are an RS-232 interface, 100 to 9600 baud, TTY current loop interface, and expanded buffer. 80 col, $975; 132 col, $1075. **Dataroyal,** 235 Main Dunstable Rd., Nashua, NH 03061. **Circle 132**

SPARE MODEM BACK-UP SWITCH, the Model 8509-D, is designed to switch the combined EIA RS-232 and telephone line interface of a faulty on-line modem to a back-up system. The

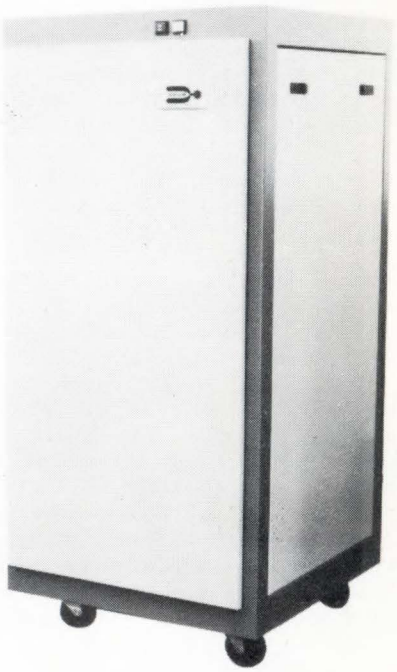


Model 8509-D incorporates a "chaining feature, which allows a single spare modem to be switched in to replace any one of a group of on-line modems. $300. **International Data Sciences, Inc.,** 7 Wellington Rd., Lincoln, RI 02904. **Circle 142**

DIGITIZER. High resolution and accuracy of the Talos Digitizer lets designers work to any level of detail at any scale without fear of error. This digitizer can decrease data collection effort to less that 1% of the previous method. Other uses include rapid evaluation of alternatives for trucking and materials flow by evaluating road spacing and minimized selected variables. **Talos Systems Inc.,** 7419 E. Helm Dr., Scottsdate, AZ 85260. **Circle 168**

Z80 ANALYZER PROBE accessory to the Model 532 Intelligent Logic State Analyzer, Model 54, simplifies logic state analysis of the Z-80. This is significant because the Z-80 does not output convenient clock or strobe signals, thus making analysis of address and data information with a logic state analyzer extremely difficult. The Model 54 (Z-80 Interface Board) and the Model 532 Logic State Analyzer (with dual clocking capabilities) solve this problem. Model 54 clips directly on to the Z-80 and generates signals required to directly capture program flow. **Paratronics Inc.,** 122 Charcot Ave., San Jose, CA 95131. **Circle 143**

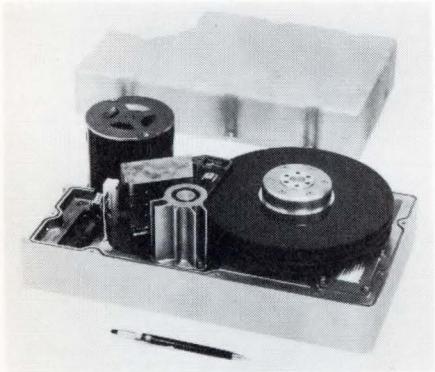
IBM 1403 CONTROLLER allows the 1403 printer to be operated alternately by any two IBM or non-IBM computers. The Spur controller performs interface, control and power functions necessary to operate 1403 printers, which have no electronics, with non-IBM computers. The S1403/Dual controller contains interface for both computers being used, enabling control to be transferred from one computer to the other by means of a rotary switch on the front panel. A



memory in the controller stores the universal character set for each type train or chain to be used, making the printer software compatible with both computers. The controller comes in an attractive stand-alone enclosure and includes all logic cards, memories, mating connectors and power supplies. **Spur Products Corp.,** 1904 Centinela Ave., Los Angeles, CA 90025.

Circle 157

DISK SUBASSEMBLY. The MINI FOX is a high performance, low cost subassembly from which a sealed fixed media disc file memory may be constructed. Each unit comes with the following components: rotary positioner, deck plate and spindle assembly, disc cover, provisions for mounting 1, 2, 3, or 4 discs 51,200,000 bytes unformatted, mounts for one servo head and the appropriate read/write heads for 1,2,3 or 4 discs, "sealed" system for low contamination, integral air filtration system, and P.C.B. for electrical connection feed through. An electronics package containing servo, control, and read/write functions as well as a simplified SMD interface is available to the customer to aid in the design of a



custom system. **SLI Industries,** 21040 Victory Blvd., Woodland Hills, CA 91367. **Circle 133**

RELOCATABLE MACRO ASSEMBLER and Linking Loader programs as well as Simulators are designed for the 6800/01, 6805, and 6809 microprocessors. The programs are written in ANSI standard Fortran IV and will run on any general purpose computer including 16 bit minicomputers. The assemblers are Motorola compatible and include such features as conditional assembly, macro assembly and a symbol or cross reference table. The object module output of the assemblers may be in a relocatable format or may be produced directly in Motorola's hex format. Assembler and Linking Loader for each processor is $1250. The Simulators are $800. **Microtec,** P.O. Box 60337, Sunnyvale, CA. 94088.

Circle 156

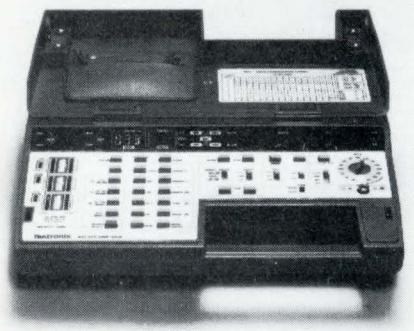
IMAGE PROCESSING. Vision One/20 is delivered with full firmware to provide a complete stand-alone system capability. And the new Vision/One/20 has capacity for system growth by field upgradeability for a wide range of image processing to meet future requirements. These include memory expansion – up to four independent user processing terminals – and options such as real-time convolution and arithmetic processing, plus 1024 x 1024 display. Typical standard features include expansion capacity to 64 RAM refresh memories for 512 x 512 pixels with 8 brightness bits. And, flexibility assignment of memories as 8-bit images or 1-bit overlays provides up to 4096 x 4096 full color data base. **Comtal Image Processing Systems,** Box 5087, Pasadena, CA 91107. **Circle 129**

IMPACT MATRIX PRINTER. The M-200/S offers bidirectional printing which effectively enhances the speed to the equivalent of 200-plus lines per minute, while maintaining the reliability of the line printer system. The M-200/S also offers a 14-pin wire matrix head which combines the flexibility of a single head with the speed and long life of multiples. Expanded, condensed and standard height characters are standard with each M-200/S printer. Other features include the capability of up to six clear copies and easy forms-loading from front or bottom. A diagnostic display permits monitoring of the printer system's functioning. $3000. **Southern Systems,** 3000 NE 30th Place, Fort Lauderdale, FL 33306. **Circle 163**

New Products

WINCHESTER-TYPE SERIES of disk drives offers 20M to 80 Mbytes of storage. Start time is less than 30 ms and stop time less than 20ms. Recording code is modified frequency modulation and interface code is NRZ. Head positioning uses a closed servo rotary actuator with track-following based upon the modified dipulse method. Storage capacities (unformatted) are 20.8 Mbytes, 41.5 Mbytes and 83.1 Mbytes for the Models 1210, 1220 and 1240, respectively. The model 1210 is a single-platter, dual-head unit with one recording surface. The model 1220 is a two-platter unit with four read/write heads and two recording surfaces. The Model 1240 is a three-platter unit with eight read/write heads and four recording surfaces. Each of the three models also has an additional servo head associated with the drive's servo track. $2,950, Model 1210; $3,300, Model 1220; $3,870, Model 1240. **NEC Information Systems, Inc.**, 5 Militia Drive, Lexington, Mass. 02173 **Circle 134**

THE 833 DATA COMM TESTER efficiently isolates the equipment that is malfunctioning in a network by simulating the data communications equipment (DCE) to verify correct



operation of the modems or phone line. $2750. **Tektronix, Inc.**, P.O. Box 500, 76-260, Beaverton, Ore. 97077. **Circle 153**

3-D OPTION FOR SANDERS. The Graphic 7 is an intelligent, interactive computer display terminal featuring two programmable microprocessors and directed-beam refreshed graphic display with high quality images. The Model 5753 Coordinate Converter option converts a standard Graphic 7 into a three dimensional computer graphic display capable of dynamic manipulation of objects in apparent space. Among the functions provided by the Model 5753 are translation, scaling, rotation, windowing, zooming, independent screen coordinate mapping and perspective or orthographic projection. With perspective, the location of the viewer is defined relative to the image space, and all lines and objects within the image space are then viewed at the proper perspective for that location. **Sanders Associates, Inc.**, Daniel Webster Highway S., Nashua, NH 03061. **Circle 161**

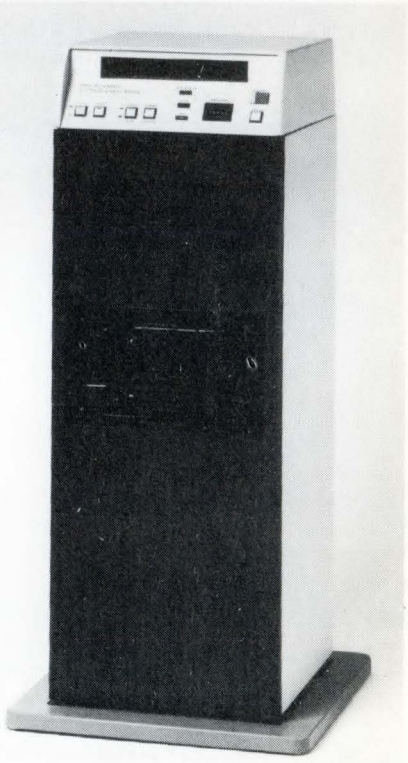
MATRIX PRINTHEADS offer 100% duty cycles and 75- and 100- million-char. lives for LRC dot-matrix alphanumeric printers. The two heads are compatible with existing LRC units. The 100-million-char. printhead, designed for LRC Model 7040 journal printers, prints continuously without overheating. Character duty cycle is 50 cps (continuously at 50°C). The 75-million-char. printhead, designed for LRC Model 7040-T ticket printers, prints continuously w/o overheating. Char. Duty cycle is 30 cps. (continuous at 50°C). **LRC, Inc.**, Technical Research Park, Riverton, WY 82501. **Circle 123**

DOUBLE-SIDED FLOPPY DRIVE. Model 6108 double-sided 5.25″ floppy disk drive offers the compact design of the BASF 6106 single-head version – yet provides twice the capacity. The 6108 requires 33% less space than Shugart's SA-400. It has an unformatted capacity of 4 Mbit in double density recording; 2 Mbits in single density. The drive allows recording on 49 tracks/side. Track-to-track access time is 12 msec – 3 times faster than the industry standard of 40 msec. BASF 6108 is plug-compatible with both the BASF 6106 and SA-400. $565. **BASF Systems**, Div. of BASF Wyandotta Corp., Crosby Dr., Bedford, MA 01730. **Circle 151**

LGS PLOTTERS produce charts, graphs, maps and diagrams on fan-fold or roll paper in width sizes ranging from 15 to 48 in. The units produce curved lines by altering the speed of the pens and paper on the unit. The plotter controller hardware and software is designed to accept logic inputs of 16-bit parallel, 8-bit parallel (GPIB) and RS-232C serial. $5500. **Logic Systems** 437a Aldo Ave., Santa Clara, CA 95050. **Circle 152**

THE Z-80 DART (Dual Asynchronous Receiver/Transmitter), a multi-function peripheral component offers two independent full-duplex channels with separate modem controls. Used as a serial-to-parallel, parallel-to-serial converter/controller, it is suitable for applications in smart and dumb terminals, peripheral controllers, and any controllers requiring only asynchronous protocol. Available in a 40-pin plastic or ceramic dual-in-line package the Z-80 DART PS (plastic, 2.5 MHz version) is $13.60, the Z-80A DART PS (plastic, 4.0 MHz version) is $16.15. **Zilog**, 10340 Bubb Rd., Cupertino, CA 95014. **Circle 147**

COLOR HARD COPY. The Model 631 color camera system makes photographic records of the display of any raster scan computer graphics system on 8″ x 10″ Polaroid Type 808 Polacolor 2 Land film, color transparency film for overhead projection such as



Kodak Ektachrome 64, and 35 mm color slides. The Model 631 is a stand-alone unit with a self-contained, high resolution, flat-faced CRT. In installation it is connected directly to the RGB outputs of any raster scan computer graphics terminal. The Model 631 is compact, standing 45″ high and measuring only 16″ on the side, on a 20″ square base plate. $12,000. **Dunn Instruments**, 544 Second St., P.O. Box 77172, San Francisco, CA 94107. **Circle 164**

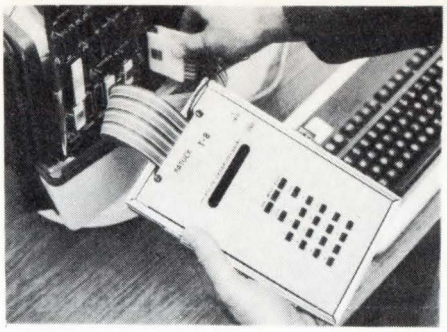
CRT SELECTOR SWITCH allows the user to switch any 2-wire input to one of two 2-wire outputs. A two-position rotary switch on the front panel instantly switches any 2-wire input from a rear panel BNC labeled Common to one of two BNCs labeled A and B. This module is also available in a rack mount configuration, and no power is required. $140. **International Data Sciences, Inc.**, 7 Wellington Rd., Lincoln, RI 02865. **Circle 144**

SIX 15V I/O MODULES provide the means for interfacing between 15V control system (or other 15V logic system) and external ac and dc voltage levels found in industrial and commercial peripheral equipment. The dc output modules accept 15V from the μP and at the output drive dc loads to 3A at 60V. The dc input modules accept voltages up to 32V and converts them to the 15V level for the μP. IAC15, $9.75; OAC15, $9.75 (50-99). **Motorola Subsystems,** Box 29023. Phoenix, AZ 85038. **Circle 127**

USERS OF COMPUTER AUTOMATION'S SyFA Network Processing Systems can order software from the vendor through their terminals and have it delivered over high-speed communication lines directly to their computer within a matter of seconds. Called the SyFA Customer Library Exchange (SyCLE), the program is available immediately at no charge to all SyFA customers. **Computer Automation,** 2181 Dupont Dr., Irvine, CA 92713. **Circle 148**

WINCHESTER DRIVES. Believed to offer the industry's fastest access time – 6 ms track-to-track, with an avg. of 27 ms – the M2282/2283/2284 series offer increased reliability (10,000 power-on hrs, MTBF), low power consumption and cool operation. Std. Storage Module Device interface provides greatest flexibility for expansion into existing disk configurations and simplified software and controller development. Basic capacities are, respectively, 66, 132, and 165 Mbytes of unformatted data storage, with an optional 655 Kbytes head/track capacity. **Fujitsu America, Inc.,** 2945 Oskmead Village Court, Santa Clara, CA 95051. **Circle 119**

Z80 TEXT. "Practical Microcomputer Programming: The Z80" by W.J. Weller is a 482-pg. hardcover book concerned with detailed assembly language programming procedures for the Z80. In 18 chapters and four appendices, it supplies everything necessary to write and debug Z80 application programs, including an assembler and debugging monitor. (Paper tape object copies of this software are supplied free to the purchaser of this book with the return of a coupon in the back.) The 18 chapters cover all of the fundamental assembly level programming techniques, reinforced by more than 100 formal tested examples which illustrate the techniques being discussed. This book is the best and most lucid introduction to Z80 programming that we have seen. **Northern Technology Books.** Box 62, Evanston, IL 60204. **Circle 167**



FIELD TESTER. A hand-held analyzer for field testing is small and connects to a microcomputer in seconds via a 40-pin chip clip. The Patuck Field Tester Model T-8 has no external connections and interfaces to almost all of the common 8-bit μC. The new tester uses a simple PC board strap option to activate and analyze the diagnostic routine. The device is set to breakpoint at prearranged diagnostic addresses. Error messages are then displayed on the 8-1/2 digit display from the 63 byte history memory. $695. Interfaces $50 each. **Patuck, Inc.,** 5073 Russell Ave., Pennsauken, NJ 08109. **Circle 136**

17.3 M BYTE CARTRIDGE. Using a recording density of 6400 bpi to give a maximum unformatted storage capacity of 17.3M bytes, the Model 640 has 4-track read-after-write heads and uses 3M-type DC300 cartridges. Data transfer rate is 192 kHz utilizing a modified frequency modulation recording mode. With 300 foot tape lengths, maximum unformatted storage is 11.5M bytes. 450 foot tapes give 17.3M bytes, considerably more than the 12M byte storage of 8″ disk drives. To reduce time-consuming rewind operations, the transport uses a serpentine technique in which adjacent tracks are recorded in opposite directions. Recording speed is 90 ips: 75 msec at 90 ips. $900 (OEM). **Kennedy Co.,** 540 W. Woodbury Rd., Altadena, CA 91001. **Circle 177**

SILENT SWITCHER. The 6000 Series Silent Switcher, a 1300W triple-output switcher houses 95% of its components on 3 plugable boards, each integral with a section of the front panel. Each is a complete stand-alone supply letting you mix modules as needed. Output sections include a choice of -5.2V at 85A, 5V at 85A (both adj. over a ±15% range) and 11 to 16V at 30A. All outputs have total regulation-band spec. of ±2%. Its complete fault protects it against almost every possible fault. Power failure? Output remains within regulation for 30 msec after loss of AC input (when operating at FL). LEDs indicate the failed channel. $1600. **Conver Corp,** 10631 Bandley Dr. Cupertino, CA 95014. **Circle 114**

Advertisers' Index

Sales Offices

NEW ENGLAND and UP STATE NEW YORK: John A. Garland **(617) 934-6464** Box 314 SHS, Duxbury, MA 02332

MID-ATLANTIC and SOUTHEASTERN STATES: Ed Shaud **(215) 688-7233** P.O. Box 187, Radnor, PA 19087

MIDWEST and TEXAS: Hank Bean **(312) 475-7173** 2633 Hillside Lane, Evanston, IL 60201

WESTERN STATES: Al Puetz **(213) 478-3017** 924 Westwood Blvd. Suite 610, Los Angeles, CA 90024

JAPAN: Hiro H. Irie **(03) 311-1746** Intl. Business Corp., 11-8 Narita-Higashi 1-chome, Suginami-Ku, Tokyo 160

New Products

EPROM PROGRAMMER MODULE. The ST4401, is designed to program +5V EPROMs such as the Intel 2716 and TI TMS2516. The 4.5″ by 6.5″ card plugs directly into any STD BUS microprocessor system. User switch selection of Memory Address, in 2K pages, and a front edge mounted ON/REMOTE switch afford flexibility for field programming applications. $155. **Applied Micro Technology**, P.O. Box 3042. Tucson, AZ, 85702. **Circle 162**

"QUICKTRAN" by Kevin McCabe is a 222-pg. paperback explaining Fortran IV – quickly – and is not badly done. Easy to understand. Lacks exercises. **Dilithium Press**, Box 92, Forest Grove, OR 97116 **Circle 111**

PDS 8000 DEVELOPMENT SYSTEMS support development of Z8, Z80 and Z8000-based microcomputer designs. Available in free-standing or rack-mounted enclosures with a choice of floppy or hard disk storage, the PDS 8000 systems feature 64K bytes of memory, printer interface, 1920-character CRT console and RS232C console interface. The PDS 8000 Model 15 comes in a free-standing enclosure and offers 600K bytes of floppy disk storage. A Z8000-based development module provides the tools necessary to create and debug Z8000 software. Communication between the module and the system allows assembled code to be loaded from disk, debugged, modified and returned to disk via simple commands from the system console. $11,995. **Zilog**, 10340 Bubb Road, Cupertino, CA 95014. **Circle 117**

18-BIT RESOLUTION D to A converter provides 16 bits of accuracy, offer integral nonlinearity and differential nonlinearity TCs of ±0.5ppm/°C, offset TC of ±0.5ppm/°C and gain TC of ±0.5ppm/°C. Long-term offset and gain stability is specified at ±8ppm for 1,000 hrs. DAC 1137 settling times are 8μs to ±1/2 LSB in voltage mode. Outputs are 0 to +5V, 0 to +10V, ±V, ±10V, or -2mA to 0mA. Inputs are TTL-compatible, in binary or 2's complement coding schemes. Uses ±15V and 35V. $460 (1-9) **Analog Devices, Inc.**, Box 280, Rte. 1 Industrial Park, Norwood, MA 02062. **Circle 118**

THIS PASCAL COMPILER implemented on the Advanced Operating System, runs on Data General's Eclipse computers. This compiler compiles larger programs at 400 lpm. Generated code is twice as fast as Fortran 4. Compiler-generated code is relocatable machine language automatically linked and loaded before execution, eliminating a separate binding operation. Compiler I/O is convenient for current DG users. The compiler is fully supported and maintained by Rhinetek with enhancements being incorporated on a periodic basis. Rhinetek will modify the compiler to satisfy particular requirements or provide applications programming support on a regular consulting basis. **Rhinetek, Inc.**, Box 220, Columbia, MD 21045. **Circle 145**

FPS-100 ARITHMETIC PROCESSOR performs up to 8-million floating-point operations per second, and offers 38-bit precision. A new resident multi-tasking operating system (Super 100) coupled with a priority-interrupt structure enables the FPS-100 to effectively address real-time applications, such as signal processing, image processing, and process control. Several of the many other applications for which the FPS-100 is suitable are vibration analysis, structural analysis, speech synthesis, oil exploration, and system simulations. An implementation of low-power Schottky, using a combination of MSI, LSI, and VLSI, allows the FPS-100 to be packaged into a 10-1/2″ x 19″ self-contained unit. **Floating Point Systems, Inc.**, P.O. Box 23489, Portland, OR 97223. **Circle 104**

8″ FIXED DISKS. The Model 6171, capacity 8 Mbytes, incorporates one double-sided 8-1/4 in. rigid disk, while the 24-Mbyte Model 6172 utilizes two double-sided disks. Either systems supplies more data storage than six double-sided floppy drives. The 6170 Series uses media compatible with IBM's 3310 "Piccolo" drive. A data transfer rate of 800 Kbytes/s, eight times faster than standard double-sided floppy drives, and a data access time of 50 ms, nine times faster than a double-sided floppy drive, are additional advantages. The 6171 and 6172 include an integral microprocessor-based controller. The systems can be configured with SMD interface, BASF bus or special controller options. Without controller, Model 6171 $2,100; **BASF Systems**, Crosby Drive, Bedford, MA 01730. **Circle 115**

SC/MP-II BOOK. "How to Design, Build & Program Your Own Working Computer System" by Robert P. Haviland uses a SC/MP-II. Most circuits and leads are fully buffered, with attention given to loading. Addresses may be changed over a wide range. And many circuits provide both direct and inverted signals, selectable by jumpers. These features provide for future flexibility. 308 pp. Paperback, $7.95; hardcover, $12.95. **Tab Books**, Blue Ridge Summit, Pa. 17214. **Circle 110**

AI BOOK. "Artificial Intelligence" by Neil Graham covers problem strategy, state-graph search, subproblems, subgoals, and plans, hierarchical plans and procedural nets, game playing programs with tree search, game playing programs with heuristics, pattern recognition and perception, propositions and predicates, Natural Language Processing and LISP. 252 pps. Paper, $7.95. **Tab Books**, Blue Ridge Summit, Pa. 17214. **Circle 109**

ELECTROSTATIC PLOTTING. Model 155 interface permits Hewlett-Packard 3000, Series I, II and III computers to use any of 47 Versatec electrostatic printer/plotters. The interface, carried in its own rack-mounted chassis, carries line printer emulation circuitry, independent power supply and required cabling. Electrical and mechanical specifications are compatible with the standard Hewlett-Packard I/O structure. Versatec supplies the hardware connection: the Hewlett-Packare universal input output card (30209A). Versaplot 07 plotting software, provides on-line and off-line electrostatic plotting capabilities. This software generates raster or vector output, spooled or unspooled. **Versatec**, 2805 Bowers Ave., Santa Clara, CA 95051. **Circle 124**

POCKET TERMINAL can be carried in a toolkit or pocket and plugged into a digital system to input and read data. The device sends and receives all 128 ASCII codes, and the last 30 characters received are held in memory for access through a built-in 16-segment alphanumeric display. Applications include fault diagnosis, interactive debug, status monitoring, information retrieval and small-scale reprogramming. Housed in a 6 in. x 3 in. case, the terminal has 40 positive response keys, allowing 128 ASCII codes to be selected and transmitted as eight-bit words with parities and start/stop bits. The terminal is provided with a 25-way connector and interfaced for RS232/C compatibility. **GR Electronics, Ltd.**, 1640 Fifth St., Santa Monica, CA 90401. **Circle 166**

"SYSTEM DESIGN With Microprocessors," a 202-pp. paperback by Dr. D. Zissos. Covers: logic design; MPUs; wait/go systems; test-and-skip systems; interrupt, DMA, DDT systems. $13.50. **Academic Press, Calgary Book Club Ltd.**, 2128-23 Ave. N.W. Calgary, Alberta. T2M 1W3 Canada. **Circle 108**

New Products

μC CONTROL SYSTEMS for OEM industrial control and instrumentation users come in custom configurations. The 6800-based system ranges from a SBC to a fully software supported disk development system that addresses up to 500 Kbyte of memory. The SYS-68 SBC has a full compliment of peripheral interface devices – four 8-bit parallel I/O ports, 2 serial I/O ports, 3 channels of timer-counter functions and 8-bit latched output. The card operates from a single 5V supply and has 1K of static RAM and up to 4K of PROM (2708 or 2716) memory. An SBC evaluation system, with a supply and terminal, allows evaluation and program development with an on-board PROM monitor. $585. **Synetic Designs**, 252 San Lorenzo, Pomona, CA 91766. **Circle 102**

8080A EXPERIMENTS BOOK. This lab-oriented two-volume set familiarizes the reader with the interfacing hardware and assembly level programming aspects of the 8080A via the MMD-1 microcomputer. Vol. 1, $12.95; vol. 2, $10.95. **Howard W. Sams & Co., Inc.**, 4300 West 62nd St., Indianapolis, IN 46268. **Circle 106**

BAND LINE PRINTER. Model 3901, offers 1100 lpm on 48 characters. A fully enclosed cabinet means quiet operation. Full line buffered with self-test capability and completely micro-processor-controlled, it offers line spacing of 6 lines per inch and features a single line advance time of 25 ms and a slew speed of 15 ips. It will accept 1 to 6 part forms ranging in width from 3″ to 17.5″. Inking is via "clean hands" operator replaceable cassette: Physical size is 40.5″ L x 32.5″ W x 27″ D, 275 lbs. **Data Printer Corp.**, 99 Middlesex St., Malden, MA 02148. **Circle 174**

LARGE ALPHANUMERIC DISPLAY. Model 4450 Taskdata display panel with 8 large characters (1-3/4″) is readable from up to 90′ away. The display has a 32-character memory divided into 4 sectors of 7 char. each. Panel displays an individual sector or upon command, sequentially displays 2, 3 or 4 sectors. All support electronics is on one 5V PCB. Serial/Parallel input, housing and supply are available. Panels used to inform operators, provide status information, signal alarm conditions and provide general information. $182 (100). **Logic Electric**, Box 5154, Kingwood, TX 77339. **Circle 103**

SYSTEMS DESIGN. How to represent systems with models, establish measures for comparison of costs and benefits, compare the ability of various systems to achieve specific goals, and integrate subsystems into an optimum building system are covered in the 665-pg. text, "Building Engineering and Systems Design," by Frederick Merritt. $38.50. **Van Nostrand Reinhold, Litton Education Publ.**, 135 West 50th St., New York, NY 10020. **Circle 169**

"LOGIC & MEMORY EXPERIMENTS USING TTL IC's", by Peter Rony and David Larsen, covers 7400-series logic lucidly, taking the newcomer through a series of hands-on experiments designed to introduce him to a good familiarity with the 7400 series. Two volumes, $9.95 each. **Howard W. Sams & Co., Inc.** 4300 West 62nd St, Indianapolis, IN 46268. **Circle 105**

AN 8.25″ FIXED DISK DRIVE mechanically interchangeable with an 8″ floppy disk drive? Model D8000 uses Winchester-technology and has a capacity of 20 Mbytes. With PCC's D8000, users get 20 Mbytes of storage from the same space once yielding a max. of 1.6 Mbytes – plus faster access time, and a 40% reduction in the price tag ($1500 - $2800) over a full-sized rigid-disk drive. Rapid seek times (50 msec avg.) are enhanced by a rotary positioner driven by a limited rotation motor. D8000 records at a density in excess of 6,000 bpi and transfers data at a nominal rate of 0.87 Mbytes/sec. **PCC Peripherals Div.**, 9600 Irondale Ave., Chatsworth, CA 91311. **Circle 135**

BUSINESS COMPUTER BOOK. "From The Counter to the Bottom Line," a 290-pg. paperback by Carl Warren and Merl Miller, uses BASIC to explain accounting systems, inventory and purchasing, billing, accounts receivable and general ledger. Paperback, $12.95. **Dilithium Press**, Box 92, Forest Grove, OR 97116. **Circle 112**

RS232 CARTRIDGE DRIVE with RS-232 interface uses a standard ANSI/ECMA 1/4-inch digital cartridge and is available in both commercial and ruggedized versions. The units are available with or without power supply, with EMI front panel, or in full EMI enclosure. Commercial units are furnished with either front or top cartridge loading. When power is turned on, a self test and tape positioning algorithm insures proper operation. $3218. **Data Electronics.**, 370 N. Halstead St., Pasadena, CA 91107. **Circle 101**

"Z80 and 8080 ASSEMBLY Language Programming" by Kathie Spracklen is unusual in that it teaches Z-80 assembly language as a first language. Appendices list 8080/Z80 assembly mnemonics conversion symbols, Z80/8080 dissassembler and answers to quizzes. **Hayden Book Co. Inc.** Essex St., Rochelle Park, N.J. **Circle 113**

SHARE A PRINTER. The Model MSA-4 interfaces four computers or CRT Terminals to one printer with option to expand from four to 16 input channels. The unit was designed to offer flexibility and cost savings by sharing one printer with four to 16 devices. The MSA-4 has its own power supply. $395. **Via West, Inc.**, 2739 W. Palm Lane, Phoenix, AZ 85009. **Circle 179**

Designers' Notebook

Format That Data

The following program (called "TABS") provides a simple way to send formatted data to an output device (CRT, PRINTER, etc.). Format commands (call a "tab") are used in the same manner as the "TAB" key is used on a typewriter; to display information in easy to read columns. "Tab" commands are used in many types of programs where neat, formatted listings are desired (Assemblers and Text Processors are two examples).

The "TABS" routine is written as a subroutine to be called from an output routine provided by the user. Each time the routine is called, spaces are repeatedly sent to the output device until the next "tab" stop is reached. Starting with character position one (the position after a "CARRIAGE RETURN" command), every eighth character position is a "tab" stop (9, 17, 25, 33 etc.).

If the output device is already on a "tab" stop when the "TABS" routine is called, spaces will be sent until the next tab stop is reached (this allows for two "tab" commands in a row). The only storage data required by the program is a one-byte character position counter (the counter can handle output devices with a line length of up to 255 characters). The output program provided by the user is responsible for decoding the "tab" character (which in turn calls the "TABS" program) along with clearing the character position counter (CPC) after a "CARRIAGE RETURN" command has been sent to the output device.

The following program was coded in 8080 Assembly Language. A sample user output decoding routine is also included to serve as an example of a routine that uses the "TABS" subroutine. A flowchart has been provided to allow the readers to convert the program to other computer languages.

As a side note, the program listing was printed using the "TABS" routine.

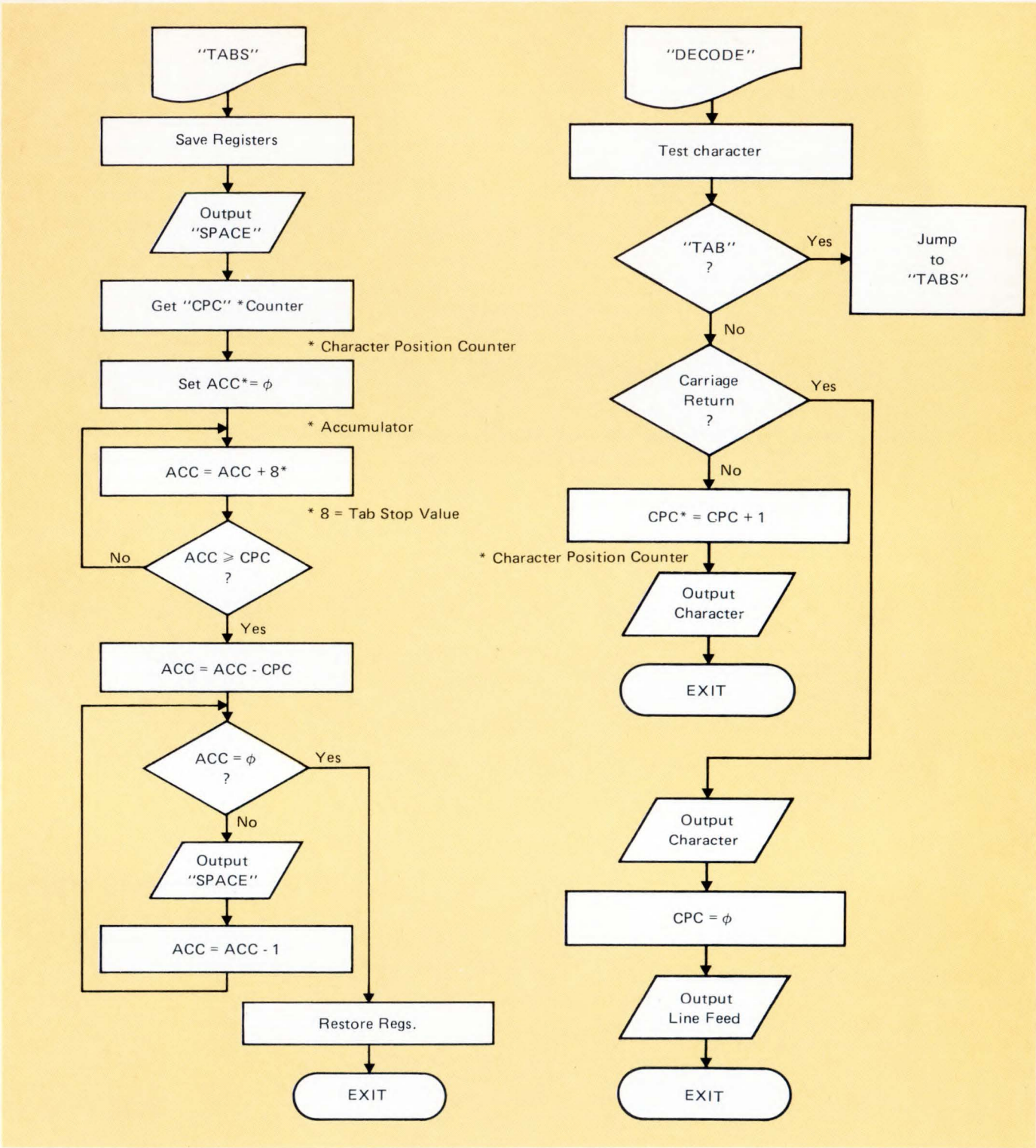
Thomas J. Newman, Dacomp Systems (Dublin), 27444 Berenda Way, Hayward, CA.

Rate this design: circle 7L, 7M or 7H on Reader Inquiry Card.

```
                        "FORMAT THAT DATA"
                *
                *  BY THOMAS J. NEWMAN
                *
                *  MARCH 1, 1979

                *       ---   "TABS"  SUBROUTINE   ---
                *
                *  TAB STOPS AT POSITION 17, 25 ETC.
                *
                *  ALL REGISTERS SAVED EXCEPT FOR 'A' AND 'FLAGS'

0000            ORG     0               * FOR EXAMPLE ONLY *

0000 08 00      TABSTOP EQU     8               DETERMINES TAB STOPS

0000 C5         TABS    PUSH    B               SAVE 'BC' REGS.
0001 3E 20              MVI     A,' '
0003 CD 2C 00           CALL    DOUT            SEND SPACE CHAR.
0006 3A 21 00           LDA     CPC             CHAR. POSITION CNT.
0009 4F                 MOV     C,A
000A AF                 XRA     A

                *  NOW DETERMINE THE NUMBER OF POSITIONS
                *  FROM THE NEXT TAB STOP.

000B C6 08      TABL    ADI     TABSTOP         TAB STOP VALUE
000D B9                 CMP     C
000E DA 0B 00           JC      TABL            LESS THAN "CPC"
0011 91                 SUB     C
0012 4F                 MOV     C,A

                *  REG 'C' = NUMBERS OF SPACES TO NEXT TAB STOP.

0013 CA 1F 00   OUTSP   JZ      TABE            DONE (ON TAB STOP)
0016 3E 20              MVI     A,' '
0018 CD 2C 00           CALL    DOUT            OUTPUT SPACE TO DEVICE
001B 0D                 DCR     C               SPACE COUNTER
001C C3 13 00           JMP     OUTSP           LOOP UNTIL TAB STOP

                *  RESTORE ALL SAVED REGISTERS.

001F C1         TABE    POP     B
0020 C9                 RET

0021            CPC     DS      1               CHAR. POSITION CNT.
                .
                .
                .
                *       ---  USER OUTPUT DECODE ROUTINE  ---
                *
                *  USED TO DECODE "TAB" AND "CARRIAGE RETURN" CHARS.
                *
                *  ENTER:  REGISTER 'A' = CHARACTER TO BE SENT
                *          TO THE OUTPUT DEVICE.

0022 03 C6      CO      EQU     0C603H          OUTPUT ROUTINE

0022 FE 09      DECODE  CPI     'I'-40H         CONTROL 'I' = TAB
0024 CA 00 00           JZ      TABS            DO "TABS" ROUTINE
0027 FE 0D              CPI     'M'-40H         CARRIAGE RETURN ?
0029 CA 38 00           JZ      DCR             YES!
002C F5         DOUT    PUSH    PSW             SAVE CHARACTER
002D 3A 21 00           LDA     CPC             CHARACTER COUNTER
0030 3C                 INR     A               ADD 1
0031 32 21 00           STA     CPC             NEW POSITION
0034 F1                 POP     PSW             GET BACK CHARACTER
0035 C3 03 C6           JMP     CO              OUTPUT CHARACTER

                *  FOUND "CARRIAGE RETURN" CHARACTER

0038 CD 03 C6   DCR     CALL    CO              OUTPUT "CR"
003B AF                 XRA     A
003C 32 21 00           STA     CPC             CLEAR POSITION CNT.
003F 3E 0A              MVI     A,'J'-40H       LINE FEED
0041 C3 03 C6           JMP     CO              SEND "LF" AND RETURN

0044            END
```

Continued on p. 96

Continued from p. 95



Send Us Your Design Ideas

Here's how: submit your Designer's Notebook entry describing a unique circuit or design technique, system design idea, procedure or program — be it in Z80, 8080A, 8085, 6800, 6809, SC/MP, F8, 6502 or other assembly language, or Pascal, PL/1, microFORTH, Basic or other high-level language. Programmable calculator programs are also fine.

We require that all entries not be published elsewhere (house organs excepted) and that they be breadboarded and debugged (or run successfully in the case of software). We cannot assume responsibility for entries shown nor represent freedom from copyright or patent infringement. We still require all submitted entries to be free from both patent or copyright infringement.

The Fujitsu M228X.

Quality.

Fujitsu is the world's largest alternative manufacturer of Winchester technology drives. The reason is quality.

Dedicated quality that means reliability, yet at OEM competitive prices on megabyte comparison. This is the Fujitsu commitment. And it is performance supported with the new M228X series of sealed drives:

Access times are the industry's fastest. Reliability 20% better (exceeds 10,000 MTBF, power-on-hours). The design is energy conservative and cool running. And for flexible expansion in existing disk configurations or software and controller development, the standard SMD interface is built-in. M2282: 66 megabytes. M2283: 132 megabytes. M2284: 165 megabytes. Optional head-per-track capacity: 655 kilobytes.

Write or call Fujitsu America, Inc., Byron Wicks, Marketing Director for further information/demonstration: Fujitsu America, Inc., 2945 Oakmead Village Court, Santa Clara, CA 95051 Tel: 408/985-2300 Telex: 357402 TWX: 910-338-0047.

The 30-Day Faster Coupon

Receive information 30-days faster by sending coupon direct, instead of circling reader service number on publication reply card.

Name/Title _____

_____

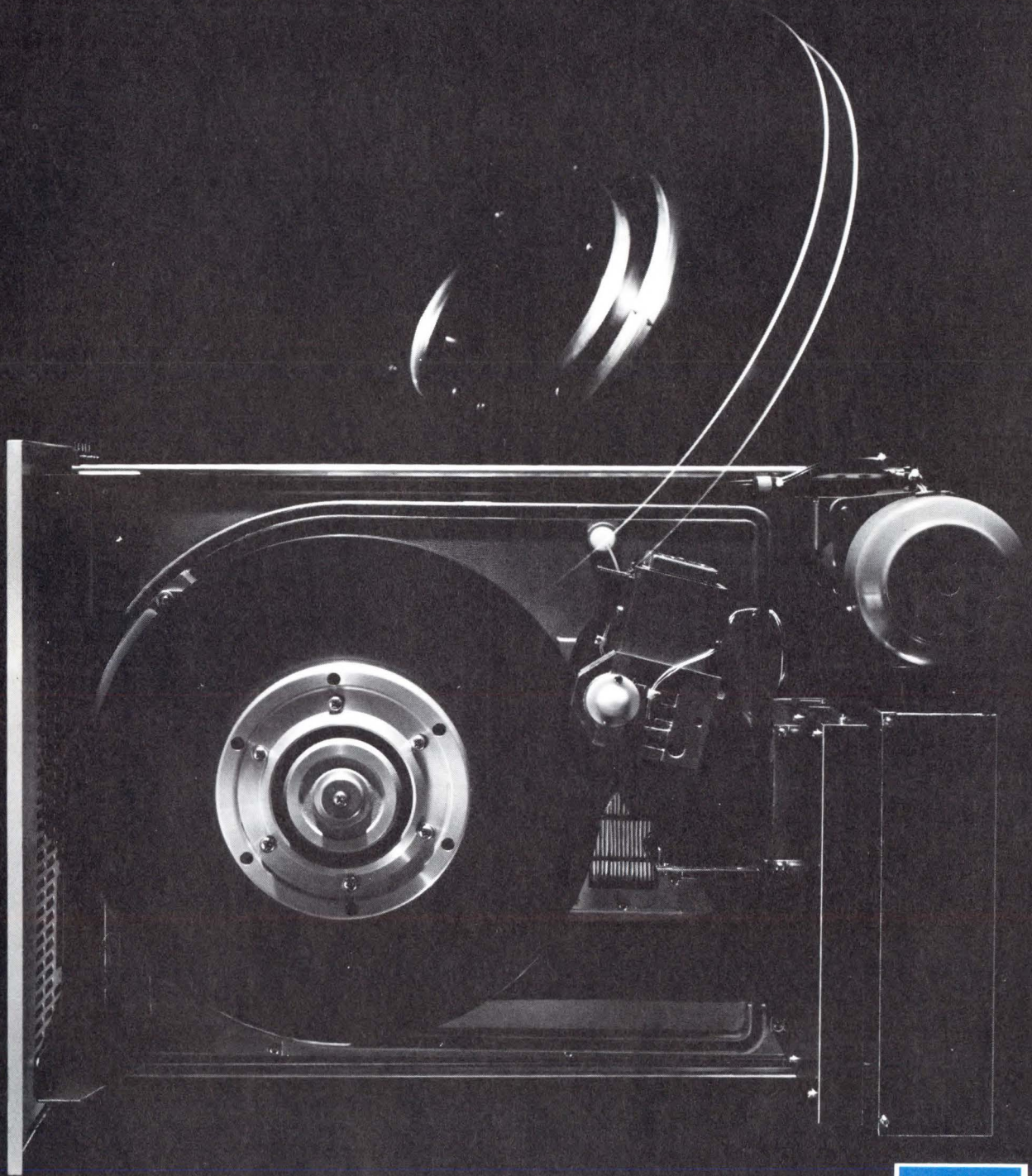
Organization/Div/Dept _____

Address _____

City/State/Zip _____

Tel/Ext _____

Potential Application _____



FUJITSU

Circle 21 on Reader Inquiry Card

Anything's possible with a WHIZZARD™ 7000.

Fast refresh graphics throughput. Unequaled vector quality. Dynamic display versatility. You get it all with a WHIZZARD 7000.

Draw the most sophisticated pictures you can imagine. Quick as a blink. The secret's in a 32-bit microprocessor with its own refresh memory. There's one inside every WHIZZARD 7000.

Get constant vector intensity and perfect end-point matching with maximum vector throughput. The best in the industry. The WHIZZARD 7000's advanced vector generator and unique Adaptive Timing™ technology guarantee it.

Pictures show up sharp. Even under the strongest office lights. That's because you can choose from 16 brightness levels. And, WHIZZARD alphanumerics are easy to read, too. Its stroke-generated characters can appear in eight programmable sizes.

When it comes to real-time graphics, the WHIZZARD 7000 is unearthly. Hardware translation, 16-bits of line texture, and blinking are standard.

For even mightier magic, you can add hardware rotate, scale, clip, zoom, and multi-viewports. You can even work in 3-D or color.

Choose the WHIZZARD 7000 that solves your graphics problem. A basic monitor/processor that'll connect to any 16-bit or 32-bit computer. An intelligent refresh terminal with computing power already built-in. Or a stand-alone graphics processing system, complete with peripherals and software.

Pick from lots of WHIZZARD 7000 graphics peripherals. Joysticks with push-button interrupt. Data tablets, digitizers and light pens. Pen plotters and electrostatic printer/plotters. And, more.

To find out the whole amazing story, just call the WHIZZARD. He'll send you a brochure. Or if you prefer, he'll bring you a magic show.

For full WHIZZARD details, write or call Pat Burke, MEGATEK, 3931 Sorrento Valley Blvd., San Diego, CA 92121. (714) 455-5590. TWX: 910-337-1270. (European office: 14, rue de l'Ancien Port, 1201 Geneva, Switzerland. Phone: (022) 32.97.20. Telex: 23343.)

The Visible Difference

MEGATEK
CORPORATION

Circle 39 on Reader Inquiry Card