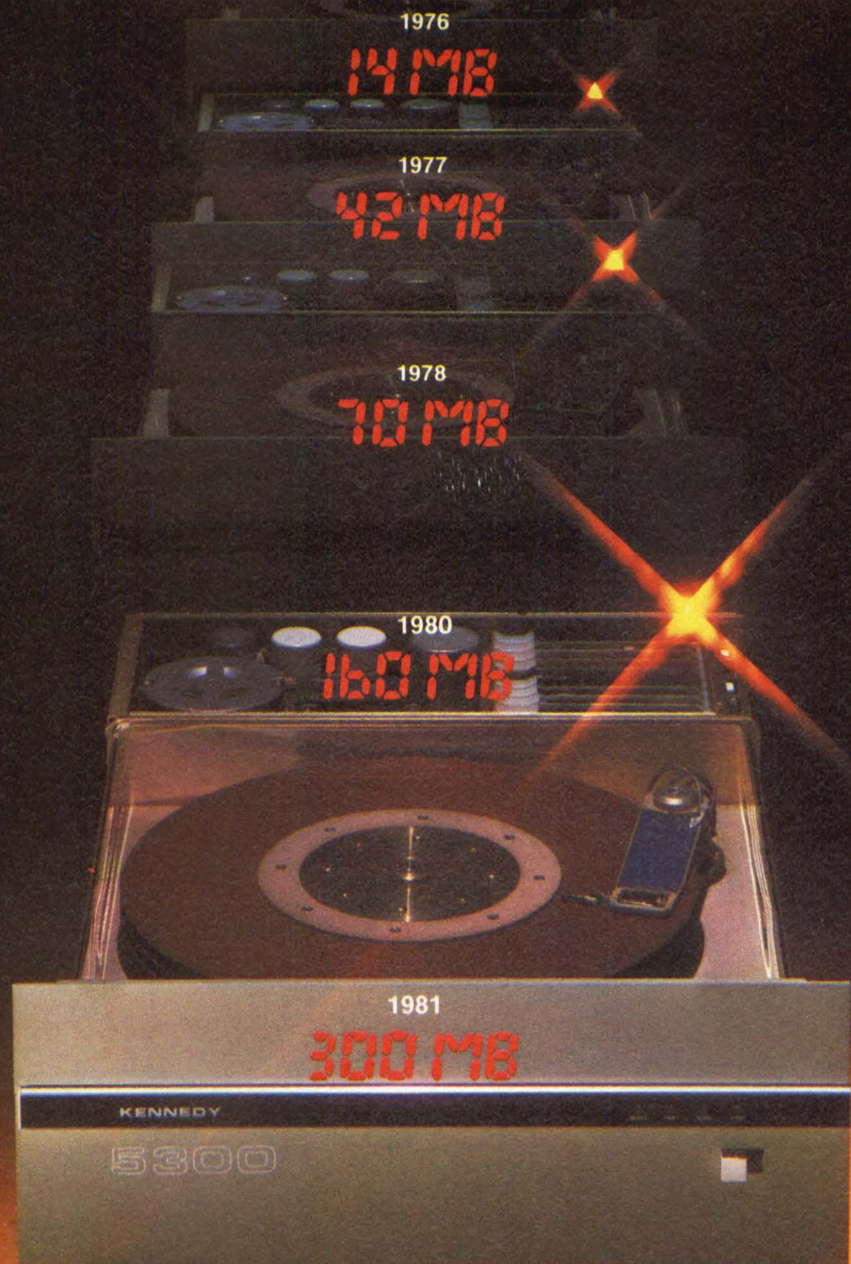
COMPUTER DESIGN

THE MAGAZINE OF DIGITAL ELECTRONICS

MAY 1979


1976
14 MB
1977
42 MB
1978
70 MB
1980
160 MB
1981
300 MB
KENNEDY
5300

IT'S THE FLEXURE THAT GIVES THE MUSCLE TO THE UNMATCHED RELIABILITY OF TALLY LINE PRINTERS.

Flexure technology—special steel couplings that support and move the print carriage. The print hammer fingers of the patented Tally print comb are also flexures.

Designed for unlimited life, a flexure has no wear points nor lubrication requirements. Adjustments are never necessary.

TALLY® PRINTERS WORLDWIDE

OEM SALES OFFICES
Boston (617) 272-8070
New York (516) 694-8444
Chicago (312) 885-3678
Los Angeles (213) 378-0805
Miami (305) 665-5751
Philadelphia (215) 628-9998
San Jose (408) 247-0897
Seattle (206) 251-6730
San Antonio (512) 733-8153
Washington, D.C. (703) 471-1145

BUSINESS SYSTEMS SALFS
Orinda, CA (415) 254-8350

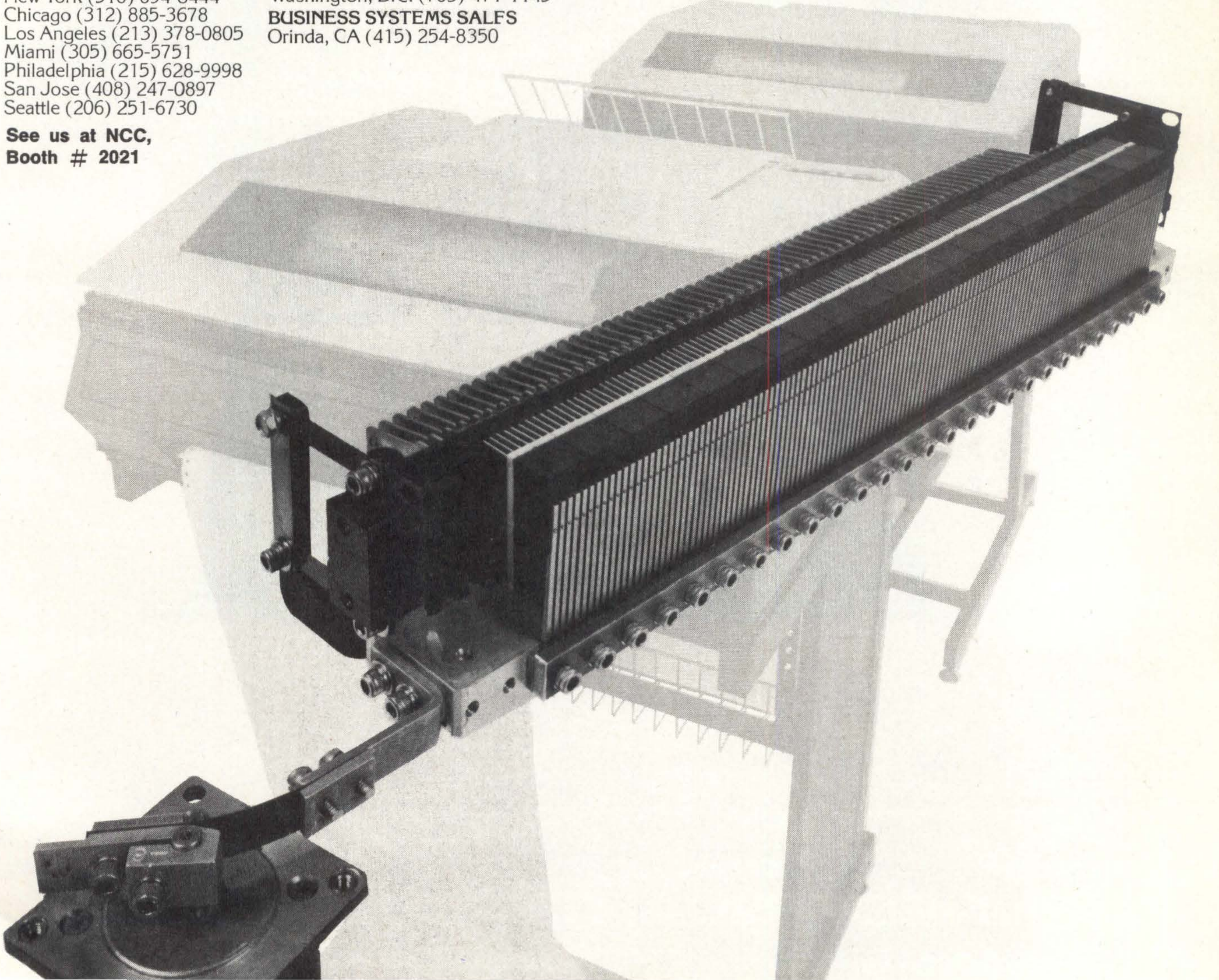
See us at NCC, Booth # 2021

Thus the stage is set for a highly reliable printing technique based on low stress parts moving at low speed over short distances. For example, print hammer movement—there's a hammer for each character position—is limited to the distance of a single character. Tally has eliminated clutches, belts, timing variables, cam shafts, pivots and sliding wear surfaces. There are no preventive maintenance requirements. No duty cycle limitations.

And this is only the beginning of the benefits you get from the Tally T-2000 printer. 125 or 200 lines per minute. Superb print quality. Quiet operation. Low cost of ownership. Contact your nearest Tally sales representative for more facts.

Tally Corporation, 8301 S. 180th St., Kent, WA 98031. Phone (206) 251-5500.

CIRCLE 3 ON INQUIRY CARD



COMPUTER DESIGN

THE MAGAZINE OF DIGITAL ELECTRONICS

MAY 1979

VOLUME 18, NUMBER 5

DEPARTMENTS

BPA **CIRCULATION: 67,155 (JUNE 1978)**

(USPS 127-340)

FEATURES

CONFERENCES

STAFF

Publisher and Editorial Director
Robert Brotherston

Associate Publisher
Anthony Saltalamacchia

Editor
John A. Camuso

Managing Editor
Sydney F. Shapiro

Technical Editor
George V. Kotelly

Senior Editor
Peg Killmon

West Coast Editor
Michael Chester
Los Angeles, Calif.
(213) 824-5438

Associate Editors
James W. Hughes
Joanne O'Donnell

Assistant Editor
Winifred L. Helfrich

Editorial Advisory Board
Brian W. Pollard
Ralph J. Preiss
Rex Rice

Contributing Editors
Richard Ahrons
A. S. Buchman
H. S. Miller
Harold H. Seward

Production Manager
Judy Lober

Advertising Production
Linda M. Wright

Art Director
James Flora

Technical Illustrator
Charles Manchester

Circulation Manager
Alma Brotherston

Marketing Manager
Geoffrey Knight, Jr.

Marketing Production
Megan Kern

Research Associate
Sidney Davis

Business Manager
David C. Ciommo

Vice President-Sales
Lindsay H. Caldwell

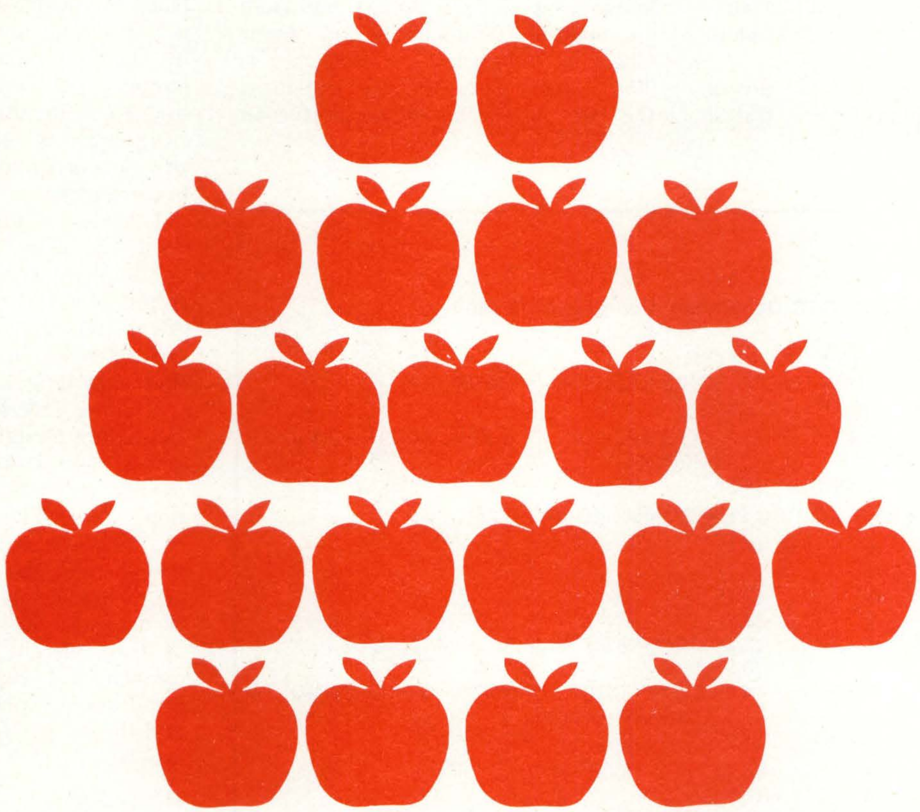
Editorial & Executive Offices
11 Goldsmith St
Littleton, MA 01460
Tel. (617) 486-8944
(617) 646-7872

Editorial manuscripts should be addressed to Editor, Computer Design, 11 Goldsmith St., Littleton, MA 01460. For details on the preparation and submission of manuscripts, request a copy of the "Computer Design Author's Guide."

Computer Design is published monthly. Copyright 1979 by Computer Design Publishing Corporation. Controlled circulation postage paid at Pontiac, Ill. No material may be reprinted without permission. Postmaster: CHANGE OF ADDRESS—FORM 3579 to be sent to Computer Design, Circulation Dept., P.O. Box A, Winchester, MA 01890. Subscription rate is $24.00 in U.S.A., Canada and Mexico, and $40.00 elsewhere. Microfilm copies of Computer Design are available and may be purchased from University Microfilms, a Xerox Company, 300 N. Zeeb Rd, Ann Arbor, MI 48106.

NCC BOOTH 1506

21 NEW, DELICIOUS IDEAS FOR MINI-MICRO MEMORY ...AND ITS CONTROL



1. 8.0 MB BULK SEMI
2. Single-board PDP-11 compatible Storage Module Controller
3. BULK SEMI RF-11 compatible disk emulation system for PDP-11
4. 128K x 18 semi ADD-IN with on-board parity for PDP-11
5. Dual port for PDP-11 BULK CORE disk emulation system
6. Dual port for PDP-11 BULK SEMI disk emulation system
7. 128K x 18 semi ADD-IN for LSI-11/23
8. BULK SEMI RF-11 compatible disk emulation system for LSI-11
9. RJS03-compatible BULK CORE disk emulation system
10. LSI-11 based BULK MINI using BULK SEMI
11. BULK SEMI main memory ADD-ON for PDP-11/70
12. 256KB semi ADD-IN for DECSYSTEM 2020
13. 256KB semi ADD-IN for Nova 3
14. 256KB semi ADD-IN for Eclipse
15. AOS and RDOS-compatible BULK CORE disk emulation system for Nova and Eclipse
16. BULK SEMI Novadisc-compatible disk emulation system for Nova and Eclipse
17. BULK SEMI AOS and RDOS-compatible disk emulation system for Nova and Eclipse
18. Dual port for Data General-compatible BULK CORE disk emulation system
19. Dual port for Data General-compatible BULK SEMI disk emulation system
20. BULK SEMI Interdata-compatible disk emulation system
21. Core ADD-ON for Univac (Varian) V77-400

DATARAM CORPORATION

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

CIRCLE 5 ON INQUIRY CARD

LETTERS TO THE EDITOR

To the Editor:

The Application Note on pp 122-126 in the Feb 1979 issue of *Computer Design* ("Software Error Checking Procedures For Data Communication Protocols," J. Wong, W. Kolofa, and J. Krause) is a reasonable examination of the generation of a CRC (cyclic redundancy check). But, the final result in the form of a computer program leaves a lot to be desired. First, it is not fast because it operates in a bit serial fashion. Second, there are better ways.

If one assumes that a table driven CRC algorithm which is the fastest nonhardware method is not used because the size of the table would be prohibitive, then a byte parallel algorithm should be found. It seems that *Computer Design* had a previous Application Note which adequately described not only how to generate a CRC, but also gave a listing of a program that did a byte parallel CRC.

The May 1976 issue of *Computer Design* on pages 190 and 192 (notice how short it can be when you really know what you are doing) had such an article ("Calculating an Error Checking Character in Software"). The author, Suresh Vasa, explained the CRC generating algorithm for an F8 and explained the method used to find it. The example given was only for SDLC, but with a little work, it can be converted for other CRC polynomials. This was done by myself and others where I work and is now a part of software and firmware routines in many products where the size of a CRC table would have been too costly. Both SDLC and BISYNC algorithms have been generated, checked, and used in the marketplace for over a year. This algorithm is fast (38 μs on an F8 as compared to 512 μs on the 6800), linear (no jumping or looping), and the one drawback in the article (MSB, LSB swapping) is easily resolved with still an order of magnitude speed improvement.

I have not programmed the 6800 itself, but as an exercise, I attempted an implementation of Vasa's algorithm on it (see SDLC CRC Generating Algorithm for a 6800). I cannot guarantee its accuracy, but I do not think anything is wrong with it.

Finally, I feel that the editors of *Computer Design* should check back across older issues to find the applicability of new articles or Application Notes. The fact that an article on CRCs was redone is good because many engineers do not have the older references, but before the article is accepted it should be shown to at least match (if not exceed) the quality and capability of previous articles or explain why it did not and have a reference to the other articles.

Henry Socha
San Antonio, Texas

SDLC CRC Generating Algorithm for a 6800

```
ENTER:    A = NEW DATA BYTE
        CRC = 2-BYTE CRC ACCUMULATION (IN MEMORY)
          B = WORK REGISTER
        EOR  A CRCH   (3,2) (LEAVE OUT IF DATA ARE KNOWN
                            ZERO!)
        STA  A CRCH   (4,2)
NOW, GENERATE SLDC CRC FOR COMBINED DATA/CRC
        LSR  A        (2,1)
        LSR  A        (2,1)
        LSR  A        (2,1)
        LSR  A        (2,1)
        EOR  A CRCH   (3,2) GENERATE I J K L M N O P
        LDA  B CRCL   (3,2)
        STA  B CRCH   (4,2) SWAP CRCS AROUND (CORRECTING
                            VASA'S FAULT)
        STA  A CRCL   (4,2)
        ROL  A        (2,1)
        ROL  A        (2,1)
        ROL  A        (2,1)
        ROL  A        (2,1)
        TAB           (2,1) SAVE   M N O P X I J K
        ROL  A        (2,1)
        ROL  A        (2,1) HAVE   O P X I J K L M
        AND  A #037   (2,2) SELECT 0 0 0 I J K L M
        EOR  A CRCH   (3,2)
        STA  A CRCH   (4,2)
        TBA           (2,1)
        AND  A #360   (2,2) SELECT M N O P 0 0 0 0
        EOR  A CRCH   (3,2)
        STA  A CRCH   (4,2) CRCH DONE
        ROL  B        (2,1)
        AND  B #0340  (2,2) SELECT N O P 0 0 0 0 0
        EOR  B CRCL   (3,2)
        STA  B CRCL   (4,2) CRCL DONE
END                   (74 CYCLES, 43 BYTES)
```

NOTE: Numbers starting with 0 are in octal

The Authors Reply:

The purpose of our article ("Software Error Checking Procedures For Data Communication Protocols," *Computer Design*, Feb 1979, pp 122-126) was to communicate the basic concept of evaluating CRC software versus hardware. While the byte parallel approach is admittedly faster, we are convinced that the bit serial routine provides better insight and understanding into the CRC problem for both BSC and SDLC protocols.

Since Mr Vasa's article ("Calculating an Error Checking Character in Software," *Computer Design*, May 1976, pp 190-192) dealt exclusively

The hot little idea that's spreading like wildfire.

Last year, Fairchild silently slipped over the silicon border into the 16-bit microcomputer systems business.

Our first product was the 9440 MICROFLAME™ microprocessor. We introduced it as "the microprocessor that thinks it's a minicomputer." But it looked like a component. So most people assumed it was just a component.

It wasn't.

It was the heart of a microcomputer system.

The 9440 was the beginning of a systems family. Designed to let you buy a microcomputer one function at a time.

The idea caught on. Like wildfire.

Fairchild now has a separate organization totally dedicated to high-performance microcomputer technology.

The FIRE Microcomputer Group.

In the past few months they've built a healthy little 16-bit microcomputer systems business without much fanfare.

The time has come for fanfare.

Please turn the page.

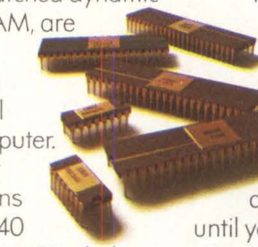
FAIRCHILD

The microprocessor that thinks it's a minicomputer.

The 9440 MICROFLAME is the world's first 16-bit bipolar microprocessor that performs like a minicomputer. In fact, it executes the NOVA* instruction set. It's a complete minicomputer CPU on one chip, packaged in a 40-pin DIP. It is supported by other family members:

The 9441 memory and DMA controller.

And the 9442 I/O bus controller. These three LSI chips, plus our performance-matched dynamic bipolar RAM, are all that is needed to build a full microcomputer.



Major applications for the 9440 MICROFLAME include OEM data processing systems used in a variety of computing control and instrumentation environments. Telecommunications PBX and PABX switching installations. And distributed intelligence, distributed multiprocessing and front-end (terminal) processing.

The MICROFLAME family is designed to let you design at your own speed, adding functions as you need them, until you have just the microprocessor system you need.

For more information on our hot little family, please write the FIRE Microcomputer Group, Fairchild Camera and Instrument Corporation, P.O. Box 880A, Mountain View, California 94042.

FIRE MICROCOMPUTER GROUP

FAIRCHILD

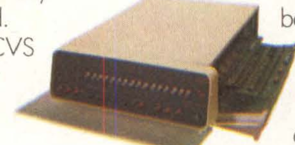
*NOVA is a trademark of Data General Corporation.

CIRCLE 350 ON INQUIRY CARD

The OEM minicomputer with definite ideas.

FOCVS XVI is a minicomputer designed to use the NOVA instruction set and compatible I/O peripheral interface boards.

It offers either 32KB or 64KB of dynamic RAM operating at minicomputer execution times. It's I/O bus-compatible to accommodate a wide range of peripherals. And it's supported by FIRE System software, allowing it to run millions of lines of applications software you've already developed.



The FOCVS XVI 9-slot chassis gives you up to eight extra slots so you can plug in other 15" x 15" boards. And it has front-panel controls for latch and display of data addresses, and examining memory or register contents.

Depending upon the minicomputer performance required, the FOCVS XVI may be equipped with either the GLOW-16 or BLAZE-16 15" x 15" boards. The boards may also be purchased for use without the FOCVS XVI enclosure for integration into your chassis.

For more information on the FOCVS XVI minicomputer, write the FIRE Microcomputer Group, Fairchild Camera and Instrument Corporation, P.O. Box 880A, Mountain View, California 94042.

FIRE MICROCOMPUTER GROUP

FAIRCHILD

CIRCLE 351 ON INQUIRY CARD

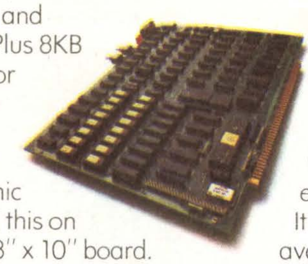
OEM microcomputer with growth in mind.

SPARK-16 is a single-board microcomputer supported by our FIRE software. It uses the 9440 MICROFLAME to give it minicomputer performance and is supported by companion boards to enhance its memory and input/output capabilities.

SPARK-16

What you do with it depends on what you want it to do.

It comes with 4KB of autoload PROM with FIREBUG, Interface Logic for current loop or RS 232C, a 100-pin connector, control switches and display. Plus 8KB of static or dynamic RAM. Or 16KB of dynamic RAM. All this on a single 8" x 10" board.



If you need even more memory, just add our SPARK-MEM board for up to 64KB of dynamic RAM, with parity.

For I/O intensive applications, you can add the SPARK I/O board — a general-purpose input/output control that helps make SPARK-16 do what you want it to do.

The THERMOSTAT, a handheld console, is also available to make your job easier.

SPARK-16 is easy to work with and easy to find. It is already available from over 60 distributor locations.

For more information on our little spark of genius, please write the FIRE Microcomputer Group, Fairchild Camera and Instrument Corporation, P.O. Box 880A, Mountain View, California 94042.

FIRE MICROCOMPUTER GROUP

FAIRCHILD

CIRCLE 352 ON INQUIRY CARD

The software you've already paid for.

If you've spent time and money developing your own applications software that uses the NOVA instruction set, we have a pleasant surprise for you.

Using our Fairchild Integrated Realtime

FIRE SOFTWARE

Executive (FIRE) System software, you can run those expensive lines of applications programs on our computers. Our SPARK-16 Microcomputer. Or our FOCVS XVI Minicomputer; our BLAZE-16; our GLOW-16 or our MICROFLAME Development System.

If you're about to write new applications software, consider this: the FIRE family of microcomputers is offered with extensive software support. It uses software familiar to most minicomputer programmers. And the NOVA instruction set has been proven for years.

Operating systems, powerful text editors, diagnostics, assemblers and high-level languages are all at your disposal from Fairchild.

For more information on our growing list of FIRE software products, write the FIRE Microcomputer Group, Fairchild Camera and Instrument Corporation, P.O. Box 880A, Mountain View, California 94042.

FIRE MICROCOMPUTER GROUP

FAIRCHILD

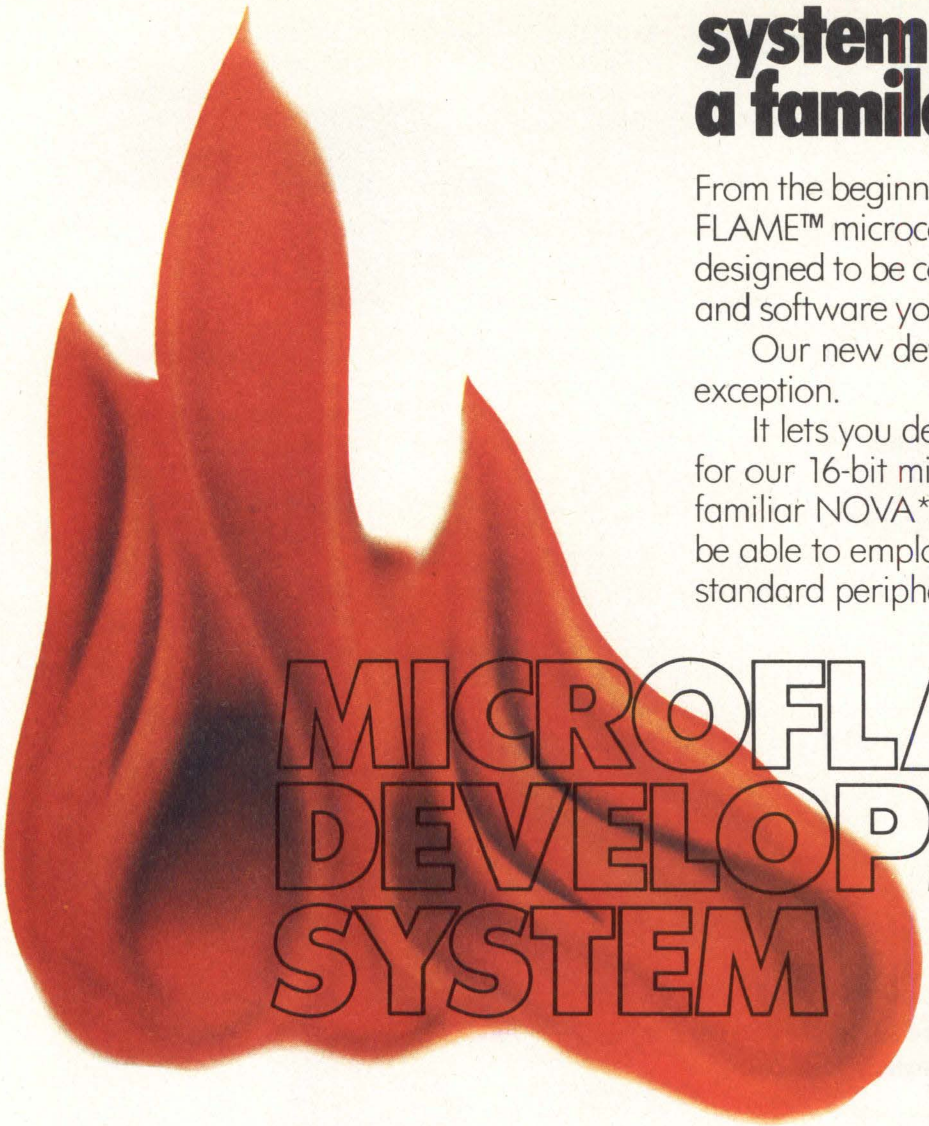
CIRCLE 353 ON INQUIRY CARD

The development system that speaks a familar language.

From the beginning, our entire MICROFLAME™ microcomputer family has been designed to be compatible with hardware and software you already have.

Our new development system is no exception.

It lets you develop applications software for our 16-bit microprocessors using the familiar NOVA* instruction set. You'll also be able to employ "off-the-shelf," industry-standard peripherals. Including high-speed



MICROFLAME™ DEVELOPMENT SYSTEM

readers, printers, PROM/FPLA programmers, modems, magnetic tape (800/1600 BPI, 9-track), cartridge disks (10MB) and storage modules (80 or 300MB).

You can save considerable time and money because you won't have to rewrite all of your programs or learn a new language. Which translates into shorter lead time to get your product on the market.

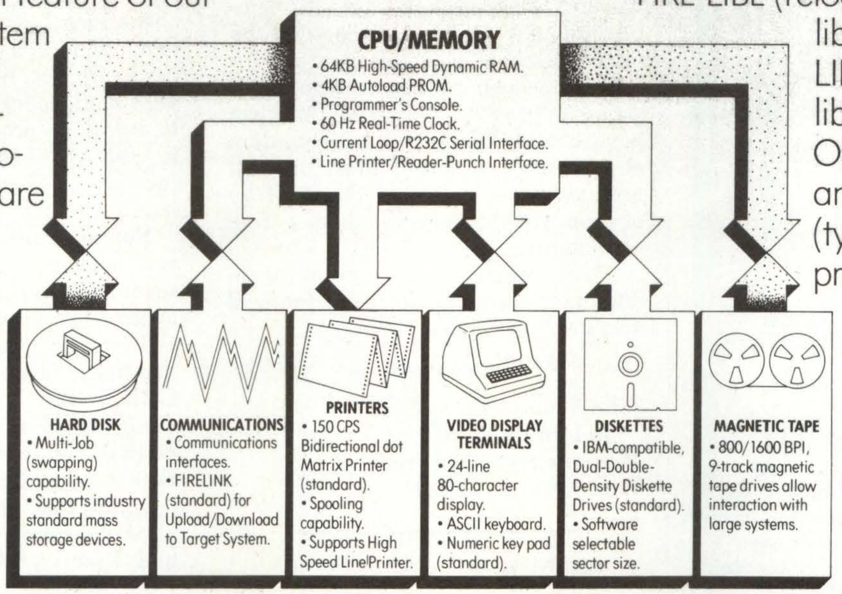
The benefits grow on you.

Fairchild's MICROFLAME Development System is an enhanceable system designed to develop prototype hardware and software for a broad range of microprocessor applications. From PROM resident code for MICROFLAME-based controllers to realtime multitasking software for distributed processing or control applications using the FOCVS XVI computer.

For the record, our development system combines the FOCVS XVI, a powerful computer offering 64KB of RAM, with a dual-double-density IBM-compatible floppy-disk subsystem (1 megabyte capacity expandable to 4 megabytes). A free-standing video display terminal and a 150-CPS bidirectional dot matrix printer complete the basic system.

A powerful link.

An important feature of our development system is the FIRELINK.™ It links the target-prototyping microcomputer hardware to the MICROFLAME Development System via an RS232C port. FIRELINK is used to upload or download assembled programs into the target system and to debug and monitor, remotely, the execution of object code in the target hardware.



FIRELINK has the additional capability of communicating with remote target systems or other MICROFLAME Development Systems via a modem/acoustic coupler over telephone lines if necessary.

Software with FIRE power.

The integrated hardware is fully supported by the Fairchild Integrated Realtime Executive (FIRE) System software.

The Interactive Multitasking Disk Operating System (FIRE-IMDOS) supports extended file management, timesharing and device-independent I/O on the development system.

With user-supplied high-performance peripherals, FIRE-IMDOS supports timesharing for a number of users, limited only by performance of the swapping device. Additional features include password protection and version number control for automatic tracking and backup during the debug phase of development. Spooling capabilities allow printing to proceed concurrently with other interactive activity, thereby increasing the throughput of the system.

The system includes, as standard, system processors such as FIRE-EDIT (text editor), FIRE-MACRO (macroassembler), FIRE-SYMBUG (symbolic debugger), FIRE-LIBE (relocatable utility library), FIRE-LIBEDIT (relocatable library editor), FIRE-OEDIT (octal editor) and FIRE-TYPESET (typesetting program).

The software for PROM formatting and burning is standard on our system using either an attached user-supplied PROM programmer or a detached paper tape.

Optional high-level languages under the development system software include BASIC, FORTRAN and PASCAL.

The system is delivered complete with documentation and an automatic installation and system-test diskette to assist user setup and checkout of the system. For more information, write the FIRE Microcomputer Group, Fairchild Camera and Instrument Corporation, P.O. Box 880A, Mountain View, California 94042.

*NOVA is a trademark of Data General Corporation.

FIRE MICROCOMPUTER GROUP

FAIRCHILD

See us at the NCC, New York Hilton, Mezzanine, Bryant Suite, June 4-7.

with SDLC protocol for an F8, we did not feel it was relevant to our presentation. In fact, we agree with Mr Socha that there is a "drawback" in Mr Vasa's article, namely, that the incoming data byte should be shifted, with MSB first, into the CRC accumulator. We believe our article made a contribution by pointing out that (1) the incoming data byte should be shifted, with LSB first, into the CRC accumulator, and (2) embedded SYNC codes are not to be included in CRC accumulations.

By presenting the academic bit serial approach, we feel that we have contributed some understanding of CRC software procedures for both BSC and SDLC protocols that will be of use to the general engineering community.

There appears to be an error in our CRC Subroutine for SDLC Protocol (Subroutine 2, page 126):

LDA A #$40 should be LDA A #$08.

John Wong, Bill Kolofa,
and Jim Krause
Motorola Inc, Data Products
West Chicago, Illinois

To the Editor:

I read with interest the article "Software Error Checking Procedure For Data Communication Protocols" (J. Wong, W. Kolofa, and J. Krause) which appeared in your Feb 1979 issue (pp 122-126).

It has been my experience that CRC computations may be made more efficient and accordingly, higher communication rates supported, if the software implementation is based on the parallel rather than the serial realization of the CRC logic. Since USARTS (universal synchronous/asynchronous receiver/transmitters) provide eight data bits at a time, each bit of the CRC field, which would result after eight bit shifts, may be expressed in terms of the bits of the existing CRC field and the eight data bits provided by the USART. Examination of the resulting expressions leads to an optimal software implementation.

This technique has been applied to both BSC and the SDLC/HDLC CRC polynomials. I would be pleased to provide further details for anyone interested.

Ted Anderson
Computerworld Corp
Ontario, Canada

To the Editor:

I have just finished reading the article by Wong, Kolofa, and Krause on "Software Error Checking Procedures For Data Communication Protocols" in the Feb 1979 issue of your magazine (pp 122-126). This article describes a relatively straightforward software emulation of the hardware feedback register approach to computing cyclic redundancy checksums. As a direct software emulation of a process intended for hardware implementation, the suggested procedure is rather expensive in terms of processor cycles. This is in contrast to more efficient software procedures that may be developed based on table driven approaches.

For example, one such approach was described in your own magazine several years ago. This was in the article by Joseph S. Whiting, "An Efficient Software Method for Implementing Polynomial Error Detection Codes" that appeared in *Computer Design* in Mar 1975 (pp 73-77). The earliest reference to this technique that I have been able to find, and actually the most lucid explanation as well, was in the article by Martin and Frambs, "A Cyclic Redundancy Checking Algorithm," that appeared in the *Honeywell Computer Journal*, Vol 5, No 3, 1971, pp 140-142. Each of these two articles describes procedures whereby storage may be traded off against processor cycles in the calculation of cyclic redundancy checksums. It is shown that the use of relatively small size tables, up to 256 bytes in length, result in quite dramatic decreases in the number of processor cycles required to compute a CRC.

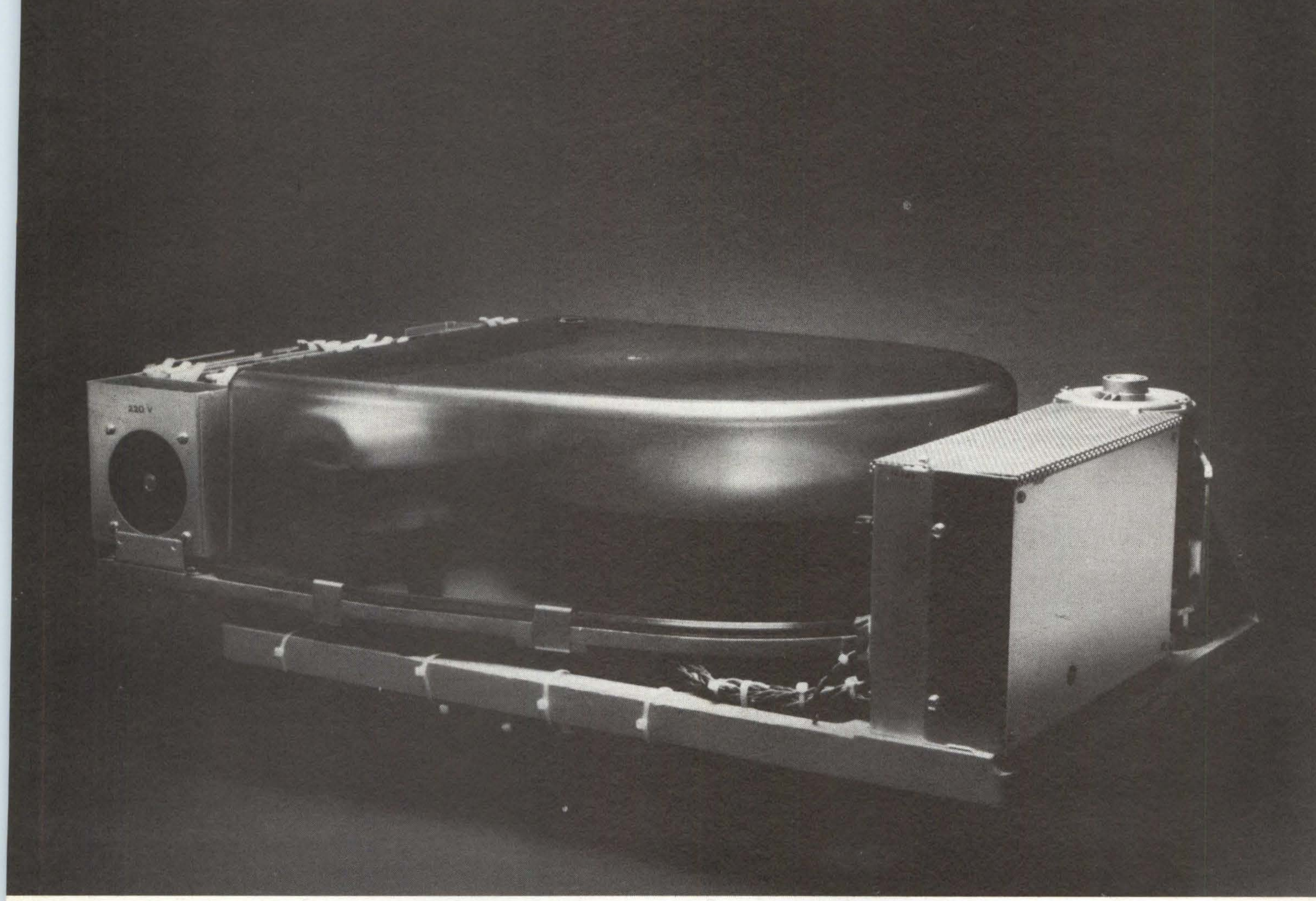
I would be interested in knowing if the present authors were familiar with this work, and if so, why they chose to ignore it.

Ira W. Cotton
National Bureau of Standards
Institute for Computer Sciences and Technology
Washington, DC

Letters to the Editor should be addressed:

Editor, Computer Design
11 Goldsmith St
Littleton, MA 01460

Memorex OEM Drives
We deliver product, not promises.



In the past 24 months we have delivered more Winchester-type OEM drives than all of our competitors put together. Here's why:

SUPERIOR DESIGN—The 601 is based on an investment of over $25 million in Winchester technology.

HIGH RELIABILITY—The sealed environment of the 601 is expected to yield MTBFs in excess of 8,000 hours. Using an 801 tester, the MTTR is only one hour.

REDUCED INFANT MORTALITY—A special quality control program at Memorex is set up to screen out early failures that are expensive and embarrassing to OEMs.

LOW COST—Other manufacturers may quote lower initial prices, but when it comes to cost of ownership over the life of the product, the Memorex® 601 disc drive is clearly the best value.

OEM SUPPORT—An extensive, worldwide service and support network assures you that help will be there when you need it.

IMMEDIATE AVAILABILITY—The 601 is in volume production and evaluation units are readily available.

Call or write:

MEMOREX

GENERAL SYSTEMS GROUP (OEM DIVISION), SAN TOMAS AT CENTRAL EXPRESSWAY, SANTA CLARA, CA 95052. BOSTON (617) 890-0700
NEW YORK (201) 325-0164; DETROIT (313) 354-4511; LOS ANGELES (714) 891-2541; DALLAS (214) 258-3510; SAN FRANCISCO (408) 987-1373

See us at NCC, New York, Booth #2129

CIRCLE 9 ON INQUIRY CARD

CALENDAR

CONFERENCES

JUNE 4-7—National Computer Conf, New York Coliseum, Hilton Hotel, and Sheraton Centre, New York, NY. INFORMATION: Marjorie Greimel, American Federation of Information Processing Societies, 210 Summit Ave, Montvale, NJ 07645. Tel: 201/391-9810

JUNE 17-20—Joint Automatic Control Conf, Hilton Hotel, Denver, Colo. INFORMATION: Prof T. F. Edgar, Program Chm, 1979 JACC, Dept of Chemical Engineering, U of Texas, Austin, TX 78712. Tel: 512/471-3080

JUNE 20-22—Internat'l Sym on Fault-Tolerant Computing, Concourse Hotel, Madison, Wis. INFORMATION: Prof Charles R. Kime, Dept of Electrical and Computer Engineering, U of Wisconsin, Madison, WI 53706. Tel: 608/262-0206

JUNE 25-27—Design Automation Conf, Town and Country Hotel, San Diego, Calif. INFORMATION: Robert J. Smith, III, Electrical Engineering Dept, U of Texas, PO Box 7728, Austin, TX 78712. Tel: 512/471-4540

JUNE 28—IEEE Indy Microcomputer Show, Sheraton Motor Inn E, Indianapolis, Ind. INFORMATION: Harry D. Bostic, Naval Avionics Ctr, D/810, 6000 E 21st St, Indianapolis, IN 46218. Tel: 317/353-3047

JULY 16-18—Summer Computer Simulation Conf, Toronto, Canada. INFORMATION: Dr A. J. Schiewe, Chm '79 SCSC, c/o The Aerospace Corp, PO Box 92957, Los Angeles, CA 90009

JULY 17-20—Joint Intermag/Magnetism and Magnetic Materials Conf, Statler Hilton, New York, NY. INFORMATION: Dr E. F. Luborsky, Conf Chm, General Electric R&D Ctr, PO Box 8, Schenectady, NY 12301

AUG 6-8—Pattern Recognition and Image Processing, Hyatt Regency O'Hare, Chicago, Ill. INFORMATION: PRIP 79, PO Box 639, Silver Spring, MD 20901

SEPT 4-7—COMPCON, Washington, DC. INFORMATION: IEEE Computer Society, PO Box 639, Silver Spring, MD 20901

SEPT 5-8—INFO/ASIA, Ryutsu Ctr, Tokyo, Japan. INFORMATION: Clapp & Poliak, Inc, 245 Park Ave, New York, NY 10017

SEPT 7-9—International Microcomputer Exposition, Dallas, Tex. INFORMATION: IME, 413 Carillon Tower, 13601 Preston Rd, Dallas, TX 75240

SEPT 17-19—Fourth Internat'l Conf on Software Engineering, Munich, Germany. INFORMATION: Prof Fritz Bauer, Institut fur Informatik der Technischen Universitat, D-8 Munchen 2 Arcisstrasse 21, Postfach 90 94 90, Germany

SEPT 17-19—Optical Communication Conf, RAI Conf Buildings, Amsterdam, The Netherlands. INFORMATION: J. H. C. Van Heuven, Philips Research Labs, Eindhoven, The Netherlands

SEPT 18-20—5th European Solid State Circuits Conf, U of Southhampton, England. INFORMATION: IEE Conf Dept, Savoy Place, London WC2R OBL, England

SEPT 18-21—WESCON, Brooks Hall and St Francis Hotel, San Francisco, Calif. INFORMATION: William C. Weber, Jr, 999 N Sepulveda Blvd, El Segundo, CA 90245. Tel: 213/722-2965

SEPT 20-26—TELCOM '79, Geneva, Switzerland. INFORMATION: John Sodolski, 2001 Eye St NW, Washington, DC 20006. Tel: 202/457-4934

SEPT 25-29—Relcomex '79—Reliability and Exploitation of Computer Systems, Ksiaz Castle near Wroclaw, Poland. INFORMATION: I. Jozwiak, Institute of Engineering Cybernetics of Wroclaw Technical U, Janiszewskiego St 11/17, 50-372 Wroclaw, Poland

SEPT 26-29—Mini and Microcomputers Internat'l Sym and Exhibition, Queen Elizabeth Hotel, Montreal, Canada. INFORMATION: The Secretary, MIMI '79, PO Box 2481, Anaheim, CA 92804. Tel: 714/774-6144

SEPT 28-30—Northeast Personal and Business Computer Show, Hynes Auditorium/Prudential Ctr, Boston, Mass. INFORMATION: Northeast Expositions, PO Box 678, Brookline Village, MA 02147. Tel: 617/522-4467

SEMINARS

JUNE 4-7 and JUNE 5-7—Automated Testing for Electronics Manufacturing, ATE Seminar/Exhibit, Radisson Ferncroft Hotel, Danvers, Mass, and Northeast Trade Ctr, Woburn, Mass. INFORMATION: Kate Fitzgerald, 1050 Commonwealth Ave, Boston, MA 02215. Tel: 617/232-5470

JUNE 11-15—Testing Microprocessor Based Systems, The Colonial Hilton Inn, Wakefield, Mass. INFORMATION: Prof Donald D. French, Institute for Advanced Professional Studies, One Gateway Ctr, Newton, MA 02158. Tel: 617/964-1412

SEPT 3-4—Fourth Annual Workshop on Microprocessor Applications, U of Liverpool, England. INFORMATION: Dr Malcolm J. Taylor, The Computer Laboratory, The University of Liverpool, Brownlow Hill and Crown St, PO Box 147, Liverpool L69 3BX, England

SHORT COURSES

JUNE 13-15—Computer Aided Design/Computer Aided Manufacturing; Electronic Display Technologies and Applications; JUNE 27-29—Modular Software Design; and JULY 9-13—ECM and ECCM for Digital Communications, George Washington U, Washington, DC. INFORMATION: Director, Continuing Engineering Education, George Washington U, Washington, DC 20052. Tel: 202/676-6106

JUNE 18-19—Minicomputer Interface Design: Examples from the Nova Computer; JULY 23-27—Mini and Microcomputers: Their Structures, Characteristics, and Applications; JULY 30-AUG 3—Microcomputer System Design and Applications; and AUG 13-17—Data Network Planning and Design; U of Michigan, Ann Arbor, Mich. INFORMATION: Viola E. Miller, Engineering Summer Conf, 300 Chrysler Ctr, N Campus, Ann Arbor, MI 48109. Tel: 313/764-8490

JUNE 18-28—Data Communications, Iowa State U, Ames, Iowa. INFORMATION: Paul Bond, Engineering Extension, 110 Marston Hall, Iowa State U, Ames, IA 50011. Tel: 515/294-1526

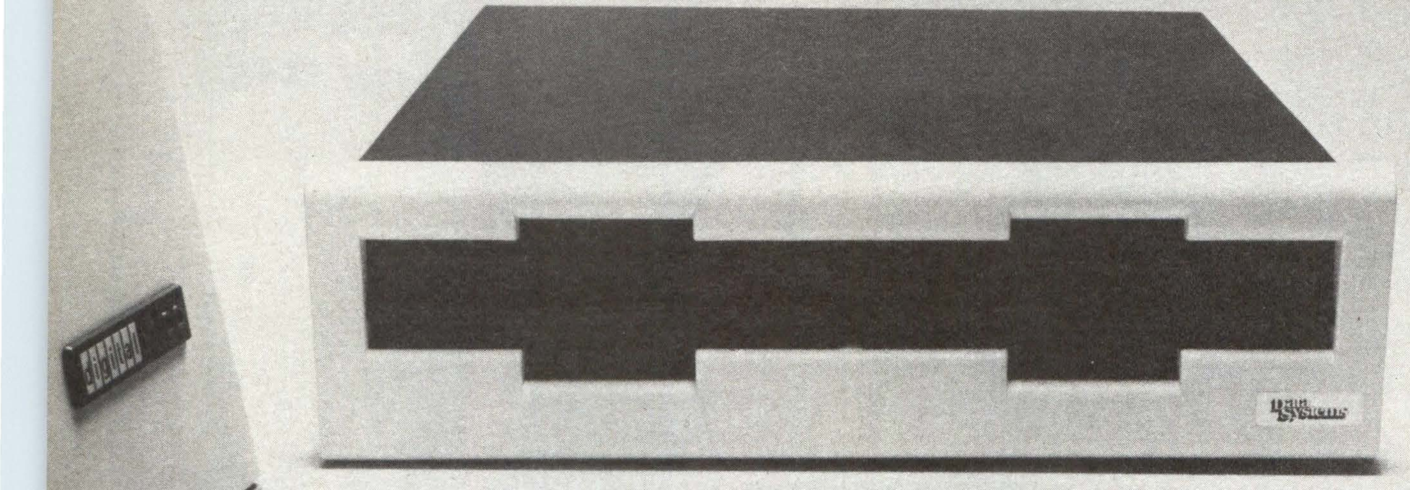
JUNE 19-22—Modern Digital Communications, National University, San Diego, Calif. INFORMATION: Dr Donald J. Rauch, Evolving Technology Seminars, 3820 Jennings St, San Diego, CA 92106. Tel: 714/224-3788

JULY 16-27—Intro to Digital Electronics and Microcomputer Interfacing, Virginia Military Institute, Lexington, Va. INFORMATION: Prof Philip Peters, Dept of Physics, Virginia Military Institute, Lexington, VA 24450

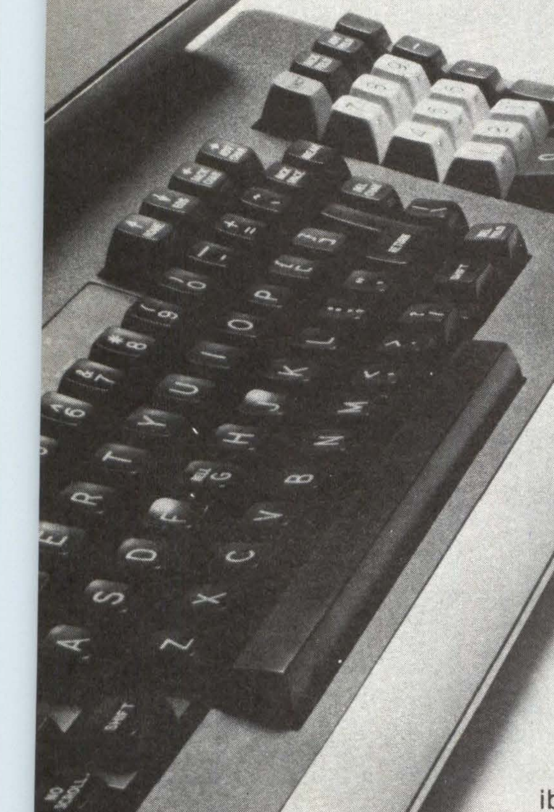
JULY 16-20—Communicating Technical Information; JULY 16-27—Information Systems Technology: Database Systems, Telecommunications, Performance Evaluation; and JULY 23-AUG 3—Advanced Software Concepts—Operating Systems, Massachusetts Institute of Technology, Cambridge, Mass. INFORMATION: Director of the Summer Session, Rm E19-356, MIT, Cambridge, MA 02139

Announcements intended for publication in this department of *Computer Design* must be received at least two months prior to the date of the event. To ensure proper timely coverage of major events, material preferably should be received six months in advance.

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.

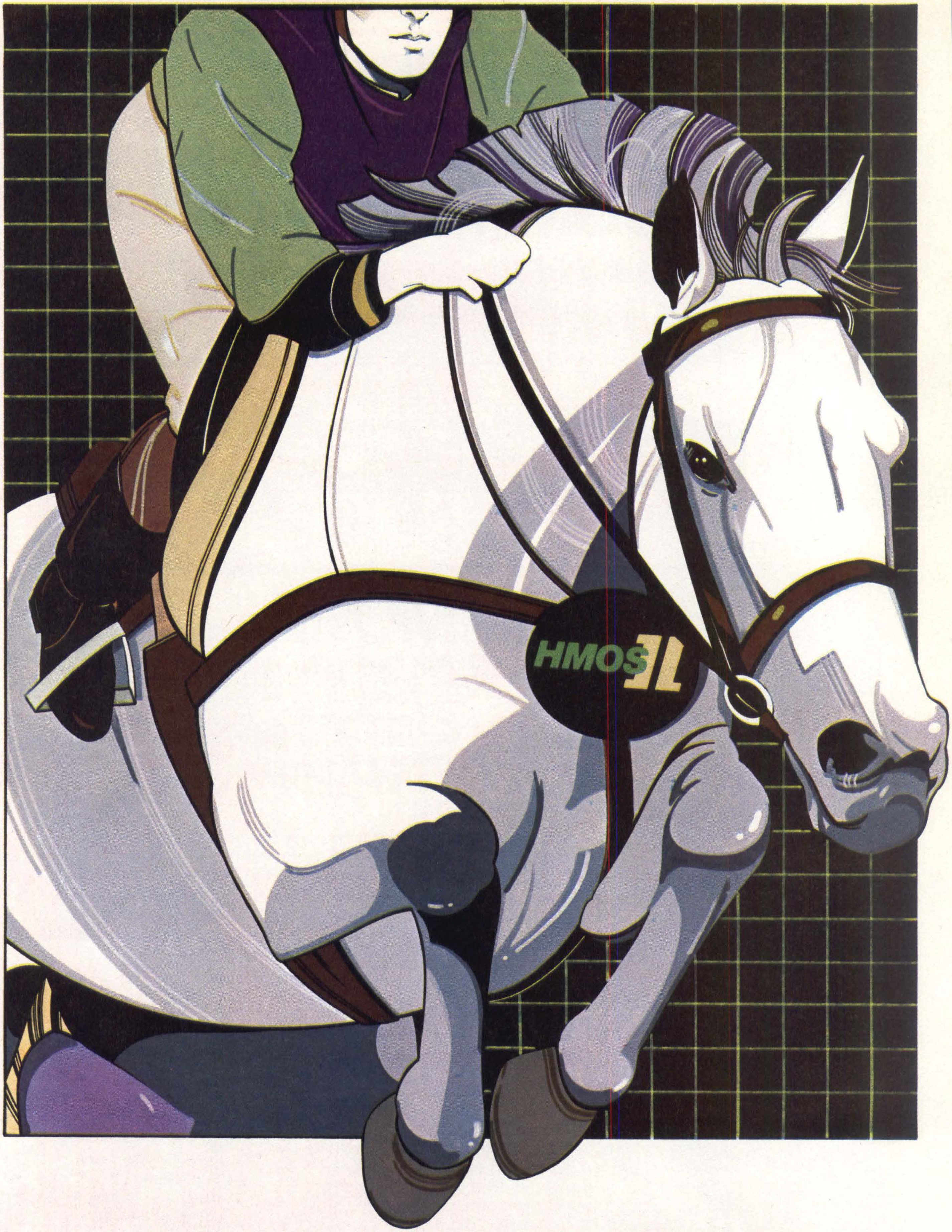
® Trademark of Digital Equipment Corporation

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

CIRCLE 10 ON INQUIRY CARD

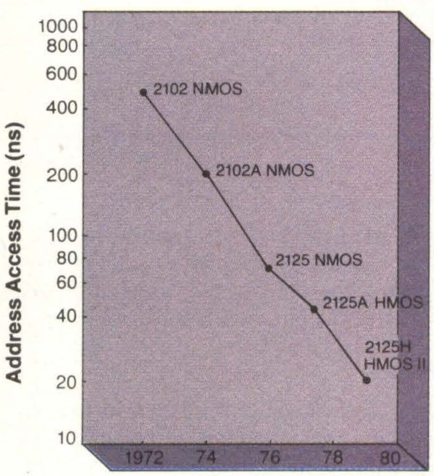

HMOS II

New Breed of MOS.

Intel introduces HMOS II*– and a new family of static RAMs that cross the finish line in 20 ns.

Intel just set a new pace for high performance memory with HMOS II. It's our patented next generation MOS technology so advanced it delivers speeds faster than bipolar and even our own first generation HMOS process. HMOS II gives designers the fastest, lowest power static RAMs ever—plus traditional MOS economy and reliability. Our new

History of MOS speed



Intel's continued process and scaling improvements have doubled MOS speeds every two years. The above graph demonstrates this trend with Intel's 1K x 1 static RAMs.

1K and 4K RAMs are fully compatible, higher speed upgrades of Intel's time-tested 2115A/2125A and 2147 devices.

1K fast statics that leave bipolars behind

Designers building cache, writeable control store or buffer memories will find our 16-pin 2115H/2125H 1K RAMs ideal. For new designs, two versions deliver record access speeds of 20 ns and 25 ns, with a speed/power product twice as good as slower bipolar RAMs.

Our 35 ns and low power 30 ns models can be used as direct plug-in replacements for 93415A and 93425A bipolar RAMs. They'll cut power dissipation up to 36%. And, best of all, they're available now.

New, faster 4K with no power increase

Intel's new 2147H gives you all the advantages of our 18-pin 4K x 1 industry standard 2147, with twice the speed and no increase in power. With access times as fast as most 1K RAMs, it's important news for anyone designing buffer, cache, control store and main memory systems. If you're presently working with 1K RAMs, you can increase density or reduce board space by a factor of four. In a 4K format, the 2147H makes possible a new dimension of higher performance systems.

The 2147H's low active power dissipation and automatic power down on deselection also mean dramatically reduced power consumption compared to constant current static RAMs. In fact, because most devices are deselected at any given time, the larger your system, the lower your power dissipation per bit. It all adds up to simplified designs and major

HMOS II fast static RAMs

Part No.	Maximum Access Time (ns)*	Power Consumption (mA)* Active	Standby
4096x1			
2147H-1	35	180	30
2147H-2	45	180	30
1024x1**			
2125H-1	20	125	
2115H-2 2125H-2	25	125	
2115H-3 2125H-3	30	100	
2115H-4 2125H-4	35	125	

*Over full 0° to 75°C operating temperature range.
**All 2115H versions have open-collector outputs, all 2125H versions have tri-state outputs.

savings in cooling and power supplies.

All HMOS II components are fully static and can be used in clocked and unclocked systems. They are directly TTL compatible in all respects: inputs, outputs and operation from a single +5V supply.

Order 2115H/2125H and 2147H RAMs from your Intel distributor. Or, for more information, contact your local Intel sales office or write: Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051.

intel® delivers.

Europe: Intel International, Brussels, Belgium. Japan: Intel Japan, Tokyo. United States and Canadian distributors: Arrow Electronics, Alliance, Almac/Stroum, Component Specialties, Cramer, Hamilton/Avnet, Harvey, Industrial Components, Pioneer, Sheridan, Wyle/Elmar, Wyle/Liberty, L.A. Varah and Zentronics.

*HMOS II is a patented process of Intel Corporation.

LOCAL NETWORK ARCHITECTURES

John M. McQuillan

Bolt Beranek and Newman Incorporated
Cambridge, Massachusetts

For the past decade, the field of data communications has been rapidly changing, with important innovations emerging all the time. One recent development of wide ranging significance is the introduction of several new techniques for short distance high speed data communications. These techniques may transform communications within offices, laboratories, factories, and universities.[1]

It is appropriate to begin with an examination of why a local network is different from other, long distance, networks. By definition, a local network is a data communications system designed to interconnect computers and terminals over a restricted geographical area, typically less than 2 km in diameter. A number of implications follow from this definition.

At a technical level, the problems involved in designing local networks are not very different from those relating to long distance networks (see Panel, "A Hierarchy of Communications Network Problems.") However, the parameters are different. Since the communication network and transmission medium are not bottlenecks, transmission rates are higher. Delivery delays are shorter and message lifetimes, ie, maximum delivery delays, are shorter. Error rates are lower compared with typical long distance transmission media. Cost of interconnecting terminal and computer equipment is lower. There is greater use of broadcast or multiaddress communications.

From an organizational point of view, a local network is likely to be designed and implemented by a single organization which, in all probability, will also be responsible for its operation. The result is a much higher degree of control than can be expected in a long distance or "global" network. This organizational approach also eliminates such problems as coordinating changes among several different groups, and the "finger pointing" problem of fault diagnosis involving many components.

Local Network Technology

From the premise that communication is required over a local region only, one can trace the line of reasoning to the conclusion that a new type of network technology can be used.

(1) A more expensive communications medium, in terms of cost per meter, can be used in a local network because the total cost of the medium is likely to be insignificant compared to installation and other hardware and software costs.

(2) Since a more expensive communications medium can be used, a more powerful medium is possible, especially in terms of its speed and error performance.

(3) Local interface hardware and communications protocols can be considerably simplified because there is less need to optimize available communications bandwidth—the inherent traffic handling capacity of the network is so much greater than in a global network.

(4) The cost to interconnect a device to a local network can (and must) be reduced significantly by the process of simplification, standardization, and eventually by large scale integration (LSI) manufacture.

(5) As a result, local networks open the possibility for connecting much lower cost devices, eg, small computers

There's no drum in Centronics' band.

Centronics' 6000 Series Band Printers have banished the drum. Forever. That means important savings and simpler operation for you.

An inexpensive changeable band lets you change character sets or type in seconds without disturbing paper or ribbon. No special tools. No expensive drum. No special service calls.

Centronics' horizontally moving print band means crisper print quality and perfect vertical alignment. You get uniform density control regardless of paper stock.

Band printers are faster and less expensive to service too. A single motor drives both the print band and cassette-enclosed ribbon. Modular construction combined with simplified design minimize downtime. And service is available at more than 100 locations throughout the world.

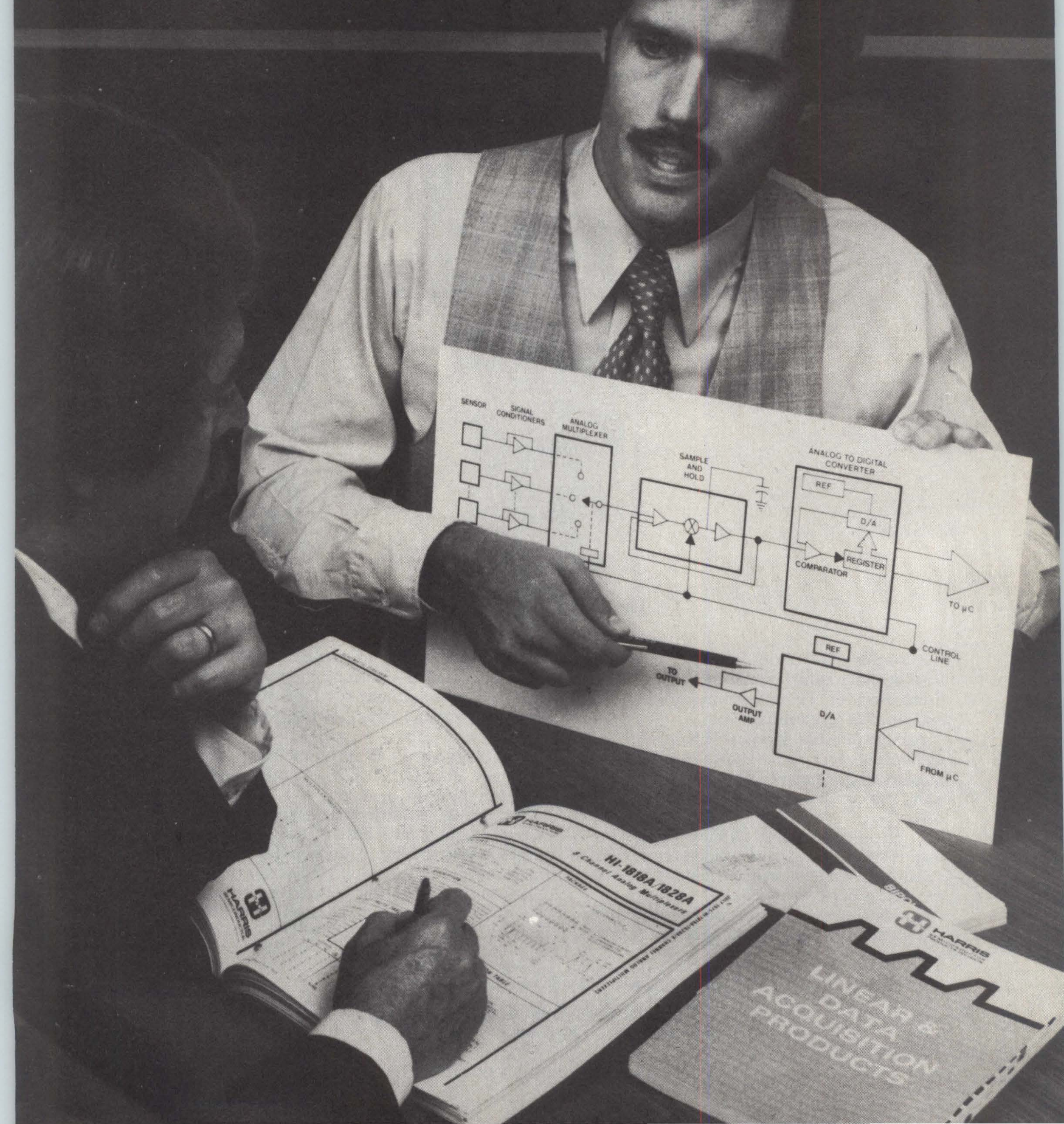
But that's not all. Centronics' band printers cost less. In fact, thousands of dollars less than comparable drum printers.

Operating flexibility. Easier servicing. Crisper print. Lower cost. Centronics' band printers beat the drum everytime. For information write or call your local authorized Centronics' distributor or Centronics Data Computer Corporation, Hudson, New Hampshire 03051, (603) 883-0111.

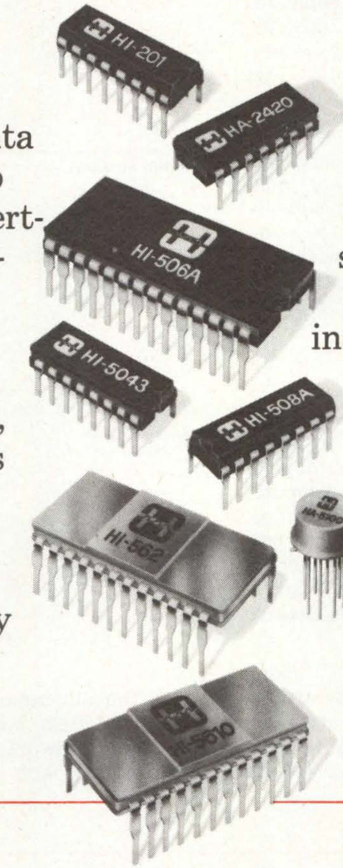
CENTRONICS®
The Band Leader

CIRCLE 12 ON INQUIRY CARD

"...And for higher performance, we'll specify Harris Data Acquisition components."



Harris high performance components assure superior speed and accuracy.



Now Harris can provide you with a complete selection of data acquisition products—from op amps to digital-to-analog converters—with the highest performance available anywhere.

It's what you expect from Harris—the leading supplier of monolithic sample-and-hold, high performance multiplexers and switches. And producer of the first 12-bit monolithic D/A converter...which has led to the most advanced family of DACs in the industry.

Harris data acquisition components provide the high speed, high accuracy and high throughput you need for processing fast signals in all types of applications—military, aerospace/ avionic, instrumentation, industrial process control, and others. To get top performance in your data acquisition systems, all you have to know is Harris. For fast facts, call the Harris Hot Line, or write: **Harris Semiconductor Products Division, Box 883, Melbourne, Florida 32901.**

HARRIS DATA ACQUISITION PRODUCTS

DIGITAL-TO-ANALOG CONVERTERS
The fastest, most accurate monolithic DACs available. Monotonic over temperature. Designed for minimum glitches.
HI-562 —12-bit, 200 ns to 0.01%
HI-5612—12-bit, 150 ns to 0.01%
HI-5610—10-bit, 85 ns to 0.05%
HI-5608— 8-bit, 50 ns to 0.19%*

ANALOG-TO-DIGITAL CONVERTERS
12-bit ADCs soon to be introduced will offer precisions and conversion speeds in microprocessor-compatible versions.
HI-5712—12-bit, 6 μs conversion*
HI-5812—12-bit, precision*

CMOS ANALOG MULTIPLEXERS
Latch-proof, Single/Differential, 8/16 channel. Overvoltage protected versions can withstand transients up to 1000 volts and inputs of ±20 volts greater than either supply.
HI-506A/7A —16-channel, overvoltage protected
HI-506/7 —16-channel
HI-508A/9A — 8-channel, overvoltage protected
HI-1818A/28A— 8-channel
HI-1840 —16-channel, high Z, overvoltage protected

CMOS ANALOG SWITCHES
Two popular series feature several latch-proof configurations with high-speed, low-on-resistance, and low-power versions.
HI-200/201 —Dual/Quad, 180 ns, 55 ohms, 15 mW
HI-5040 series—370 ns, 25 ohms, 1.5 mW

MONOLITHIC SAMPLE-AND-HOLD
Low droop rate coupled with fast acquisition time furnishes the speed and precision needed for 12-bit systems.
HA-2420—4 μs to 0.01% acquisition, 5 pA drift current

VOLTAGE REFERENCES
Two new laser trimmed +10 volt references offer industry milestones in precision and stability.
HA-1600—+10 volt, ±1 ppm/°C
HA-1610—+10 volt, ±5 ppm/°C

SIGNAL CONDITIONERS
New precision BIFET op amps to complement the Harris high-performance line. Laser trimmed for low offset voltage.
HA-5100/5110—Wide band BIFET
HA-5150/5160—High slew BIFET*

FAST-SETTLING OP AMP
The fastest monolithic true op amp in the world has superior settling times for voltage output DACs.
HA-5190—100 ns to 0.01%, 200 V/μs Slew

COMPARATORS
A family of fast quad comparators is coupled with a soon-to-be-introduced, high-speed precision single comparator for use in ADCs. The 4950 will give true 12-bit accuracy with no sacrifice in throughput.
HA-4950—35 ns response, with 100 μV resolution*

*To be introduced

HARRIS HOT LINE!
1-800-528-6050, Ext. 455
Call toll-free (except Hawaii & Alaska) for phone number of your nearby Harris sales office, authorized distributor or expedited literature service.

Harris Technology ...Your Competitive Edge

HARRIS
SEMICONDUCTOR PRODUCTS DIVISION
A DIVISION OF HARRIS CORPORATION

CIRCLE 13 ON INQUIRY CARD

A Hierarchy of Communications Network Problems

Local Networking Problems

(1) The central computer facility problem: organization of the several mainframe computers and large peripheral devices operated by a particular organization into a coherent set of commonly accessible resources.

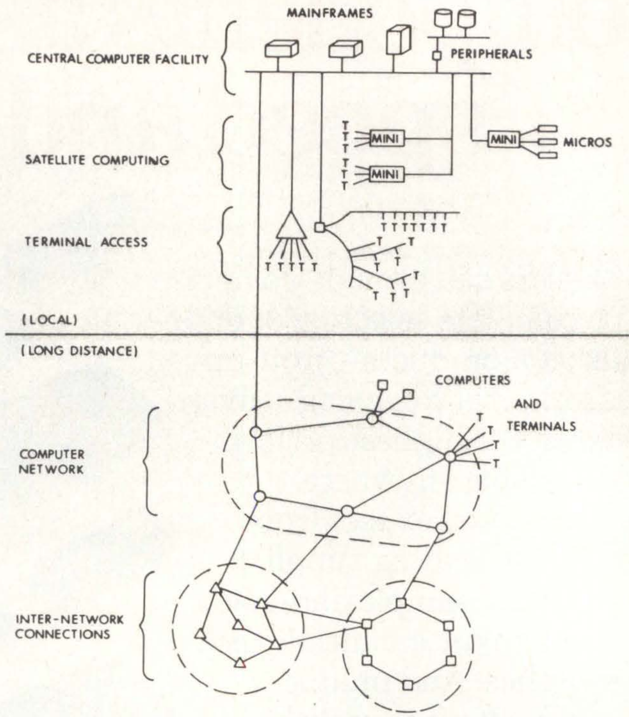
(2) The "satellite" or remote computing problem: interconnection of a wide variety of minicomputer based equipment and associated peripheral devices, located over a limited geographical area up to several km in diameter, to the central computing facility. This is usually termed "distributed data processing" or local intelligence.

(3) The terminal access problem: general interconnection of any terminal device, intelligent or nonintelligent, to any computer system, usually a satellite computer, but also to a mainframe in the central computing facility. These terminals may include traditional keyboard terminals, as well as office automation devices, digital voice terminals, and other microcomputer based equipment.

Long Distance Networking Problems

(4) The standard computer network problem: interconnecting the computing equipment of one organization, typically its central computing facility, through a single transparent, application-independent computer network to some set of other computing resources. This can be accomplished through a public data network, through a private or dedicated packet switching network, through the use of one of the network architectures offered by computer vendors such as SNA or DECNET, or by various other strategies.

(5) The internetwork communications problem: linking together a number of separate and independent computer networks by means of gateway computers, so that messages can be exchanged from one network (possibly through several intermediate networks), to the destination network.



Local vs long distance networks

The illustration depicts these networks schematically, and Refs 2 and 3 provide an overview of available vendor network architectures, and a comparison of the IBM approach with new industry standards, respectively.

and even intelligent terminals, directly to the local network without the use of terminal concentrators or device controllers.

(6) In turn, this implies that a local network may evolve into a collection of a large number of small, slow devices and a relatively smaller number of high speed computers and peripheral devices.

It is clear from this line of reasoning that there is no sharp division between global and local networks; there is, rather, a continuum in which smaller geographical areas are served with higher speed, lower cost interfaces.

Technical Design Issues

Topological structure is the central design decision in selecting the appropriate local network for a particular situation. Connecting each computer to all of the other computers is impractical in all but the smallest configurations. The figure shows four other basic possibilities in local network structure: star (or more generally, tree), ring, bus, and general distributed topology.

Next important question in designing a local network is the protocol that governs communications between the basic network elements. Conventional star networks have often operated by a polling principle in which the central controller indicates to each of the peripheral devices when they can transmit. A related type of control technique used in star networks is to configure the central controller as a message switching system. In this case, each of the devices connected to the star can transmit whenever it has information. The data are stored by the central switch until the intended destination can accept the traffic.

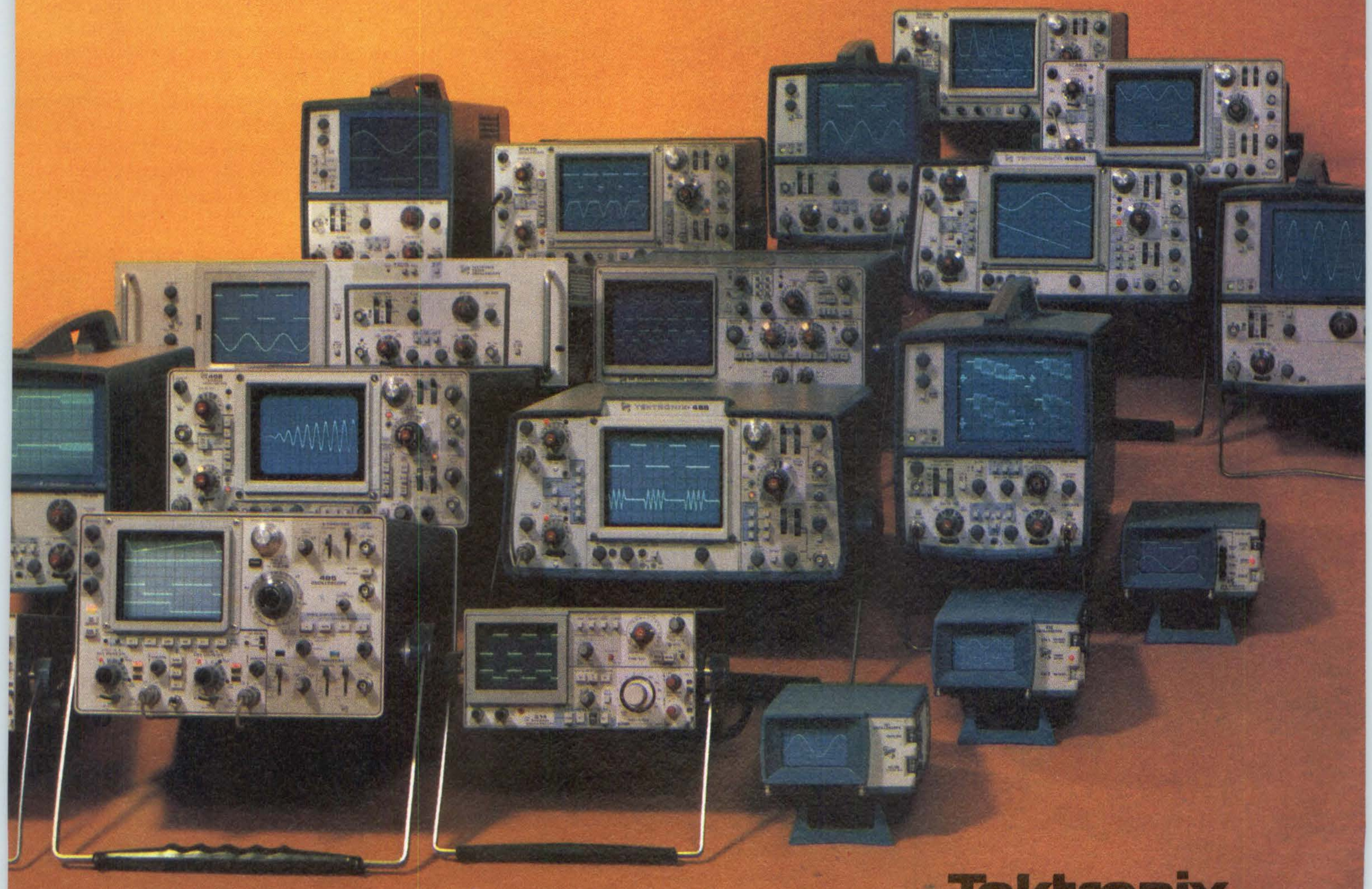
A common means of controlling the use of a ring network is some form of multiplexing, since each of the devices can remember when its turn to send will come and thus avoid collisions when attempting to use the shared transmission facilities. Contention is an alternative to polling and time division multiplexing. Devices are free to transmit over the network whenever they have information to send, and they are prepared to deal with the possibility that some other device may send at the same time, and perhaps render both transmissions ineffective. Contention has been used most often in bus networks but could be used in any of the other topologies as well.

One important protocol feature that can be designed into a contention system or other control strategy is the

scope meets

	Product	Bw	Dual Trace	Delayed Sweep	Fastest Sweep Rate	Other Special Features	Price*
Storage Models	466	100 MHz @ 5 mV/div	yes	yes	5 ns/div	3000 div/μs stored writing speed	$5355
	464	100 MHz @ 5 mV/div	yes	yes	5 ns/div	110 div/μs stored writing speed	4375
	434	25 MHz @ 10 mV/div	yes		20 ns/div	Split-screen storage	3480
	314	10 MHz @ 1 mV/div	yes		100 ns/div	Only 10.5 lbs (4.8 kg)	2645
	214	500 kHz @ 10 mV/div	yes		1 μs/div	Only 3.5 lbs (1.6 kg)	1595
	T912	10 MHz @ 2 mV/div	yes		50 ns/div	Low-cost bistable storage	1545
Nonstorage Models	485	350 MHz @ 5 mV/div	yes	yes	1 ns/div	Widest bw in a portable	5725
	475A	250 MHz @ 5 mV/div	yes	yes	1 ns/div	High-performance 250-MHz portable	3800
	475	200 MHz @ 2 mV/div	yes	yes	1 ns/div	Highest gain-bw in a portable	3435
	465	100 MHz @ 5 mV/div	yes	yes	5 ns/div	Cost effective for 100-MHz bw	2495
	465M	100 MHz @ 5 mV/div	yes	yes	5 ns/div	Triservice standard 100-MHz scope	2620
	455	50 MHz @ 5 mV/div	yes	yes	5 ns/div	Cost effective for 50-MHz bw	2055
	335	35 MHz @ 10 mV/div	yes	yes	20 ns/div	Only 10.5 lbs (4.8 kg)	2175
	305	5 MHz @ 5 mV/div	yes		0.1 μs/div	Autoranging DMM	1725
	221	5 MHz @ 5 mV/div			100 ns/div	Only 3.5 lbs (1.6 kg)	1190
	213	1 MHz @ 20 mV/div			400 ns/div	DMM/Oscilloscope @ 3.7 lbs (1.7 kg)	1595
	212	500 kHz @ 10 mV/div	yes		1 μs/div	Low cost for dual trace & battery	1190
	T935A	35 MHz @ 2 mV/div	yes	yes	10 ns/div	Delayed sweep and differential	1535
	T932A	35 MHz @ 2 mV/div	yes		10 ns/div	Variable trigger-holdoff and differential	1245
	T922	15 MHz @ 2mV/div	yes		20 ns/div	Low-cost dual-trace scope	975
	T922R	15 MHz @ 2mV/div	yes		20 ns/div	Rackmount version of T922	1345
	T921	15 MHz @ 2mV/div			20 ns/div	Lowest-cost TEKTRONIX Portable	795
Time Interval Readout	DM44	Optional, factory-installed, direct numerical readout of time intervals and DMM functions for the 464, 465, 466, 475 and 475A					445

*U.S. sales prices are F.O.B. Beaverton, OR. For price and availablity outside the United States, please contact the nearest Tektronix Field Office, Distributor or Representative. Prices are subject to change without notice.

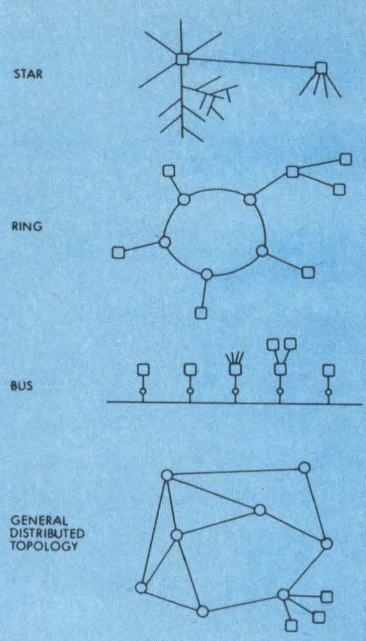


Tektronix®
COMMITTED TO EXCELLENCE

For literature please circle # 15

For demonstration please circle # 16

For immediate action, dial our toll free automatic answering service: (800) 547-1512 (in Oregon, collect 694-9051)



Four possible network topologies. Star network is organized around single controller. In ring configuration data flow is sequential around single transmission loop connecting communicating devices. In bus network, data are broadcast to all devices; there is no closed loop in the transmission facilities. In general distributed topology there are several paths between communicating nodes, but not all nodes are connected directly to each other

explicit detection of collisions among transmissions. That is, prior to transmitting, each station can continuously monitor the communications medium to insure that no other station is transmitting. In the case that a collision is detected after a transmission has begun, both stations can immediately cease sending, and initiate transmission at a later time.

Packet switching is the technique in most common use today for long distance computer networks; data are communicated by the store-and-forward method through one or more switching nodes. Strictly speaking, it is not a protocol at the same level as those previously discussed; it is a collection of protocols at several levels. It has application in local networks when a general distributed topology is used.

Future Problem Areas

There are several unsolved problem areas in local network design.

Gateways Between Central Computers and Satellite Computers—Radically different network architectures are being proposed for linkages between central mainframe computers on the one hand, and between satellite computers and remote processing stations on the other. The satellite computer network may be only one-tenth the speed of the central computer facility network, and may make use of different protocols and formats. For this reason, several organizations have proposed the use of a gateway computer to interconnect the very high speed mainframe network to the somewhat lower speed satellite computer network. This gateway computer then becomes the focus for a number of difficult problems, including security and access control, congestion control, and resource management.

The congestion control problem is one of paramount importance: how to avoid overloading the slower network with a large burst of traffic from the faster network. Conversely, it is as important not to degrade the faster net by too slow a transmission or reception of a particular block of data by the slow network. The gateway computer also has an important role to play with regard to resource management, in resolving such questions as fair allocation of resources among users, optimal distribution and scheduling of network use, and the like. Since the gateway controls access to one network from the other, it acts as a sort of scheduler. Therefore the algorithm it uses for determining which of several competing users to serve next is of critical importance to overall performance of the network system.

Local Network Interface Standards—One of the most attractive possibilities for standardization is the prospect for a standard interface to ring or bus type networks. These interfaces are so simple that even in experimental form they have been implemented in microcomputers. This suggests that in operational form they could be implemented by means of LSI chips. If this step is taken, and several manufacturers are persuaded that the production of such standard interfaces is in their interest, it might be possible to foresee the introduction of local network interfaces which are so cheap, say $100 each, that even rudimentary terminals could be directly connected to such networks.

High Level Protocols—One of the topics often ignored when considering the design of a local network is that many levels of function-oriented protocols are necessary in order to accomplish useful work on the network. For instance, the local network may make it possible for the first time to connect mainframe computers constructed by different vendors, or to connect several different terminals with several different mainframes. In addition to being a solution to a particular problem, however, this interconnection also raises the much more general problem of higher level protocols. In order to be useful, the local network must support some form of data transport protocol, file transfer protocol, and virtual terminal protocol. These protocols are necessary so that a computer which was designed with one data and file format, and one particular terminal type in mind, can transfer data and files to other computers in other formats, and accept information from foreign terminal types.

It has been our experience in network implementation that these higher level protocols are often the last element of the network to be completed and the most difficult to specify with regard to efficiency and generality.

References

1. J. M. McQuillan, "Understanding the New Local Network Technologies," BBN Report No 3927, Sept 1978, $75
2. J. M. McQuillan, "Evaluating the Vendors' Network Architectures," BBN Report No 3950, Oct 1978, $75
3. I. Richer and M. Steiner, "Choosing Between X.25-Based Networks and IBM's SNA," BBN Report No 3948, Oct 1978, $75

SYNERTEK

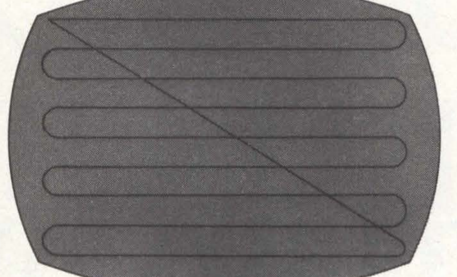
6545 CRT Controller. The designer's choice.

DESIGN FLEXIBILITY.

That's what the SY6545 CRT Controller delivers, giving you an unlimited range of system design configurations—all programmable with the SY6545. You can design all your terminals with the same controller. It's easy. And it's all the result of the programmability and flexibility of the SY6545.

ROW AND COLUMN ADDRESSING.

In addition to the conventional binary sequential memory addressing modes, the SY6545 gives you the option of addressing the refresh memory by row and column. There's no need to perform special algorithms for address conversions. Because we've made the memory location one-to-one correspondent to the screen location.



TRANSPARENT RAM ADDRESSING.

Transparent RAM addressing allows the CRTC to address the refresh memory "transparent" to the MPU—the refresh memory can be configured to be a slave to the CRTC instead of being shared with the MPU. The SY6545 does all the work of generating memory addresses for display refresh and memory updates. The memory can be updated either during horizontal and vertical blanking periods or interleaved with screen refresh during the display period.

HIGH PERFORMANCE AT LOW COST.

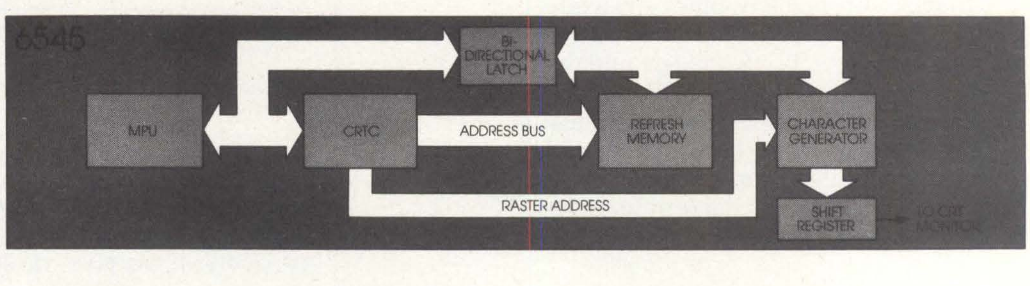
The SY6545 allows maximum hardware/software design trade-offs. With its multiple mode operation, minimum component systems can be achieved without sacrificing performance. With fewer components, you get higher reliability. And lower systems cost. Add to this the fact that a second source is readily available for the proprietary SY6545 CRTC and you've got an unbeatable combination.

Our 6545 CRT Controller offers these standard features:

- Alphanumeric and semi-graphic capabilities
- Fully programmable display formats
- Interlaced or non-interlaced scan
- Fully programmable cursor
- External light pen capability
- Up to 16K RAM addressability
- Binary and row/column memory addressing
- Refresh memory can be slaved to CRTC
- Transparent RAM addressing allowing memory updates during horizontal/vertical blanking periods; interleaved during display period; and other modes
- Scrolling capability
- Internal status register to simplify system designs

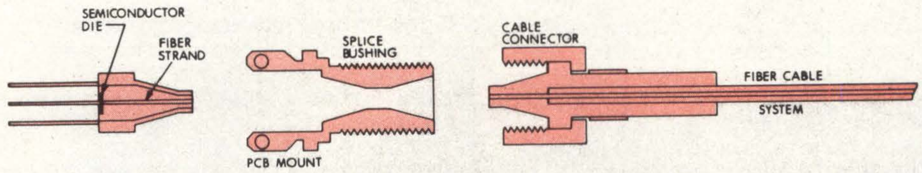
UPWARD COMPATIBLE TO MC6845.

The SY6545 is plug-in replaceable with Motorola's MC6845, working in all systems designed for the MC6845—without the need for system modifications of any kind. That's compatibility. And more, too. Because the SY6545 does even more than the MC6845, operating in more modes and possessing additional features above and beyond the MC6845. That's upward compatibility.



CIRCLE 18 ON INQUIRY CARD

Coordinated Development Produces Fiber Optics Active Connectors



Fiber optic active connector. One end of short 200 μm fiber pigtail is bonded to semiconductor die, other end fitted into accurately drilled hole in "nose cone" of ferrule package. Alignment between device and cable is assured by resilience of elastomeric ferrules, and is repeatable due to tight fit of ferrules into splice bushing

Interactive design of device package and cable connector for coupling solid state light sources and detectors to optical fiber cables is said to result in greatly improved light transfer between active device and fiber, a rugged semiconductor package well suited to high volume production, and a simple efficient interconnection. The new system is the result of a joint design effort by Motorola Semiconductor Products, Inc, PO Box 20912, Phoenix, AZ 85036, and AMP, Inc, Harrisburg, PA 17105.

Light emitting or detecting semiconductor chips are packaged in a resilient plastic ferrule which becomes an integral part of the optical interconnecting system. An optical fiber strand contained in the ferrule package, and pigtailed to the active area of the semiconductor die, extends to the highly polished surface of the ferrule for optimum light transfer. An Optimate fiber optic connector mates directly with the semiconductor package to provide efficient coupling to all major commercially available fiber cables. An increase of device-to-fiber coupling efficiency of up to 50 times that of some current systems is claimed. Measured performance includes speeds to 30M bits/s and operation on systems of 1-km length.

Light-coupling aperture of the semiconductors is an 0.008" (204-μm) diameter core with a numerical aperture (NA) of 0.48. Connector coupling losses to a like fiber are typically 2 dB. Coupling losses due to mismatched diameters or NAs are easily calculated and the amount of light coupled into the cable from the emitter or into the detector from the cable can be readily determined. The devices will be available in the second quarter of 1979 and include one light emitting diode and four detectors.

The Optimate connector compatible with these devices can be bulkhead or PC board mounted and is less than 0.3" (7.6-mm) high for use between PC boards located on 0.5" (12.7-mm) centers typical of computer applications. The metal connector provides effective electrical shielding; snap-on shields afford further EMI/RFI protection for critical receiver circuitry. The connector accepts all-glass and plastic clad silica fibers down to 125 μm diameter.

Circle 380 on Inquiry Card

Hybrid Switching System Adapts to Variety of Communications Modes

System EDX, a fully electronic computer controlled switching system for digital communications, handles such data switching applications as time-division circuit, packet, and store and forward. The system has been designed by Siemens Corp, 186 Wood Ave S, Iselin, NJ 08830, to meet CCITT and U. S. Telex, telegram, data, and packet switching standards for public and private data networks.

Hardware for the system basically consists of line terminators, communications controller, a central processor (CPU) from the DEC PDP-11 family to control the communications hardware and peripherals, and the peripherals themselves. A system status panel provides visual indication of system condition, plus visible and audible alarm signals.

Software comprises an operating, and a maintenance system. Operating system includes a control system and switching programs to run the EDX, and language processors and utility programs based on individual requirements of specific EDX systems. Maintenance system is used to commission and maintain an exchange, and consists of test and diagnostic programs to monitor all of the hardware.

As a circuit switch, EDX can be used as a concentrator, terminal exchange, tandem or transit exchange, international gateway, a combination of all four, as well as a PABX. In the circuit switch mode the system can switch asynchronous and synchronous data at speeds to 9.6k bits/s. Manual switching positions are available as required primarily for operator-assisted international traffic.

A data transfer technique that does not load the CPU during the call connect phase assures a high call setup rate, as well as a data throughput of about 400k char/s per switching block, a rate equivalent to about 1500 simultaneous duplex connec-

Pack 10 to 120 megabytes in a unit one-third the size of conventional disk drives.

For OEMs and system builders, the D100 family of compact disk drives offers a surprising list of advantages. Two new models, D140 and D160 add capacity and flexibility to the proven performance of the D120. The D140 includes a 10MB fixed platter in addition to the 10MB removable cartridge as used with the D120. The D160 uses a sealed (non-removable) module which includes low pressure heads and carriage.

Small Size: Occupying approximately one-third the volume of conventional drives, models D120 and D160 measure 5.6" × 12.2" × 21.8". Model D140 is slightly taller at 6.7".

Innovative Cartridge: Both D120 and D140 models use a flat, thin (11" square by .9") self-ventilated cartridge weighing only 2.8 pounds.

Common Interface: The same controller handles D120, D140, D160, or any combination of the three models. One or more D160's in conjunction with a D120 provide a fixed data base with a high-throughput-10MB load-dump yielding twice the operating flexibility at half the size of conventional single-spindle drives.

High Density/Speed: Up to 7300 BPI, 600 TPI; 920 kilobytes/sec transfer rate.

Accuracy: Data-imbedded servo-tracking techniques assure accurate head positioning and full cartridge interchangeability.

Low Power Consumption: From 100 to 130 watts depending on model.

Reliability: Simplified mechanisms rule out any need for preventive maintenance. The spindle-mounted dc motor is brushless. There are no belts or pulleys, no blower, no transducer, no thermal compensation device. And no head alignment is required. MTBF is 5000 hours for models D120 and D140, 8000 hours for the D160.

Look us up at NCC.

Cii Honeywell Bull

For more information, send coupon to:
Jean-Paul Garodel, Bull Corporation of America, 200 Smith Street (MS 430), Waltham, Massachusetts 02154. Or call, (617) 890-8400, extension 2019.
[In Europe, write Alain Kiffer, Cii Honeywell Bull, 6 Avenue des Usines, 90001 Belfort, France. Or call, (84) 228200.]

Name

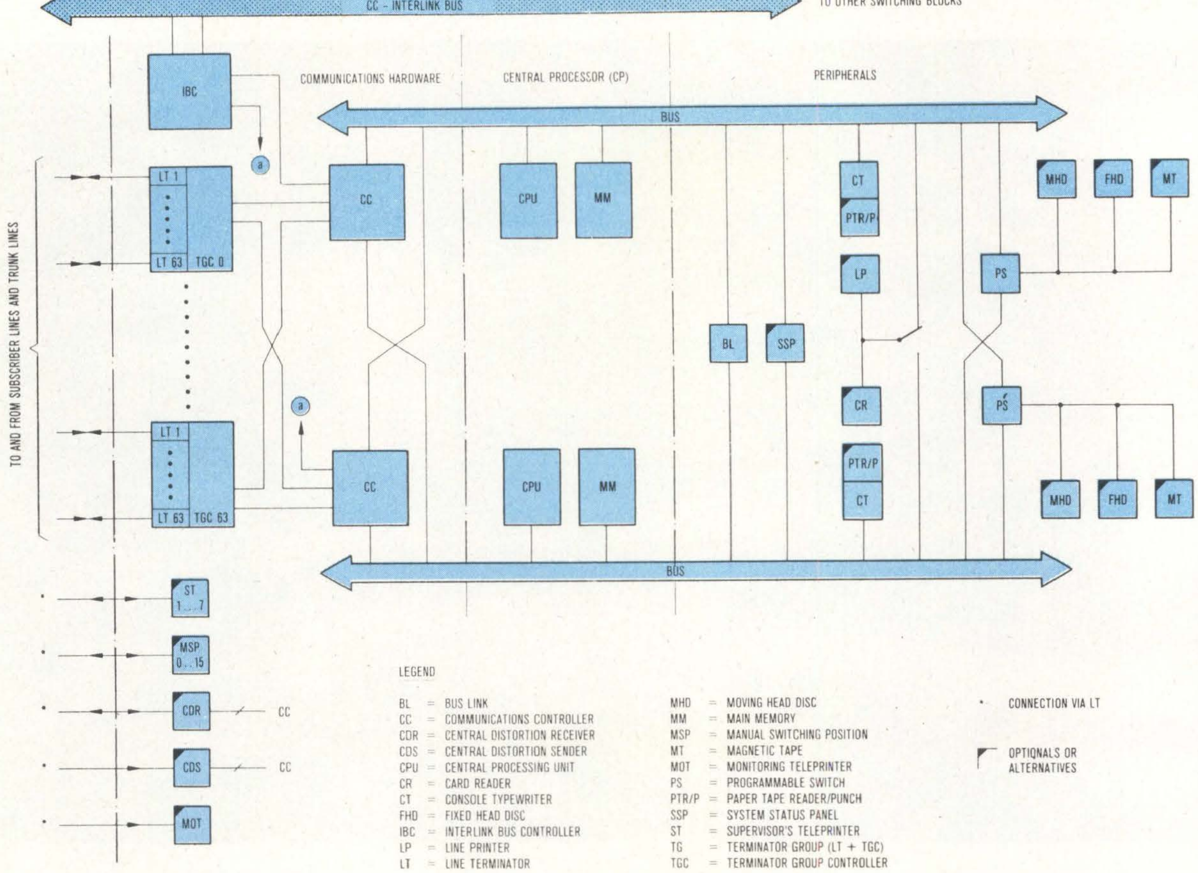
Company

Address

City State Zip

CD

CIRCLE 19 ON INQUIRY CARD



Hardware structure of EDX switching block. Each block can terminate up to 4032 subscriber and trunk lines in any combination. Basic block structure consists of communications hardware, central processors, and peripheral devices. Modular system concept permits several switching blocks to be interconnected through communications bus so that exchanges of as few as 100, to more than 20,000 line terminations can be implemented

tions at speeds of 1200 baud each. The system can process 20 to 30 calls/s per switching block.

In the packet switching environment the system supports a number of protocols including CCITT X.25 for terminals and X.3, X.28, X.29 for the packet assembler disassembler functions for synchronous and asynchronous terminals. EDX also supports a large variety of protocols such as HDLC, SDLC and Bisync. Throughput capabilities are up to 1000 packets/s.

Redundancy in all common hardware units and a hot standby method of operation assure maximum reliability. Disc and mag tape storage units are connected to both CPUs via programmable switches. The current system status stored in the dynamic fields is protected constantly by ledgering it from the online CPU to both discs. Data are thus available in the online CPU and also on both discs.

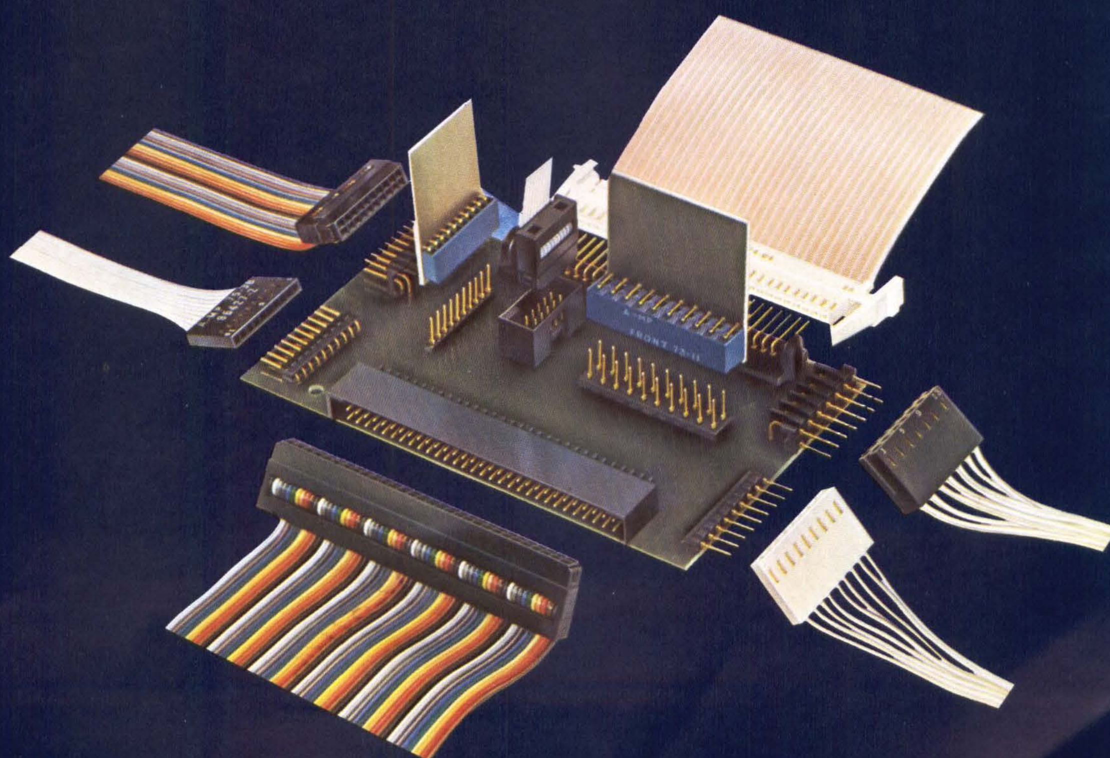
Circle 381 on Inquiry Card

Multimode Tester Checks Data Systems Parameters

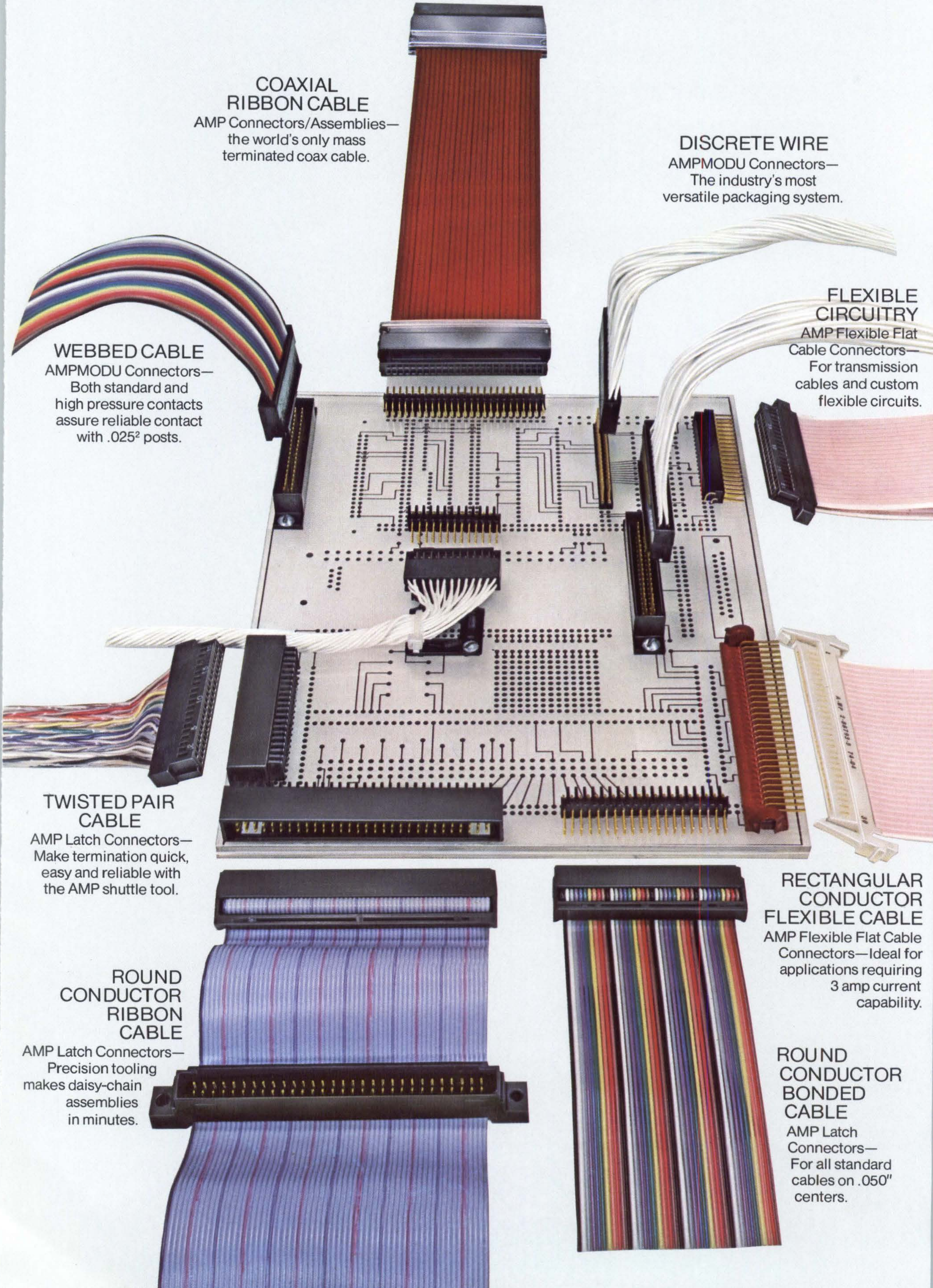
An 11-lb (5-kg) portable test instrument for comprehensive onsite checking of data communications systems, the 832 data comm tester operates in four modes: monitor, simulate, echo, and repeat.

In monitor mode, the set will record both data terminal equipment (DTE) and data communications equipment (DCE) either synchronously, asynchronously, or, with proper option, HDLC, as well as record status of key interface lines. In simulate mode, the 832 simulates modem operation, and can send a message

“.100 ℄ packaging from AMP allows us to utilize virtually any cable our design requires. Without need for board redesign.”



".100¢ packaging from AMP equals unlimited flexibility of cables and headers."



COAXIAL
RIBBON CABLE
AMP Connectors/Assemblies—
the world's only mass
terminated coax cable.

DISCRETE WIRE
AMPMODU Connectors—
The industry's most
versatile packaging system.

FLEXIBLE
CIRCUITRY
AMP Flexible Flat
Cable Connectors—
For transmission
cables and custom
flexible circuits.

WEBBED CABLE
AMPMODU Connectors—
Both standard and
high pressure contacts
assure reliable contact
with .025^2 posts.

TWISTED PAIR
CABLE
AMP Latch Connectors—
Make termination quick,
easy and reliable with
the AMP shuttle tool.

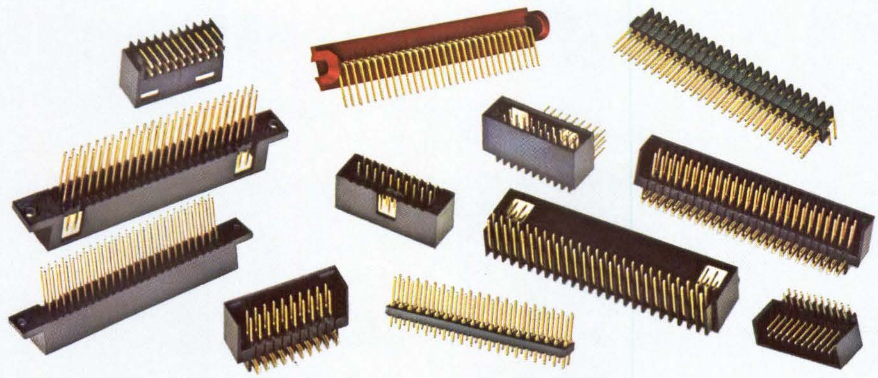
RECTANGULAR
CONDUCTOR
FLEXIBLE CABLE
AMP Flexible Flat Cable
Connectors—Ideal for
applications requiring
3 amp current
capability.

ROUND
CONDUCTOR
RIBBON
CABLE
AMP Latch Connectors—
Precision tooling
makes daisy-chain
assemblies
in minutes.

ROUND
CONDUCTOR
BONDED
CABLE
AMP Latch
Connectors—
For all standard
cables on .050"
centers.

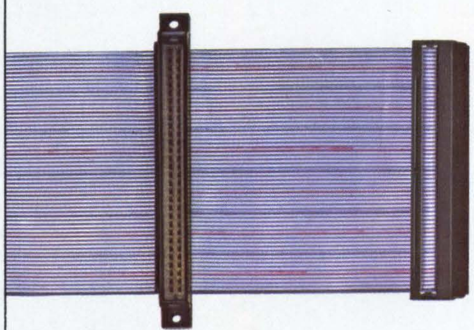
"Compatibility with the industry's broadest line of headers is the reason why."

.100¢ PACKAGING



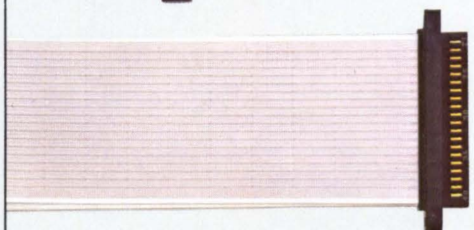
Headers

- The Industry's most complete selection—more than 4,000 different variations.
- Barrier inserts allow mixing several connector styles and sizes in one header.
- Accept polarized and detent connectors.
- Panel feed-thru headers for connecting two cable types.



AMP Latch Connectors

- Mass terminates round conductor ribbon cable.
- Redundant duplex-plated contacts and heavy duty strain relief/covers for reliable electrical and mechanical performance.
- Polarization and positive latching for accurate mating to headers.
- Cable-to-cable, edge card, DIP, and receptacle connectors available.
- Mate with AMPMODU headers.

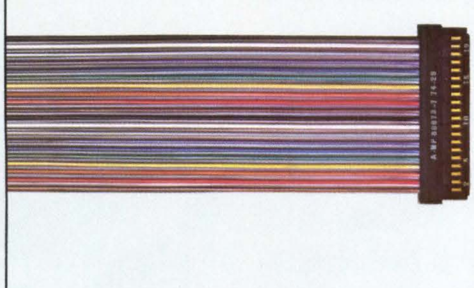


Flat Cable Connectors

- Terminates flat rectangular conductor cable and flexible circuitry.
- Rated for 3 amp current capacity.
- Crimp-on, snap-in contacts are automatically machine applied.
- Housings accept both flat cable and discrete wire.
- Reliable solution for repeated cable flexing applications.
- Mate with AMPMODU headers.

Coaxial Ribbon Cable/Connectors

- Upgrades signal integrity without requiring board redesign.
- Unique AMP cable/connector system allows mass stripping and mass termination for low applied cost.
- 50, 75 and 93 ohm cable on .100" centers.
- Mate with AMPMODU headers.



AMPMODU Connectors

- For discrete wire and webbed cables.
- Complete system for board-to-board and wire-to-board interconnects.
- Polarized housings with strain relief and detent.
- Mate with AMPMODU headers.

Check Reader Service Number 89

"AMP termination equipment and technical service bring out the best in .100 ¢ packaging."

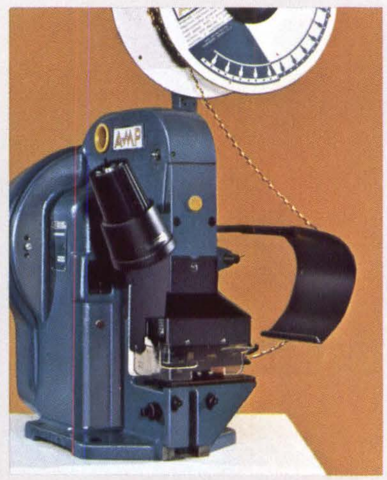
Both the AMP Latch and AMPMODU product families include a broad range of application tooling that helps to lower applied costs in today's .025² technology.

AMP Latch tooling, for example, includes universal bench mounted applicators as well as simple hand tools. They all have the capability of terminating virtually all popular types of round conductor flexible cable.

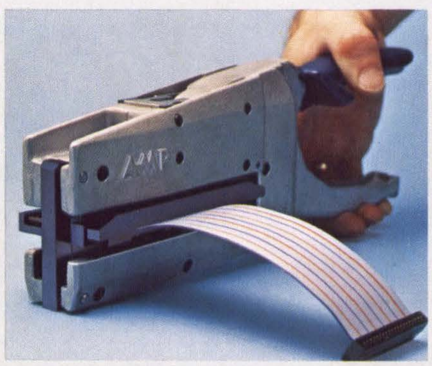
AMPMODU tooling includes manual and automatic printed circuit board insertion machines and terminating equipment. Each provides production efficiencies and uniformities that increase the value of a wide range of end products.

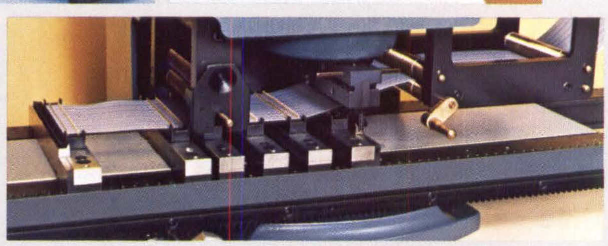
AMP technical assistance can also help increase product value and we urge you to take advantage of it. It's available without obligation.

For more information on AMP Latch, AMPMODU, Coaxial Ribbon, and Flat Cable Connectors, call Customer Service at (717) 564-0100 or write AMP Incorporated, Harrisburg, PA 17105.



AMP has a better way.





AMP

AMP and AMPMODU are trademarks of AMP Incorporated

Check Reader Service Number 89

"Quick brown fox" and six other messages are stored in 832 tester for use in simulate mode as controlled stimuli, or built-in user definable P/ROM can be used to custom tailor the message. LED display supplies all information in unambiguous readout

to the DTE and record its response. In echo mode the unit will accept and record data directly from the DTE and record the same data for display. In repeat mode the instrument will send data repeatedly to the DTE or can be programmed to repeat the transmission only on receipt of a preselected trigger character from the terminal.

In any mode the set operates on either full or half duplex lines with characters from five to eight bits long, with odd, even, or no parity. Baud rates are switch selectable at 13 popular rates between 50 and 9600 bits/s, or can be synchronized to either the DTE or DCE system clocks. An optional self-test adapter allows diagnostic routines to be run beyond the standard routines to assure proper instrument operation.

The instrument was designed by Tektronix, Inc, PO Box 500, Beaverton, OR 97077, to fill the gap between sophisticated analyzers priced from \$6k to \$12k and the simple status monitors priced at \$50 to \$200. Basic price for the 832 is \$1595.

Circle 382 on Inquiry Card

Software Package Enables Packet Network Access

RDOS X.25 protocol permits ECLIPSE®, NOVA®, and microNOVA™ computers to access national and international public packet-switched networks, and also supports point-to-point communications between these computers. Availability of the package was recently announced by Data General Corp, Route 9, Westboro, MA 01581. The protocol operates under the realtime disc operating system (RDOS), realtime operating system (RTOS), and disc operating system (DOS.) It supports all three levels of CCITT Recommendation X.25, the internationally accepted packet switching protocol.

Public packet-switched networks include Telenet in the U.S., Datapac in Canada, and Transpac in France. Telenet and Transpac have certified RDOS X.25, and certification is in process for Datapac.

RDOS X.25 is supported by DG/CS communications subsystems including synchronous line multiplexers and the DCU/200 data communications controller. Data link control is supported by the link access procedure (LAP), a level of X.25 that specifies the software interface to enable the user's data terminal equipment (DTE) to exchange data with the network's data circuit-terminating equipment (DCE). Physical and electrical interface between DTE and DCE is defined by CCITT Recommendation X.21 bis, the standard EIA RS-232-C interface. The interface is full duplex, character level connecting the DTE to packet-switched networks via high speed synchronous lines up to 56k bits/s. □

Circle 383 on Inquiry Card

TECHNOLOGY AND ECONOMICS: POWER SYSTEM PACKAGING CONSIDERATIONS

Montgomery Phister, Jr
Systems Consulting
Santa Monica, California

Design of an electronic technology involves selection of components and design of interconnect, packaging, and power systems. All of these elements interact, and choices made in one area affect the others. Exploration of tradeoffs centered around the power system, and specifically the choice of component power, and of linear regulated versus switching power supplies provides designers with useful insights into packaging problems and potentials.

Relationships between components, power, and volume are described by two equations.

Power required by components = Power supplied by supply (1)

No of components =

$$\frac{\text{Available Cabinet Volume}}{\text{Volume/Component + Power Supply Volume/Component}} \quad (2)$$

If parameters are assigned these symbols:

- V = Cabinet volume—the product of outside cabinet dimensions
- f = Fraction of cabinet volume usable for components, fans, and power supplies
- n = No of components
- p = Power/component (W)
- d = Component density on PC boards (components/in^2 or /cm^2)
- s = PC board spacing in cabinet (in or cm)
- V_p = Power supply volumetric efficiency (in^3/W or cm^3/W)
- V_c = Cooling fan volumetric efficiency (in^3/W or cm^3/W)

then Eq (1) becomes

$$\frac{d}{s} \bullet p \bullet f \bullet V_x = \frac{f(V - V_x)}{V_p + V_c} \quad (3)$$

where $f \bullet V_x$ is the volume occupied by components and $f(V - V_x)$ is that occupied by the power supply and cooling system.

Using these same parameters Eq (2) becomes

$$n = \frac{f \bullet V}{\frac{s}{d} + p(V_p + V_c)} \quad (4)$$

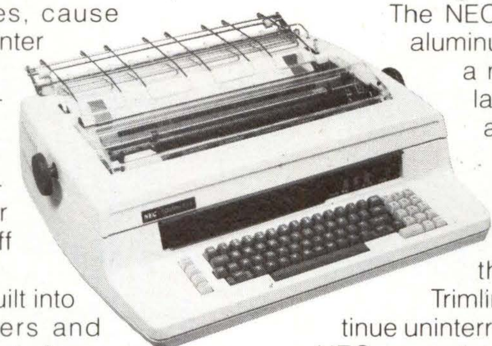
A graphical solution to Eq (3) is given in Fig 1, using the parameters described in the illustration. The line sloping up from the left demonstrates how component power requirements increase as the cabinet volume occupied by components increases. That sloping up from the right shows how supplied power increases as cabinet volume occupied by the power-cooling system increases. These lines intersect at a point where 6363 components occupy 5.85 ft^3 (0.165 m^3) of cabinet volume and dissipate 827 W of power.

Switching power supplies have V_p = 1 in^3/W (16.4 cm^3/W). Fig 2 illustrates that the use of such a supply increases the cabinet's component capacity by 21%,

The NEC Static Withstand.

It keeps man-made lightning from knocking out our printers.

People walking on nylon carpet can easily generate thousands of volts of static electricity—enough to knock out mainframes, cause head crashes and create costly printer failures.



Most electronic operations in computer products use only 5 to 10 volts of energy. When someone with high static energy touches such a product, equipment failure can occur unless that energy is siphoned off quickly and safely.

That's why NEC designed and built into its Spinwriter™ character printers and Trimliner™ band printers the industry's most complete static electricity withstand system. Some standard NEC printers have been independently tested with 20,000-volt jolts of static electricity and not missed a single print cycle.

The NEC withstand system starts with an aluminum frame and die-cast cover set—a massive electrical ground. It puts large protective ground planes on all circuit boards and it installs more than 25 ground cables and straps throughout each printer.

The result: a man-made lightning bolt can be dissipated in thousandths of a second, while Trimliner and Spinwriter operations continue uninterrupted.

NEC goes to greater lengths to build better grounding systems into its printer products.

But then, NEC wants to build perfect printers.

Send for our new printer brochures.

NEC. Going after the perfect printer.

NEC

NEC Information Systems, Inc.

Eastern Office: 5 Militia Drive: Lexington, MA. 02173, (617) 862-3120
Central Office: 3400 South Dixie Drive, Dayton, OH. 45439, (513) 294-6254
West Coast Office: 8939 S. Sepulveda Blvd., Los Angeles, CA. 90045, (213) 670-7346
Southern Office: 2965 Flowers Rd. South, Atlanta, GA. 30341, (404) 458-7014

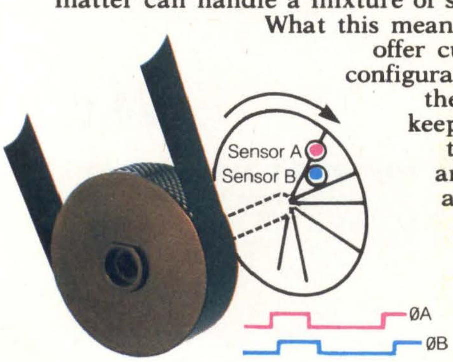
Now, there's a minicomputer tape system with the ability to handle NRZI (800 bpi), PE (1600) bpi), and GCR (6250 bpi) with just one drive and one formatter: The STC 1950.

But it's a lot more than a tri-density subsystem. The microprogrammed drive and formatter are designed to give you total flexibility for matching your architecture, and for meeting your customer's price-performance requirements.

For example, you can order the 1950 in lower-cost PE/NRZI or PE/GCR configurations, then field up-grade to tri-density whenever your customer desires.

The 1950 also gives you a choice of 50, 75, or 125 ips. And again, the system can be field converted to any other speed.

Up to four tape drives can be radially attached to the 1950's formatter. In a multiple-drive subsystem, the formatter can handle a mixture of speeds and densities. What this means is the flexibility to offer customers the precise configuration they need. Yet, at the same time, the 1950 keeps your design costs, training requirements, and parts inventories to an absolute minimum.

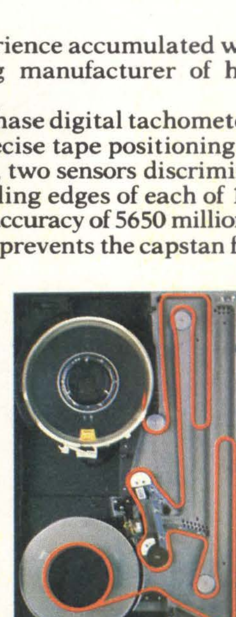


Read/write reliability you can bank on.

To assure the most accurate read/write technology, STC has incorporated into the 1950 all the experience accumulated while becoming the world's leading manufacturer of high-performance tape subsystems.

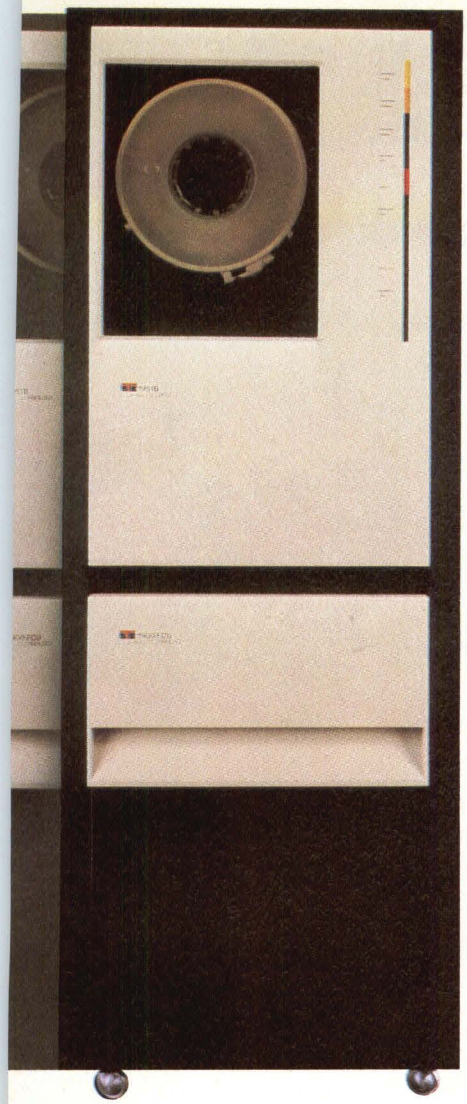
For example, a unique, two-phase digital tachometer in the capstan motor provides precise tape positioning and stop-lock control. As illustrated, two sensors discriminate the position of leading and trailing edges of each of 1000 tach lines to establish a capstan accuracy of 5650 millionths of an inch. The stop-lock feature prevents the capstan from moving more than one tach line when the drive is stopped. So no tape creep can ever occur.

For speed control, tach pulses are compared to a crystal clock pulse. This approach dispenses with potentiometers, making the system adjustment-free.



The gentlest possible tape handling.

The STC 1950 is equipped with automatic thread/load, for both open reels and easy-load cartridges. This feature, combined with a minimum length, straight-shot, gravity-assisted tape path, assures extraordinarily accurate tape loading. Tape acceleration is kept to a minimum by a microsequencer-controlled linear reel



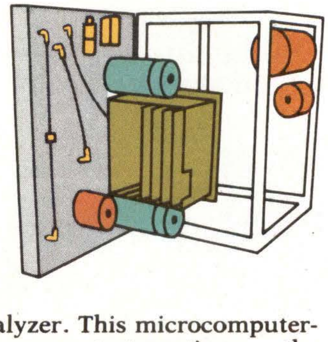
The new STC 1950: Three densities and any of three speeds in one state-of-the-art tape subsystem.

servo system. Tape drag and tape edge damage is minimized by the use of hydrostatic air bearings at all critical points. A hydrostatic rewind foot prevents tape and head wear during high speed rewind. And a unique STC tape footage counter, in conjunction with the digital tach and microsequencer, smooths tape acceleration and deceleration for faster and gentler rewind.

New standards of maintainability.

When you specify the 1950 you benefit from all the cost-effective maintenance features developed to service STC's mainframe tape systems.

As an OEM customer, you'll receive, at no charge, a a host-independent, on-line diagnostic program that performs over 700 tests. This includes not just functional and reliability tests, but artificial stress testing and fault isolation to uncover potential problems that are often masked by GCR's inherent fail-soft characteristics.



For off-line diagnosis, your service people can use the STC Subsystem Analyzer. This microcomputer-controlled analyzer runs the same test routines as the on-line program, and includes a remote communication capability to facilitate diagnostic assistance from a central point.

On-line or off-line, this diagnostic approach keeps labor costs to a minimum. Typically, it takes less than an hour to find the problem, swap the components, and verify the fix.

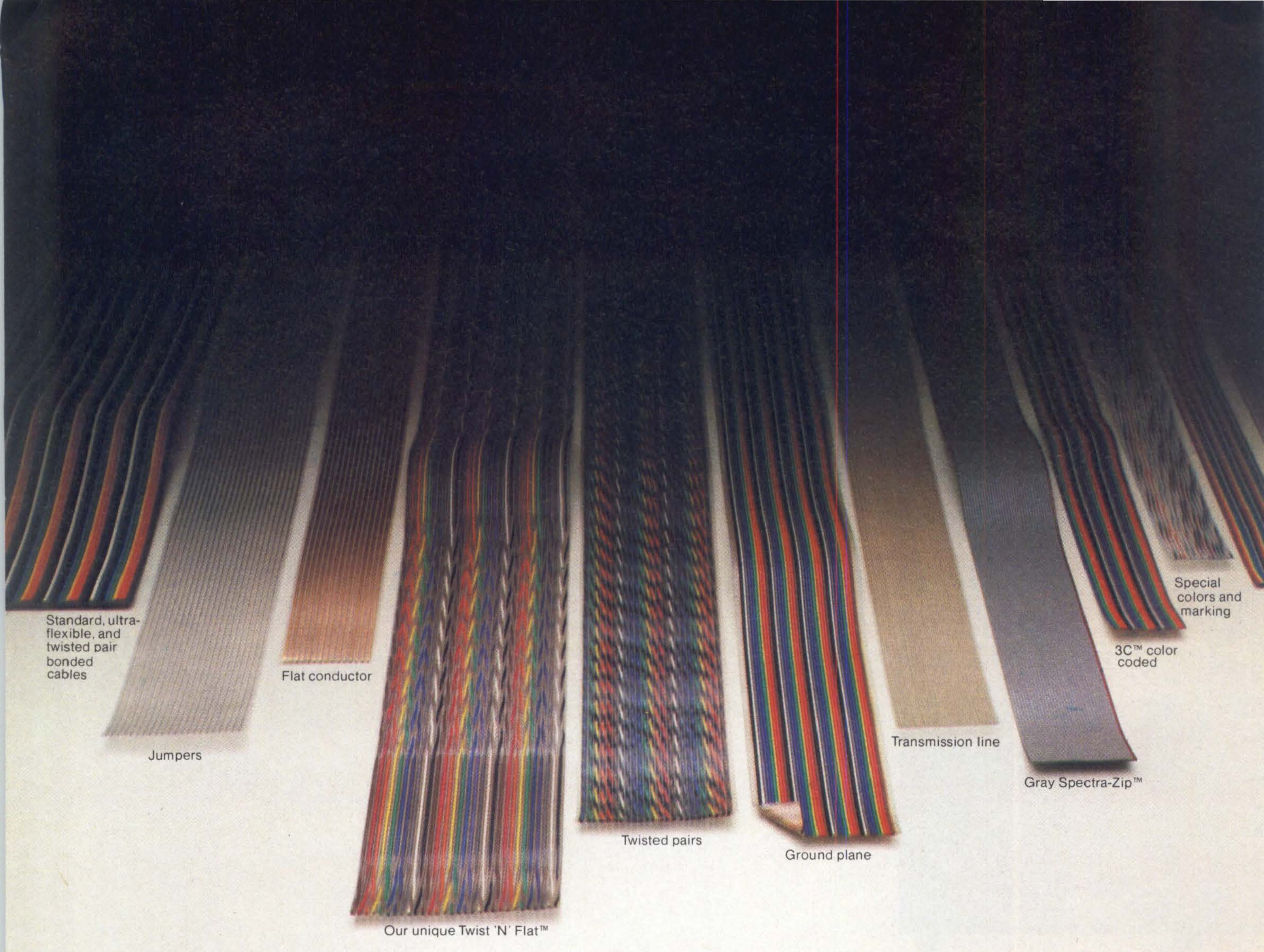
To get the full story, get in touch with us today.

For full details, please contact: OEM marketing, Storage Technology Corporation, P.O. Box 6, Louisville, Colorado 80027. Or phone (800) 525-2940; in Colorado 497-5151. In Canada: STC Ltd., 272 Galaxy Blvd., Rexdale/Toronto, Ontario M9W. Phone (416) 675-3350.

STORAGE TECHNOLOGY CORPORATION

SEE US IN NCC BOOTH 3614

CIRCLE 22 ON INQUIRY CARD



When it comes to flat, we've been around.

We make more different kinds of planar cables for more different kinds of interconnect systems than anyone on the planet Earth. And, in this world of planar-come-lately's, Spectra-Strip has been around since the cable world turned flat.

For all your interconnect needs from planar cables to IDC connectors to complete custom assemblies, just check us out. We'll take total responsibility for solving your interconnect problems, and you won't need to call anyone else.

For the name and number of our nearest distributor or rep, write Spectra-Strip, an Eltra Company, 7100 Lampson Avenue, Garden Grove, CA 92642. Or call (714) 892-3361 today.

SPECTRA-STRIP An Eltra Company

When you're down to the wire

CIRCLE 23 ON INQUIRY CARD

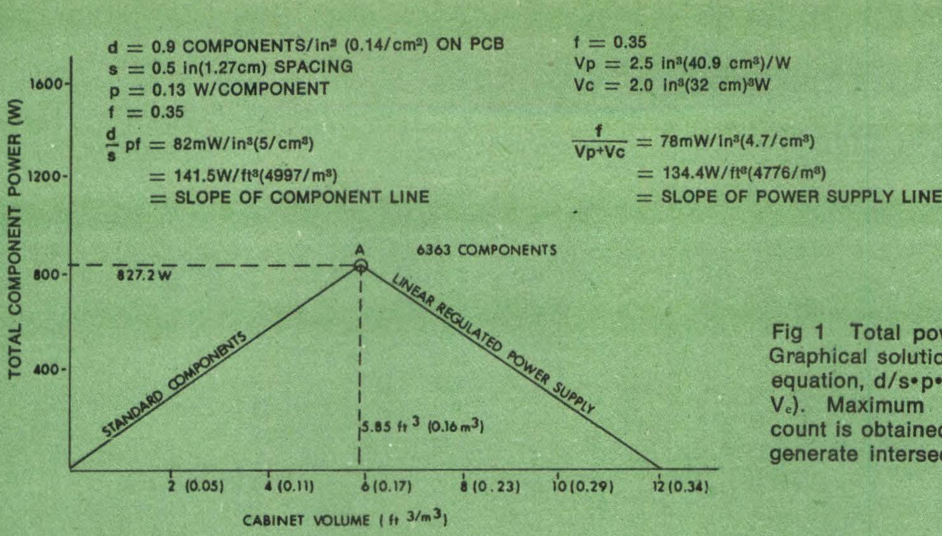


Fig 1 Total power vs cabinet volume. Graphical solution to the cabinet power equation, $d/s \cdot p \cdot f \cdot V_x = f(V - V_x)/(V_p + V_c)$. Maximum obtainable component count is obtained using parameters that generate intersecting lines

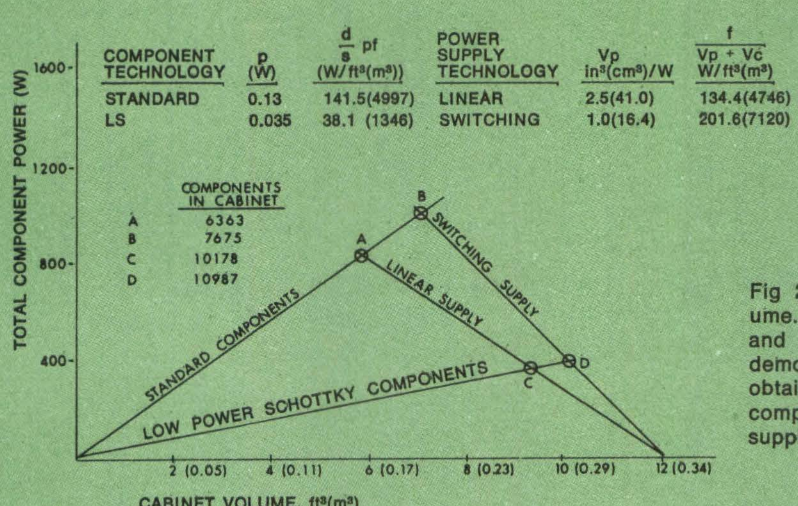


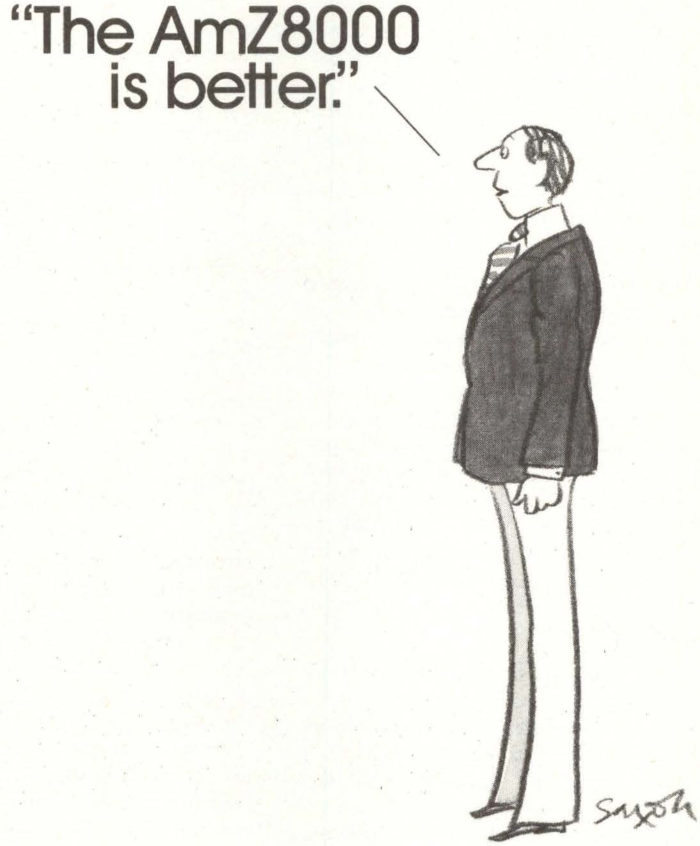
Fig 2 Total power vs cabinet volume. Effects of varying component and power supply technologies are demonstrated. Optimum density is obtained using low power Schottky components with switching power supply

to 7675 components. Use of low power SSI and MSI Schottky components may reduce average component power requirements from 0.13 to 0.035 W/component. The graph also shows that the use of such components with a linear supply increases cabinet capacity to 10,178 components; their use with a switching supply increases capacity to 10,987 components, a 73% increase over the initial design.

From these graphs much useful information can be gained, and can be applied to individual design problems. The gains in real component density that may be achieved in a system by the use of low power components or switching power supplies, either (or both) of which increase density by reducing power supply volume is particularly dramatic. With the assumptions given here, the use of low power components is more effective than the use of switching supplies in improving effective component density. However, this result is attained in part because of the assumed cooling fan requirement of 2 in³/W (32.78 cc/W).

The proportion of cabinet volume occupied by the power/cooling system ranges from 15 to 50% of the total. It can be shown that this proportion is solely a function of the ratio $(V_p + V_c)/(s/dp)$—of power/cooling to component dissipation volume requirements.

The Author solicits comments on the material presented here, data supporting or contradicting his approach, and suggestions for topics to be explored in future articles.—**Ed.**



programs faster than ever before. That means you'll be able to get new products to market faster than ever before.

And to speed things up even more, we designed a software development system especially for the AmZ8000. It combines versatile hardware with powerful software. And it's got a real catchy name: the System 8/8.

One last thing: we know it hurts to drop Intel for somebody else. We've just been through it ourselves. But it's going to hurt a lot more next year and the year after that. By then your competitors could be so far ahead of you, you might never catch up.

Call Advanced Micro Devices and we'll send you all the facts on the AmZ8000.

Then quietly and calmly, in the privacy of your own office, compare the AmZ8000 with the 8086.

We think you'll agree with us: Intel may make a lot of noise. But the AmZ8000 makes a lot of sense.

Advanced Micro Devices

901 Thompson Place, Sunnyvale, CA 94086 · Telephone: (408) 732-2400

Micromodular Architecture Upgrades Performance Of Medium Scale Computers

'900' series systems provide five times the performance of their predecessors, occupy half the space, and use 50% less power. Burroughs Corp, Detroit, MI 48232 has enhanced performance of the machines through use of dense logic and memory circuits coupled with a micromodular concurrent central system architecture.

Providing twice the processing power of the B 2800, the entry level B 2930 uses a fast asynchronously operating modular processor. Its 524k-byte memory expands to 1M bytes using 16k MOS chips. This system includes a separate data communications processor, and a microprocessor based, integrated disc controller. Equipped with from 2M to 5M bytes of main memory and up to 32 data link processors, the B 3950 provides up to five times the throughput of the B 2800.

Data link processors control flow of data to and from peripheral units. These independent microprocessors are each programmed to service a specific category of peripheral devices. By assuming overhead associated with I/O functions the processors free the CPU for more efficient operation.

Memory in both systems is formed of 16k-bit memory chips with error correcting capability. Wide bandwidth enables the processor to fetch four bytes of information simultaneously, providing fast access to programs and data. Logic circuits are advanced TTL bipolar microcircuits, containing as many as 800 gates each. Logic speed is augmented by high speed control devices that make instruction codes available to the processor in 45 ns.

Micromodular concurrent architecture of the systems provides a central system made up of independent processing elements or modules, each dedicated to specified steps in the overall task. Functions for each respective task are stored in micrologic circuits. The modules run concurrently, each at its own maximum rate. As a result the computer can use all resources at peak efficiency to maintain a consistently high throughput rate.

Functional units of the central processor include program, control, memory access, execution, and memory control modules, and data buffer, I/O processor, data link processors, memory, and logic units. The program module prefetches program instructions, analyzes operations, calculates data addresses, and passes the translated instruction information to the address buffer. The buffer holds the instruction until the control module accepts and processes it, and then passes addresses, size, and formats of the operation to the memory access module.

All data or memory accesses required by the execution module are performed by the memory access module, which stores or retrieves data in the data buffer. Specified arithmetic, logic, and special operations are handled by the execution module with the data buffer acting as a temporary store and work area for data that have been processed or are waiting to be processed by the execution unit.

Memory requests from the memory access module and I/O processor are coordinated at the memory control module. The I/O processor independently moves data between main memory and peripheral devices. It uses an I/O descriptor to manage the entire I/O operation.

The systems are fully compatible with the company's other medium scale computers. Software products required for system operation are packaged together and are available for a license fee. A basic package includes Master Control Program VI, an enhanced version of Burroughs Network Definition Language, a Generalized Message Control System, and a compiler for RPG II, ANSI COBOL, FORTRAN, or BASIC.

Additional software available for this class of computer includes a workflow management system and a data management inquiry system. The workflow system permits the user to control execution of jobs consisting of interrelated tasks, and assign system resources to jobs for execution concurrently, based on classification and priorities. The inquiry system allows users to access information stored in the DBS II database. **Circle 400 on Inquiry Card**

Vector Graphic Systems Reduce Host Overhead Through Use of Technology

Ease of interfacing, software, modularity, and multiterminal and remote capabilities are emphasized in the Whizzard 7000 and 5000 vector refresh graphic systems. Developed by Megatek Corp, 3931 Sorrento Valley Blvd, San Diego, CA 92121, the families encompass graphic peripherals, graphic terminals, and standalone graphic processing systems, and are based on building block modularity.

A self contained system, the 7000 is based on the dual bus architecture of the company's Megraphic 7000 terminal (see *Computer Design*, June 1978, pp 39, 42). A proprietary vector generator and an Adaptive Timing™ technique produce fine vector control and capacity for 20,000 short vectors, increased throughput, quality, and repeatability. The vectors have constant intensity; precise endpoint matching is ensured by a patented vector closure feature. Readability down to very small character sizes is provided by the use of stroke generated characters, which can be rotated, scaled, or translated at any angle with full precision of the rotate-translate circuitry.

An internal 32-bit bipolar microprocessor provides the high data processing rates necessary for interactive graphics applications, processing both X and Y information simultaneously. The 3-state 32-bit graphics bus insures that data transfer occurs at optimum rates. Peripheral I/O devices occupy a separate 16-bit bus.

The system's parallel interface uses programmed I/O or DMA control, connecting to DEC PDP-11 or Data General NOVA or ECLIPSE. A Universal Interface module allows connection with IBM Series/1, Hewlett-Packard, VAX 11/780, Interdata, and Prime computers.

An intelligent peripheral control unit (IPCU) updates location counters, recording cursor location and making the data available to the CPU only when necessary, thus reducing the overhead loading needed to service peripheral interrupts. The IPCU serves to interface joystick, data tablet or digitizer, and keyboard to the system.

Three-dimensional graphics capability includes rotation. 2D and 3D can be obtained simultaneously on the same display. An optional color


The WHIZZARD™ will amaze you.
Graphics magic you never had before.
Fast, interactive computer graphics. Unequaled refresh vector quality. Astonishing performance at unbelievable prices. The best in the industry.
Buy a WHIZZARD refresh terminal. Connect it to your computer. Buy a WHIZZARD intelligent terminal. With built-in computing power. Or, buy a stand-alone graphics processing system. With the WHIZZARD's powerful FORTRAN-based graphics software, you're up and running fast.
Add an RS-232-C interface for remote or distributed processing. Up to four monitors for shared graphics processing. Plus all the graphics peripherals you may need.
Two WHIZZARD families. It's your choice.
Choose the WHIZZARD 7000 for unmatched graphics throughput and versatility. With features like hardware rotate, zoom, and multiple viewports. And easy interfacing to any 16-bit or 32-bit computer. Or, the WHIZZARD 5000 for the lowest-cost, high-performance graphics possible. Every 5000 system includes its own NOVA/ECLIPSE computer.
Plus, TEKTRONIX®* users can get complete 4014™* compatibility with our Emutek™ software. It's the easy, economical way to upgrade from storage tube graphics.
For the whole WHIZZARD story, 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 25 ON INQUIRY CARD
See the WHIZZARD at NCC, booth 3319-27.
*TEKTRONIX® and 4014™ are registered trademarks of Tektronix, Inc., use of which in no way constitutes endorsement.

Beaver. The workstation builder.

If you're building an application-specific workstation, start with a Beaver. This new intelligent terminal supplies all the hardware and software you need to get your workstation up and running in record time. For as little as $2995 in quantity 50.*

Optimize your workstation layout.

The Beaver comes in three hardware modules: CRT display, detachable keyboard, and mass storage. These independent modules let you human engineer your workstation for peak efficiency.

Put the CRT in front of the operator or to the side. Place the keyboard near the display or away from it. Make the optional floppy disks accessible or lock them up. If space is at a premium, the Beaver modules can be stacked in a compact, single unit.

The Beaver gives you the flexibility to optimize your workstation to fit your needs.

Fast program development.

The Beaver comes with plenty of sophisticated software, to help you write your application system quickly.

You get a friendly operating system that lets you communicate in plain, simple English. ANSI-standard BASIC with commercial and scientific extensions. A command substitution system. Multiprogramming capability. Complete file management. A macro assembler. An editor. Debug utilities.

And communications software for the Beaver is outstanding. You get sophisticated emulators for TTY, 3275, 2780/3780, and more.

Unbeatable I/O performance.

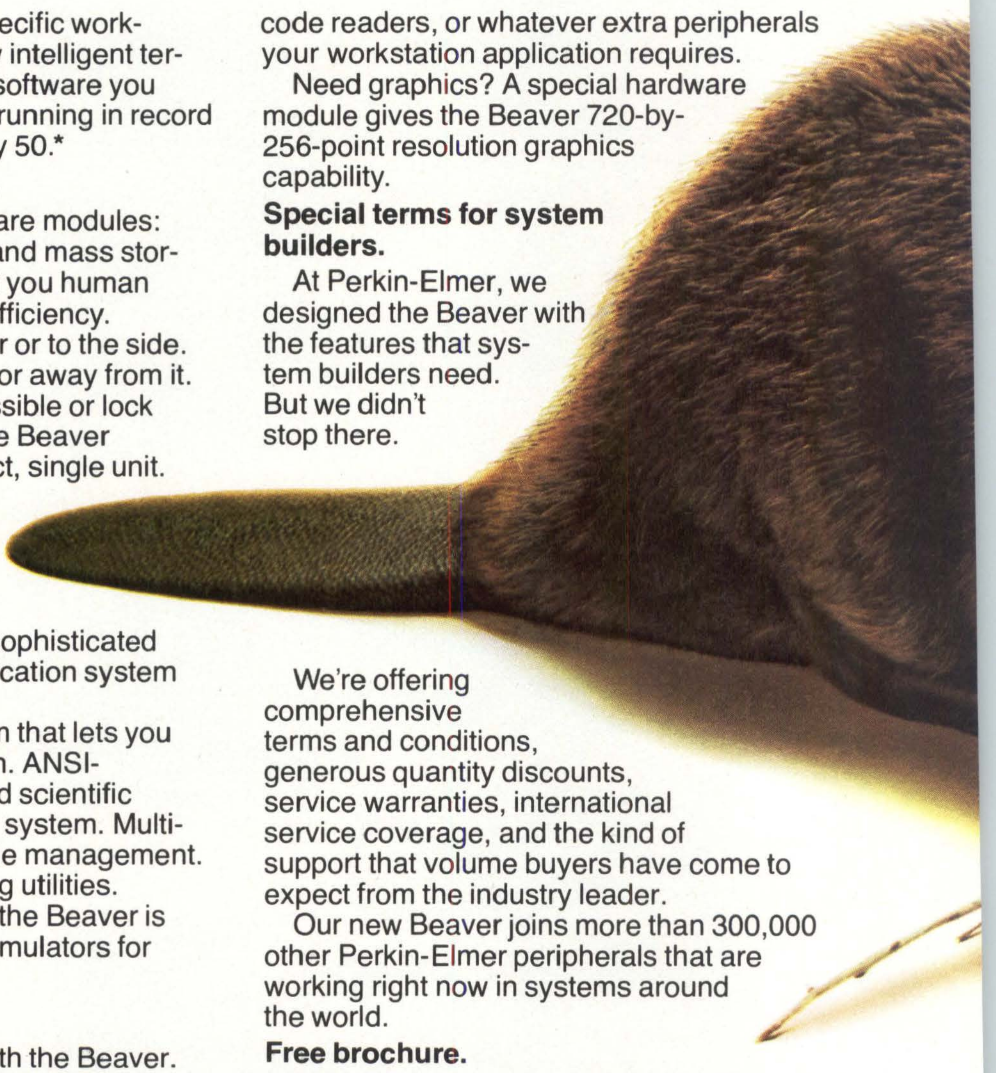
I/O throughput is not a problem with the Beaver. Each floppy disk has its own DMA channel and controller.

An optional I/O processor makes it easy to add special devices. Two slots, complete with power, are ready for you to add interfaces to OCR wands, bar code readers, or whatever extra peripherals your workstation application requires.

Need graphics? A special hardware module gives the Beaver 720-by-256-point resolution graphics capability.

Special terms for system builders.

At Perkin-Elmer, we designed the Beaver with the features that system builders need. But we didn't stop there.



We're offering comprehensive terms and conditions, generous quantity discounts, service warranties, international service coverage, and the kind of support that volume buyers have come to expect from the industry leader.

Our new Beaver joins more than 300,000 other Perkin-Elmer peripherals that are working right now in systems around the world.

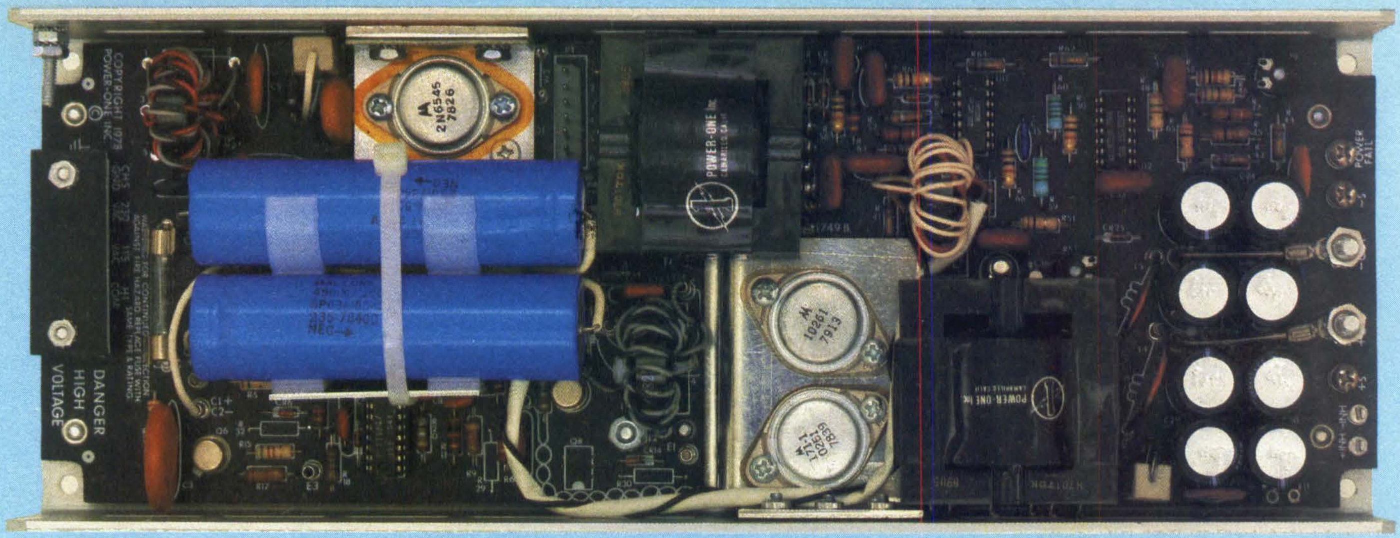
Free brochure.

To find out more, just give us a call or write. Perkin-Elmer, Randolph Park West, Route 10 & Emery Avenue, Randolph, NJ 07801. (201) 366-5550.

We'll send you our free brochure about the Beaver. The workstation builder.

*U.S. domestic price.


PERKIN-ELMER



IT TOOK POWER-ONE TO DO IT...

a switching power supply as dependable as a linear.

When Power-One decided to build a switching power supply, we issued one simple mandate: it must be as dependable as our linears. Well, we did it. A direct drive 5-volt 40-amp switching power supply that's smaller, lighter, simpler, more reliable and less expensive than the rest.

Direct Drive Switching

By using a self-driven switching stage, we've done away with the starting bias, drive and the current sensing transformers. A big reduction in weight plus lower cost, more precise drive control and fewer input to output noise paths. To assure maximum protection against AC line transients and fluctuations, a unique "volt-second" regulation circuit is employed.

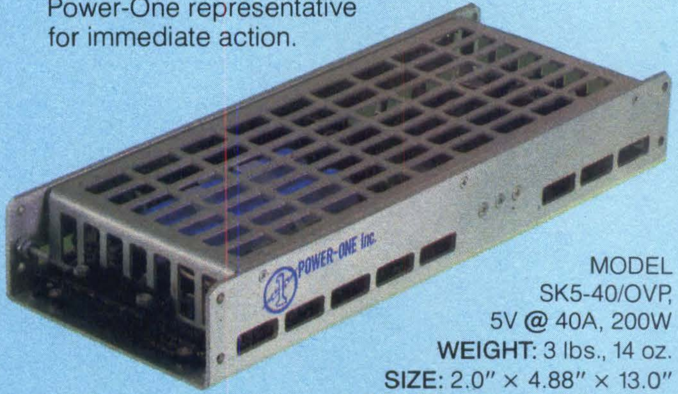
Safeguard Design

We've built in a number of safeguards. Like our digital feedback system which yields exceptional loop stability while maintaining positive control of critical switching parameters. And a unique anti-saturation circuit to protect the power transistors from the dire effects of transformer saturation. Plus, by putting inputs at one end of the supply and outputs at the other, we've eliminated inter-circuit cross talk. And speaking of inputs, our dual range design permits either 115 or 230 VAC operation without changing jumpers.

The Bottom Line

Switching frequency: 28KHz — stable as a rock. Size: a mere 4.88 × 13 × 2 inches — more watts to the inch and more power for the buck. The price: $250 for single units.

Send for complete details. Or better yet, contact your local Power-One representative for immediate action.

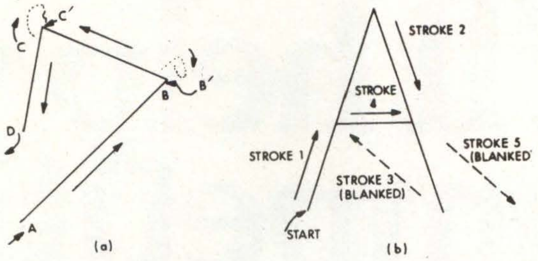


MODEL
SK5-40/OVP,
5V @ 40A, 200W
WEIGHT: 3 lbs., 14 oz.
SIZE: 2.0" × 4.88" × 13.0"
PRICE: $250 Single Quantity

Power-One INC.
D.C. POWER SUPPLIES

Power One Drive • Camarillo, California 93010 • (805) 484-2806 • TWX 910-336-1297

CIRCLE 27 ON INQUIRY CARD



Constant vector intensity of Megatek's Whizzard graphic system is produced by turning off beam precisely as it passes through B. Beam continues on in undefined manner (a) and finally settles at point B'. After appropriate set-up time, beam begins from B' and moves toward C. As it passes precisely through B, beam is unblanked and vector is drawn toward C where cycle repeats. Stroke generated characters (b) take advantage of precision of vector generator, producing readable characters even at sizes below 0.1 in

monitor provides up to five colors in 16 bits of user definable, user programmable line texture. Any line texture may be blanked, doubling the total line texturing capacity of the system.

Hardcopy output is facilitated by a vector to raster converter implemented in hardware. The Rastorizer™ processes vectors, randomly converting from an unordered vector list into raster bit data for the plotter, eliminating the need for the host to order vectors prior to printing.

An interactive total refresh graphic system, 5000 series standalone and terminal configurations are compatible with Data General RDOS, DOS, and RTOS operating systems. The system has a self contained NOVA or ECLIPSE with 32k-words memory, dual floppy disc drive, and RS-232 interface.

The dual board MG552 graphic display unit uses hardware routines to speed vector processing and minimize host processing time. As a DMA device the graphic display unit receives coordinates directly from the computer's memory. Precise analog stroke writing offers typical endpoint matching and closure of 0.005" (0.0127 cm), 16 levels of intensity control, and constant vector intensity.

Circle 401 on Inquiry Card

Magnetic Tape Formatter Adapts GCR To Use With Minicomputers

The F6250 intelligent formatter carries out magnetic tape drive management and GCR/PE encoding and decoding, enabling group coded recording to be used with minicomputers. By incorporating this formatter, Pertec Computer Corp, Pertec Div, 9600 Irondale, Chatsworth, CA 91311, was able to simplify the system sufficiently to meet use and service needs of the minicomputer market.

An important feature of the maintenance concept is the simplicity of the I/O structure. Most tape dependent functions have been built into the formatter, relieving the host CPU and magnetic tape controller of considerable demands. The formatter interface communicates with the host CPU over a 28-line bus: a 16-bit control/status/data bidirectional bus, five common address space address lines, and six handshake control lines.

Three-level self-diagnostics allow troubleshooting without outside test equipment. Subsystem operation can be verified at the formatter panel keyboard in offline mode independent of external test equipment. First level diagnostic operation supplies the CPU with a continuous performance report and alerts it in the event of fault. A second level, offline mode, allows self test routines to be called by the technician to verify individual module integrity. The formatter's microprocessor executes these test routines stored in internal memory, polling individual microsequences associated with each module as test patterns are routed through the module to verify proper handling. The third level uses the CPU in a dedicated diagnostic mode and provides approximately 50 interface test messages. The first part of this diagnostic verifies the CSD bus/CAS memory interface and formatter control path. The second part checks the various modules, submodules, and individual circuits of the formatter.

Circle 402 on Inquiry Card

3-Terminal Module Reduces Current Drain For Standard Keyboard

A 3-terminal Hall effect keyboard module combined with an integral microcomputer reduces current drain for a standard 64-module keyboard by 140 mA. Replacing the customary 4-terminal module to achieve the 60% reduction in current, the 3T module was developed by Micro Switch Div, Honeywell, Inc, 11 W Spring St, Freeport, IL 61032, as a logical outgrowth of the keyboard's microcomputer capabilities.

In the 3T module the input terminal also serves as a minus supply connection. The module integrates with the onboard microcomputer's scan capabilities permitting application of power to only eight key modules at a time during a scan cycle.

Additional production economies are offered by the reduced size of the 3T Hall effect chips, helping to hold the line on prices without affecting traditional features and performance. The modules use the same variety of keytops provided since the Hall effect keyboards were introduced. Yet power requirements are reduced from the 1 A specified for a typical 64-key device to the 140 mA specified for keyboards using the 3T modules.

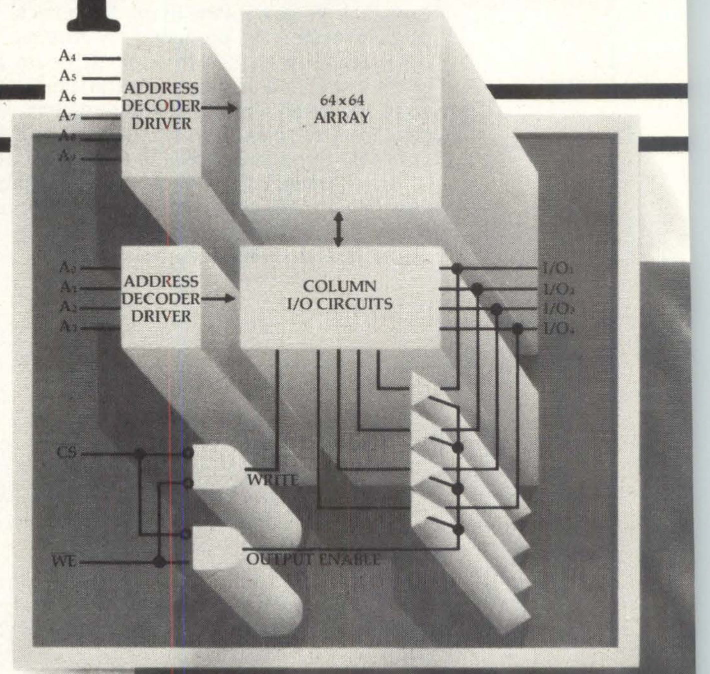
Other economies that are incorporated in the keyboards are materials that permit use of a punchable single

The S2114H 4K at 70ns it'll help you your competition.

With 70, 90 and 120 nanosecond access times, our S2114H VRAM family will give you the speed you're looking for in the 1024 x 4 organization you need. (For those really fast applications, there's a 55 ns version on the way.)

So, if your application requires small cache or buffer memories, you're in for a quick boost in performance. With a sharp reduction in cost and board space.

You'll no longer have to overbuild your system with 4K x 1 memories or fill up four times as many boards with 1K x 1 parts.



This 18-pin VRAM is fully TTL compatible on all inputs and outputs. It has a single +5V power supply. It's completely static. And the chip select function makes it easier to expand your memory system by allowing the I/O pins to be OR-tied to other devices.

Block diagram of the S2114H: a very fast number.

High speed runs in the family.

Our entire family of 4K Static VRAMs is geared toward high speed and low power dissipation. That's the beauty of VMOS.

Static VRAM: run away from

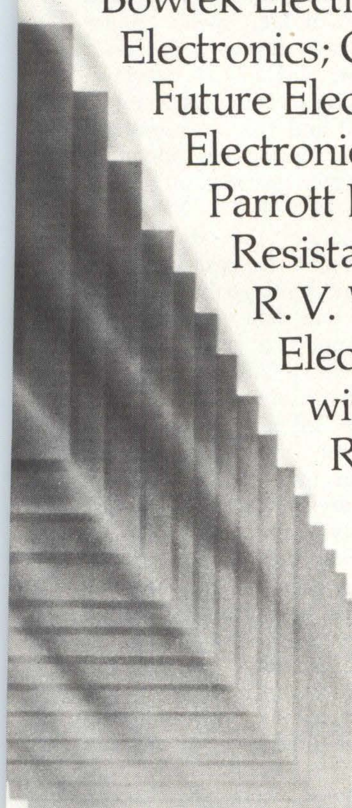
And it extends to our 16K and 64K VROMs, too. (As well as the S2147 and S4017 4K x 1 parts which are coming soon.)

So check out our family tree. Then call your local AMI salesman or one of these authorized distributors for fast delivery: Arrow Electronics; Bowtek Electric Co., Ltd.; Century Electronics; Cesco Electronics, Ltd.; Future Electronics; Intermark Electronics; Kierulff Electronics; Parrott Electronics, Inc., Resistacap; R/M Electronics; R.V. Weatherford; Schweber Electronics; Sterling Electronics; Western Microtechnology. Or get in touch with us at AMI Memory Marketing, 3800 Homestead Road, Santa Clara CA 95051. Phone (408) 246-0330.

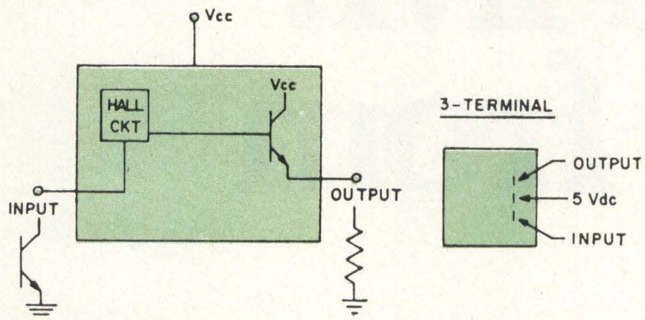
A lot of people have been waiting for the S2114H. So put in your order fast.

The high-speed, low-powered S2114H family.

Part Number	Address Access Time (max)	Power Supply Current (max)
S2114H	70 ns	125 mA
S2114H4	90 ns	125 mA
S2114HF	120 ns	125 mA



AMI®
AMERICAN MICROSYSTEMS, INC.

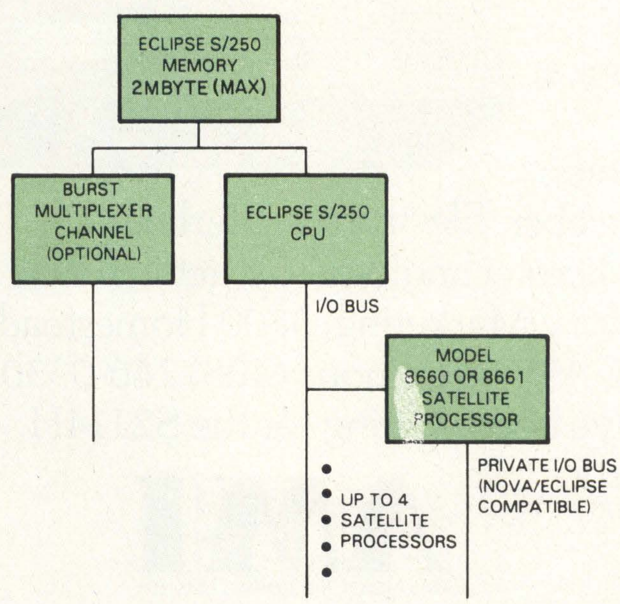


3-terminal Hall effect scan module from Honeywell's Micro Switch Div combines with keyboard's integral microcomputer, permitting power to be applied to only eight key modules at one time thereby reducing power requirements of keyboard by 60%

sided PC board. Automatically inserted jumper wires allow the manufacturer to keep all circuitry on one side of the board. Silk screening of component locations on the board facilitates assembly and field servicing.

Circle 403 on Inquiry Card

Satellite Processors Increase Computer's Processing Capabilities



Data General's satellite processors models 8660 and 8661 are configured on S/250 data channel and act as CPU I/O device, offloading host. Each has its own independent I/O bus for programmed I/O and data channel transfers, and supports cross-interrupt facility with host for interprocessor synchronization

Satellite processors models 8660 and 8661, optional peripheral processing units, increase the processing capabilities of ECLIPSE S/250 processors (see *Computer Design,* Oct 1978, p 30) from Data General Corp, Rt 9, Westboro, MA 01581. The units operate as frontend or independent processors significantly offloading the CPU. Both include two circuit boards of independent processor logic, memory and I/O buses, and implement the standard ECLIPSE instruction set with powerful extensions.

General purpose satellite processor model 8600 consists of 64k bytes of parity MOS with memory allocation and protection (MAP) capability, a microprogrammed processor with 200-ns cycle time, an independent CPU compatible I/O bus, software controllable console, and interface for bidirectional data transfer between S/250 and satellite processor. The satellite's instruction set consists of the basic ECLIPSE set plus character instruction set that facilitates bit, byte, and data string manipulation and translation.

Model 8661 with a fast hardware array processing extension consists of 56k bytes of parity MOS memory and MAP, 8k bytes of high speed bipolar array processing memory, processor logic, I/O bus, and S/250 interface. Array processing instructions common to the HP/130 and the CPU's integral array processor option are added to the basic ECLIPSE instruction set.

Configured on the S/250 high speed data channel, the satellite processors act as I/O devices. Each has its own independent I/O bus for programmed I/O and data channel transfers. Both support a cross interrupt facility with the S/250 for interprocessor synchronization.

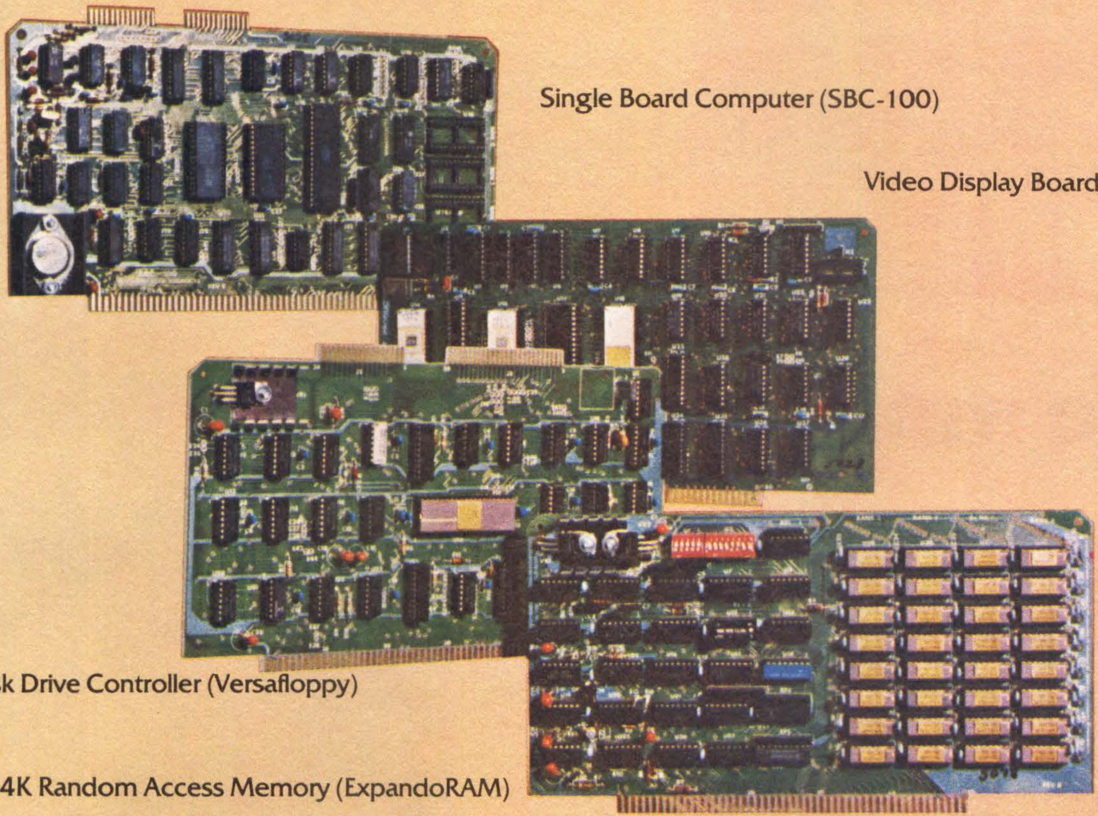
Using MAP software control, the satellites direct memory reference instructions in the satellite program to local memory or to the host S/250 main memory. This facility also exists for data channel DMA references from devices on the satellite's private I/O bus, permitting both high speed interprocessor data transfer as well as enabling data sharing and routing.

Software supports the enhanced system for realtime event-driven and interactive environments. Tasks running under RDOS in the S/250 can bidirectionally communicate and transfer data with tasks running under RTOS in the satellite processor. Programs can be written in global

Guaranteed Compatible!

S-100 Bus OEM Boards

From SD Systems at reasonable prices



ASSEMBLED TESTED AND FULLY BURNED IN

The search is over for the convenience of S-100 Bus Computer boards that are really compatible and dependable. State-of-the-Art engineering, outstanding flexibility, rapid delivery, and low costs make the SD Systems computer boards the best OEM buy. The **SBC-100 Single Board Computer** is based on the Z80 microprocessor. Up to 8K of 2716 PROM, Serial RS-232 Port, Parallel Input/Output Ports, Software programmable baud rate generator, Four channel counter/timer, and 1K of RAM, all on-board. **VDB-8024 Video Display Board** features an on-board Z80 microprocessor for maximum flexibility in video control. 80 characters by 24 lines, displayed with high resolution on a 7×10 dot matrix. On-board Keyboard power and interface, 2K memory and a glich-free display by use of I/O mapped interface make this board the most superior board on the market.

The **ExpandoRAM** is available in 16, 32, 48, or 64K versions using 4116 RAMS. The population can be increased in the field at a future point if requirements change. Featuring Switch selectable boundaries, Bank Selectable Write Protect and using less than 5 watts, the ExpandoRAM is more reliable memory for the money than any other OEM board. **Versafloppy, Flexible Disk Drive Controller** with IBM 3740 soft sectored format compatibility controls up to four single or double sided disk drives either mini or standard size. **Full Line Software** includes Editor, Z80 Assembler, Linker, C-Basic, Complete Business Packages, System Diagnostic and Control Software and Disk Operating System. **PROM Programming Software and Hardware** also available. Circle the reader service number for full Technical Data... or call toll free to our Customer Service Department: 800-527-3460.

POST OFFICE BOX 28810 — DALLAS, TEXAS 75228

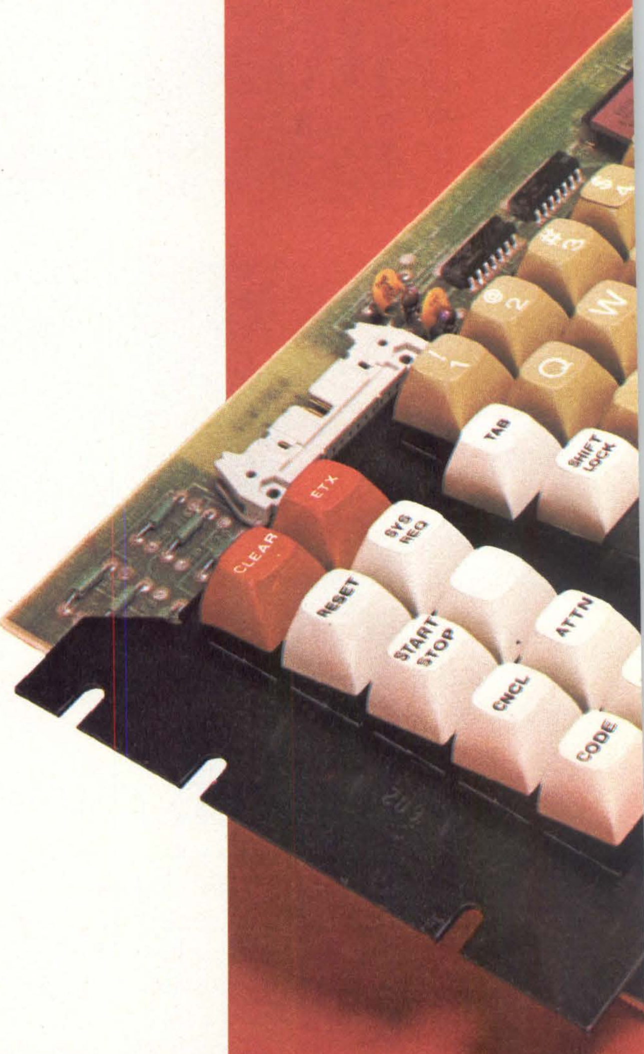
800-527-3460 — 214-271-4667 — TELEX 73-0151

CIRCLE 28 ON INQUIRY CARD

Should you specify solid state or hard contact?

ASK CHERRY.

We make both.



When you ask Cherry about keyboards, we'll tell you about our **solid state** (capacitive) style—a simple switch idea with no bounce constraints that enables a 110 key matrix to be scanned every millisecond. We'll also tell you about our **hard contact** (gold crosspoint) style that has proven so reliable in so many different applications for over a decade.

We'll also tell you which approach will best meet the unique requirements of your application. Such factors as encoded or non-encoded, number of keys, lighted positions... and more. This is particularly important since keyboard applications vary so greatly in complexity and use that there really isn't any one style of keyboard or one technology that's best for all.

Which keyboard technology is best for you? Ask Cherry. Since we make both, we won't try to talk you out of either one.

Hard contact or solid state? Standard or custom design? Sloped, stepped or sculptured keys? Cherry makes 'em all.

Send for our colorful new 36-page catalog that lets you see 'em all. Includes details, data, output codes and specs on both solid state and hard contact keyboards... plus keyboard switches... keycaps... and more.

See Us At
NATIONAL COMPUTER CONFERENCE
June 4-7, 1979
New York Coliseum
CHERRY BOOTHS 1022-1024

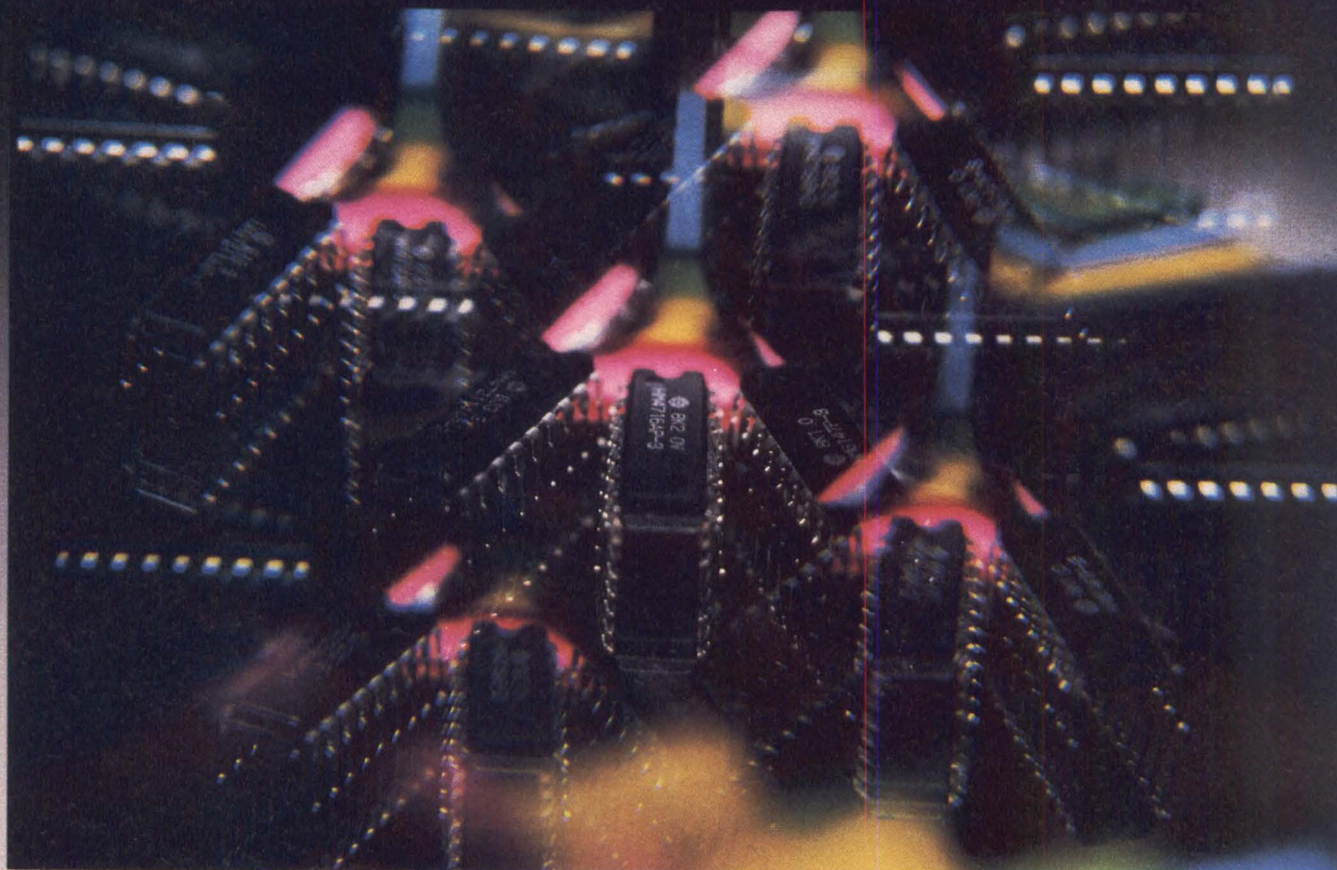
CHERRY® KEYBOARDS

CHERRY ELECTRICAL PRODUCTS CORP.
3614 Sunset Avenue, Waukegan, IL 60085 • 312/689-7612 • TWX 910-235-1572

CIRCLE 29 ON INQUIRY CARD


CONTROL
PROGRAM MODE
SHIFT
NEW LINE
EOM
BACK SPACE
LINE FEED
RETURN
SP
CR
ESC
TAB
SHIFT LOCK
BREAK
CLEAR
ON LINE
CTRL

DO WE HAVE A LOT OF MEMORIES TO REMEMBER?



SURE THING!

In fact, we have a Hitachi memory device available for almost every application need. Just look at the next page for proof.

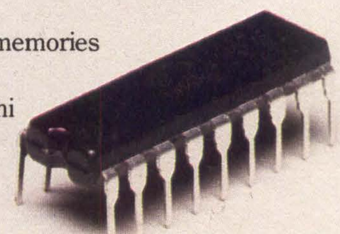
We manufacture everything from 1K CMOS all the way through our million-bit bubble memories. The list goes on and on. And so does our commitment to new and future product development.

But our wide choice of part types isn't the only thing that should keep us memorable.

It's the added value you get with every Hitachi order. Value in proven quality and reliability. In availability. In competitive pricing. In total customer service and attention.

Hitachi value.

That's what makes our memories so hard to forget!



Call your local Hitachi representative or distributor for more information. Or call (800) 323-6713.

(Samples, detailed data sheets and catalog are available on written request on your company letterhead.)

MEMORIES TO REMEMBER

MOS RAM

Type	Operation	Process	Organi-zation	Access Time (ns) max.	Cycle Time (ns) min.	Supply Voltage (V)	Power Dissipation (mW)	Pins	Package[1] C	Package[1] G	Package[1] P	Replacement
HM4704L-2 HM4704L-3 HM4704L-4	Dynamic Dynamic Dynamic	NMOS NMOS NMOS	4096 x 1 4096 x 1 4096 x 1	150 200 250	320 375 375	+12, +5, −5	462 max. 392 max. 392 max.	16		• • •		MK4027-2 MK4027-3 MK4027-4
HM4716A-1* HM4716A-2 HM4716A-3 HM4716A-4	Dynamic	NMOS	16384 x 1	120 150 200 250	320 375 375 410	+12, +5, −5	462 max.	16		• • • •	 • • •	 MK4116-2 MK4116-3 MK4116-4
HM4816*	Dynamic	NMOS	16384 x 1	100	200	+5	440 max.	16		•		
HM46810 HM468A10	Static	NMOS	128 x 8	450 360	450 360	+5	370 max. 420 max.	24	• •		• •	MCM6810 MCM 68A10
HM4847-2* HM4847-3* HM4847*	Static	NMOS	4096 x 1	45 55 70	45 55 70	+5	945 max. 893 max. 840 max.	18		• • •		 2147-3 2147
HM472114AP-2 HM472114-3 HM472114-4	Static	NMOS	1024 x 4	200 300 450	200 300 450	+5	330 max.	18		 • •	• • •	2114-2 2114-3 2114-4
HM435101 HM435101-1 HM435101V	Static	CMOS	256 x 4	650 450 650	650 450 650	+5	142 max. 142 max. 160 max.	22		• • •	• • •	5101L 5101L-1
HM4315P	Static	CMOS	4096 x 1	450	620	+5	83 max.	18			•	
HM6147P-3 HM6147P HM6147LP-3 HM6147LP	Static	CMOS	4096 x 1	55 70 55 70	55 70 55 70	+5	184 max.	18			• • • •	2147-3 2147 2147-3 2147

BIPOLAR RAM

Type	Level	Organi-zation	Output	Access Time (ns) max.	Cycle Time (ns) min.	Supply Voltage (V)	Power Dissipation (mW/bit)	Pins	Package C	Package G	Package P	Replacement
HM2106	ECL	256 x 1	Open Emitter	15	15	−5.2	1.8	16		•		
HM2110 HM2110-1 HM2110-2	ECL	1024 x 1	Open Emitter	35 25 20	35 35 35	−5.2	0.5	16		• • •		F10415A
HM2112	ECL	1024 x 1	Open Emitter	7	8	−5.2	0.8	16		•		
HM2510 HM2510-1 HM2510-2	TTL	1024 x 1	Open Collector	70 45 35	70 45 35	+5	0.5	16		• • •		93415 93415A
HM2511 HM2511-1	TTL	1024 x 1	3-state	70 45	70 45	−5	0.5	16		•		93425 93425A

MOS ROM

Type	Program	Process	Organi-zation	Access Time (ns) max.	Supply Voltage (V)	Power Dissipation (mW)	Pins	Package C	Package G	Package P	Replacement
HN462716	Erasable & Electrically	NMOS	2048 x 8	450	+5	385 max.	24	•			2716
HN46830	Mask	NMOS	1024 x 8	500	+5	683 max.	24	•		•	MCM6830
HN46532-3	Mask	NMOS	4096 x 8	600	+5	440 max.	28	•			

*Preliminary
[1]C: Side brazed ceramic
G: Cerdip
P: Plastic

HITACHI. The sure thing.

Electronic Devices Sales and Service Division
707 W. Algonquin Road, Arlington Heights, IL 60005 (312) 593-7660 • TLX: 20-6825

Representatives:
AL, Tech. Mktg. Assoc., (205) 883-7893
CA, Irvine, Bestronics, (714) 979-9910
Culver City, Bestronics, (213) 870-9191
San Diego, Littlefield & Smith, (714) 455-0055
Sunnyvale, Quadrep, (408) 733-7300
CO, Parker Webster Co., (303) 751-2600
FL, Orlando, TMA, (305) 857-3760
Pompano, TMA, (305) 942-0774
IA, PMA Corp., (319) 362-9177
IL, Sumer, (312) 991-8500
IN, ES&E, (317) 849-4260
KS, PMA Corp. (913) 381-0004
PMA Corp., (316) 684-4141
MA, TSI, (617)862-1306
MD, Rob't Elect. Sales, (301) 766-6374
MI, O-M Sales, (313) 973-9450
MN, Northport Eng., (612) 854-5556
MO, PMA Corp., (314) 569-1220
NJ, ABC Elect., (201) 568-2354
NY, S.F. Foster, (315) 637-5427
S.F. Foster, (716) 265-2072
ABC Elect., (516) 747-6610
ABC Elect., (914) 769-8808
OH, Bear Mktg. (216) 659-3131
PA, Campbell Assoc., (215) 322-6630
TX, Delta Comp., (214) 358-4288
Delta Comp., (713) 783-6848
UT, Parker Webster Co., (801) 487-5911
WI, Sumer, (414) 259-9060
Canada: Ontario, RFQ, Ltd., (416) 626-1445
Quebec, RFQ, Ltd., (514) 694-5724

Stocking Distributors: Bell • Future • Jaco • Marshall • Time

optimizing FORTRAN 5, DG/L, or assembler.

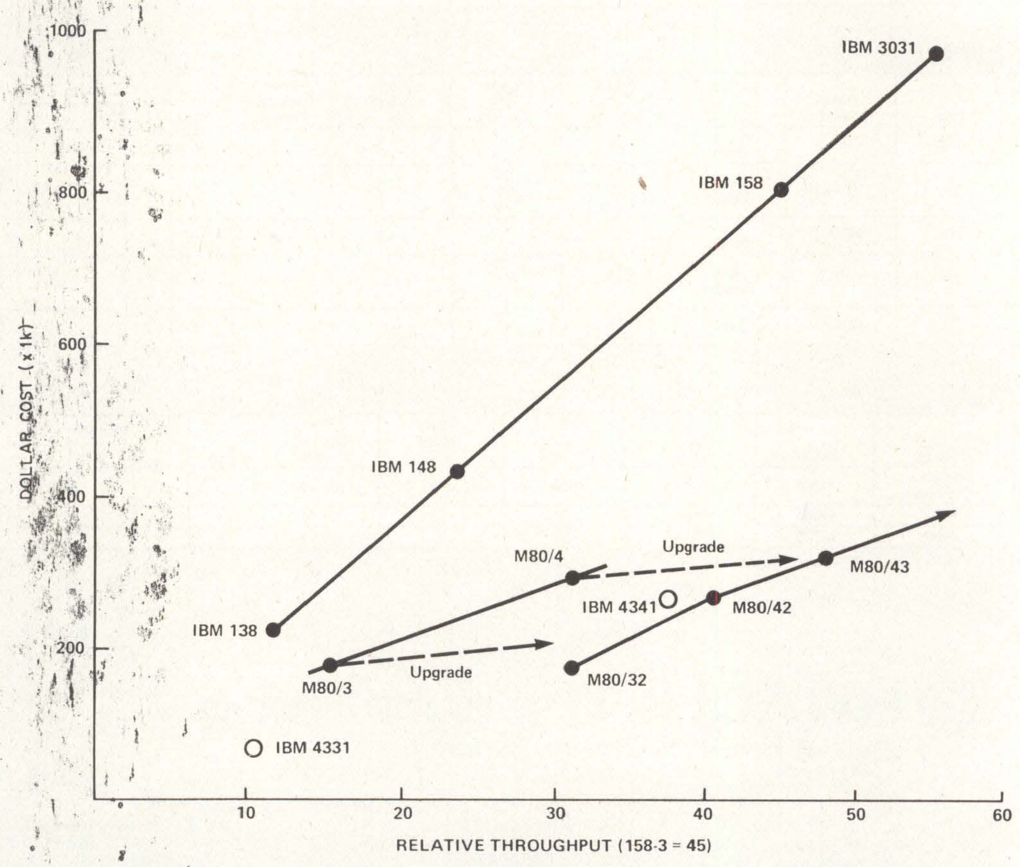
Both models include an 8-slot system module that accommodates processor, memory, internal cables, and up to six (8660) or three (8661) I/O device controllers. Each unit can be expanded to support up to 10 I/O device controllers with an 8-slot I/O system module 8652. Four satellites in any mix can be supported by an S/250.

Circle 404 on Inquiry Card

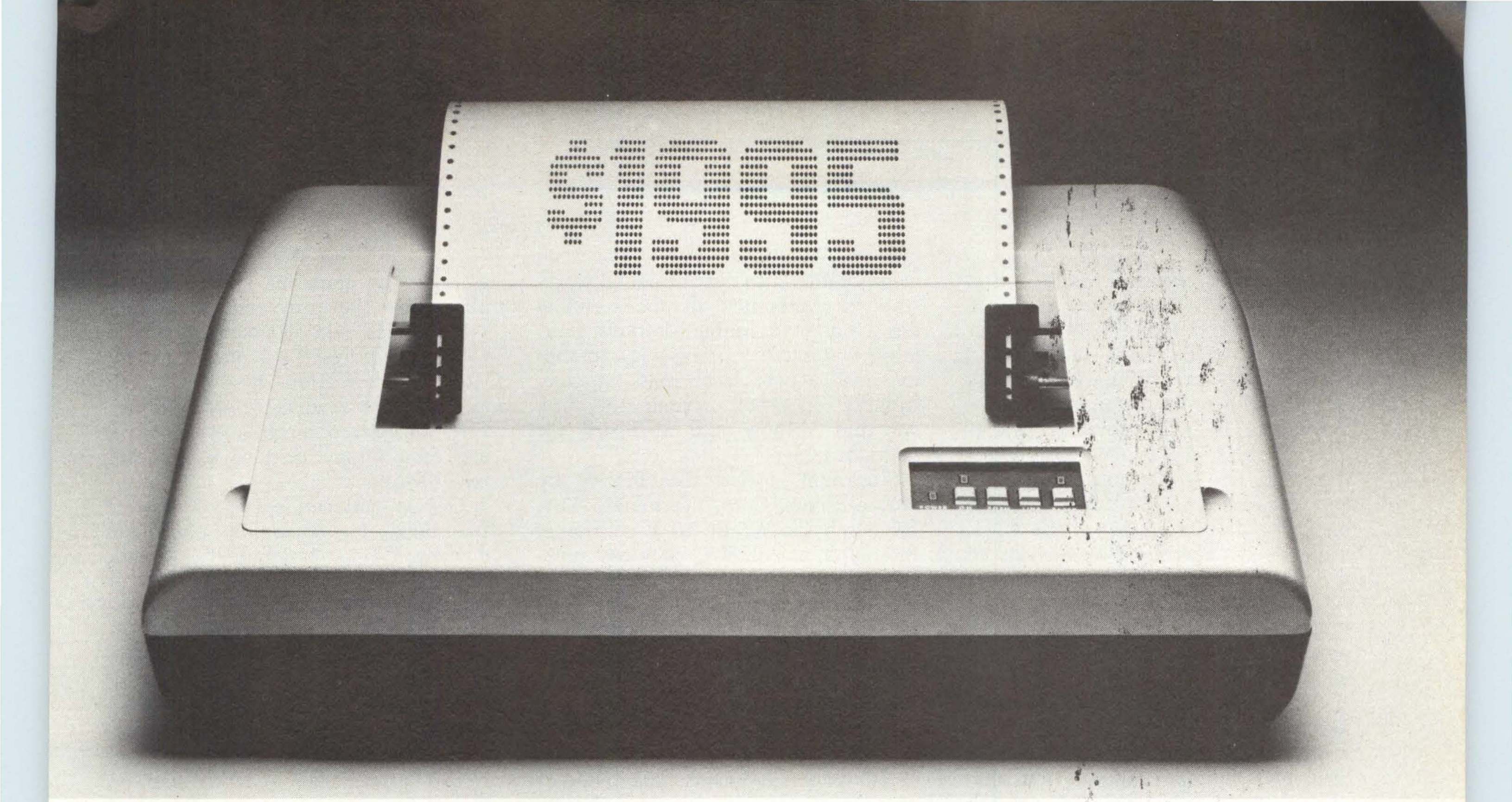
Performance of Expandable CPU Doubled In Intermediate Range

By boosting the performance of the CPU used in the M80 series, Magnuson Computers, 2500 Augustine Dr, Santa Clara, CA 95051, has provided the capability to upgrade a single computer throughout IBM's intermediate computer performance range. The M80 series (see *Computer Design,* Aug 1978, pp 47-48) is based on the strategic architecture concept, giving it its open ended expandability. Performance, memory capacity, and data channel capacity are extended through addition of PC modules and modifications to firmware control programs.

Extensions to the series provide two models that are claimed to be higher in performance than the 4331 and one that lies between the 4331 and 4341. All are remotely maintainable, include diagnostic processors, and have main memory expandable



Magnuson's M80 series processors are expandable across medium scale performance range. Graph illustrates areas where company feels systems' relative performance and costs are competitive with IBM units



Bells and whistles standard.

When you buy our 300 Series Ballistic™ Printer, there's one thing we won't offer you much of.

Options.

Because we made most of them standard on the 300. And lowered its price, too.

NOT MANY OPTIONS. BUT A LOT OF STANDARDS.

The new 300 Series Ballistic Printer is a low-cost, 180 cps matrix printer with a built-in microprocessor. It gives you 15 switch selectable form lengths, 15 perforation skips over formats, and full horizontal and vertical tabulation control. Space and blank character compression. Interface control for serial, parallel, or polling and addressing operation. X-ON, X-OFF, capability. Plus a non-volatile forms retention system that retains these programmable settings when power to the printer is turned off.

The 300's character buffer is optionally expandable to 2048 characters. With it, the printer can fully buffer a 1920 character CRT screen of data without waiting for the screen to transfer to the printer on a line-by-line basis.

THE 300 HAS A GOOD HEAD ON ITS SHOULDERS.

Like all our Ballistic Printers, the 300's dependability originates with its ingeniously simple, patented Ballistic Print head. Instead of moving cores attached to the wires, it uses small armatures that propel its matrix wires in free flight to the platen.

This revolutionary principle greatly reduces drag. Minimizes wire tip wear. Eliminates clogging with inks, dust, and paper fibers. And most importantly, significantly increases head life.

When the head finally does wear out, you can replace it yourself. In minutes. Without a single service call.

IT HAS PRACTICALLY EVERYTHING. EXCEPT A BIG PRICE TAG.

The 300 Series has a full 96 ASCII character set, with up to 128 printables optionally expandable to *two* sets of 128. Which makes it great for bilingual applications. It's even got an elongated character capability, and 10 or 12 pitch standard, with a 10/16.5 dual pitch option. Not to mention 100% duty cycle operation.

On top of that, you get the whole package for a measly $1995.

Honest.

After all, we couldn't print it if it wasn't true.

300 SERIES
Ballistic Printer

Tougher in the long run.

LEAR SIEGLER, INC.
DATA PRODUCTS DIVISION

Lear Siegler, Inc./Data Products Division, 714 Brookhurst Street, Anaheim, CA 92803; (800) 854-3805. In California (714) 774-1010. TWX: 910-591-1157 Telex: 65-5444

CIRCLE 31 ON INQUIRY CARD

to 16M bytes. Existing M80/3 and /4 processors join with the /32, /42, and /43 in competing with IBM's recently announced 4300 and existing System/360 and /370 systems. All five of these units are upgradable.

Model M80/32 provides performance said to be three times better than that of a 4331; and models /42 and /43 offer performances cited to be 110 and 130% of that of the 4341, respectively. Existing /4 converts to a /43 with one upgrade option; the /3 to a /4, /32, /42, or /43. A /4 upgrade option increases processing power 50% and /3 options raise power up to 200%.

Base prices for the additions to the line are $185,000 for a /32 with 1M-byte memory, three configurable channels, system console, audible alarm, and remote data link. A /42 having 2M-bytes memory and three channels with the same complement sells for $275,000; and a /43 with 2M and six channels is priced at $315,000. Additional memory is available at $15,000/M in 2M-byte increments; additional channels are $5,300 each. Shipments are planned for second quarter of 1980.

Circle 405 on Inquiry Card

Intelligent CRT Terminal Combines Modularity With Program Development Aids

Introducing the concept of the Data Station, the 3500 is a modular intelligent CRT terminal designed for incorporation into OEM designed workstations. Embodied in the terminal are a range of communications emulators, interactive processing capability, fast access local mass storage, friendly operating system software, and CRT display and keyboard for operator I/O.

The unit, called the Beaver by Perkin-Elmer Corp, Terminals Div, Randolph Pk W, Rt 10 Emery Ave, Randolph, NJ 07801, provides powerful program development aids and I/O performance features. Designed for use in distributed and standalone dedicated data processing, the station can include 12" (30.5-cm) CRT display, detachable keyboard, up to 2 floppy disc units with 160k bytes of online storage, 48k bytes of RAM in 16k-byte increments, 30k bytes of ROM, and provides overlapped I/O, device independence, and shareable I/O devices. Downline loading facilities are available without floppy disc.

System software comprises multitasking disc operating system; extended BASIC interpreter with commercial and scientific extensions including string manipulators, double precision arithmetic, and array and matrix operations; macroassembler; line editor; and 3275, 2780/3780, and TTY communications emulators. Utility and file management programs include automatic file expansion; and a powerful command substitution facility is provided.

A significant functional feature of the unit is inclusion of two fully powered extra PC board slots. The task of interfacing additional hardware to the operating system is simplified by the provision of a high performance smart DMA interface which can be used to connect to any workstation related hardware such as bar code readers or OCR wands. Overlapped I/O is obtained by having each floppy disc on a separate DMA channel.

Device independent I/O answers the need for changing peripheral devices. Device assignment and task establishment from the keyboard or from within tasks allow the development of completely transparent interactive application packages. The PETOS multiprogramming operating system for the microprocessor based unit is stored in a 30k-byte ROM, eliminating the need for startup and reload procedures. A 25th line on the 24-line CRT screen area functions as the system console, eliminating the need to interrupt the display with operator messages.

The unit can be programmed in BASIC, assembly language, or using a macroassembler. Program development is further aided by source statement and task generation, a complete file management system that offers automatic file expansion, generalized copy, disc verify and dump, directory, and backup utilities. A DEBUG allows setting of multiple breakpoints, facilitates snapshot dumps, and permits examination and alteration of memory and register contents. An optional hardware debug provides for stop-on-address capability and produces a map of the 128 most recently executed instructions.

Communications software includes an asynchronous TTY emulator, bisynchronous terminal manager, bisynchronous downline loader, 3275 emulator, and 2780/3780 emulator in both single and multidrop versions. A set of FORTRAN IV routines is available that can cross assemble any Motorola 6800 S-format output into a format compatible with the data station; or generate code on one of the company's 32-bit minicomputers and load it directly.

A standard unit with dual floppies is priced at $3995 in quantities of 50. A down loading version without disc storage is priced at $2995 (same quantity). Units are currently available for delivery.

Circle 406 on Inquiry Card

The HP 2621: sim

Simple doesn't have to mean unsophisticated. The proof is in our new CRT terminal, the HP 2621.

Before building it, we took a long, hard look at the way you use a simple terminal. Then we took the knowledge gained in more than 10 years designing computer products and applied it to engineering an interactive character-mode CRT terminal from the .user's point of view.

The outcome was actually two models. The HP 2621A, which sells for $1450. And the HP 2621P, which has a built-in printer, costs $2550. You obviously want the sharpest display made. So we used the 9x15 character cell you see on every HP CRT terminal, including the top-of-the-line. And, to help you look back at the data you've entered, we provided two full pages of continuously scrolling memory.

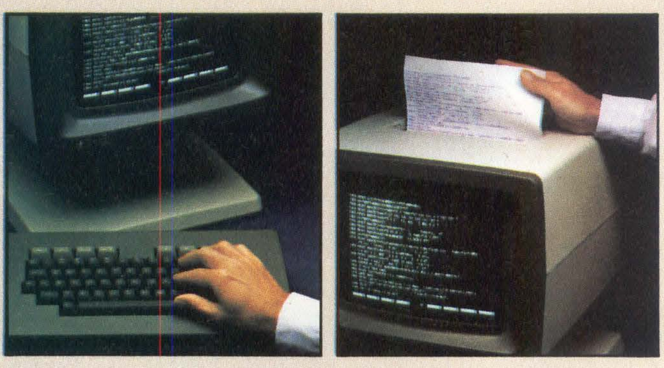
We designed the keyboard like the familiar typewriter, so you don't have to waste time relearning it. We built in eight function keys, too. These control the cursor, rolling and scrolling. And, to make life easier, they're labeled on the screen for self-test, configuration, display and editing.

Editing? On a simple terminal? Certainly. We included character and line insert and delete, clear line and clear display. And, since the 2621 keeps your input separate from your CPU's, you can edit data before sending it to the computer. All without writing a line of system software.

Since flexibility is important in interfacing, we included a user-definable return key that will send your computer whatever code it expects. We also made our terminals compatible with RS232C and Bell 103A, and able to communicate with your CPU at 110 to 9600 baud.

If you need hard copy at your fingertips, take a look at the HP 2621P. With a keystroke, its built-in 120 cps thermal printer will deliver a printout from the screen in seconds.

So why don't you check out the HP 2621 by calling the nearest HP sales office listed in the White Pages. Or send us the coupon. Then see for yourself how sophisticated a simple CRT terminal can be.



Try this on your favorite CRT! With the 2621P, you just hit a key and in seconds you have hard copy of your CRT display. The built-in thermal printer prints upper and lower case at up to 120 cps.

The 2621's bright, high-resolution CRT, with enhanced 9x15 character cell, displays the full 128-character ASCII character set, including upper and lower case, control codes, and character-by-character underline, in 24 80-character lines.

Eight screen-labeled preprogrammed function keys magnify the power of the 2621's keyboard. Preprogrammed functions include editing, terminal configuration, printer control and self-test.

To make numeric data entry faster and easier, we put the 2621's numeric keypad right in the middle of the keyboard. And the 2621's familiar 68-key keyboard is almost as easy to use as a typewriter.

☐ I'd like to know more about HP's new 2621A and 2621P with built-in hard copy.
☐ I'd like to see HP's new 2621A and 2621P with built-in hard copy.
☐ I'd like to know more about HP's complete family of terminals.

Name ______
Title ______
Company ______
Address ______
Phone ______

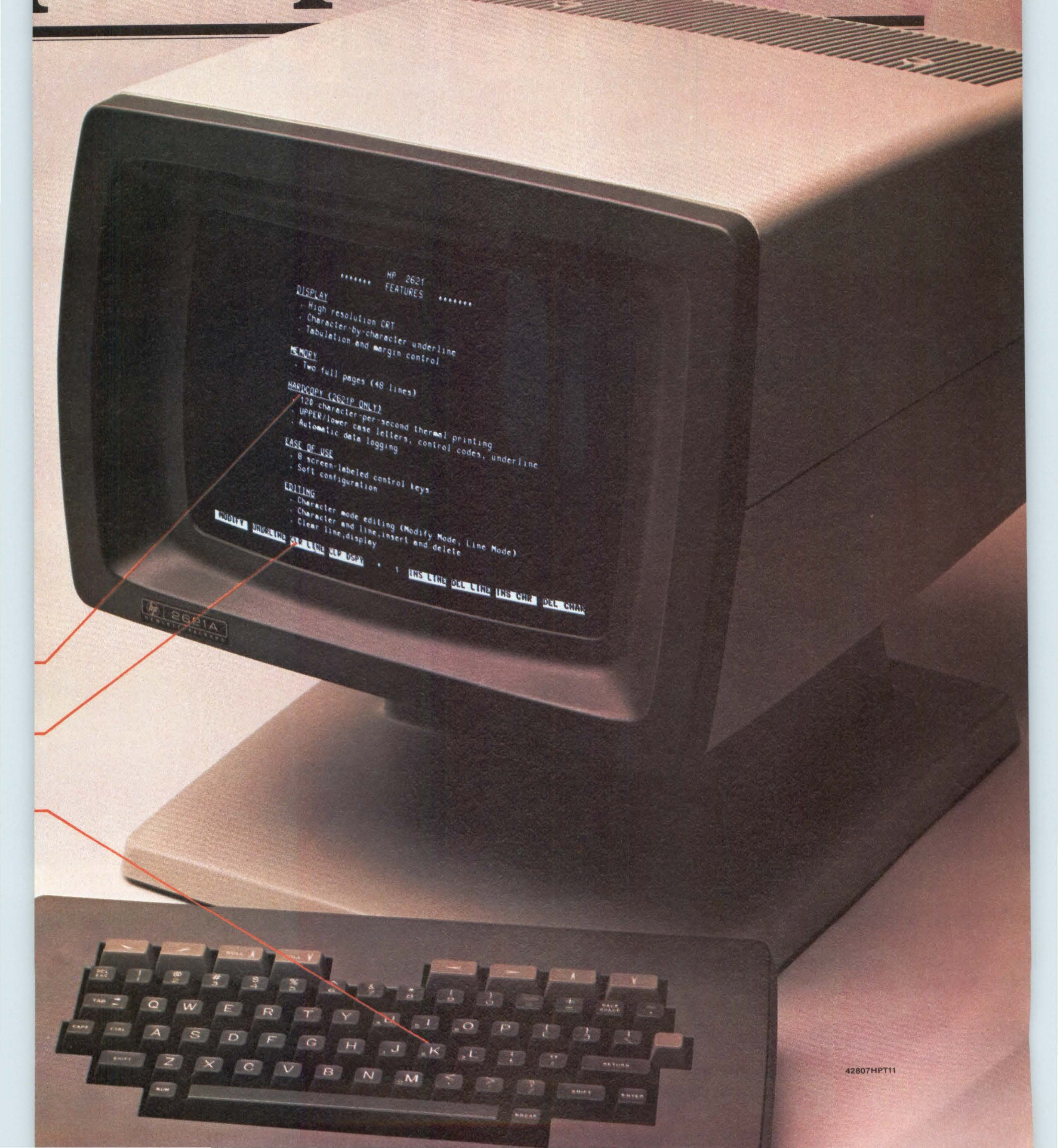
Mail to Hewlett-Packard, Attn: Ed Hayes,
Marketing Manager, Data Terminals Division, Dept. 1247,
19400 Homestead Road, Cupertino CA 95014.

HEWLETT hp PACKARD

All prices are U.S. list.
Available on GSA Contract #GS-00C-01529 from 12/8/78 through 9/30/79.

CIRCLE 33 ON INQUIRY CARD

ple sophistication.



We've just built a brand new case for color graphics.

The new Intecolor 3621.

Desk top computing will never be the same.

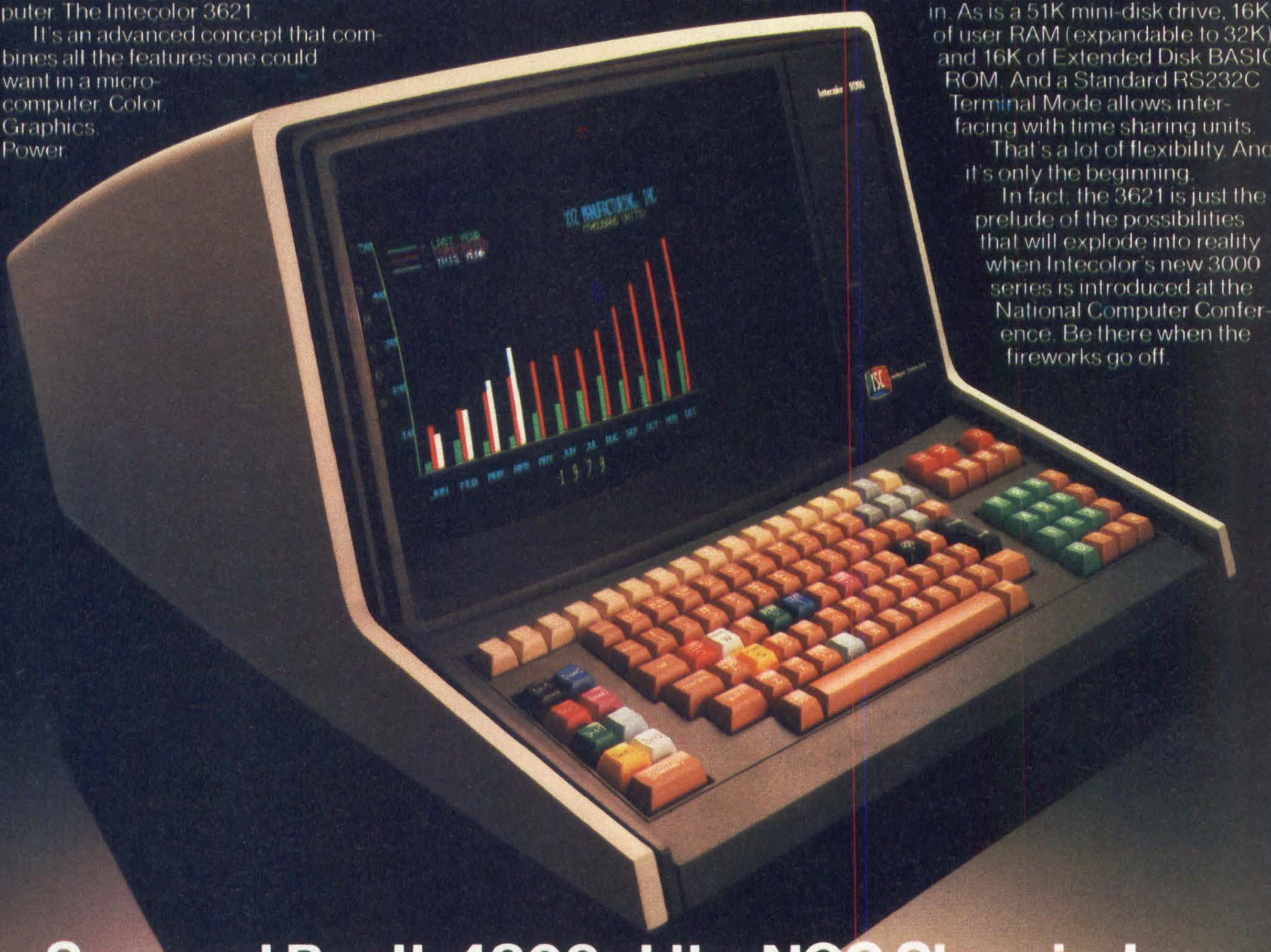
From Intelligent Systems Corporation, the company that developed color graphics at black and white prices, comes a sophisticated new design that will put dynamic, efficient color at the fingertips of everyone who uses a desk top computer. The Intecolor 3621.

It's an advanced concept that combines all the features one could want in a microcomputer. Color. Graphics. Power. Reliability. Performance. Style. All in a sleek, compact package. At a price that's irresistible.

Eight brilliant colors speed comprehension and communication on an ample 13" screen. The unit has the capability of displaying 32 lines of 64 ASCII characters, as well as plotting graphics on a 128 x 128 grid. Vector software is built in. As is a 51K mini-disk drive, 16K of user RAM (expandable to 32K) and 16K of Extended Disk BASIC ROM. And a Standard RS232C Terminal Mode allows interfacing with time sharing units.

That's a lot of flexibility. And it's only the beginning.

In fact, the 3621 is just the prelude of the possibilities that will explode into reality when Intecolor's new 3000 series is introduced at the National Computer Conference. Be there when the fireworks go off.



See us at Booth 4806 at the NCC Show in June.

Unretouched photo of screen

ISC SALES REPRESENTATIVES: AL: 205/883-8660, **AK:** (GA) 404/449-5961, **AZ:** 602/994-5400, **AR:** (TX) 214/840-2169, **CA:** Alhambra 213/281-2280, Goleta 805/964-8751, Irvine 714/557-4460, Los Angeles 213/476-1241, Mountain View 415/964-9300, San Diego 714/292-8525, **CO:** 303/759-0809, **CT:** (GA) 404/449-5961, **DE:** (GA) 404/449-5961, **DC:** (VA) 703/569-1502, **FL:** Orlando 305/425-5505, Ft. Lauderdale 305/776-4800, Melbourne 305/723-0766, Tallahassee 904/878-6642, **GA:** 404/455-1035, **HI:** 808/524-8633, **ID:** (UT) 801/973-7969, **IL:** (No.) 312/564-5440, (So.) (MO) 816/765-3337, **IN:** (IL) 312/564-5440, **IA:** (MO) 816/765-3337, **KS:** (MO) 816/765-3337, **KY:** 606/273-3771, **LA:** 504/626-9701, **ME:** (GA) 404/449-5961, **MD:** (VA) 703/569-1502, **MA:** (GA) 404/449-5961, **MI:** 313/227-7067, **MN:** 612/822-2119, **MS:** (AL) 205/883-8660, **MO:** 816/765-3337, **MT:** (CO) 303/759-0809, **NB:** (MO) 816/765-3337, **NH:** (GA) 404/449-5961, **NJ:** (GA) 404/449-5961, **NV:** (AZ) 602/994-5400, **NM:** 505/292-1212, **NY:** (GA) 404/449-5961, **NC:** 919/682-2383, **ND:** (MN) 612/822-2119, **OH:** Dayton 513/429-9040, Cleveland 216/464-8113, Columbus 614/436-2051, **OK:** (TX) 214/840-2169, **OR:** 503/620-5800, **PA:** 412/922-5110, **RI:** (GA) 404/449-5961, **SC:** 803/798-8070, **SD:** (MN) 612/822-2119, **TN:** 615/482-5761, **TX:** 214/840-2169, El Paso Area (Las Cruces, NM) 505/523-0601, Houston Only 713/780-2511, **UT:** 801/973-7969, **VT:** (GA) 404/449-5961, **VA:** 703/569-1502, **WA:** 206/455-9180, **WV:** 412/922-5110, **WI:** (IL) 312/564-5440, **WY:** (CO) 303/759-0809. **EUROPEAN EXPORT SALES**: **EUROPE**: (MA) 617/661-9424, **BELGIUM**: Brussels 02-242 36-04, **FRANCE**: Rueil Malmaison 749-40-37, **GREECE**: Athens 642-1368, **ITALY**: Roma 805-647/872-457, **THE NETHERLANDS**: Poeldijk 01749-7640, **SPAIN**: Barcelona 204 17 43, **SWEDEN**: Vallingby 08-380-370, **SWITZERLAND**: Mutschellen 057-54655, **UNITED KINGDOM**: Bournemouth 0202-293-115, **WEST GERMANY**: München 089-31881, **AUSTRALIA & NEW ZEALAND**: Melbourne 543-2077, Meadowbank 808-1444, Chermside 59-6436, Wellington 64-4585, Auckland 876-570, **CANADA**: Datamex, Ltd. (Distributor) Dorval 514/636-9774, Ottawa 613/224-1391, Toronto 416/787-1208, Vancouver 604/684-8625, **CENTRAL & SOUTH AMERICA & CARIBBEAN**: (GA) 404/394-9603, **MEXICO**: Monterrey 564-876, **FAR EAST**: (CA) 213/382-1107, **HONG KONG**: 5-742211, **JAPAN**: Tokyo 402-8596, **TAIWAN**: Taipei 02-7026284, **MIDDLE EAST**: **IRAN**: Tehran 891148, **ISRAEL**: Tel Aviv 266-291, **KUWAIT**: Kuwait 438 180/1/2, **LEBANON**: Beirut 221731 260110, **SAUDI ARABIA**: Jeddah 27790, Ryadh 25083-39732, **UNITED ARAB EMIRATES**: Sharjah 24068.
For sales and service in other countries contact ISC headquarters in Norcross, GA., U.S.A.

Intelligent Systems Corp. □ 5965 Peachtree Corners East □ Norcross, GA 30071 □ Telephone 404-449-5961 □ TWX 810-766-1581

Midrange Computer Family Includes Multiprocessor Configurations

Up to 67% higher performance and lower prices are offered by additions to the 8500 series from NCR Corp, Dayton, OH 45479. In addition to multiprocessing machines that provide the power and reliability necessary in transaction processing environments, the company has reduced prices on memory, provided further unbundling of software, and extended customer software services.

All systems use the virtual resource executive (VRX) operating system that provides full dynamic resource allocation as well as virtual memory without rigid memory partitioning. V-8500M systems accommodate VRX-MP which offers multiprocessing capabilities. Multiprocessing versions of the systems feature up to four tightly coupled processors that share all system resources. The VRX-MP system provides the ability to link different processor models in a single multiprocessing complex, allowing implementation of multiprocessing involving processors with different performance characteristics.

Improved transaction processing is obtained through the use of parallel multitasking techniques in VRX. This provides more parallel operations of critical software segments. The MP version can be implemented with no operator retraining. It incorporates concurrent online diagnostics, multiple remote job entry, and enhanced online program development features.

By conforming to the Migration Path Engineering design philosophy, the systems allow programs, files, and peripherals to be moved from current 8400 and 8500 series units without time consuming conversion effort. Internal bus architecture provides a flexible high speed data path to which all components attach. Extensive use of ECL circuits, 370-ns read/440-ns write RAM, and bit serial link I/O capable of transferring data in a serial bit stream at 16M bits/s further extend performance.

Largest member of the family, the V-8585M is a 56-ns mainframe with from 2M to 6M bytes of main memory. It offers 65% greater performance than the -8580 at a price about 20% lower—$375,000. Consisting of two -8585Ms and offering about 1.7 times the throughput of a single processor system, the V-8585M is available at $810,000.

With 2M to 4M bytes of memory and 56-ns processor, the V-8575M has 24% more processing power than the V-8570 at 37% less cost. Two tightly coupled V-8575M processors make up the v-8575MP and provide 70% more processing power.

Offering 45% more power than the V-8560, the V-8565M has from 1M to 3M bytes of main memory, and sells for $140,000 in a 1M-byte version. In a multiprocessor configuration with two tightly coupled processors and from 2M to 6M bytes of memory, the 8565MP has a price of $340,000.

Also offered are V-8555M and MP versions with from 0.5M to 4M bytes of memory, and an -8400 series machine, the V-8455 which supplements the current V-8400 family. This machine operates under VRX with 0.5M to 1M bytes of main memory and offers 90% of the power of a -4331 at 73% of the price.

Circle 407 on Inquiry Card

English-Like Language For Data Base Management On Small Computers

An application development foundation system, SIMILE (Software Intensive Micro-Processing System) fully integrates CODASYL-like database management with query and reporting facilities. Developed by Small Business Machines, Inc, 527 Madison Ave, New York, NY 10022, the system is effective both standalone and as a node on a network.

Based on English-like commands, the conversational system runs on 64k and larger machines. Commands enable the user to define, create, access, maintain, and query a data base. Easy on- and offloading between system data bases and disc files combine with communication routines to allow interface between mini/micro and mainframe.

Heart of an application is a set of data bases and their subsidiaries with cross-referencing keys. Each data base is a file of individual records in a standardized format. Complementing this database structure is the command system. Responses to the original prompt allow the user to create or modify the schema file which establishes the database structure; to enter, change, or delete information in the data bases, or to query or produce reports; to erase a data base; or to exit the system. Each of these actions initiates a dialog in which the system accepts commands, specific information, and alternatives or parameters.

For the system builder, the software provides a general solution to a large number of common situations and problems. By identifying the elements of the structure as they apply to the particular situation, providing detailed descriptions of the character, and supplying organization of the particular items and reports, the builder creates a solution to his problem through the system.

Circle 408 on Inquiry Card

Graphic Processing Systems Speed Design and Manufacturing Cycles

Graphic processing systems HITAC G-710 and -730 increase efficiency of design and manufacturing by providing speedy response and easy operation. Hitachi, Ltd, No. 5-1, Marunouchi 1-chome, Cyiyoda-ku, Tokyo 100, Japan, developed the systems specifically for shortening the design and manufacturing processes using CAD and CAM systems.

The G-710 intelligent graphic terminal system is used as a remote terminal, forming part of a centralized large scale processing system. It operates a CAD system requiring large volume interactive computation and is particularly suited for improving efficiency in the design process. Easy operation is provided through use of input methods such as menu command and symbolic command based on a graphic tablet.

A distributed computer graphic system, the G-730 uses its own small computer for application programming, and operates a CAD system in interactive mode. Suited for automation of machine parts drafting, the system is capable of graphic I/O and interactive modifications without user programs.

Substantial graphic processing programs as well as basic and extended support programs are supplied for the system. These provide capabilities for processing graphic I/O, modifications, and additions and deletions, without program changes or modifications. Operation is through the graphic tablet as well as programmed function keys and macrocommands.

Circle 409 on Inquiry Card

Computer Mainframe Extends Memory Capacity to 8M Bytes

Extending performance of the OMEGA 480 line into the range of the IBM 3031, the model III, announced by Control Data Corp, Box O, Minneapolis, MN 55440, uses 16k MOS memory chips and ECL circuitry to pack 8M bytes of memory in a cabinet one-half the size of a System 370/158 with 1M bytes. Prices for the systems range from $360,000 for a 2M-byte unit to $540,000 for a machine equipped with 8M-byte memory.

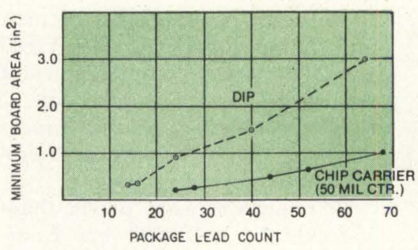
Memory used in the systems is made up of 16k n-channel MOS chips and is expandable in 2M-byte increments to maximum capacity of 8M bytes. Existing models I and II can be field upgraded, providing current users with greater flexibility.

Standard input and output of data are accomplished through the use of one byte multiplexer and five block multiplexer channels. In byte mode maximum data transfer rate on the byte multiplexer channel is 50k bytes/s. Each block multiplexer channel transfers data at a rate of more than 1.85M bytes/s to provide a maximum data transfer rate on all channels of 7.5M bytes/s.

Deliveries of the model III are scheduled to begin in third quarter of this year. The systems are manufactured by IPL Systems, Inc, Bedford, Mass.

Circle 410 on Inquiry Card

IC Packaging Technology Raises Reliability While Lowering Costs



Large cost savings can be realized at systems level through use of premolded chip carriers from AMP which accommodate ICs with up to 64 leads providing significant increase in packaging density and allowing automatic packaging and insertion

A premolded plastic chip carrier package not only satisfies the need for increased packaging density but also brings the economies of back-end operations to the semiconductor packaging houses. Designed by AMP Inc, Harrisburg, PA 17105, as an integral part of a complete process, the technology includes machinery and equipment necessary to operate on a cost applied basis.

Allowing completely automated packaging of bipolar and MOS chips from die attach through marking and testing, the series of strip fed devices are designed to reduce manufacturing cost while substantially improving onboard density, termination reliability, and ease of diagnostics and repair. Population densities include 24-, 44-, and 68-position square packs. A floating outer lead structure provides reliable package to board termination.

The premolded package (PMP)² is a composite metal/dielectric assembly that includes a conductor lead frame and molded insulating body with one or more apertures for mounting microelectronic elements. All necessary plating operations are performed by the package manufacturer to eliminate plating or tinning by the user. Without a specific form factor, the PMP may be fabricated in forms that include conventional DIP, chip carrier types, and multicomponent modules.

The encapsulation technique uses silicone gel encapsulation compounds that remain soft after full polymerization, assuring internal compliance and minimal stress build-up inside the package. Prior to application of silicone the area to be protected is cleaned and covered with a monomolecular layer of water. When the compounds are applied to the prepared surface the silicone molecules displace water molecules to form a chemical bond to the chip surface, preventing further bonding or mobility of water and ions across the surface and preventing corrosion.

Assembly options allow direct attachment of the semiconductor device to an external package element facilitating outward thermal transfer. Nominal power handling capabilities range from 350 mW to 10 W for various options.

A complete system of assembly, encapsulation, and finishing equipment incorporates features that include reel to reel stock handling, modularity, and adaptability to assembly options within the technology. Chip assembly and interconnection are based on existing industry techniques.

Circle 411 on Inquiry Card

Computer Series Adds High Performance, Large Capacity CPU

The AS/3-5, an extension to the Advanced System™ family of processors from Itel Corp, Data Products Group, San Francisco, CA, has a processor cycle time of 115 ns and claims to offer 22% more performance than IBM's 4341. Functionally compatible with the IBM 4341, System/370 model 158-3, and with all of the company's Advanced Systems, the /3-5 is available with 2M bytes of processor storage and can be upgraded to 8M bytes in 1M-byte increments.

The combination of high performance 16k cache buffer and large memory capacity permits users to run the MVS operating system comfortably in addition to DOS/VE, DOS/VSE, OS/VSI, SVS, and VM/370. Other features include a microcoded processor with many of the assist features of the 3033 as well as IBM 1400/1700 compatibility, and hardware and firmware diagnostics used in the 370/158-3 and /168 as well as diagnostics developed exclusively for Advanced System processors.

Purchase price of the system is $600,000. Each additional megabyte of memory costs $75,000. The system is currently available for customer shipment. □

Circle 412 on Inquiry Card

CIRCLE 35 ON INQUIRY CARD

Computers Control and Test Processes in Entire Pharmaceutical Tablet Manufacturing Facility

Automation can serve many purposes, many of which directly or indirectly benefit either workers or the public. In a munitions plant, it eliminates the need for humans in a potentially hazardous environment; in an engine fabrication facility, it enables heavy blocks of metal to be maneuvered without physical strain on people. However, in pharmaceutical fabrication facilities—in addition to providing desired precision—it minimizes the handling of chemicals and materials in areas where strict sanitary standards must be maintained in order to prevent contamination or reduction in quality.

The Elkton, Va, Pharmaceutical Laboratories facility of Merck & Co's Merck Sharp & Dohme Div is a prime example. Although similar but smaller plants are in operation in the U.S. and in Europe, when the Elkton facility was dedicated in October 1977 it was the first large scale computer controlled tablet manufacturing operation in the U.S.

Computer control is maintained on all steps in the production of one of the company's major prescription pharmaceutical products. With virtually no human handling of chemicals or processing materials during or between processing steps, the system automates movement of all necessary materials through the process; controls weighing, mixing, grinding, drying, lubricating, and blending of bulk pharmaceutical ingredients; compresses code-identified tablets; coats tablets with a water based solution; and provides partially computerized control of quality control testing of both raw materials and finished tablets.

The computer controlled tablet manufacturing process fills 21,600 ft^2 (2000 m^2) in an 80-ft (24-m) high, 3-story (equivalent to an average 6-story) building area, with what is described as a "labyrinth" of equipment: sophisticated pharmaceutical manufacturing, material handling, and computer process control equipment. Included are machines for blending, granulating, drying, tablet compressing, and tablet film coating plus hoppers, tanks, bins, pipes, columns, vacuum and bucket conveyors, belts, coils, cables, valves, dampers, sensing devices, and alarms. An additional 113.000-ft^2 (10,500-m^2) area in the 154,000-ft^2 (14,300-m^2) facility is used for packaging, quality control, warehousing, receiving, shipping, maintenance, and mechanical operations.

The Production Process

Controlling element for the process is a Control Data Corp System 17 computer. Integrated within the system are approximately 240 sensing, regulating, and controlling devices; a communications system that includes visual display terminals and printers; and an 8 x 14' (2.5 x 4.3-m) backup panel that can become a manual control center if required. Hundreds of miles of wiring interconnect system components.

The computer regulates valves, dampers, motors, and belts to maintain flow and processing of materials and to control processing conditions within specified limits and ranges. Weights and rates of flow of chemicals, liquids, and tablets are checked by the computer via sensing devices at various stages of the process. In addition, the computer monitors temperatures, humidity levels, and pressures in both manufacturing and conveying equipment.

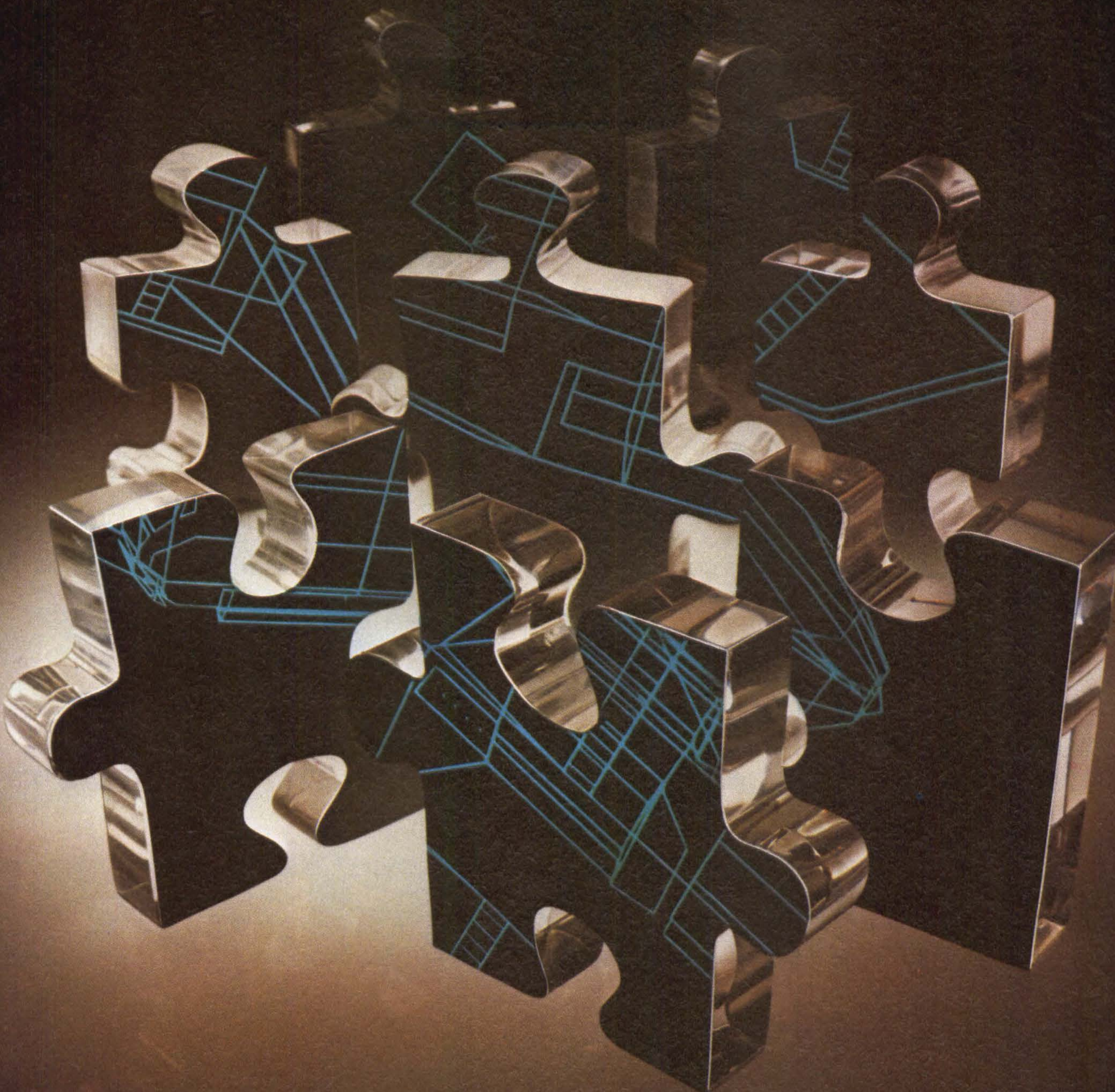
Movement of all solid and liquid chemicals, processing fluids, and, at later stages of the process, compressed and film coated tablets, is totally automated. For greater efficiency, the custom designed automated materials handling system incorporates vertical drops through pipes and columns to utilize gravity flow where possible, but uses pumps, vacuums, and bucket conveyors to accomplish upward and horizontal flow when necessary.

Chemicals flow by vertical drop from a third floor bulk loading station through a series of holding and feeding hoppers into blending equipment and finally to continuous granulating and drying equipment on the first floor (see simplified flow diagram). A vacuum system draws granulated powder from a first floor dryer through an 80' (24-m) high stainless steel column to the third floor for grinding and sizing.

Again by vertical drop, the components move through lubricating hoppers and blenders that add and blend chemicals to ease compressing, and into first floor compressing machines. As tablets are compressed to proper specifications for thickness, weight, and hardness, a code identification is added to each.

Bucket conveyors then carry the tablets up into hoppers that feed second floor coating columns. Finally, the finished tablets are placed in stainless steel tote bins for storing prior to packaging.

(Continued on page 74)



WHY PUZZLE OVER PIECES?

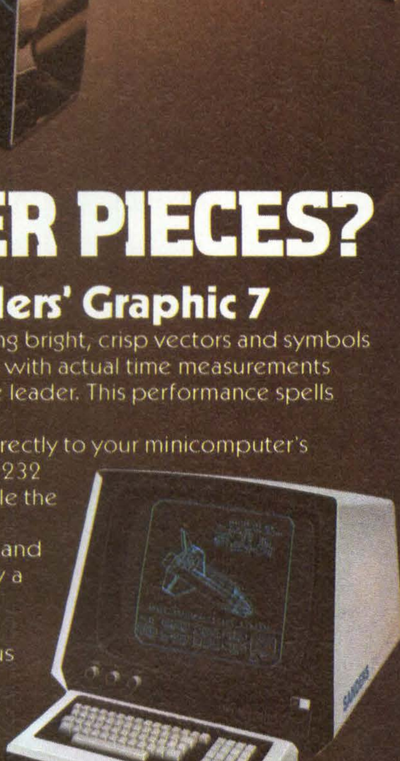
See the whole picture on Sanders' Graphic 7

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.

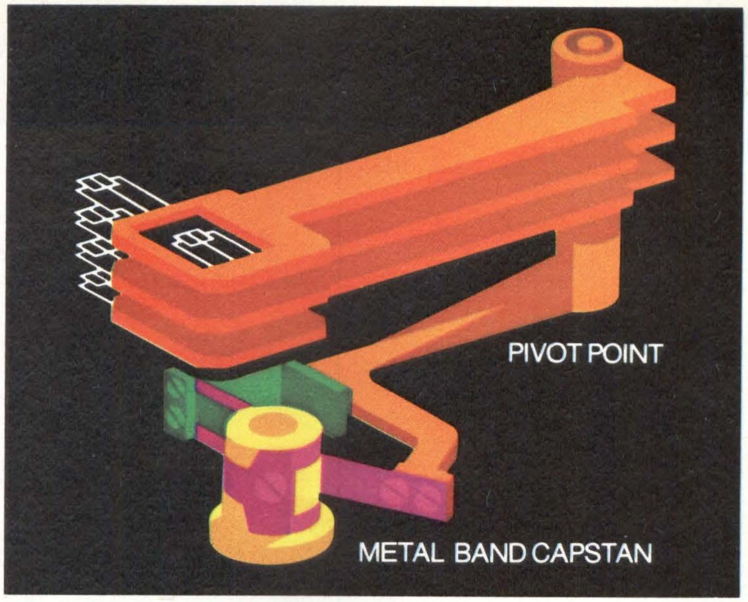
CIRCLE 36 ON INQUIRY CARD

The SA4000 Fixed Disk Drive.
The SA4000 Series of rigid disk drives are the newest line of low cost mass storage products from Shugart. Our floppy disk drives have been the industry standard for years, and now our fixed disk drives are setting new standards of their own. Like the lowest cost per megabyte in their capacity range so you can have up-to-date Winchester storage at a price that won't bite into your system profits. That means real dollars and cents savings to help keep your system competitive. SA4000 drives are available in capacity ranges that are just right for most systems too—14.5 and 29 megabytes (unformatted). And when you design our drives into your system, you can be sure you've got a system architecture that's compatible with IBM S/32, S/34 and System 1 fixed/floppy architecture.

The head in cost per

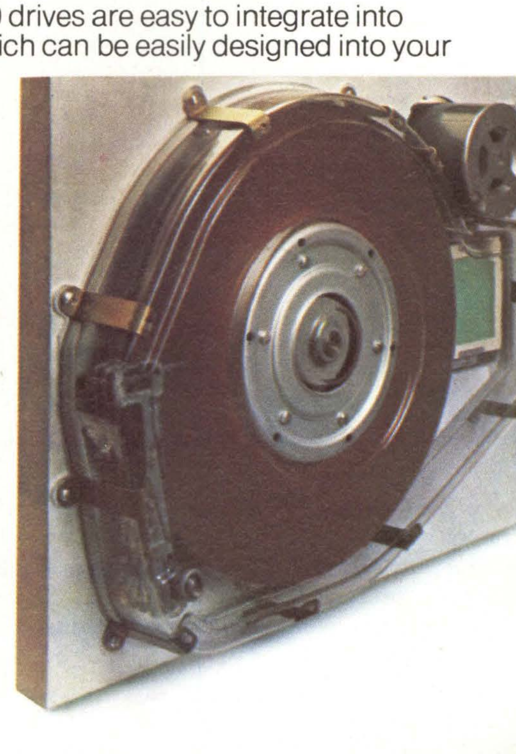
Winchester Technology and Two Configurations.
Shugart fixed disk drives use industry-proven Winchester head and media technology to preserve your data in its own safe, sealed environment. The model SA4004, with 14.5 megabyte capacity, utilizes one disk and four heads. The SA4008, 29 mbyte version, has two disks and eight heads. Eight optional fixed heads are available to give you an additional 144 kbytes (unformatted) of head-per-track storage for applications such as indexed files or table look-up. The SA4000 Series offers an easy upgrade too. Keep your floppys for I/O and system back-up. Add our rigid disk drives for the additional capacity and throughput you need to upgrade your operating systems and mass storage.

When You Think Actuators, Think Fasflex II.™ Shugart's new, proprietary Fasflex II™ is another result of Shugart's headstrong commitment to R&D. This open loop band actuator is virtually wear-proof, and it doesn't require any adjustments in the field. Heat dissipation? With Fasflex II it's extremely low—only 200 watts is typical. But the Fasflex II acutator is only one of the benefits you get with the SA4000 series. The drives weigh a mere 35 pounds—that's about half the weight of comparable units. They're compact. They use only 5.25 inches of panel space, they can be easily mounted in a 19-inch RETMA rack. The drives are rugged, yet easy to maintain. The PCB and spindle drive motor are open and accessible on the underside of the drive. No preventive maintenance is required.



# of its class megabyte.

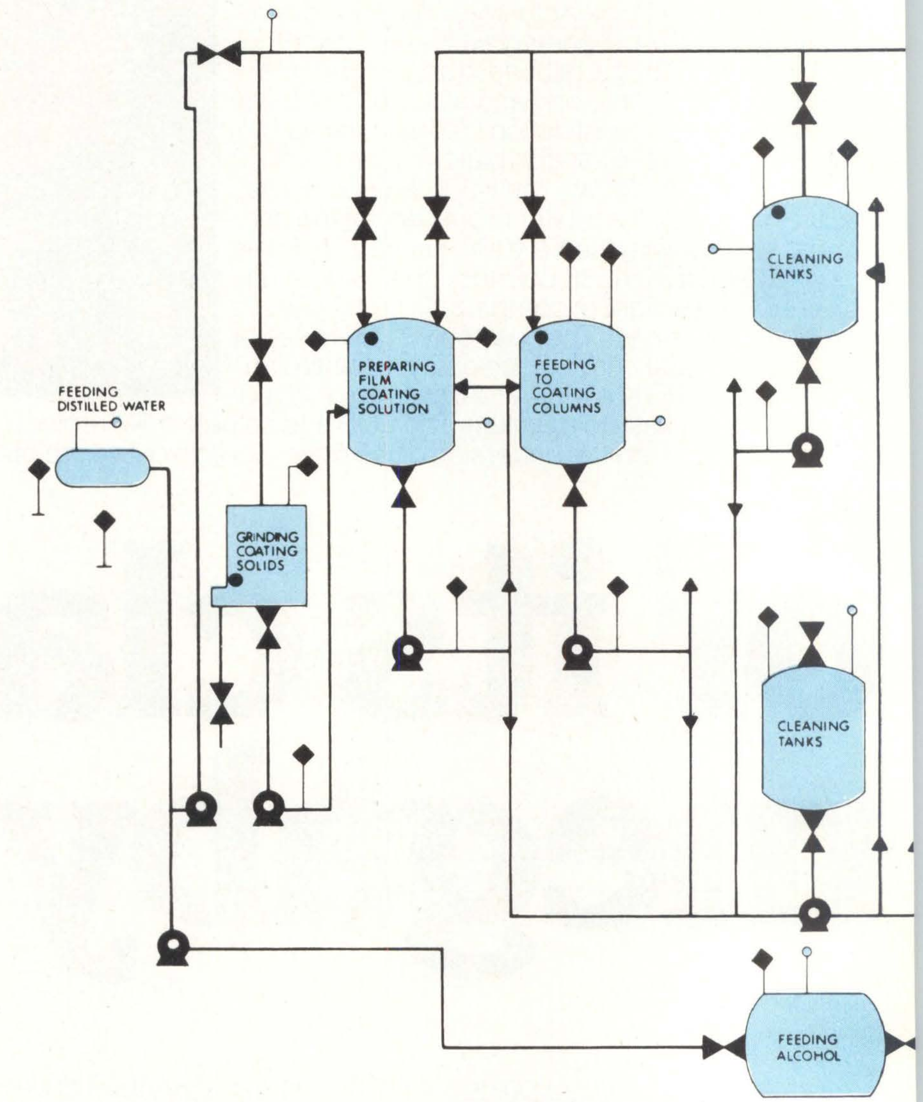
And If You're Looking at the Bottom Line. SA4000 drives are easy to integrate into your system. The drives utilize a simplified interface which can be easily designed into your system. In addition, you can use the same power supply for both the SA4000 drives and floppy drives, since they have the same voltage requirements. Want to get on-line quick? Our new SA4600 controller handles up to four SA4000 drives with an option to control up to four single or double density floppy disk drives. Bottom line? Lower overall system cost. So now's the time to design a classy system with the head of its class—the compact, reliable, low cost SA4000. Shugart Associates, Headquarters: 435 Oakmead Parkway, Sunnyvale, California 94086 (408) 733-0100; West Coast Sales/Service: (408) 252-6860; Midwest Sales/Service: (612) 574-9750; East Coast Sales/Service: (617) 893-0560; Europe Sales/Service: Paris (1) 686-00-85; Munich (089) 17-60-06.



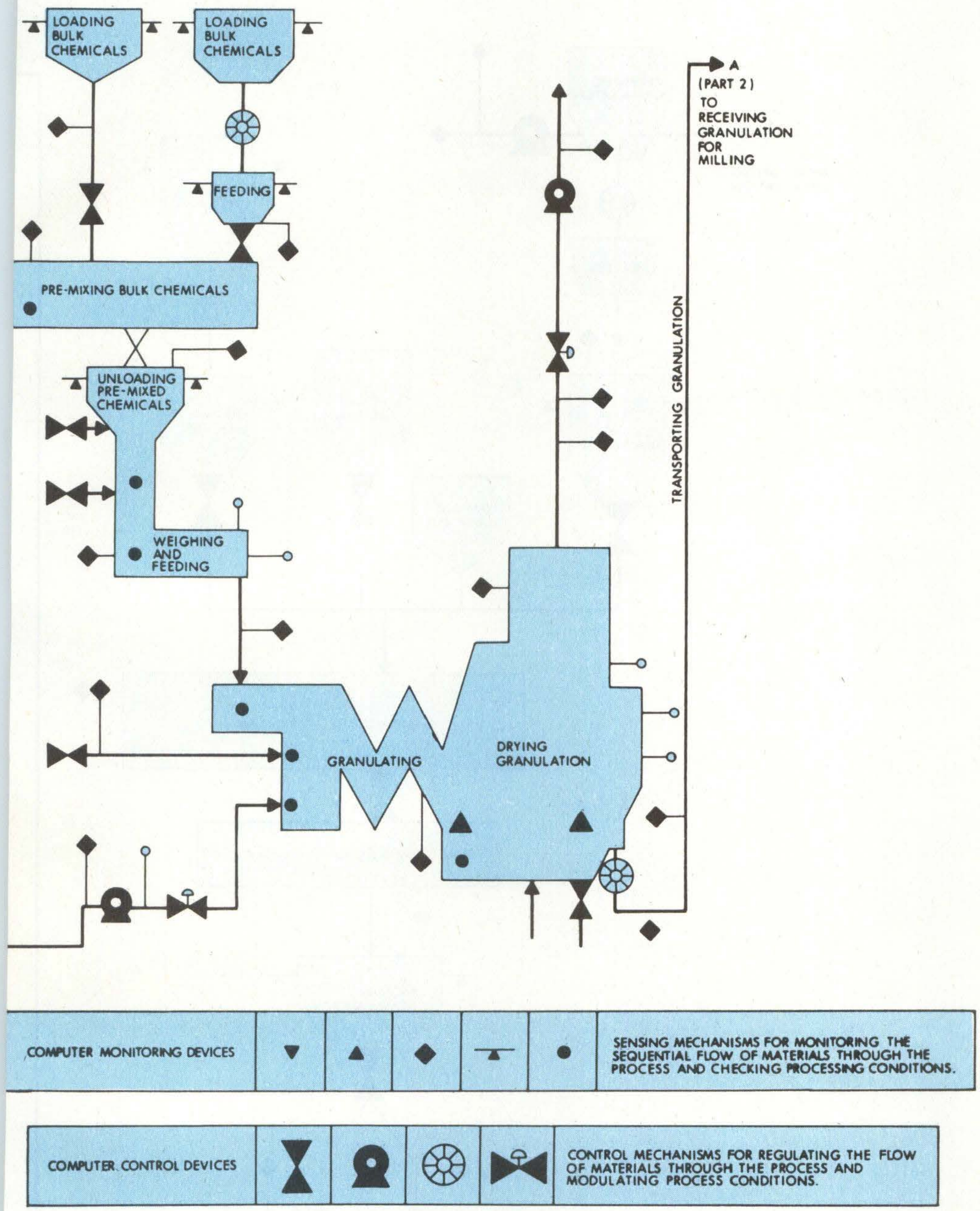
Shugart

The Headstrong Company

CIRCLE 37 ON INQUIRY CARD



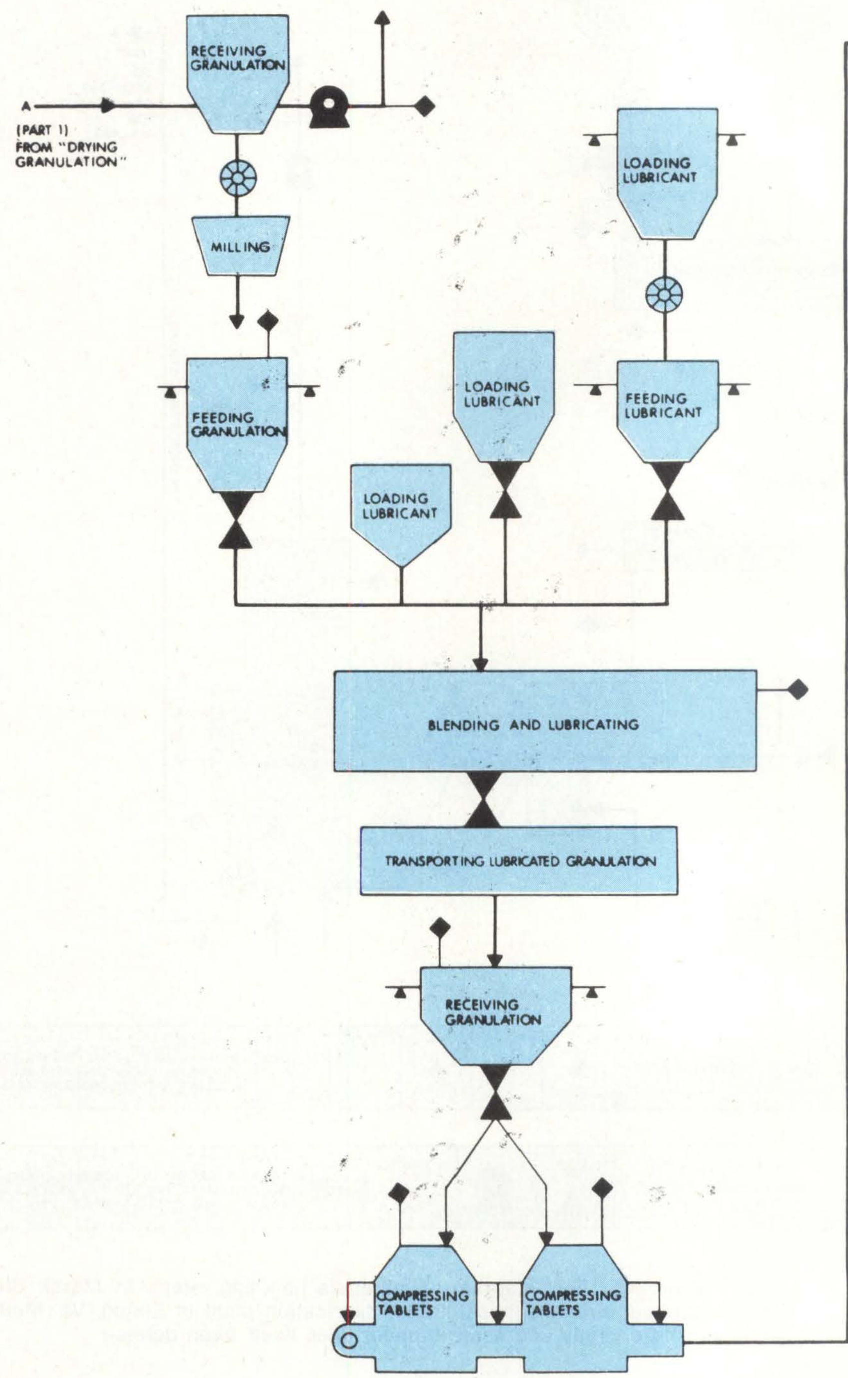
Operators at stations in the "field" within the building monitor critical steps and communicate via 2-way radios with a process operator in the central control room. The field operators initiate the loading of bulk materials at the beginning of the process and conduct tests of the tablets at compressing and film coating stages. Materials are not permitted to pass these stages of the process until the computer has checked the in-

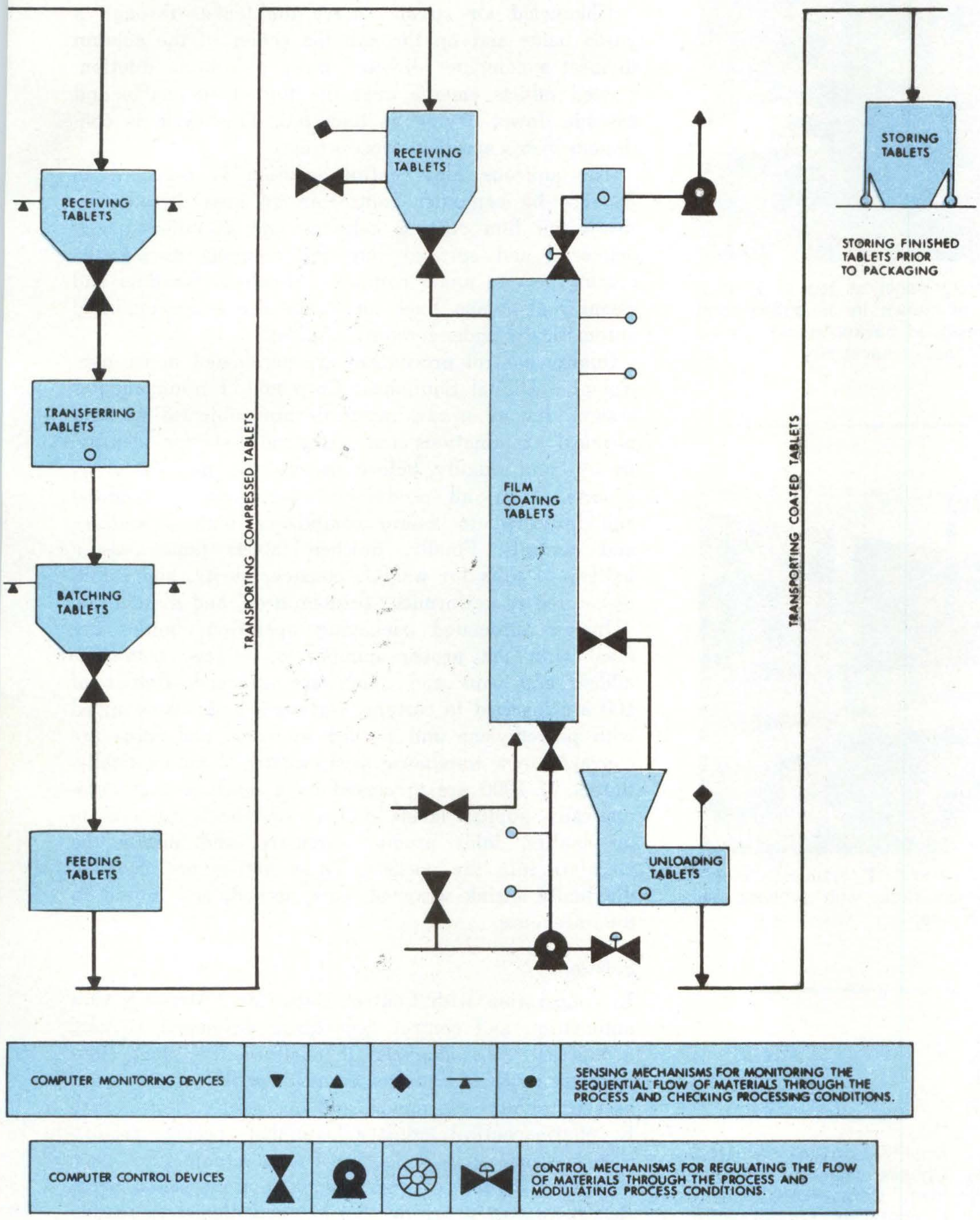


Simplified process flow diagram of materials handling steps in Merck Sharp & Dohme's computer-controlled pharmaceutical tablet fabrication plant in Elkton, Va. Multiple stages of process are shown here singly and some transfer lines have been deleted

formation relayed from the field operators and determined that the overall process is functioning within bounds. Then signals from the computer initiate the next procedural steps.

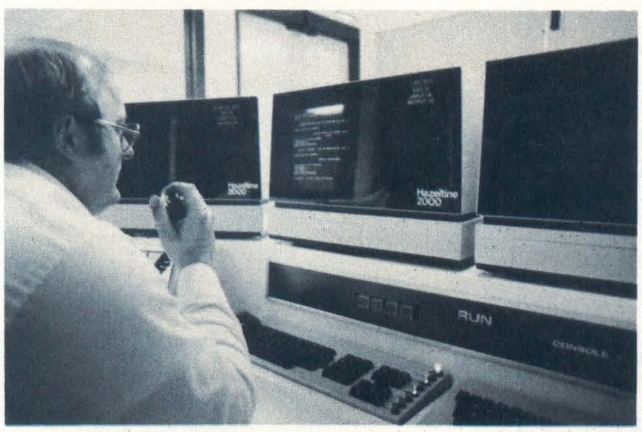
Computer directed application of a Merck developed aqueous (water based) film coating solution takes place in massive plexiglass columns, rather than in traditionally used cylindrical coating pans. Each of four


RECEIVING GRANULATION
A
(PART 1) FROM "DRYING GRANULATION"
MILLING
LOADING LUBRICANT
FEEDING GRANULATION
LOADING LUBRICANT
FEEDING LUBRICANT
LOADING LUBRICANT
BLENDING AND LUBRICATING
TRANSPORTING LUBRICATED GRANULATION
RECEIVING GRANULATION
COMPRESSING TABLETS
COMPRESSING TABLETS

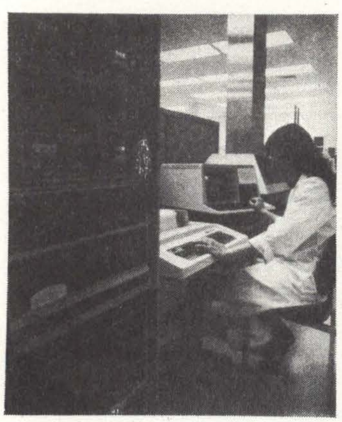


Simplified process flow diagram of materials blending and tablet compressing and handling stages

Computer control room. 14′ long panel at top of backup panel is complete flow diagram shown in simplified form earlier in this article. Merck designed backup panel can be used for manual control of process if necessary



Closeup of control room console and CRT terminals. "Field" operators communicate via 2-way radio with process operator who interfaces with computer



Quality control facility. Chemist uses Digital Equipment Corp PDP-11 minicomputer to control automated weighing and potency testing of finished tablets produced in automated process. Prior tests check incoming materials and production procedures

film coating installations consists of a 6′ (1.8-m) diameter plexiglass column positioned several feet off the floor. Compressed tablets are automatically conveyed and dropped into the column from tablet feeding hoppers above.

Channeled air streams carry the tablets through a guide baffle and up through the center of the column to meet a computer directed spray of coating solution. Coated tablets emerge over the top of the baffle and cascade down, drying as they fall. This cycle is continuous over a specified process time.

The aqueous film coating solution is prepared in advance by computer control in an area directly beneath the film coating columns and is automatically delivered and sprayed into the columns during the coating process under computer direction. Washing and cleaning of pumps, lines, and tanks also is accomplished automatically under computer control.

Quality control procedures are automated under control of a Digital Equipment Corp PDP-11 minicomputer system. Incoming raw materials are subjected to both physical examinations and analytical tests for identity, purity, and quality before use in the manufacturing process. Then, all production operations are audited and inspected to assure compliance with procedures and controls. Finally, finished tablets must pass a battery of tests for weight, potency, purity, and stability as well as uniformity, disintegration, and dissolution.

In an automated packaging operation, bottles are filled with the proper number of tablets, cotton is added, and caps and labels are attached. Bottles of 100 are inserted in cartons, cartons are shrink wrapped with polyethylene and packed in cases, and cases are conveyed to a warehouse area—again all automatically. Bottles of 1000 are processed by a machine that automatically applies labels and thermoplastic pockets to the bottles, folds product circulars, and inserts the circulars into the pockets. These bottles are then individually shrink wrapped, case packed, and moved to the warehouse.

Software

In cooperation with Control Data Corp, Merck & Co's automation and control department developed AUTRAN, a FORTRAN like language that allows the plant engineer to write his program in a familiar form—such as start pump, stop motor, and open valve. Traditionally, pharmaceutical industry logic that specifies production sequence steps and control loop setpoints has been organized on sets of operator instructions called batch sheets. AUTRAN programs can be read almost as readily as the former batch sheets. This eases program and computer system checkout procedures.

Currently, approximately 250 separate applications programs handle 22 simultaneous batches, run by the plant in 6 separate processes. However, for possible future expansion, the computer system is designed to accept up to 60 simultaneous batches in 30 processes.

SIEMENS

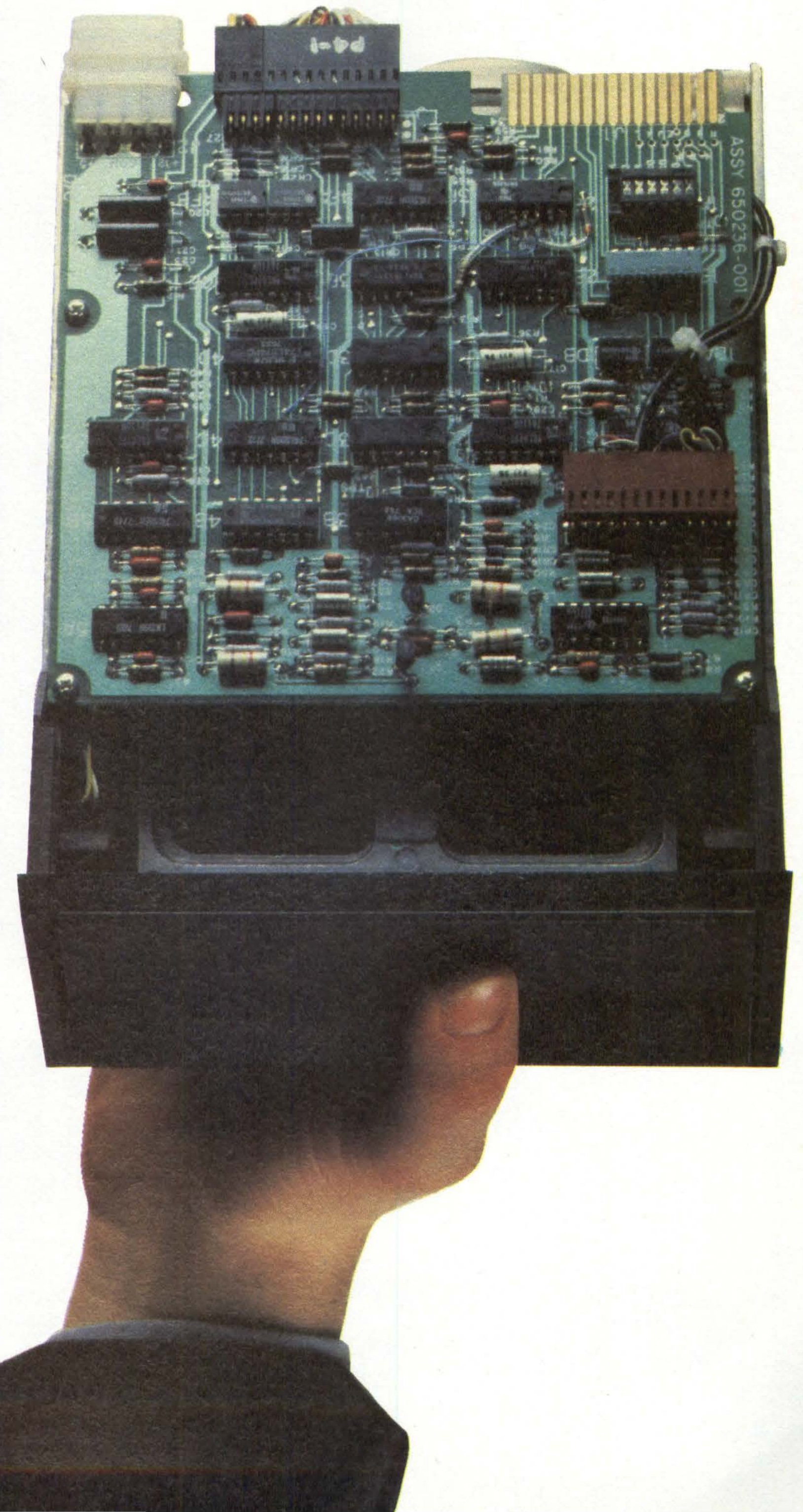
The Maxi-Mini.™

5¼" double-sided, double-density industry compatible mini-disk drive.

Maximum storage capacity in minimum space. Siemens offers a 500K byte capacity in a compact drive half the size of a standard 8-inch. And our plug-to-plug compatible Maxi-Mini disk drives are available for immediate delivery.

Siemens Maxi-Mini disk drives utilize Wangco technology which has been proven in over 20,000 installations. Available with either single or double head, these mini-disk drives also provide many other important features. Such as a true anti-crunch mechanism which prevents cover closure until the diskette is fully in place. This helps avoid data loss and provides a very real dollars and cents savings on disk replacement. There's also a wide mouth which permits easier, more convenient insertion of media, shortening load/unload time.

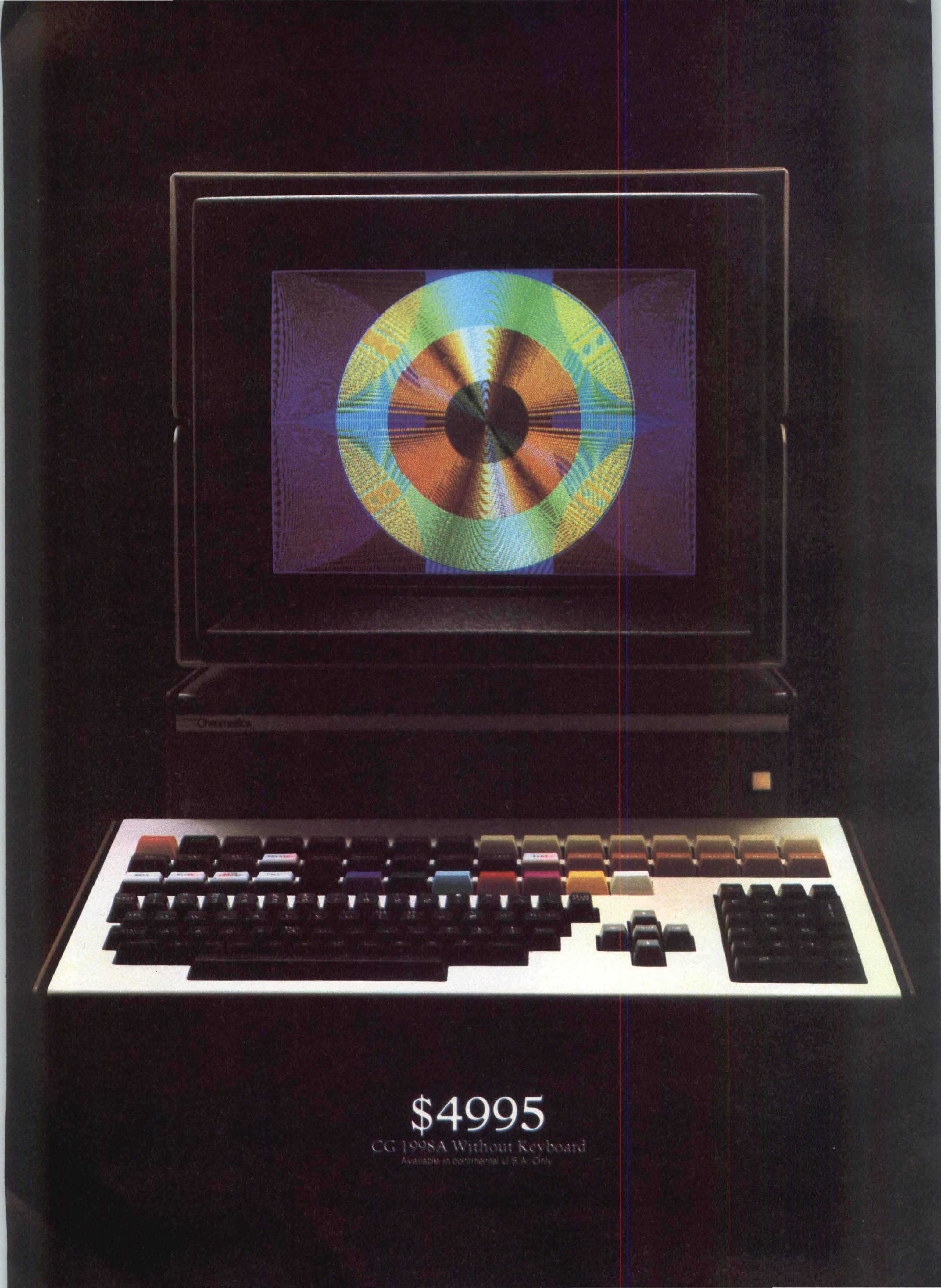
Also available from Siemens are single- and double-sided 8" floppy disk drives and mini-disk controllers. For immediate delivery of the Maxi-Mini or information about other OEM products from Siemens, contact us at:



Siemens Corporation
OEM DIVISION
1440 Allec Street
Anaheim, California 92805
(714) 991-9700

CIRCLE 38 ON INQUIRY CARD

The technology to do more.


$4995
CG 1998A Without Keyboard
Available in continental U.S.A. Only

HERE'S AN INCREDIBLY BRIGHT IDEA FOR YOUR NEXT SYSTEM.

At Chromatics, one of our most important corporate goals is to stay ahead of our competition—with more innovations, more reliable products and more personalized service.

The result of our efforts is the CG SERIES of color graphic computers that start at $5995 for a complete usable system with color monitor.

Enter your artwork and graphics quickly with our X-Y digitizer tablet and store them on our floppy disk peripherals. Analyze and operate on your results with our Microsoft® Z-80 BASIC software and our graphics packages.

Viewability is enhanced with our multi-hue pattern fill routines, and the operator can Zoom in on the fine detail of a 512 by 512 high resolution color screen. And, for a permanent full-color record, you can even output the final results to a Xerox® 6500 color copier with our color hard copy interface.

In addition, our unified approach creates a powerful Z-80 development system with Assembler, Text Editor and Disk Operating System with operation in full color.

We're so confident of our color graphic computers that we back them with a full year's warranty instead of the usual ninety days or six months. If you should have a problem, we have a strict policy of giving customers the fastest possible turn-around time on repair service.

Watch out for us. We're determined to meet our corporate goal of staying out in front of everybody else. Way out in front.

Chromatics, Inc., 3923 Oakcliff Industrial Court, Atlanta, Georgia 30340; tel: 404/447-8797; TWX: 810/766-4516.

Chromatics™
The World's Most Colorful Computer Company.

Sales Representatives
USA
Alabama: Huntsville
Col-Ins-Co. 800/327-6600
Arizona: Phoenix
Thorson Co. 602/956-5300
California
Graphics Marketing Corp. 213/880-4062
Colorado: Denver
Thorson Co. 303/759-0809
Connecticut
Bartlett Associates 914/949-6476
Delaware
Bartlett Associates 301/656-3061
District of Columbia
Bartlett Associates 301/656-3061
Florida: Ft. Lauderdale
Col-Ins-Co. 800/432-4480
Florida: Orlando
Col-Ins-Co. Inside Fla. 800/432-4480
Local 305/423-7615
Georgia: Atlanta
Col-Ins-Co. 800/327-6600
Hawaii: Honolulu
Thorson Co. 808/524-8634
Illinois
Resource Data Systems 312/564-5440
Indiana
Resource Data Systems 312/564-5440
Iowa (Eastern)
Resource Data Systems 312/564-5440
Iowa (Western)
Professional Marketing Services 612/474-5939
Louisiana: Baton Rouge
Col-Ins-Co. 800/327-6600
Maine
Bartlett Associates 617/879-7530
Maryland: Bethesda
Bartlett Associates 301/656-3061
Massachusetts: Framingham
Bartlett Associates 617/879-7530
Michigan: Detroit
WKM Associates 313/588-2300
Minnesota
Professional Marketing Services 612/474-5939
New Hampshire
Bartlett Associates 617/879-7530
New Jersey:
Bartlett Associates 914/949-6476
New Mexico: Albuquerque
Thorson Co. 505/265-5655
New York: Holcomb
Bartlett Associates 716/657-6309
New York: White Plains
Bartlett Associates 914/949-6476
North Carolina: Winston-Salem
Col-Ins-Co. 800/327-6600
Ohio: Cleveland
WKM Associates 216/267-0445
Ohio: Dayton
WKM Associates 513/434-7500
Oregon: Portland
Graphics Marketing Corp. 213/880-4062
Pennsylvania: Pittsburgh
WKM Associates 412/892-2953
Pennsylvania: Wayne
Bartlett Associates 215/688-7325
Rhode Island
Bartlett Associates 617/879-7530
South Carolina: Greenville
Col-Ins-Co. 800/327-6600
Texas: Austin
Thorson Co. 512/451-7527
Texas: Dallas
Thorson Co. 214/233-5744
Texas: Houston
Thorson Co. 713/771-3504
Utah: Salt Lake City
Thorson Co. 801/973-7969
Vermont
Bartlett Associates 617/879-7530
Virginia (Northern)
Bartlett Associates 301/656-3061
Virginia (Southern)
Col-Ins-Co. 800/327-6600
Washington: Seattle
Graphics Marketing Corp. 213/880-4062
Wisconsin
Resource Data Systems 312/564-5440
Any other states
404/447-8797
Europe & Near East
Techexport, Inc. 617/661-9424
Far East
Computers International 213/382-1107

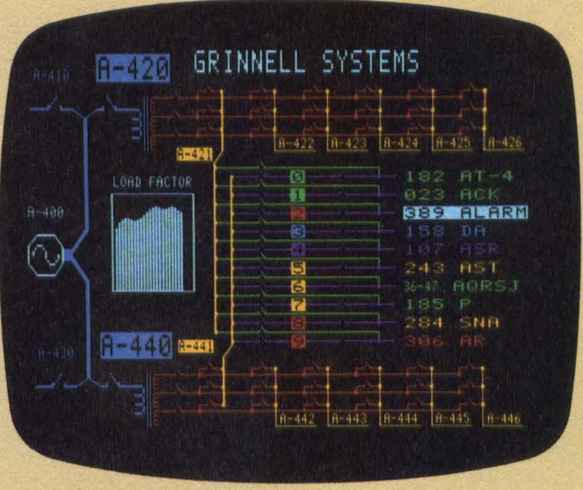
FOREIGN COUNTRIES

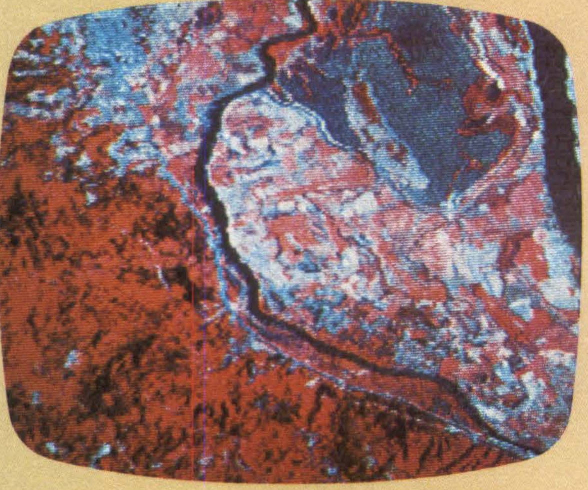
Australia: Crows Nest, NSW
TCG 439-6477
France
Techdata 749-40-37
Japan: Tokyo
Computers International Japan 03/402-8596
Scandinavia: Sweden
Teleinstrument AB 08-380-370
South Africa: Pretoria
Infodata Pty. Ltd. 01278-8141
Switzerland
W. Stolz AG 057-54655
United Kingdom: Bournemouth
Techex Ltd. 0202-293-115
Belgium: Brussels
Spesi (02) 37491-12

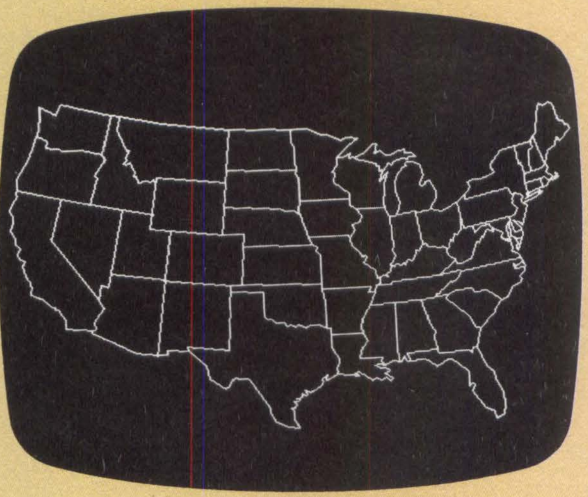
MEET US AT THE NCC

CIRCLE 39 ON INQUIRY CARD

Grinnell has your display...







from low cost imaging and graphics to full color image processing

Our modular, solid state systems can meet your computer display requirement, easily and economically.

And, they're intelligent. Every system has a complete alphanumerics and graphics package, and a powerful instruction set that simplifies programming—no need for complex macro-instructions and high order programming languages.

There's also a choice of standard resolutions: 256 x 256, 256 x 512, 512 x 512 (30 Hz or 60 Hz refresh) and 1024 x 1024. Plus plug compatible interfaces for most minis.

Options include overlays, function memories, pseudo-color tables, zoom and pan, independent cursors with trackball and joystick controls, split-screen, image toggling, and real time digitizers that grab and store images and sum consecutive frames.

Grinnell displays are already used for tomography, ERTS imaging, process control, image processing, animation and much more. All systems drive standard TV monitors.

So before you choose a display system, let our experts show you how to maximize performance and minimize cost. For details, and/or a quote, call or write.

GRINNELL SYSTEMS

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

CIRCLE 40 ON INQUIRY CARD

DC&AS BRIEFS

Data Acquisition System Performs Several Additional Functions

A hardware and software programmable data acquisition system, the DataloggerPlus 6200 series also monitors, processes, computes, and performs interfacing functions. It is based on an M6800 microprocessor, handles both analog and digital inputs, and provides RS-232 and parallel outputs. The system provides 16 channels, expandable in 16- or 32-channel increments up to 128 in the basic unit, and 256 additional in each remote unit. Other features include 4k memory expandable to 32k, gain programmable inputs for each channel, digital calendar clock, high/low alarm capability for each channel, and 20-col alphanumeric printer. Dynatech R/D Co, 99 Erie St, Cambridge, MA 02139 provides turnkey configurations to individual customer requirements.

Circle 294 on Inquiry Card

Servo Drive/Digital Control Package Designed for Use with Programmable Controllers

Commander I, a closed loop positioning module, is claimed to be the first servo drive/digital control package for use with programmable controllers. It also can be used with dc motors and open loop numerical control systems. Introduced by Hyper-Loop Inc, 7459 W 79th St, Bridgeview, IL 60455, the 7 x 5 x 11.5" (18 x 13 x 29-cm) unit has resolution ranges of from 0.001" (0.0254 mm) to 0.00001" (0.000254 mm). Pulse frequency is up to 100k pulses/s and guaranteed closed loop control accuracy is ±2 pulses. A fault detector prevents runaway conditions that might be caused by loss of resolver feedback or stored command position.

Circle 295 on Inquiry Card

Peak Power Demand Control Systems Lower Energy Costs

Data on present and foreseeable utility rate structures as well as metering methods are maintained by microprocessors in two power demand control systems introduced by Dynapar Corp, 1675 Delaney Rd, Gurnee, IL 60031. These microprocessors permit control over a variety and mix of electrical loads for a wide range of industrial and commercial facilities to reduce peak power demand and thereby lower energy costs.

PDC-1100/1150 series systems can control from 8 to 32 separate loads in groups of eight. Each unit provides eight priority levels and each level can accommo-

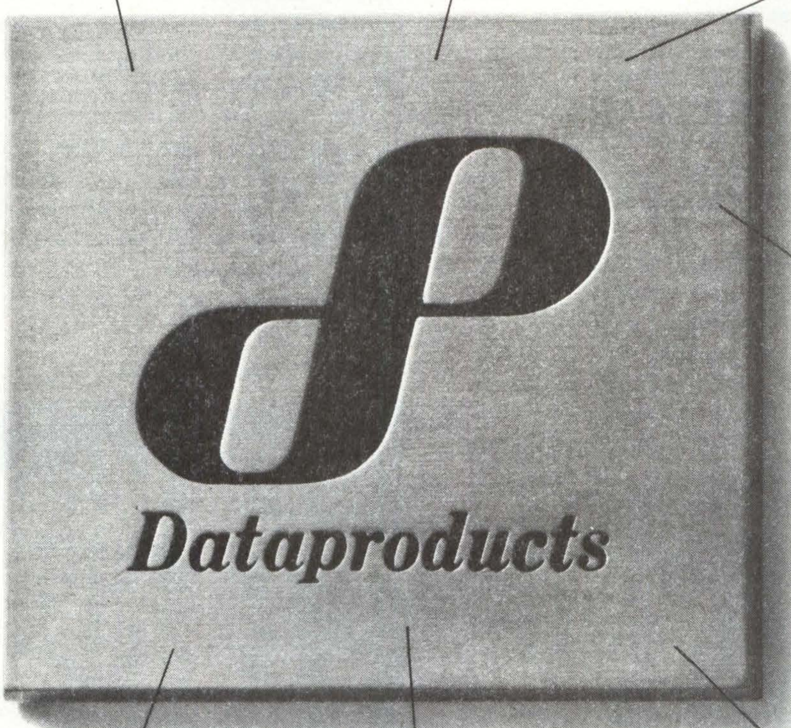
WE'RE THE WORLD'S LARGEST INDEPENDENT PRINTER MANUFACTURER. WE HAVE MANY ANSWERS.

TECHNOLOGIES.

We offer Band, Matrix, Thermal, Drum, and now, Daisy Wheel.

SPEED.

Our answers range from 45 CPS up to 1800 LPM



VOLUME.

Our range of technologies and speeds will meet most requirements.

SPECIAL APPLICATIONS.

Tell us about your special requirements. We didn't become the printer experts by sidestepping our customer needs.

PRINT QUALITY.

The answer is consistent top quality in each technology ranging from letter quality on our Daisy Wheel to multiple copy on our Impact printers.

NEED MORE ANSWERS?

Call or write us today, so we can talk.

North American Sales HQ: 6219 DeSoto Ave., Woodland Hills, Ca. 91365. Telephone: (213) 887-8451 Telex: 67-4734
European Sales HQ: Darmstaedter Landstrasse 199, Frankfurt, W. Germany. Telephone: 681-034, Telex: 841-416344.

CIRCLE 42 ON INQUIRY CARD

date up to eight loads. Each priority level can be assigned one of four priority types.

Access to operational data is provided by a CRT alphanumeric display and keyboard. Each keyboard interacts with four operational and four data entry displays. Options include printers, chart recorders, digital and analog I/O modules, remote CRT displays, and remote input keyboards.
Circle 296 on Inquiry Card

Error Status Indicator Troubleshoots Programmable Controller Systems

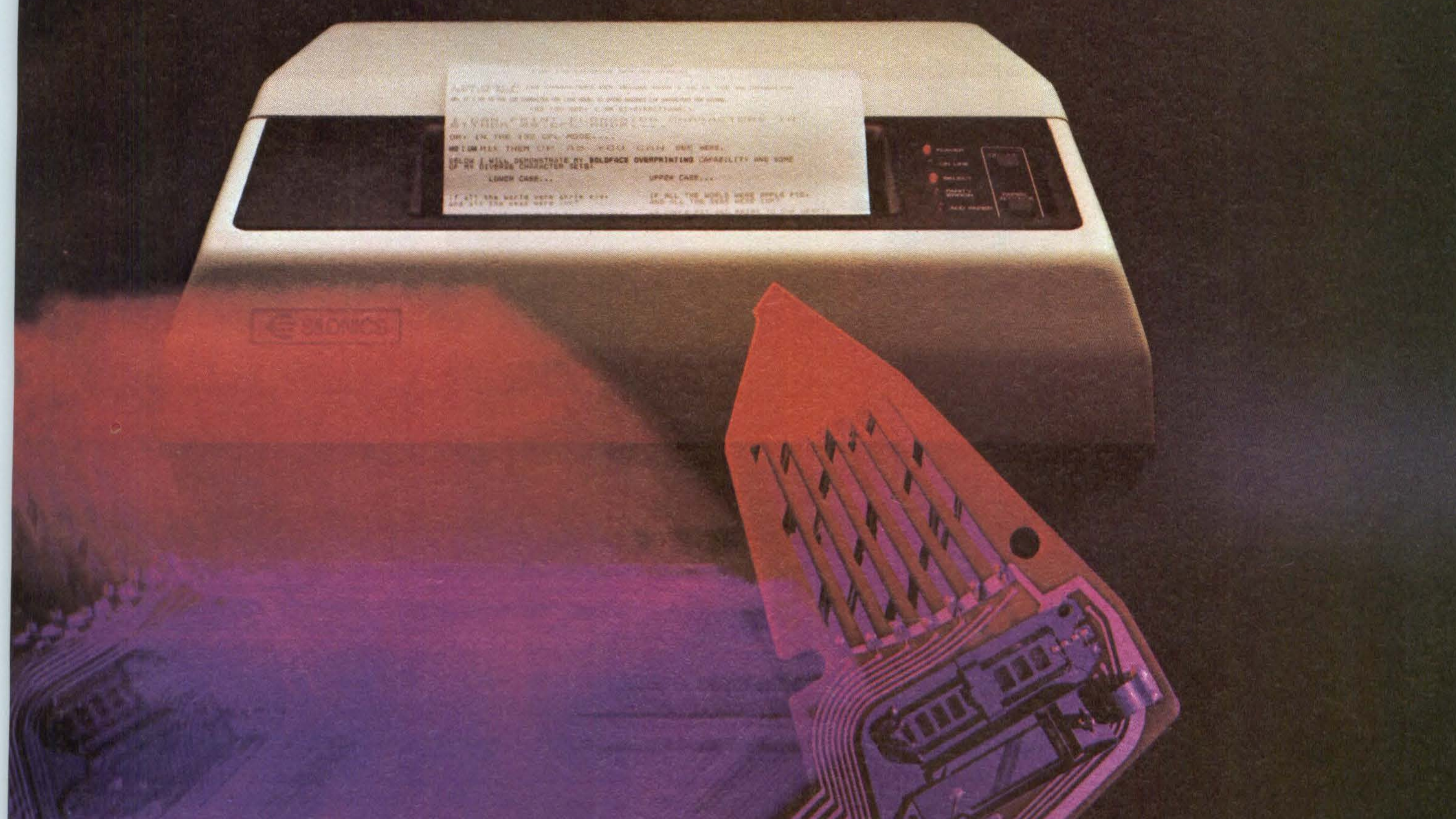
An error status indicator module that instantly troubleshoots any system controlled by its programmable controllers has been introduced by Cincinnati Milacron, Electronic Systems Div, Lebanon, OH 45036. A 3-digit numerical display immediately identifies online failures within the system. The module can be programmed to show 512 cycle interruption alerts and 64 noncycle related alerts.

Each application designer generates a diagnostic manual tailored to particular application and documents the specific online device for each alert. Whenever an unprogrammed interruption occurs in the system, the indicator flashes a 3-digit alert and the user references the diagnostic manual to identify the source of trouble. Other lighted indicators show the proper operation of the 12-, 5-, and −18-V power supplies; a fourth indicator flashes if there is ever a failure of the programmable controller contact bus.
Circle 297 on Inquiry Card

Handheld Input Unit for Industrial Control Retains Long Messages

A large display buffer that stores up to 960 characters is a key feature of the HT/7 control/display unit. The handheld unit, made by Termiflex Corp, 17 Airport Rd, Nashua, NH 03060, displays two 20-char lines of 0.15" (0.38-cm) high char. Control messages are scrolled in a selectable format as they are accessed from the buffer memory. The 7 x 4.25 x 2.25" (17.8 x 10.8 x 5.7-cm) unit operates on 5 Vdc and internally develops the ±12 Vdc necessary for the RS-232-C interface. Operation can be either full or half duplex and all 128 ASCII characters and codes can be transmitted or displayed. □
Circle 298 on Inquiry Card

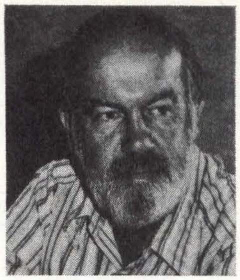
The Quietype.™



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 44 ON INQUIRY CARD

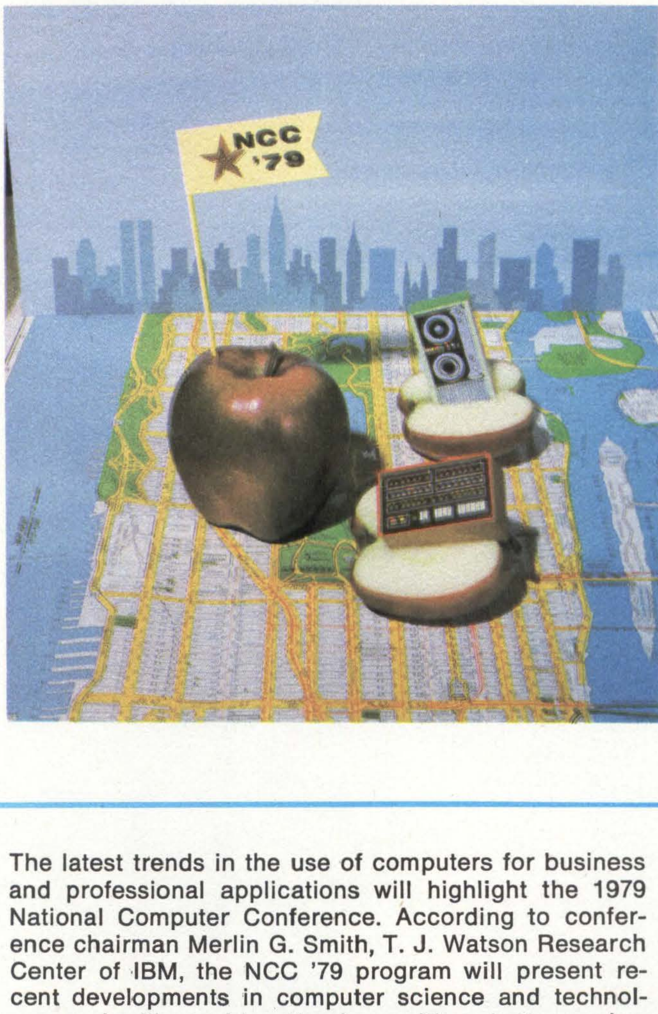


Richard E. Merwin
Program Chairman

Merlin G. Smith
Conference Chairman

John P. Opel
Keynote Speaker

Richard A. Kuzmack
Personal Computing
Festival Chairman



1979 National Computer Conference

June 4-7

New York Coliseum and New York Hilton and Sheraton Centre Hotels

The latest trends in the use of computers for business and professional applications will highlight the 1979 National Computer Conference. According to conference chairman Merlin G. Smith, T. J. Watson Research Center of IBM, the NCC '79 program will present recent developments in computer science and technology and will provide attendees with a better understanding of the total industry, including a greater consciousness of the social implications of the expanding use of computers.

Organized by program chairman Richard E. Merwin, George Washington University, approximately 150 technical program sessions will cover the latest developments in computer applications, science and technology, management, and social implications. Twelve parallel groups of sessions run all four days of the conference at the New York Hilton and Sheraton Centre (formerly the Americana). Included in the technical program are three "mini-conferences"—application areas that will receive in-depth coverage. Augmenting the technical sessions are 15 1-day professional seminars plus 1 all-day workshop.

John R. Opel, president of IBM, will deliver the keynote address Monday June 4 at 10 am. The all-conference reception Monday evening, the third annual Personal Computing Festival, plus the finals of the Amazing Micro-Mouse Maze Contest, a Science Film Theater, Pioneer Day, and a morning TV program will be special attractions of NCC '79.

Technical Program

Technical program sessions feature expanded coverage of management and user requirements, while

The Cook-able Computer

Introducing a ruggedized version of Intel's iSBC* 80/10A Single Board Computer

From Cryogenics to Hades

Our ruggedized SECS 80/10A likes it hot — or cold. It shrugs off shock, vibration, moisture. And thrives on dust, dirt and grime.

Meets MIL-E-5400, 16400, 4158 — and more. This makes our SECS 80/10A perfect for military systems and tough industrial applications — petroleum, steel, oceanography, communications.

In fact, anywhere a rugged microcomputer is needed.

Functional counterpart of Intel iSBC 80/10A

Exclusively licensed by Intel, our SECS (Severe Environment Computer System) is a functional counterpart of the standard iSBC 80/10A board. Even uses the same development system software.

*Trademark of Intel Corporation

The difference is in the packaging

Our SECS 80/10A, which uses rugged Intel 883B chips, is mounted on a 9″ by 6″ shock and vibration resistant, full ATR compatible board. Conduction cooled, it operates from −55°C to +85°C. Add our numerous support modules and you end up with a versatile severe environment microcomputer system at a fraction of the development cost.

Other SESCO products

We also have a complete line of MIL SPEC core and semiconductor memories. New products include D-DAS, a digital data acquisition system for the 1553 bus, and SETS, a compact digital tape recorder with 23 megabit capacity.

When you're faced with a tough environment, "buy SESCO... it works!"

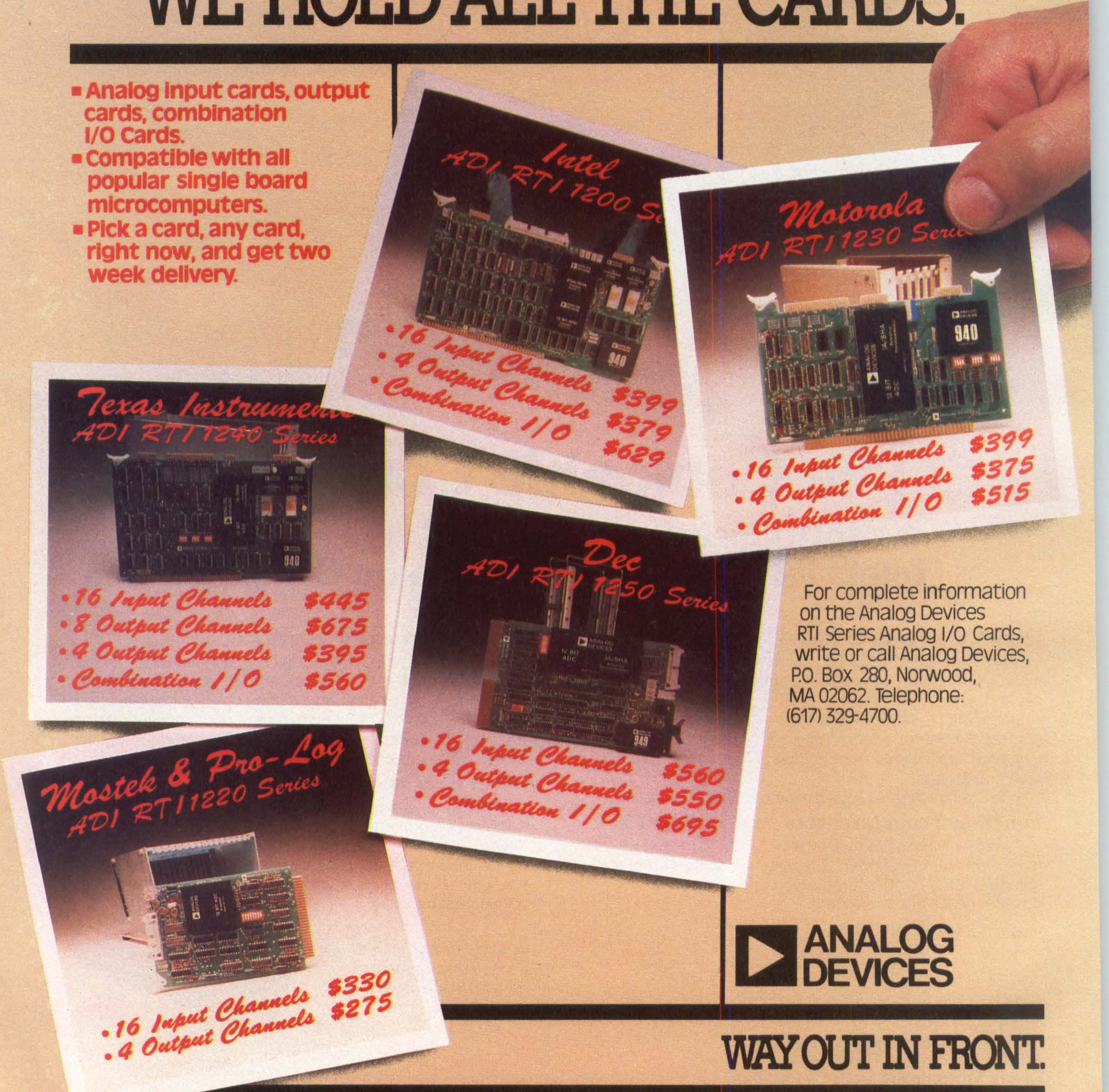
SECS 80/10A

SESCO
Severe Environment Systems Company
A Subsidiary of Electronic Memories & Magnetics Corporation

20630 Plummer Street • P.O. Box 668 • Chatsworth California 91311
Telephone: (213) 998-9090 • Telex: 69-1404

ANALOG I/O FOR MICROCOMPUTERS? WE HOLD ALL THE CARDS.

- Analog input cards, output cards, combination I/O Cards.
- Compatible with all popular single board microcomputers.
- Pick a card, any card, right now, and get two week delivery.



For complete information on the Analog Devices RTI Series Analog I/O Cards, write or call Analog Devices, P.O. Box 280, Norwood, MA 02062. Telephone: (617) 329-4700.

ANALOG DEVICES

WAY OUT IN FRONT.

Analog Devices, Inc., Box 280, Norwood, MA 02062; East Coast: (617) 329-4700; Midwest: (312) 894-3300; West Coast: (213) 595-1783; Texas: (214) 231-5094; Belgium: 031/37 48 03; Denmark: (02) 845800; England: 01/94 10 46 6; France: 686-7760; Germany: 089/53 03 19; Japan: 03/26 36 82 6; Netherlands: 076/879 251; Switzerland: 022/319704; and representatives around the world.

For more information: DEC 354, Motorola 355, Intel 356, Texas Instruments 357, Mostek 358, Pro-Log 359.

providing in-depth treatment of the latest technical developments. Fourteen sessions throughout the conference constitute the mini-conference devoted to Computers, Law, and Public Policy. These sessions will address legal and social issues relevant to data processing including the Federal Communication Commission's second Computer Inquiry, the rewrite of the Communications Act, a software tax, recommendations for expanded copyright protection, anti-trust enforcement by promoting competition in data processing and communications industries, and the difficulty of obtaining criminal prosecution or civil action against perpetrators of computer crime and fraud.

Rounding out the concentrated focus on the "mini-conferences," the remainder of the program sessions cover recent strides in computer applications, science and technology, management, and social implications. Those sessions under the heading science and technology give major emphasis to data base technology, computer architecture, networking, software reliability, distributed operating systems, and modeling of program behavior. The social implications sessions are devoted to problems of computer security and privacy including data base security, data encryption, security enforcement in programming languages, operating systems security, and information flow and leakage. Receiving particular attention among the computer applications will be computer simulation with sessions planned on emulation laboratories and their use by industry, government, and universities; plus the future of simulation languages, and state of the art of biological simulation.

Personal Computing Festival

Technical sessions, applications demonstrations, and commercial displays will be offered in the NCC '79 Personal Computing Festival under the direction of chairman Richard A. Kuzmack, Mathematica, Inc, to answer the questions most frequently heard by those who use or own personal computers: "What do you do with it?" and "Is a personal computing system worth the investment in time, money, and effort?" Utility will be the watchword throughout this year's program. Session topics include small computer maintenance, personal computer simulation, modeling, personal investment analysis, communications between computers, home and school computer aided education, speech synthesis and recognition, recreational mathematics, and interactive intelligent games including chess. This year, for the first time, prizes will be awarded for the best papers accepted for publication in the *NCC '79 Personal Computing Proceedings,* and for the best applications demonstrations.

Personal Development Seminars

Covering topics designed to stimulate personal, managerial, and technical growth, each full-day Personal Development Seminar will be limited to 100 attendees, with the exception of the hands-on microcomputer workshop that will be held twice and limited to 60 attendees per day. The seminars, held at the New York Sheraton, each require a separate $50 fee that includes course material plus admission to NCC and Personal Computing exhibits. Following are abstracts of selected seminars.

An Overview of Distributed Processing, Burt H. Liebowitz, International Computing Co. Introductory seminar covering issues involving processors, communications, inter-computer coupling, executive software structures, system architectures, component selection, and allocation of functions and data files will define and discuss point-of-use systems, resource sharing networks, and multiple processor systems.

Database Machines, Dr David K. Hsiao, Ohio State U. A review of various approaches to design, implementation, and use of database machines. Current projects on database machine development and use of such machines to replace existing DBMS software will be emphasized.

A Practical View of Computer Communications Protocols, John M. McQuillan, Bolt Beranek and Newman, Inc. Fundamental choices in computer communications system design and computer communications protocols will be explored. Topics will include message routing and addressing, transmission facilities, switching methods, link control procedures and subnet protocols, and network/host level interfaces.

Human Engineering in Teleprocessing Systems, Thomas R. Baley, TRB Systems. An overview of effective man/machine communications in teleprocessing systems. Topics will include categorizing of terminal operations, response times, available procedural and syntactical alternatives, the terminal environment, terminal operators, and the major causes of errors.

An Introduction to Microprocessors, Dr Rodney Zaks, Sybex, Inc. Introductory course will cover microprocessor concepts, system components and their interfaces and operation, microprocessor programming, typical applications, how to get started, and the future outlook.

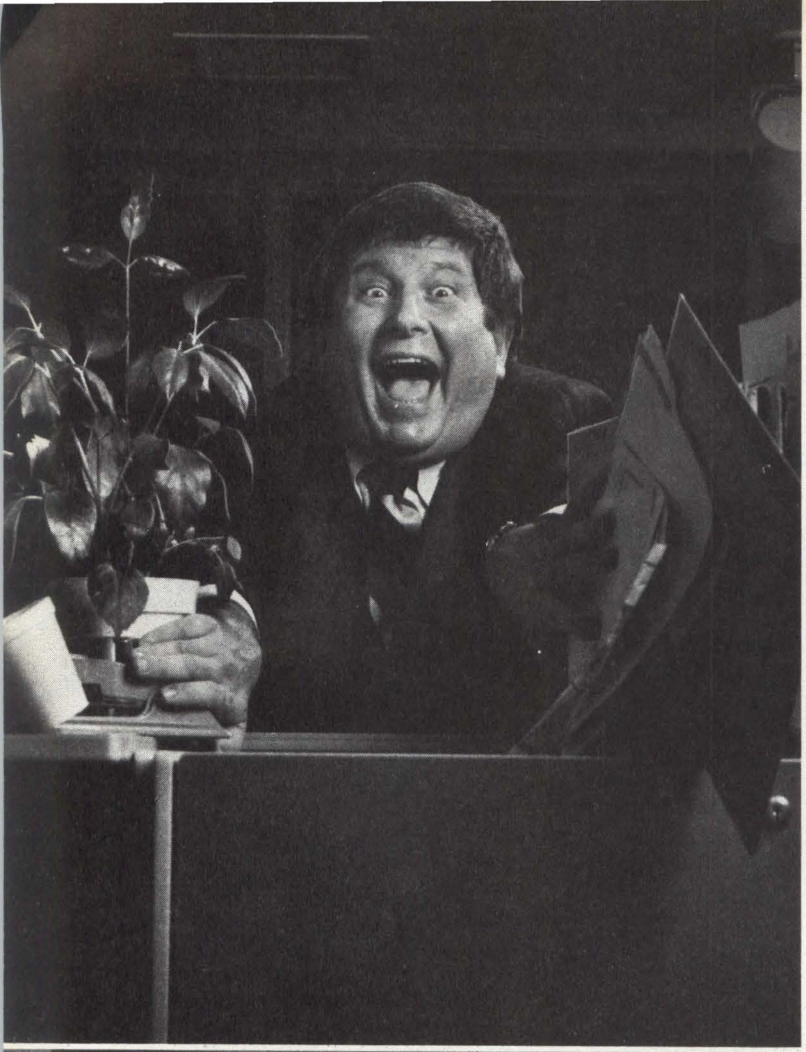
Hands-on Microcomputer Software/Hardware Workshop, Eric R. Garen, Integrated Computer Systems, Inc. Introduction to fundamental principles of single-board microcomputer software/hardware interaction through hands-on exercises. A complete microcomputer system will be available for use by each pair of participants. Topics to be covered include manipulation of CPU registers, stack pointer operations, P/ROM-RAM memory conventions, microcomputer memory addressing, and program debugging techniques.

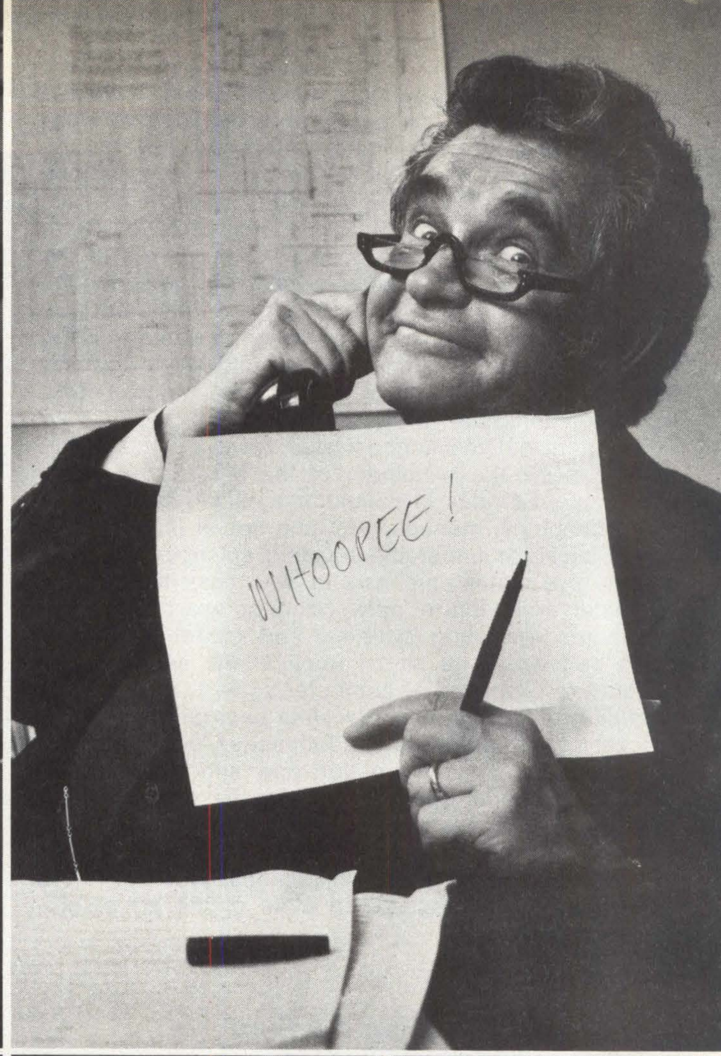
Recent Developments in Minicomputer Technology, Dr John H. Carson, Carson Associates. Seminar will cover recent hardware and software changes in minicomputer systems including memory systems, memory mapping and management, microprogramming, instruction set evolution, multi-state architectures, interrupt processing, I/O capabilities, peripherals and interfacing, languages, and operating systems. Differences between minis and powerful new micros will be analyzed.

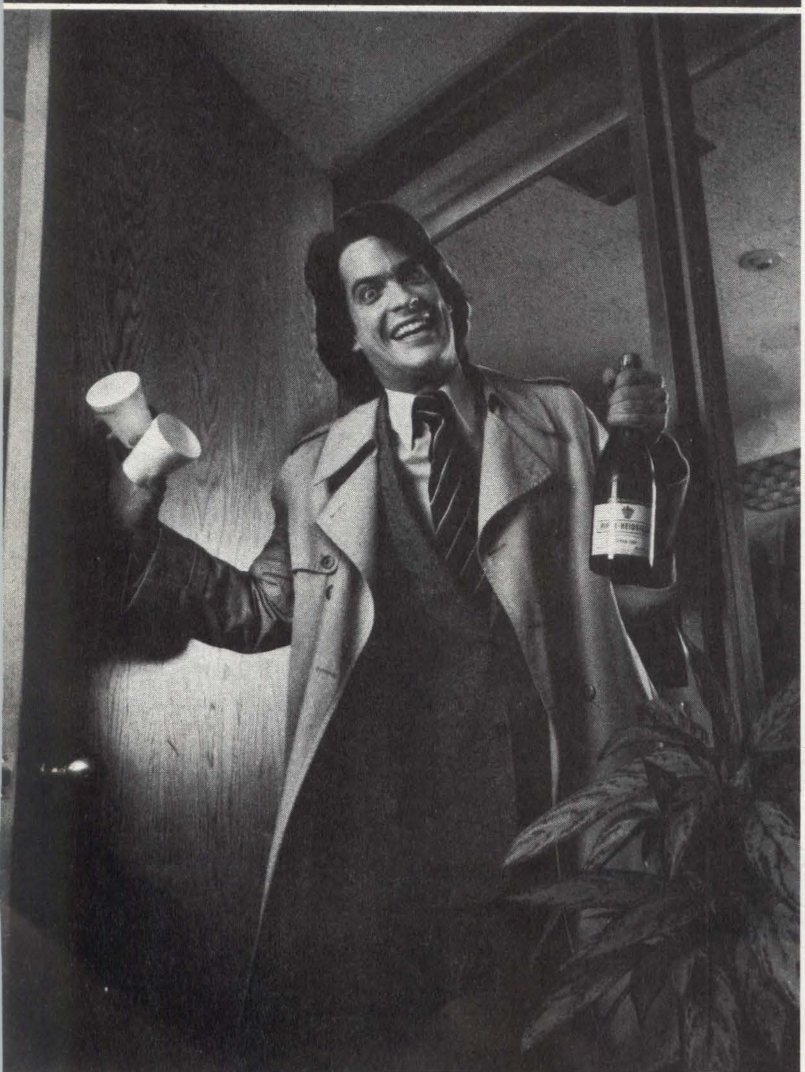
Special Activities

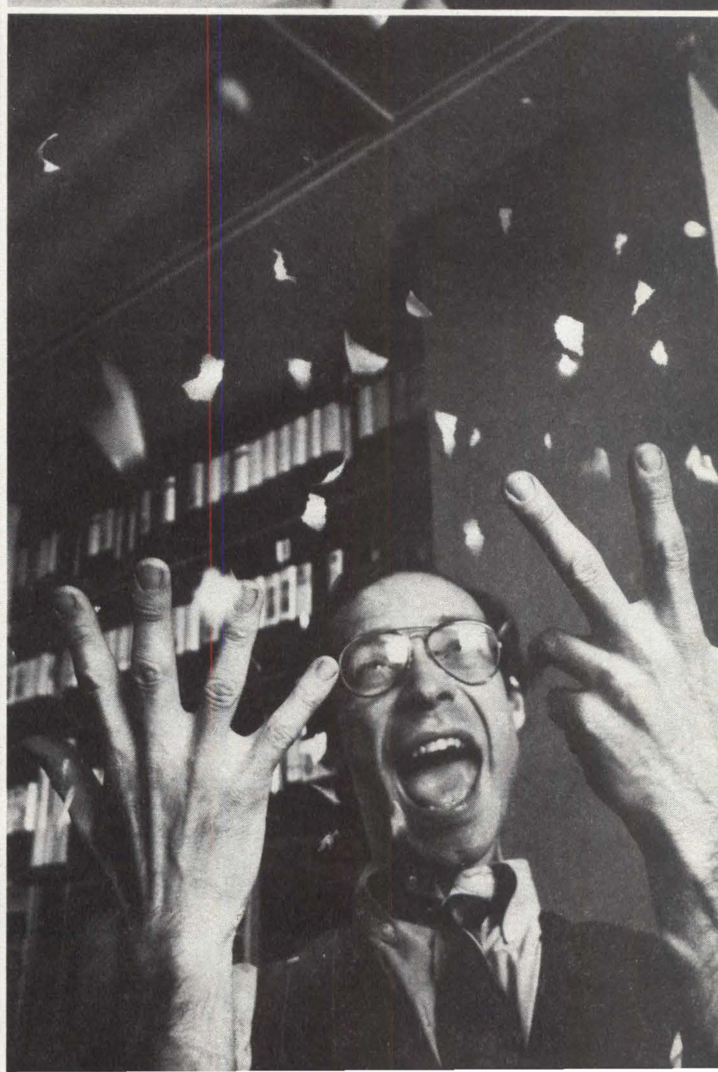
An International Visitors Center, located in the Canada room on the second mezzanine level of the New York Coliseum will be staffed from 8:30 am until 6:00 pm throughout the conference. Translation assistance will be available for Spanish, Japanese, French, and German. Also provided will be telephones and limited copier service.

At 7 and 8 am each day a special 1-hour TV program will be aired at most conference hotels. Each "Today at NCC" will spotlight that day's events and




WHOOPEE!





OUR CUSTOMERS' REACTION TO THE NEW NOVA 4 DIDN'T SURPRISE US.

After the success we've had with the Data General NOVA computer line (in the 10 years since its introduction, over 60,000 have been shipped), who could blame them? But what really counts is your reaction to our latest NOVA—NOVA 4.

The new NOVA 4 gives you three ways to sell. It's the one computer system that's really a family of three. It's the one computer that will give you so wide a range of capability and options it will meet the price and capability needs of all your customers.

NOVA 4/C. The component OEM's dream.

The speed and performance you get in the NOVA 4/C, for $3500* (complete), is the best deal ever offered a customer needing a basic computer to integrate in his terminals, test instruments or business applications. And it includes a unique self-diagnostic capability that lets the computer trouble-shoot itself to cut service time and cost.

NOVA 4/S. An important part of your process.

Whatever data your customers process now—from blood analysis to pipeline flow—the new NOVA 4/S can cut processing time in half. Outstanding processing throughput comes from its new high speed floating point and character manipulation capabilities. Plus, it includes NOVA 4 self-diagnostic features.

NOVA 4/X. The business end of the line.

For the business computer customer, or the technical one, the 4/X will do the job. All the capabilities of the 4/S with memory up to 256K bytes, with self-diagnostic capability.

NOVA 4. The multi-customer mini.

4/C, 4/S, 4/X—all three are fully compatible with the NOVA 3 computers now in use. And there's one that's right for your customer's application.

And they match the 10 year NOVA tradition of increasingly high performance (NOVA 4 achieves up to twice the speed of competitive systems as well as the NOVA 3), newsworthy price (lower than competitive units; 43% lower than NOVA 3) and reliability and maintainability features unheard of in competitive systems.

The all new NOVA 4. It's the brand new computer with 10 years of proven performance that will leave your customers smiling. Mail the coupon for full information.

*NOVA 4/C with 64K bytes of MOS Memory, asynchronous interface, automatic program load, power fail/auto restart, and 5-slot chassis with power supply. Domestic U.S. price, quantity one. OEM and quantity discounts available.

Mail to: Data General Corporation
Westboro, MA 01581

☐ Send me full information on the NOVA 4.

Name____________________

Title____________________

Company____________________

Address____________________ Tel.__________

City____________________ State__________ Zip__________

CD579

Data General

We make computers that make sense.

Data General Corporation, Westboro, MA 01581, (617) 366-8911. Data General (Canada) Ltd., Ontario, Canada. Data General Europe, 61 rue de Courcelles, Paris, France, 766.51.78. Data General Australia, (03) 89-0633. Data General Ltda., Costa Rica, Latin America, 22-79-42. Data General Middle East, Athens, Greece, 952-0557. (c) Data General Corporation, 1979.

preview upcoming events. The special program will also be shown throughout the day on TV monitors at the New York Coliseum and New York Hilton.

Pioneer Day will honor a milestone in the history of computing—the development of COBOL. Two special sessions will mark the twentieth anniversary of the creation of COBOL—Common Business Oriented Language. The first will discuss the origins of COBOL, focusing on the programming environment in the late 1950s and emphasizing the rationale behind committee decisions. Topics will include the use of English language and separation of the data description from executable statements, as well as some of the administrative and political factors that were involved in achieving acceptance by users and manufacturers. The second session will provide a retrospective view of COBOL, including establishment of initial standards, comparisons between the original language and COBOL's present form, and prevailing attitudes of the computing community towards COBOL.

The Science Film Theater will screen a sampling of films and videotapes from universities, industry, private filmmakers, and distributors to show how a computer can be used as an artistic creator, an industrial aid, and an educational instrument.

Exhibits

With regular exhibits occupying the four floors of the New York Coliseum plus the second floor and suites of the New York Hilton Hotel, NCC'79 promises to be the largest and most diverse display of state-of-the-art computer products and services. Exhibit hours are 11 am to 7 pm Monday, June 4; 10 am to 6 pm Tuesday and Wednesday June 5 and 6; and 10 am to 4 pm Thursday, June 7. In addition, the Personal Computing Festival exhibit at the Sheraton Centre Hotel will be open Tuesday and Wednesday, June 5 and 6 from 10 am to 6 pm and Thursday June 7 from 10 am to 4 pm.

Registration

Complete onsite conference registration fee including technical and professional program, conference exhibits, Personal Computing Festival, and conference *Proceedings* is $75. One-day conference program and exhibits, including the corresponding Personal Computing Festival activities, is $25; four and one days of exhibits are $25 and $10, respectively. Personal Computing Festival fees are $15 for the complete festival including *NCC '79 Personal Computing Proceedings;* excluding the *Proceedings,* registrations are available at $5 for one day and $9 for all four days. Registration begins from 4-8 pm Sunday June 3 at the New York Hilton, and continues beginning 7:45 am on Monday, June 4, at the New York Hilton and Sheraton Centre (formerly the Americana). Shuttle buses will run at regular intervals between the Coliseum, the Hilton, and the Sheraton Centre.

Conference *Proceedings* may be ordered at $30 for members of any of the 13 AFIPS constituent societies, and $60 for nonmembers; *Personal Computing Proceedings* are $8. Please send payment with order to AFIPS Press, 210 Summit Ave, Montvale, NJ 07645.

Excerpts from the Technical Program contain sessions of particular interest to *Computer Design* readers. Information is limited to that available at press time.

Why buy a technical computer from a stranger...

from Hewlett-Packard?

interface, for use with 200 HP instruments. As well as a wide variety of general purpose interface cards, ranging from A/D converters to a 16-bit relay output register.

In a data collection system using terminals, our Multipoint interfacing package keeps communication costs down. You can string multiple HP display stations or graphic terminals on a single line.

Getting the whole picture.

We're making it easier for you to get a graphic look at your data with software developed for use with HP output devices. Graphics/1000, combined with our graphics terminals, printers and plotters, is an important aid in research and engineering data plotting, electrical and mechanical design, and presentation of management and production data.

The HP 1000: a family that grows on you.

Your search for compatibility is further simplified by our wide range of peripherals. You can build systems with printers and printing terminals, CRTs and data input devices, disc and tape drives—all manufactured by HP. They work together smoothly, without making you do a lot of interfacing work. And you can be sure of quick single-source service whenever you need it.

So why don't you get together with a company that has 25,000 technical computer installations to its credit? We're listed in the White Pages of your phone book. Or write for complete information about the HP 1000 family to Hewlett-Packard, Attn. Roger Ueltzen, Dept. 1242, 11000 Wolfe Road, Cupertino CA 95014.

HEWLETT hp PACKARD

The Paper Tiger™ is here.

The Paper Tiger sets a new standard for low-cost impact printers. More capability. More versatility. For just $995.

You get a full upper and lower case 96-character set. Eight software-selectable character sizes. Plain paper, multiple copies. Forms length control. Parallel and serial interfaces. Multiple line buffer. Tractor feed. Automatic re-inking. 80 and 132 columns.

It's all standard with the Paper Tiger.

Unbeatable capability.

The Paper Tiger prints just about any paper form you need. From address labels to multicopy invoices and legal-size reports.

Adjust the tractor width from 1-3/4 to 9-1/2 inches. Choose from 8 switch-selectable forms lengths. Print 6 or 8 lines per inch.

Unmatched versatility.

Want graphics? Add the Paper Tiger's software-selectable full dot plotting graphics. Print illustrations, block letters, charts, graphs, and more.

Need a bigger buffer? The Paper Tiger features an optional 2K-byte memory that holds a full 24-by-80 CRT screen.

Feature \ Printer	Integral Data 440	Tally 1200	Lear-Seigler 300	Texas Instruments 810	Centronics 779-2
96-character ASCII set, upper and lower case	YES	OPTION	YES	OPTION	NO
Software-selectable character sizes	YES	NO	NO	OPTION	NO
Throughput, lines per minute @ 10 char./line	275	100	Data not available	440	130
@ 132 char./line	42	40		64	21
Parallel and RS-232 serial interfaces standard	YES	NO	NO	NO	NO
CRT screen buffer	OPTION	NO	OPTION	NO	NO
Footprint (W x D = sq. ft.)	1.37	3.45	3.18	3.58	2.44
Weight (lbs.)	20	64	50	55	45
Forms length control	YES	OPTION	YES	OPTION	NO
Full dot plotting graphics	OPTION	NO	NO	NO	NO
Unit Price	$995	$2500	$1995	$1895	$1350

Comparison data from manufacturers' current literature.

And there's more.

The Paper Tiger is small, lightweight, and compact. That's because it's designed especially to work in small computer systems.

And it's built rugged and simple. For high reliability and easy maintenance. Just like the thousands of IDS printers already in the field.

See for yourself.

Check the comparison chart.

Find out why this Paper Tiger just set a new standard for low-cost impact printers.

For more information, write or call. We'll send you our free brochure. Integral Data Systems, 14 Tech Circle, Natick, MA 01760. (617) 237-7610.

See us at NCC, booth 440-442.

Integral Data Systems, Inc.

CIRCLE 50 ON INQUIRY CARD

Technical Program Excerpts

Monday Afternoon

Session 3 2:30-4 pm Sheraton Centre Imperial A

Software Performance Modeling and Analysis

Chairman: Amrit L. Goel, Syracuse University

Focusing on the models and measures for software system performance, this session will present results of applications to actual software projects.

Session 4 2:30-4 pm Sheraton Centre Imperial B

Impact of Future Technologies on the Computer Industry

Chairman: Robert Colten, Gnostic Concepts

Two-thirds of the products sold by the computer industry today did not exist five years ago. New technologies are the driving forces behind the growth of the computer industry, and this session will provide data processing professionals with an understanding of those forces, together with insights into emerging data processing, mass memory system, distributed computing, and mainframe technologies, and their impacts.

Session 5 2:30-4 pm Sheraton Centre Georgian A

An Assessment of Future Computer System Needs for Large-Scale Computation

Chairman: Peter Lykos, Illinois Institute of Technology

The number of degrees of freedom available to the computer designer is increasing rapidly, but there is a communications gap between users and designers of large scale scientific computers. It is no longer sufficient for users to express their growing needs with the simplistic statement "bigger and faster." Users must organize in order to determine to what extent there are classes of problems and corresponding algorithms generic to several disciplines, together with some measure of their importance, so that the computer vendors can reduce the uncertainty in estimating user needs and reduce the corresponding risk of entering that marketplace.

Session 7 2:30-4 pm Sheraton Centre Royal B

State of Art of Minicomputer Hardware/ Software and Distributive Processing

Chairman: Marvin Golland, Peat, Marwick, Mitchell & Co

A panel of hardware/software vendors will present their organization's products, how they perceive the marketplace, and how their organization is attempting to fulfill the need. An overview of minicomputer hardware today and realistic expectations over the next few years will introduce the panel.

Session 9 2:30-4 pm Sheraton Centre Georgian B

Networks and Data: An Interim Report by the CODASYL Systems Committee

Chairman: Bernard K. Plagman, DBD Systems, Inc

The distributed database environment is a logical outgrowth of two major trends in the data processing industry. The CODASYL Systems Committee's analysis of the relationship between database technology and distributed processing serves managers interested in incorporating one or more data bases into a distributed processing environment. Design choices available will be discussed as well as network and database oriented components and their relationships.

Session 10 2:30-4 pm Hilton Sutton

Developing Professional Standards

Chairman: William P. LaPlant, Jr

(Information not available at press time)

Session 11 2:30-4 pm Sheraton Centre Royal A

Practical Applications of Data Encryption

Chairman: Durrell Hillis, Motorola Government Electronics Div

Two users, from different organizations in the financial world, will relate experiences in implementing data security and discuss their cost tradeoff analysis leading to that implementation. An electronic surveillance expert will review the current threats associated with wiretapping and other electronic surveillance techniques, and two suppliers of standard data encryption equipment will discuss capabilities and limitations of current state of the art encryption systems.

Session 13 4:15-5:45 pm Sheraton Centre Imperial A

Measurement of Software Reliability

Chairman: T. C. Wesselkamper, Virginia Tech

Presenting recent research results in measuring and predicting software reliability, this session will focus on methods that take into account the differences between hardware and software. The work done in verifying the validity of the theory will be carefully considered in the two papers to be followed by a panel discussion.

Session 14 4:15-5:45 pm Sheraton Centre Imperial B

Mass Storage System Technology

Chairman: George A. Michael, Lawrence Livermore Laboratory

(Information not available at press time)

Session 15 4:15-5:45 pm Sheraton Centre Georgian A

Array Processing: An Innovative Approach to Scientific Computing

Chairman: Roy D. Gwin, Floating Point Systems

Discussions of history, philosophy, and implementation of array processors will emphasize problem solving environments. Two environments to be detailed are computer tomography which has allowed the medical profession to have a greater diagnostic capability, and cockpit flight simulators where advances made will allow full simulation of aircraft for pilot training. Also discussed will be the basic mathematical requirements of such environments and their adaptation to array processing through the mathematical solutions of sparse matrices.

Session 17 4:15-5:45 pm Hilton Grand Ballroom West

Database Machines

Chairman: T. H. Bonn, Sperry Research Center

Database machines are commanding wide-spread interest. Users are concerned over increasing database computational loads, and yet they need new functionality. A number of different approaches to database machine architecture have been reported in technical literature and in product announcements. With the rapid advances in VLSI technology, even some of the exotic ideas soon may be cost-effective. These trends need to be put into perspective both from short and long term, and from the user and designer.

Session 20 4:15-5:45 pm Sheraton Centre Georgian B

The ANSI Reference Model for Network Protocols

Chairman: Helen M. Wood, National Bureau of Standards

A provisional reference model, intended to guide subsequent standardization activities, is being developed under the auspices of the American National Standards Institute (ANSI). The model currently consists of seven layers, each of which supports specific data transmission and/or data processing oriented functions, protocols, and interfaces. In this session, the ANSI provisional reference model and its relationship to existing and future, national and international standards will be examined.

Tuesday Morning

Session 25 8:30-10 am Sheraton Centre Imperial A

Designing Distributed Systems

Chairman: Dennis J. Frailey

One company can cut keyboard costs. Even when their keyboards cost more.

The most expensive mistake you'll ever make selecting a keyboard could be spending too little. In the long run, that adds up to cutting corners, not costs.

So to make sure you get the keyboard that really meets your needs, MICRO SWITCH uses Value Engineering.

Through Value Engineering, we look at your particular product needs to design a cost-effective solution to your problems. That means designing a keyboard that interfaces with your total system and meets your needs. Precisely.

It also means we can often lower your total system cost. For example, we might be able to incorporate into a keyboard several levels of codes that you had been paying for separately. And at a much higher cost.

Or maybe customize integrated circuits to provide you more logic for less money.

Besides giving you cost-efficiency, MICRO SWITCH keyboards out-feature practically every other in the industry.

You can choose LED or incandescent lighting. Tactile or linear feel. Sealed versions for military and industrial uses. Alternate or momentary action. Encoding techniques that'll meet any code requirement.

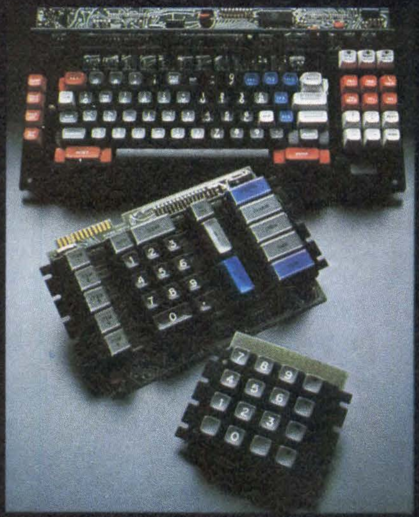
There are also wired-only assemblies or separate modules available. And you can pick from the industry's largest legend library.

Standard, solid state Hall-effect technology throughout the line delivers reliability no mechanical keyboard can offer. Plus, we back up every keyboard we make with a 1% Acceptable Quality Level and a two-year warranty.

It all adds up to quality you can put your fingers on every time.

For more information, call 815/235-6600.

With MICRO SWITCH, you'll be paying for keyboards instead of mistakes.



MICRO SWITCH

FREEPORT ILLINOIS 61032

A DIVISION OF HONEYWELL

MICRO SWITCH products are available worldwide through Honeywell International.

CIRCLE 53 ON INQUIRY CARD

The Future Has Arrived.

Intel delivers the 8086. Powerful. Practical. And the Architecture of the Future. Here today.

We have seen the Future and it is called 8086. Even better, it's here today. Our new 16-bit microcomputer is an architectural triumph, introducing designers to a new world of system expansion capability, high-level language programming and dramatically increased system thruput.

Why we call it "The Future"

To deliver the Future, we designed the 8086 with a totally new architecture, super-efficient for implementing high-level, block-structured languages such as Pascal and PL/M-86.

The 8086 addresses up to a full megabyte of system memory with new addressing modes and efficient register utilization that totally support such minicomputer-like capabilities as relocatable and re-entrant code and instruction look ahead.

And the 8086's powerful new instruction set includes both 8-bit and 16-bit multiply and divide in hardware, with efficient byte string operations and improved bit manipulation.

We're committed to delivering the industry's highest performance, today and into the future. The 8086's architecture maximizes system thruput today by delivering ten times the processing power of its 8-bit predecessors. Planned expansion promises another order of magnitude increase in performance through the addition of I/O processors, special instruction set extension processors, memory management and distributed intelligence configurations.

System components for expanded multiprocessor applications are available right now, supporting the Multibus™ architecture in timing, control and drive levels. They include 8288 Bus Controller, 8282/8283 Octal Latches and 8286/8287 Octal Transceivers.

Get a jump on the future.

8086 is the most successful new microcomputer ever. The list of major market leaders who have evaluated 16-bit machines and chosen the 8086 is staggering.

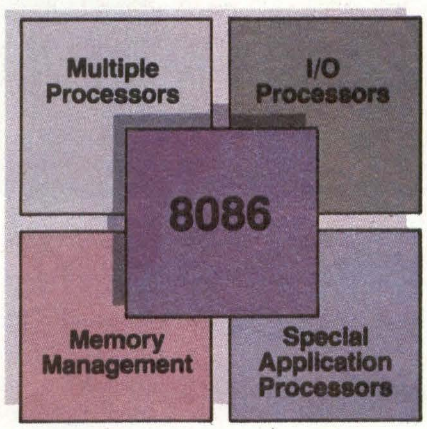
One reason for the 8086's success is our commitment to *your* success. We've made the 8086 the industry's best-supported microcomputer. The cpu, interrupt controller and six additional support circuits are on distributors shelves, with more on the way. You can take advantage of the 28 existing Intel® peripheral interfaces. Our 2716 (16K) and 2732 (32K) EPROMS provide programming flexibility and unique features for 8086 users, including protection against bus contention.

And we complete your system with a variety of off-the-shelf +5 volt MOS RAMs.

You can begin hardware/software development today, using the Intellec® Microcomputer Development system with ICE-86™ in-circuit emulation, PL/M-86 and ASM-86 for assembly language programming and 8080/8085 software conversion.

SDK-86, a complete system design kit including all essential components, makes it easy to begin prototyping without delay.

For an additional head start, iSBC 86/12™ single board computer brings the power of the 8086 to the Multibus with a fully assembled and tested 16-bit system.



The Future belongs to you.

Get to market first and capture a piece of the future for your product. You can order the complete 8086 family from your distributor. Or, for more information, contact your local Intel sales office or write: Intel Corporation, Literature Dept., 3065 Bowers Avenue, Santa Clara, CA 95051.

intel® delivers.

Europe: Intel International, Brussels, Belgium. Japan: Intel Japan, Tokyo. United States and Canadian distributors: Arrow Electronics, Alliance, Almac/Stroum, Component Specialties, Cramer, Hamilton/Avnet, Harvey, Industrial Components, Pioneer, Sheridan, Wyle/Elmar, Wyle/Liberty, L.A. Varah and Zentronics.

See us at NCC, New York City, June 4-7.

CIRCLE NO. 54 FOR INFORMATION

Topics relating to design issues ranging from tools for analysing potential designs to experience with existing systems will be explored, with emphasis on directly coupled physically distributed multicomputer systems.

Session 29 8:30-10 am Hilton Grand Ballroom West

Distributed Database Systems

Chairman: S. Bing Yao, New York University
(Information not available at press time)

Session 32 8:30-10 am Sheraton Centre Georgian B

An Overview of Network Technology

Chairman: Dixon Doll, DMW Telecommunications
(Information not available at press time)

Session 35 10:15-11:45 am Hilton Mercury

Evolution of the Computer Communications Market in a New Technological Era

Chairman: L. Dan O'Neil, National Telecommunications and Information Administration

Domestic communications issues which are affecting the data processing industry, including the FCC's Second Computer Inquiry, the rewrite of the Communications Act, and the impact of new technology upon the development of this law will be addressed.

Session 37 10:15-11:45 am Sheraton Centre Imperial A

The Interface Between Database Management Systems and Operating Systems

Chairman: Eduardo B. Fernandez, IBM Corp

This session will bring into focus some of the problems faced by designers of database systems to adapt to the environment provided by the operating system.

Session 40 10:15-11:45 am Hilton Grand Ballroom West

Relational Database Systems

Chairman: P. Bruce Berra, Syracuse University

This session will deal with several current issues in relational database systems. Specifically, the authors will address query operations that require means of finding efficient procedures for creating new relations; performance enhancement through query compilation; update problems and solutions to problems; and finally, a new design procedure for relational data base.

Session 41 10:15-11:45 am Sheraton Centre Royal B

Benchmark Selection of Teleprocessing Systems

Chairman: Gerald W. Findley, GSA/ADTS

The advent of plug-compatible mainframes, distributed processing, and falling hardware prices has raised new questions about the technical validity and cost-effectiveness of benchmarking during the selection of teleprocessing systems. The use of teleprocessing benchmarks, however, has been increasing. Leading CPE and benchmarking experts will discuss these developments and issues including the advantages of benchmarking, technical approaches and pitfalls, the cost for both vendors and users, benchmarking goals, remote terminal emulation, and the future of benchmarking.

Session 43 10:15-11:45 am Sheraton Centre Georgian B

Measurement Phases of Computer Selection

Chairman: Sandra A. Mamrak, Ohio State University

This session will address the feasibility of executing measurement phases in a comparison study of interactive services available through a computer network. Theoretical, technical, and economic aspects of measuring interactive services will be discussed,


µSA READY
MILLENNIUM

Zap! Your system's tested.

Test in "real time" up to 5 megahertz and drastically cut development time and costs.

With the force of the MicroSystem Analyzer, developing diagnostics now can be a snap. Operating in real time at microprocessor speeds up to 5 MHz, the MicroSystem Analyzer speeds total development time, performs hardware/software integration, and gets your prototype into production faster.

A Whole New Way of Microprocessor System Testing

With the MicroSystem Analyzer, you now can control your system with In-Circuit Emulation, and find faults with Signature Analysis, Time and Frequency measurements.

No other system available combines the elements to let you control and test at *all levels*—system, board, and component—in real time. The MicroSystem Analyzer lets you discover intermittent problems over a wide range of temperatures, operate without a built-in test source, and perform fault detection in multiboard systems. Test programs are easier and faster to develop, more complete and more accurate.

Universal—Both Today & Tomorrow

The MicroSystem Analyzer plugs directly into the most common microprocessor sockets—Z80, 8085A, 6800, 8080, with more to come—and uses a series of personality cards and probes to let you thoroughly isolate faults to the subsystem and component level.

No matter what major microprocessor you are using in product development or in production test, the MicroSystem Analyzer is the one universal and portable instrument for you.

Get Your Products into Production Faster

The MicroSystem Analyzer eliminates the need for long and expensive test fixture development, so you can move onto the next project sooner. Plus, with the diagnostics developed you have provided total production, depot repair and field test support!

Complete the coupon below for details on the most advanced microprocessor test instrument available today.

MILLENNIUM

MILLENNIUM SYSTEMS, INC.
19020 Pruneridge Avenue, Cupertino, CA 95014
Phone: (408) 996-9109 TWX: 910-338-0256
A subsidiary of American Microsystems, Inc.

Gentlemen:

OK, you got my attention. Now I'd like you to prove your MicroSystem Analyzer can shorten my development cycle, test systems and boards faster than anybody else, and save me a ton of money in the process.

PLEASE:

☐ Call me to set up a live demo on my Z80A, 8085A, 6800, or 8080 system.
☐ Send me complete information on the MicroSystem Analyzer today!

NAME__________
TITLE__________
COMPANY__________
ADDRESS__________
CITY__________ STATE__________ ZIP__________
PHONE__________

CD 579

both in relation to generating test workloads and doing statistically sound data collection and analysis. The emphasis will be on special problems present in the comparison of interactive (as opposed to batch) systems.

Tuesday Afternoon

Session 46 — 2:30-4 pm — Hilton Mercury

Computer Communications and the International Marketplace

Chairman: L. Dan O'Neil, National Telecommunications and Information Administration

A status report of international negotiations relating to communications facilities, planning, and ownership will be presented, with attention given to the impact of these disputes and agreements upon the worldwide data processing industry.

Session 48 — 2:30-4 pm — Sheraton Centre Imperial A

Computer Systems Analysis and Evaluation

Chairman: Victor L. Wallace, University of Kansas

(Information not available at press time)

Session 49 — 2:30-4 pm — Sheraton Centre Imperial B

Dynamic and Reconfigurable Architectures

Chairmen: Svetlana P. Kartashev, University of Nebraska; C. V. Ramamoorthy, University of California; and Steven I. Kartashev, Dynamic Computer Architecture, Inc

Adaptable architectures change their structure via software to adapt to computational peculiarities of a program and are divided into three classes: dynamic, reconfigurable, and microprogrammable. This session will make a survey of dynamic and reconfigurable architectures, specify new architectural adaptations of future computer systems, and outline program analysis techniques aimed at finding these adaptations.

Session 50 — 2:30-4 pm — Sheraton Centre Georgian A

Impact of Security and Protection on Computer Architectures

Chairman: Virgil D. Gligor, University of Maryland

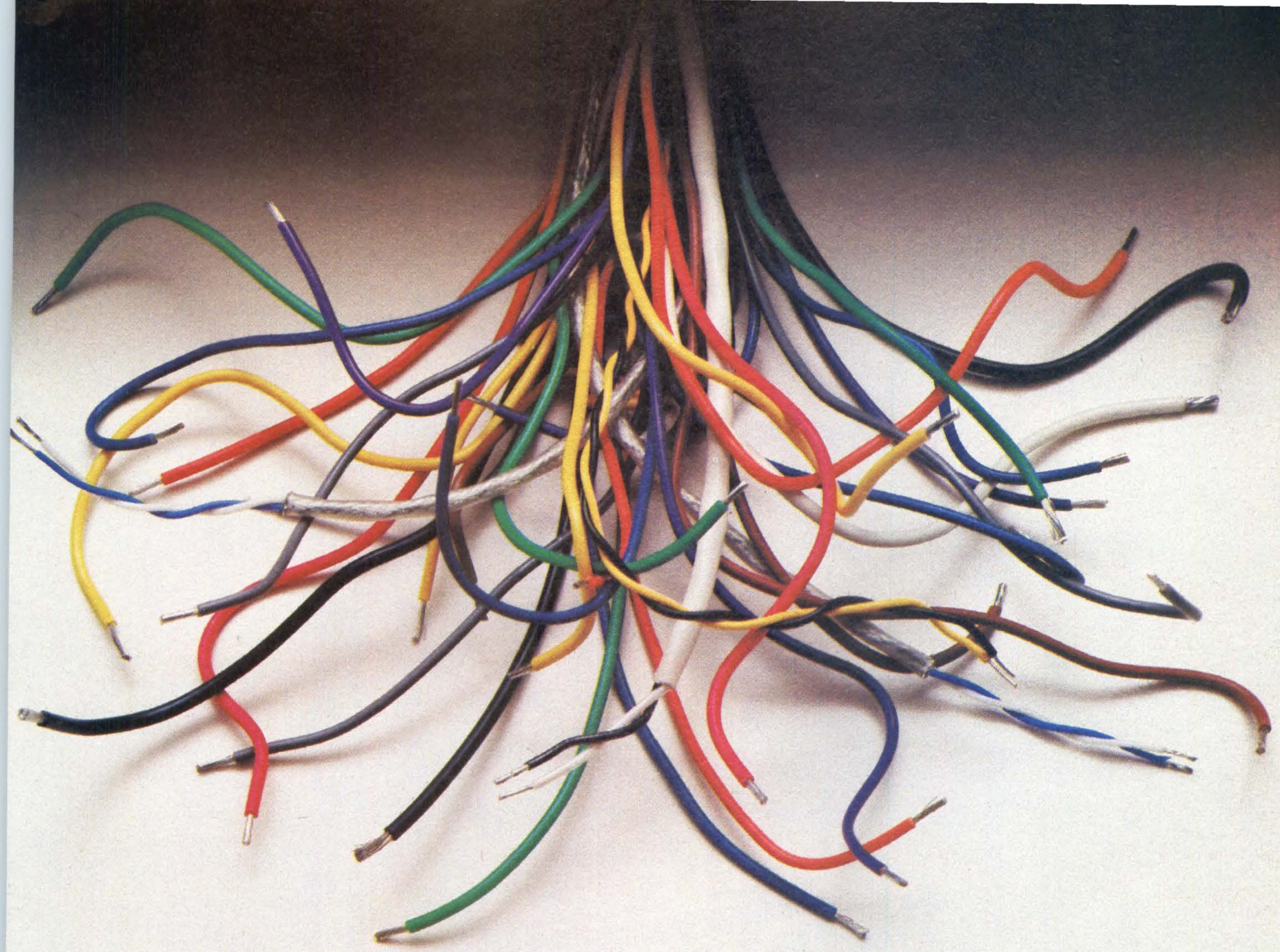
Recent advances in protection architectures for both centralized systems and networks will be reviewed. The relevance of these advances to the users' security needs in various environments such as military security, banking, industry, and personal computing will be delimited. Focus will be on the ease (or lack thereof) of integrating protection mechanisms into existing architectures, with some practical limitations of security and of the corresponding protection mechanisms that may restrict the impact of such mechanisms on commercially available systems.

Session 52 — 2:30-4 pm — Hilton Grand Ballroom West

Database Evolution

Chairman: Dennis McLeod, University of Southern California

The structure of a computerized data base must adapt with time, as the needs and requirements of an organization change. This evolution must accommodate changes in the user views of a data base as new information must be incorporated. Changes in data base usage and performance requirements must also be handled. This panel will discuss current techniques, approaches, and research directions in addressing the problem of database evolution.



We'll take it from here.

Let's face it, interconnections can really leave you at loose ends.

So we're offering to take total responsibility for solving your mass termination problems.

We're Spectra-Strip, and what we make is exactly what you need to get your job done right, reliably and within reason.

For all your interconnect needs from jumpers and flat cables to IDC connectors and ready-to-go standard and custom planar assemblies, just check us out. You won't need to call anyone else.

For the name and number of our nearest distributor or rep, write Spectra-Strip, an Eltra Company, 7100 Lampson Avenue, Garden Grove, CA 92642. Or call (714) 892-3361 today.

SPECTRA-STRIP An Eltra Company

When you're down to the wire

CIRCLE 59 ON INQUIRY CARD


Ball

The company whose glass jars became a legend is now making history in computer products.

Ball...where quality has been a tradition for 99 years.

In 1880, the Ball Mason Jar offered a simple solution to an age-old problem. Known for their consistent quality, these jars revolutionized an industry.

In 1979, after seven years of research and development, the Ball name is again making history with OEM computer peripheral products and the ReaDoc System for automatic processing of payments.

Ball Disk Drives

Products you'll be proud to label your own.

Ball Computer Products people understand the needs of the OEM. When you buy a disk drive, it must be fully operational when delivered. After that drive ships to your customer, it must exhibit high field reliability. And, if the drive does fail, it must be readily repairable. The BD-50 and BD-80 Disk Drives satisfy those needs . . .

- ☐ Because we insist on perfection through every step in the manufacturing process. (We ensure it through long, elevated temperature burn-in before shipment.)
- ☐ Because all BD-Series Drives employ modular construction and diagnostic features that simplify service.
- ☐ Because all BD-Series Drives are supported by the most complete field maintenance documentation in the industry.

Ball's total approach to product quality—That's what you'll like most about BD-Series Disk Drives.

Ball Disk and Tape Controllers

Powerful, yet easy to use.

Ball controllers for Nova and PDP-11 series computers are easy to incorporate into your system. Our **tape controllers** emulate similar products from the computer manufacturer. No software impact! And they are host-resident for lowest cost.

Our **disk controllers** include emulating controllers, which require no software modification, and non-emulating controllers, which come with complete software modification packages. Microprocessor-based, the Ball controllers incorporate all the latest features. Some even offer IBM format capability. All our controllers operate with any SMD interface drive—the Ball BD-50 and BD-80, or any other—even intermixed on the same controller.

Ball Disk and Tape Subsystems

Complete systems from a single source.

Ball Computer Products specializes in fully integrated disk and tape subsystems. Single source responsibility eases the headache of integrating components from several vendors. You decrease inventories and significantly improve factory throughput. Your shipments aren't held up for lack of a minor system component. And you have the comfort of knowing that before the system ever left Ball, it was tested on a system identical to yours.

Ball ReaDoc

Cash processing system.

The ReaDoc Remittance Processing System broke new ground in data processing for major companies processing mail and agency payments. This complete system, with terminal, memory, central processor and software, has already reduced cash processing expense for many firms and is building an enviable reliability record. While the system concept remains constant, each ReaDoc system is tailored for a specific customer application.

Ball Computer Products

Legendary in their own time.

Ball Computer Products Division is a growing part of the Ball Corporation, a company with annual sales of more than half a billion dollars. Ball people personify the company philosophy of quality and performance leadership. Our products solve your problems by providing straightforward and reliable answers to complex requirements. We would like to be part of your company's success story. Call us for complete information.

Ball Computer Products Division

Division Headquarters
860 East Arques Avenue
Sunnyvale, California 94086
(408) 733-6700

See us at NCC, Booth #1426

Session 53 2:30-4 pm Sheraton Centre Royal B

Planning, Acquisition, and Implementation of Minicomputer Based Business Systems

Chairman: Marvin Golland, Peat, Marwick, Mitchell & Co

Data processing consultants and experienced users who are thoroughly familiar with implementing minicomputer business systems will comprise this panel, the focus of which is nontechnical. An overview of the minicomputer field, basic definitions, and opportunities will be provided, intending to identify and describe the various steps such as requirements definition, hardware/software selection, contractual arrangements, and implementation of minicomputer systems.

Session 60 4:15-5:45 pm Sheraton Centre Imperial A

Modeling of Program Behavior

Chairman: David Kuck

Concerned with two very different models of program structure, one paper will analyze the way in which references to array elements are contained within iterative loops, and restructure the program to improve performance on virtual memory systems; the second will explain behavior, and describe the relationships between their primitive operators.

Session 61 4:15-5:45 pm Sheraton Centre Imperial B

Dynamic and Reconfigurable Architectures: Problems, Evolution, and Applications

Chairmen: Svetlana P. Kartashev, University of Nebraska, and Steven I. Kartashev, Dynamic Computer Architecture, Inc

Under discussion will be software and hardware problems of designing powerful systems with adaptable architectures (involving dynamic, reconfigurable, and microprogrammable adaptations). Such architectures increase a system's throughput using the same resource, augment the area of effective applications, and simplify the process of creating a system's prototype. Panelists will discuss the problems of supersystems of the 1980s, computation of program(s) by a sequence of computers, new requirements to operating systems, and finding the best system architectures through analysis of an algorithm.

Session 62 4:15-5:45 pm Sheraton Centre Georgian A

Distributed System Control Architecture

Chairman: Daniel Schutzer, Naval Electronics Systems Command

There has been much study in recent years concerning the advantages and disadvantages of distributed processing architectures and networks. This session will describe three representative applications of distributing processing, and some specific analyses performed in support of these applications. It is believed that these analyses will provide general insight as to some major issues associated with the management and control of distributed processing architectures and networks.

Session 64 4:15-5:45 pm Hilton Grand Ballroom West

Database Management Systems Architecture

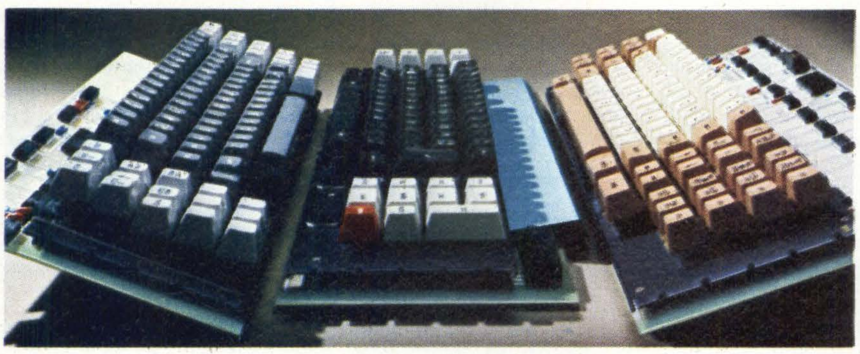
Chairman: John Berg, National Bureau of Standards

What makes a complete database environment from a user viewpoint? A discussion of components, interfaces, and interactions is necessary to make a database environment useful and acceptable to potential users. Of the many ways which an entire database

More cost efficiency...

Introducing Series III SOLID STATE KEYBOARDS

Now: Ferrite Core Reliability At Lower Prices



More cost efficiency you can put your finger on...

Just imagine, a solid state keyboard at a price you can afford that delivers MTBF's in excess of 40,000 hours, is unaffected by contaminants, has excellent resistance to static discharge and EMI, plus high speed operation without "misses." Well the keyboard professionals have done it again—the Series III keyboard.

That's right, the SERIES III will provide cost efficiencies you can put your finger on. It's designed to increase operator productivity and performance under demanding operational and environmental conditions. This means cost efficiency for you—reduced downtime, lower repair cost, fewer service calls, satisfied customers, and lower prices. That's total value!

It's in the unique SS3 ferrite core keyswitch

We've built our reputation on ferrite core switching technology. And once again, we've advanced our technology through the unique SS3 keyswitch.

Like its proven and successful predecessor, the SS3 keyswitch is mechanically simple and contactless. The SS3 is designed with fewer parts, lower profile and exceptional feel while maintaining excellent resistance to environmental factors. This combined with a 100 million cycle life test rating offers unsurpassed cost efficiency.

You have our word on quality—Cortron

All Cortron® Series III Solid State Keyboards are 100% inspected and tested to insure your specifications are met. We're so sure of our reliability that we have extended our warranty to 2 full years. Let us convince you.

We've touched on a few of the many cost efficiency benefits that Cortron Series III Solid State Keyboards offer you and your customers. There's much more we can talk about. For full cost efficiency details and our Cortron Series III Solid State Keyboard brochure, write or call Cortron, A Division of Illinois Tool Works Inc., 6601 West Irving Park Road, Chicago, Illinois 60634. Phone (312) 282-4040. TWX: 910-221-0275. Toll free line: 800-621-2605.

itw CORTRON
A DIVISION OF ILLINOIS TOOL WORKS INC
THE KEYBOARD PROFESSIONALS

system might be viewed, which views are better, and what criteria should be used to judge or measure "better"?

Wednesday Morning

Session 72 8:30-11:45 am Sheraton Centre Imperial A

Quantitative Measures of the Quality of Programs and Systems

Chairman: Ned Chapin, InfoSci Inc

Easy, inexpensive, and controllable maintainability characterizes most high quality systems and programs. The focus of the first half of this double session will be on quantitative factors affecting maintainability. These include design, management, and statistical factors with some ideas for quantitative measurement and control. The second session will focus on solidly grounded measures useful in program and system design, development, debugging, and maintenance as complexity in design and implementation has long been pointed to as degrading the quality of systems and programs. Recent advances now make it possible to measure the complexity present in quantitative and reliable ways.

Session 74 8:30-10 am Sheraton Centre Georgian A

Fault Tolerant and Maintainable Systems

Chairman: Jacob A. Abraham, University of Illinois

Focusing on techniques to tolerate hardware or software failures in systems, or to effectively diagnose them in order to reduce down time, this session will feature papers on a highly reliable, fault-tolerant multiprocessor for aircraft control and on a low cost, easily maintainable business computer. The question is whether the additional cost of fault-tolerance or maintainability is justified in terms of the improvement in overall throughput.

Session 78 8:30-10 am Hilton Regent

Simulation for Predicting Computer System Performance

Chairman: Brian W. Unger, University of Calgary, Canada

This session will present recent work in discrete-event and hybrid simulation models for predicting the performance of computer systems.

Session 80 8:30-10 am Hilton Sutton

Advances in Secure Operating Systems Technology in the Department of Defense

Chairman: Stephen T. Walker, Department of Defense

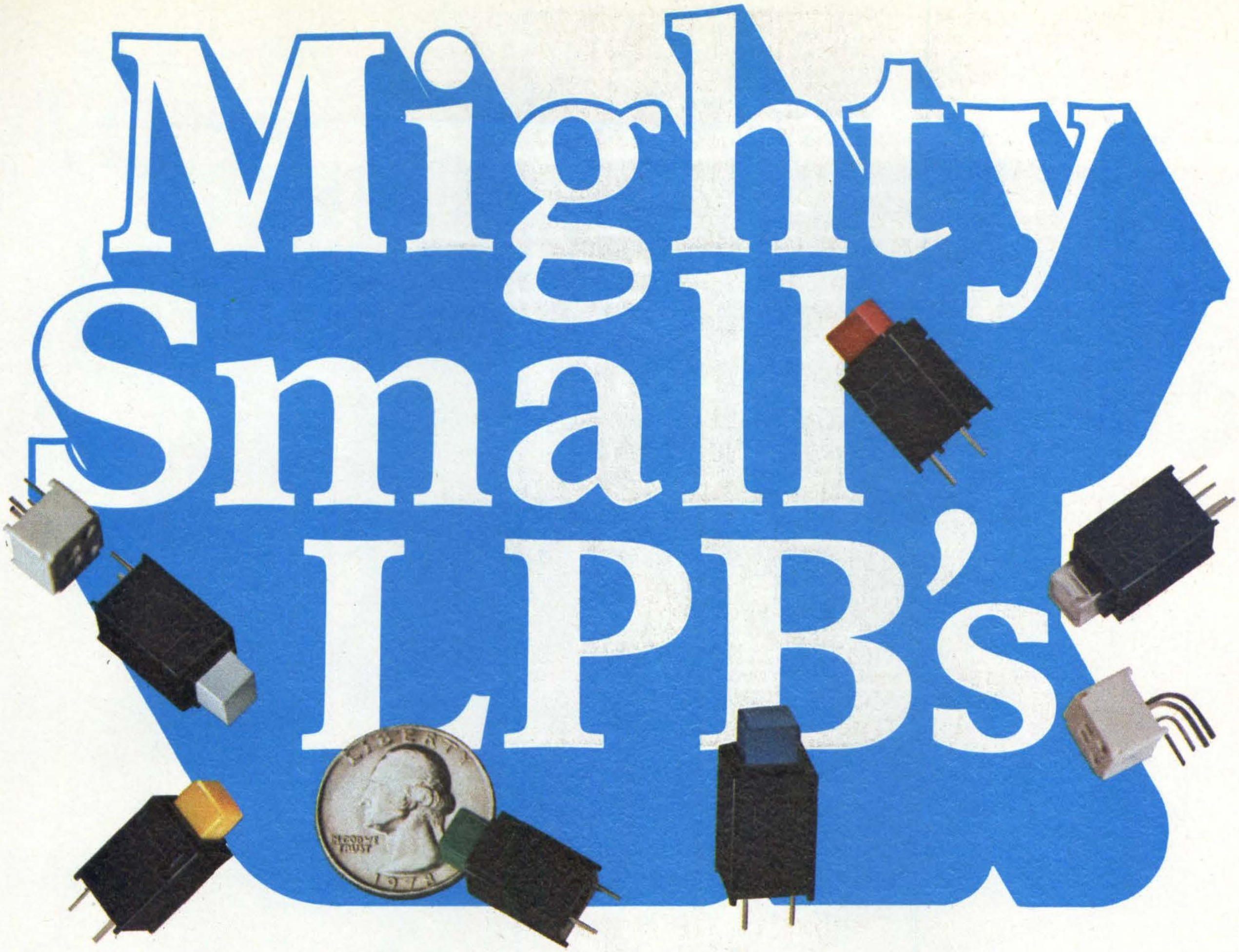
The day of trusted ADP systems is at hand. After eight years of computer security research, operating systems with sufficient integrity for DOD multilevel secure use will be available during 1979. These systems serve as existing proof to the computer industry that trusted ADP systems can be built, with profound implications on all sensitive information handling applications. This session will describe the design of their secure operating systems.

Session 84 10:15-11:45 am Sheraton Centre Imperial B

The Impact of New A-D LSI Technology on Systems

Chairman: Rob Walker, Intel Corp

Examples of a recently available class of semiconductor devices combining linear and complex digital functions on the same chip are microprocessors with A-D converters, telecommunication CODECs and filters, and analog microcomputers. The combination of linear and complex digital circuitry on a single chip constitutes a fundamental advance in semiconductor technology, inferring both lower cost and higher performance. A variety of technologies



More versatility and economy than you've ever had in a miniature L.E.D. lighted PB switch!

We're really excited about something small. It's the Licon® Series 39 High Density Miniature Pushbutton Switches. It's one of the smallest LPB's available. If you need greater versatility and economy for your miniature switching application, here's your answer.

Licon Series 39 switches are offered in L.E.D. lighted, non-lighted and L.E.D. indicator versions, and momentary or maintained action. Choose from a variety of lens cap colors.

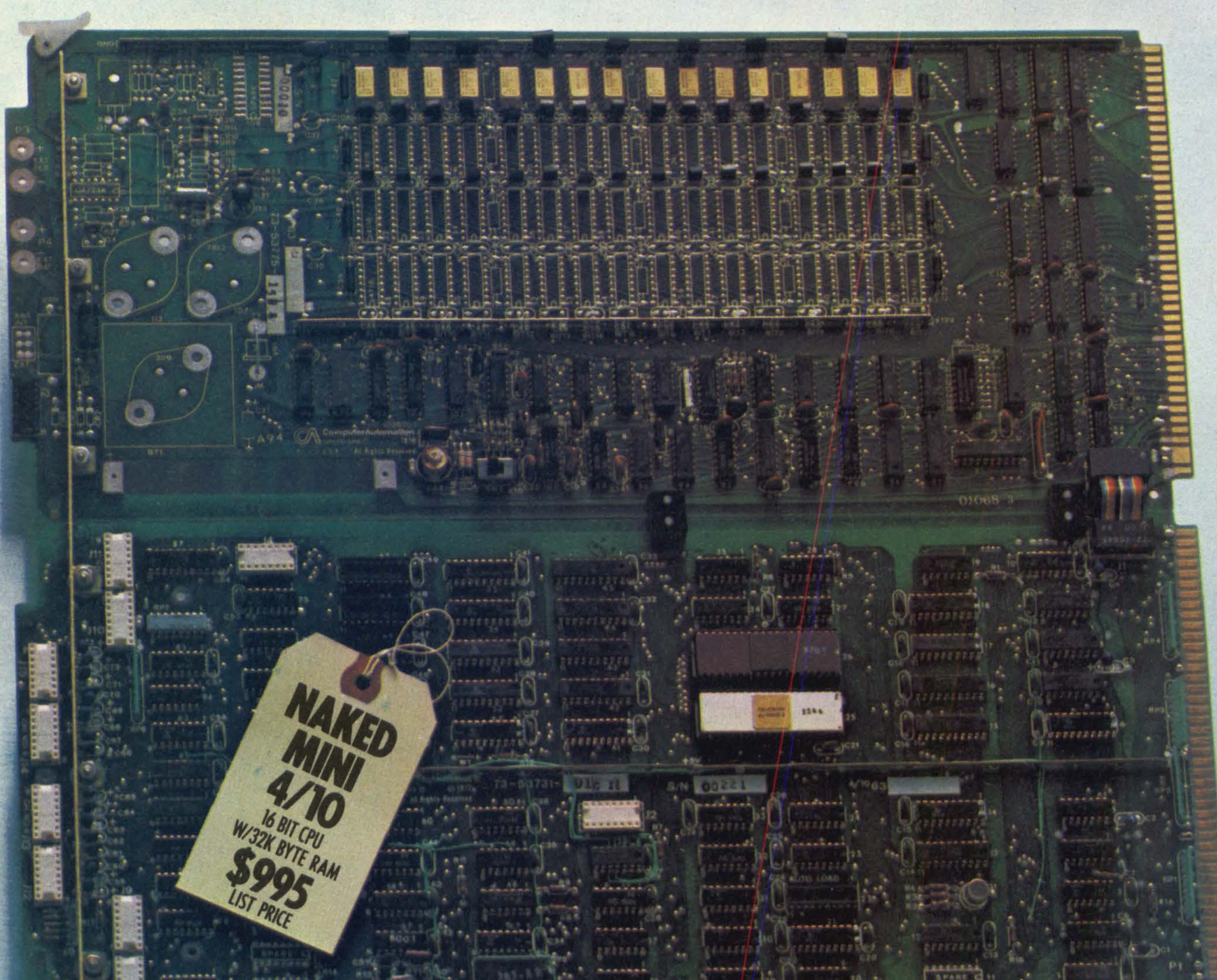
Proven bifurcated, silver-plated switch contacts provide the switching integrity required for logic loads. These contacts are recognized for their self-cleaning wiping action, that eliminates the need for expensive gold contacts. Series 39 switches mount directly to a PC board, or with optional connectors in-line or at right angles, a method for use with card files. Switches may be mounted on .390″ (10mm) or larger centers in the x and y directions. Behind panel depth is .625″ (16mm) maximum to PC board mounting surface. Series 39 Switches are rated at .25 Amp., 30 VDC max. Typical logic load is .010 Amp., 5 VDC.

These small LPB's are ideal for instrumentation, mini and micro-computers, word processors, test equipment, programming and other resistive-load milliamp uses. For full details contact your local Licon salesman or distributor, or call or write for Series 39 Bulletin: LICON, 6615 West Irving Park Road, Chicago, Illinois 60634. Phone (312) 282-4040. TWX: 910-221-0275.

LICON
A DIVISION OF ILLINOIS TOOL WORKS INC.

CIRCLE NO. 64 FOR FULL DETAILS
CIRCLE NO. 65 TO HAVE SALESMAN CALL

THE ONLY 32K BYTE COMPUTER FOR UNDER $1000. (QTY=1)



Our NAKED MINI 4/10 is a genuine price/performance breakthrough. For OEM quantity discounts that'll improve your bottom line even more, call one of the following sales offices: Santa Ana, CA, (714) 546-9550; Santa Clara, CA, (408) 985-6800; Denver, CO, (303) 399-1383; Orlando, FL, (305) 896-1440; Atlanta, GA, (404) 455-1649; Elk Grove Village, IL, (312) 860-1810; Waltham, MA, (617) 890-7190; Livonia, MI, (313) 261-5170; Bloomington, MN, (612) 854-2305; Bloomfield, NJ, (201) 338-8300; Greensboro, NC, (919) 294-5367; Cincinnati, OH, (513) 771-7530; N. Olmsted, OH, (216) 777-8700; King of Prussia, PA, (215) 265-5770; Nashville, TN, (615) 383-3315; Dallas, TX (214) 350-5681; Houston, TX, (713) 981-8859; Bethesda, MD, (301) 656-1217; Bellevue, WA, (206) 455-9650; or write us at 18651 Von Karman, Irvine, CA 92713.

ComputerAutomation
Naked Mini® Division

WHERE OEM'S COME FIRST.

CIRCLE 66 ON INQUIRY CARD

such as bipolar processors, NMOS, and CMOS are being proposed in the search for optimum price/performance.

Session 85 10:15-11:45 am Sheraton Centre Georgian A

Testing and Fault-Tolerance in Digital Systems

Chairman: Stephen Y. H. Su, State University of New York

Since the technology has moved into VLSI, testing has become more important than ever. Intermittent faults are the major cause of failure. The first paper will survey the techniques for modeling, testing and reliability evaluation, and fault-tolerant design of digital systems with intermittent faults. Testing schemes for computer architecture are essentially ad hoc. The second paper will identify the likely errors in implementing an architecture and provide tests for improving the error coverage.

Session 86 10:15-11:45 am Hilton Grand Ballroom East

How to Sell New Technology to Management

Chairman: Herbert B. Safford, GTE Data Services, Inc.

(Information not available at press time)

Wednesday Afternoon

Session 95 2:30-5:45 pm Sheraton Centre Imperial A

Case Studies in Software Development Techniques

Chairman: Julie E. K. Landstein, IBM Corp

In this session the participants will discuss their experiences, tools, and methods used in the various phases of the software development process, the importance of project planning which involves problem and requirement definition, and the necessity of control throughout the life of the project. Next, the technical issues of software implementation and software validation will be addressed; and finally, the inevitable phase of all software projects, that of enhancements and modifications.

Session 96 2:30-4 pm Sheraton Centre Imperial B

High End Microprocessor Architecture

Chairman: Bernard Peuto, Zilog Corp

High end microprocessors are competing with top of the line 16-bit minicomputers and have many of the architectural features of 32-bit minicomputers. The panel will assess the market for this new product and speculate about the impact on computing.

Session 97 2:30-4 pm Sheraton Centre Georgian A

Advanced Industrial Robotics

Chairman: John Albus, National Bureau of Standards

Current and near-future applications of industrial robots to materials handling, tool manipulation, assembly, and inspection will be discussed. Issues of modeling, simulation, high level programming languages, and interfaces to external data bases such as CAD/CAM CL data files will be addressed. Methods by which robots can be programmed to respond to sensory input so as to cope with uncertainties and recover from errors will also be considered.

Session 100 2:30-4 pm Sheraton Centre Royal B

Special Computer Applications

Chairman: Daniel Van Belleghem

(Information not available at press time)

Session 101 2:30-5:45 pm Hilton Regent

Simulation Results

Chairman: John McLeod, Society for Computer Simulation

Panelists in the field of computer simulation will address the question of how simulationists can contribute more effectively to the solution of problems of our time.

Session 107 4:15-5:45 pm Sheraton Centre Imperial B

Database Design

Chairman: Sham Navathe, New York University

Addressing itself to the problems of designing and implementing data bases in business, industry, and government, this session will discuss design decisions, issues, and strategies for each of the following phases: requirements analysis, collection of application needs in information structuring and processing, integration of user/application needs into a logical database design, transformation of logical database design into a DBMS schema, schema implementation and physical design, operational considerations, administration, and control.

Session 108 4:15-5:45 pm Sheraton Centre Georgian A

Advances in Computer Graphics

Chairman: Bertram Herzog, University of Colorado

(Information not available at press time)

Thursday Morning

Session 117 8:30-10 am Sheraton Centre Imperial A

Communications Technologies: Their Impact on Computing

Chairman: David L. Mills, Communications Satellite Corp

The panelists will discuss a number of technology related issues upon which the development of large scale information networks pivot. Of particular interest is the rapid growth of packet switching technology for the integration of multimedia traffic, including speech, facsimile, and record data. Facilitating the growth of this technology is the emerging use of dynamically shared satellite and radio channels accessable by large user populations. This technology is bound to current and proposed networks by the development of sophisticated protocols uniquely suited for high reliability and efficient utilization of resources, even under adverse operational conditions.

Session 119 8:30-10 am Sheraton Centre Georgian A

New Directions in Distributive Architectures

Chairman: Frank Westervelt, Wayne State University

(Information not available at press time)

Session 124 8:30-10 am Sheraton Centre Georgian B

Network Performance Modeling

Chairman: Vijay Ahuja, IBM

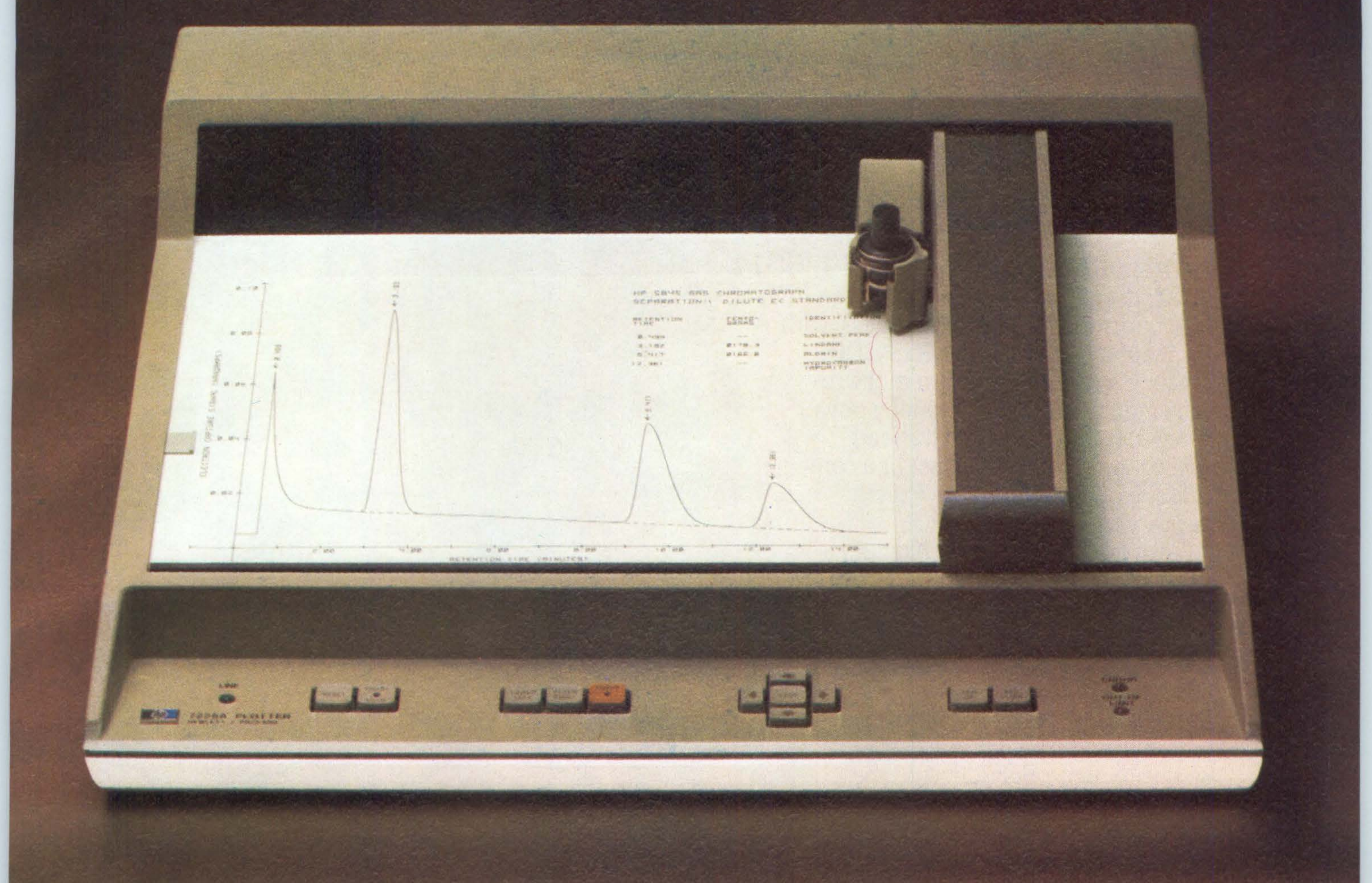
(Information not available at press time)

Session 130 10:15-11:45 am Sheraton Centre Royal B

Computation Problems in Pattern Recognition and Image Processing

Chairman: King Sun Fu, Purdue University

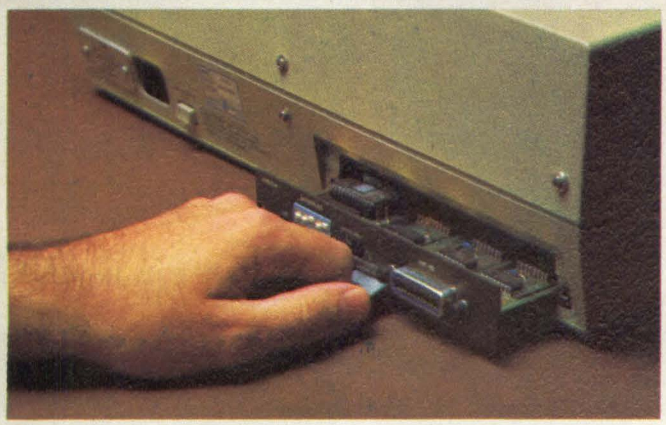
Discussing various computation problems involved in pattern recognition and image processing applications, this session will present special computation algorithms, computer architectures, and software considerations for pattern recognition and image processing.



Now OEM's can draw high quality graphics even when the bottom line is price.

Graphics gives you the best way to analyze and communicate data. But cost has been keeping it out of the picture for many OEM systems. That's why Hewlett-Packard is offering the new Model 7225A Graphics Plotter.

The price: $1750 (domestic USA price with 17602A general purpose "personality" module), in quantities of five. With further OEM discounts from there.



Plug-in "personality modules" customize the plotter for you.

HP's versatile 7225A converts the output of processor based systems into high quality charts and graphs in any size up to 8½ x 11" (A4). A wide selection of plug-in "personality modules" lets you adapt the plotter to suit your needs. Different modules determine interface hardware, language, and capabilities such as internal character sets, axis generation, labeling and scaling.

Simple linear stepping motors eliminate many moving parts to assure reliability. Visually smooth, high resolution ink lines of any length and angle are generated, requiring only end point data.

And you give your customers the confidence of Hewlett-Packard's worldwide service network.

So if you want high quality graphics but you draw the line at price, look into the Model 7225A Graphics Plotter. For a detailed 24-page OEM brochure, contact Hal Phillips at Hewlett-Packard, 16399 West Bernardo Drive, San Diego, CA 92127; (714) 487-4100. 11901

HEWLETT hp PACKARD

1501 Page Mill Road, Palo Alto, California 94304

For assistance call: Washington (301) 948-6370, Chicago (312) 255-9800, Atlanta (404) 955-1500, Los Angeles (213) 877-1282

CIRCLE 69 ON INQUIRY CARD

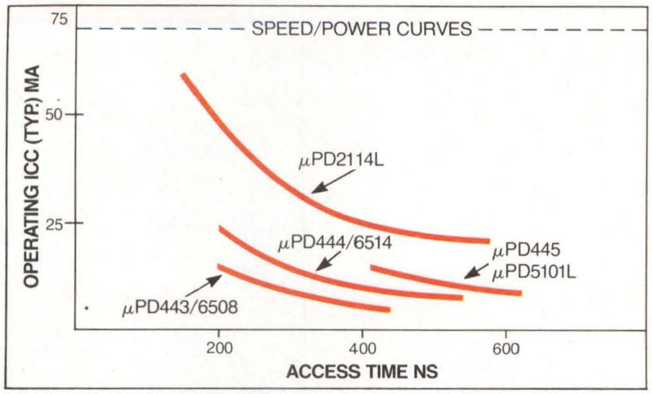
NEC gets serious about CMOS RAMs.

Introducing the μPD444/6514

Our new 1K x 4 CMOS RAM, the μPD-444, offers pin for pin compatibility with our industry-standard NMOS μPD-2114L. So whether your memory requirements call for low standby power down to 0.065 μW, or high speed applications down to 150 ns, or a combination of both, NEC has exactly the part you need.

With our unique short channel length CMOS technology, we've designed the μPD444 to provide access and cycle times as low as 200 ns in the industry standard 300 mil wide 18-pin package. Like the μPD2114, it's manufactured on four-inch wafers—for low cost and high volume production. And the μPD444 will operate in a fully static or asynchronous mode.

The μPD444/6514 is the latest



PART NUMBER	ACCESS TIME	OP. POWER (TYP.)	NO. PINS	STANDBY POWER (TYP.)	LOW Vcc POWER (TYP.)
μPD444/6514C	450 ns	45mW	18	.065μW	.022μW
μPD444/6514C-1	300 ns	60mW	18	.065μW	.022μW
μPD444/6514C-2	250 ns	75mW	18	.065μW	.022μW
μPD444/6514C-3	200 ns	95mW	18	.065μW	.022μW
μPD445LC	650 ns	45mW	20	100μW	1μW
μPD445LC-1	450 ns	75mW	20	100μW	1μW
μPD5101LC	650 ns	45mW	22	1μW	.016μW
μPD5101LC-1	450 ns	75mW	22	1μW	.016μW
μPD443C/D	450 ns	25mW	16	5μW	.3μW
μPD443C/D-1	300 ns	45mW	16	5μW	.3μW

addition to our growing line of CMOS RAMs—a line that includes a 20-pin 4K RAM (μPD445), a 22-pin 1K RAM (μPD5101), and an 18-pin 1K RAM (μPD443/6508). And besides depth in products, we offer depth in support—including engineers available to help with specific application problems, plus complete documentation, testing, and special selection. Our 1979 product catalog contains full details on our complete line of memories, plus our 8-bit and 4-bit microprocessors and peripherals. If you are in North America, you may obtain a copy by attaching your business card or letterhead stationery to this page and sending it to NEC Microcomputers, Inc., 173 Worcester St., Wellesley MA 02181.

Next time, think NEC.

NEC

NEC Microcomputers, Inc.

REPS: Action Unlimited, Arlington, TX, Spring, TX; Burton-Medley Associates, Grandview, MO; Cerco, San Diego, CA; Contract Sales, Inc., Burlington, MA; D/Z Associates, Inc., Denver, CO; Electronic Innovators, Inc., Minneapolis, MN; Eltron, Phoenix, AZ; HLM Assoc., Torrington, CT, Northport, NY, Parsippany, NJ; Imtech, Inc., Cleveland, OH, Dayton, OH; Kaytronics Limited, Ville St. Pierre, Quebec, Downsview, Ontario, Surrey, British Columbia; L & M Associates, Pikesville, MD, Montpelier, VA; Harry Nash Associates, Willow Grove, PA; R.C. Nordstrom & Company, Lathrup Village, MI; Nycom, Inc., East Syracuse, NY; Perrott Associates, Inc., Fort Lauderdale, FL, Clearwater, FL, Orlando, FL; Santana Sales, Costa Mesa, CA; Stone Component Sales, Waltham, MA; Technology Sales, Inc., Palatine, IL; Trident Associates, Inc., Sunnyvale, CA; Tri-Tronix, Albuquerque, NM; Tri-Tronix, NW., Mercer Island, WA; 20th Century Marketing, Inc., Huntsville, AL, Knoxville, TN; Wolff's Sales Service Company, Raleigh, NC.

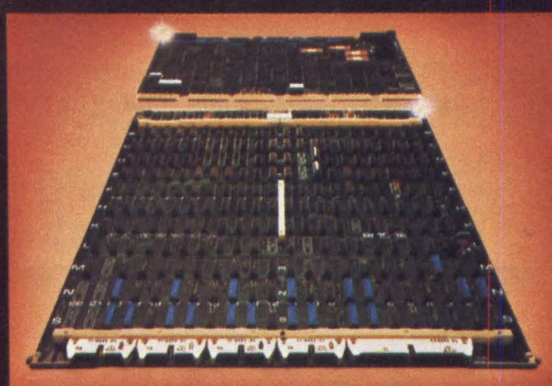
DISTRIBUTORS: Almo Elextronics Corp., Philadelphia, PA, Baltimore, MD; Bell Industries, Bellevue, WA; Century Electronics, Albuquerque, NM, Wheatridge, CO, Salt Lake City, UT; Normal Davis Electronics, South Euclid, OH; Diplomat/Westland, Inc., Sunnyvale, CA; Diplomat/Southland, Inc., Clearwater, FL; Diplomat/Lakeland, Inc., Elk Grove Village, IL; Diplomat/IPC of Mass., Chicopee Falls, MA; Diplomat, Holliston, MA; Diplomat/Northland, Inc., Farmington, MI; Diplomat/Electro-Com Corp., Minneapolis, MN; Diplomat/St. Louis, Inc., St. Louis, MO; Diplomat/IPC Corp., Totowa, NJ, Mt. Laurel, NJ; Diplomat Electronics Corp., Woodbury, NY; Diplomat/Alta-Land, Inc., Salt Lake City, UT; Future Electronics Corp., Montreal, Quebec, Downsview, Ontario, Ottawa, Ontario, Natick, MA; Hughes-Peters, Inc., Cincinnati, OH, Columbus, OH; Intermark Electronics, Sunnyvale, CA, Santa Ana, CA, San Diego, CA; KA Electronics, Dallas, TX; Kent Electronics, Houston, TX; G.S. Marshall, Sunnyvale, CA, Canoga Park, CA, El Monte, CA, San Diego, CA, Phoenix, AZ; Milgray Electronics, Inc., Freeport, NY, Orange, CT; Reptron Electronics, Inc., Livonia, MI, Columbus, OH; Resco/Raleigh, Raleigh, NC; Semiconductor Specialists, Inc., Chicago, IL, Burlington, MA, Farmington, MI, Minneapolis, MN, Hazelwood, MO, Pittsburgh, PA, Dallas, TX, Milwaukee, WI; Sterling Electronics, Phoenix, AZ, Santa Clara, CA, San Diego, CA, N. Hollywood, CA, Baton Rouge, LA, Waltham, MA, Albuquerque, NM, Dallas, TX, Houston, TX, Tukwila, WA; Summit Distributors, Inc., Buffalo, NY; Summit Elec. of Roch., Inc., Rochester, NY; Technico, Inc., Columbia, MD, Roanoke, VA; Western Microtechnology Sales, Cupertino, CA. Western Region office in Orange, CA at (714) 633-2980; our Eastern Region office in Melville, NY at (516) 293-5660; or our Midwestern Region office in Des Plaines, IL at (312) 298-7081.

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 ( ) ________________

While you're at the NCC show, see our newest products at our hospitality suite in the New York Hilton.

Interdata people, ask about the SMC903.

CIRCLE 70 ON INQUIRY CARD

Session 132 10:15-11:45 am Sheraton Centre Georgian B

AUTODIN II—Data Communication System

Chairman: Sydney Gordon

(Information not available at press time)

Session 133 10:15-11:45 am Hilton Sutton

Microcomputers in Technical Professional Development

Chairman: Raymond G. Fox, Learning Technology Institute

Continuing personnel development in the field of science and engineering is critical in maintaining technical competence in an era of rapid technological change and obsolescence. This session will look at solutions to these problems which employ the use of microcomputers in the technical professional development process. Panelists will describe methods of microcomputer uses, applications, and results achieved, and will identify the future potential of this technology.

Thursday Afternoon

Session 136 2:30-4 pm Sheraton Centre Imperial B

Associative Processors—Why Are They Needed? What Can We Expect in the Future?

Chairman: Tadao Ichikawa, Hiroshima University

Considering the rapidly developing LSI technology of recent years, there is now a need to work toward the economical implementation of application oriented, high performance associative processors to meet social requirements. Session participants with theoretical and physical backgrounds of implementing the systems will discuss practical applicability of associative processors to database management and image processing problems in terms of cost-effectiveness.

Session 137 2:30-4 pm Sheraton Centre Georgian A

High Level Language and Direct Execution Machines

Chairman: Edward Feustel

(Information not available at press time)

Session 142 2:30-4 pm Sheraton Centre Royal A

Computerized Control Systems for Automated Production Facilities

Chairman: Leonard B. Gardner, U.S. Army Armament Research and Development Command

Different types of control systems for automated production facilities will be discussed, beginning with relay type logic and analog controls, and progressing to computers and digital controls. Included will be programmable controllers, microprocessors, and minicomputers. Procedures for system design and equipment specification will be presented. The production line is treated as a continuous process. A control strategy for optimization will be discussed, along with methodology used to develop functional guidelines and process control standards, and requirements for interfacing hardware and software.

Session 148 4:15-5:45 pm Sheraton Centre Royal B

Error Correcting Codes: Applications to Memory Systems

Chairman: Raymond S. Lim, NASA—Ames Research Ctr

(Information not available at press time) □

Preliminary Conference at a Glance

Professional Development Seminars

Tuesday 8:30 A.M.-4:30 P.M.

An Overview of Distributed Processing *Burt H. Liebowitz, International Computing Company*
An Introduction to Microprocessors *Rodnay Zaks, Sybex, Inc.*
Hands-on Microcomputer Software/Hardware Workshop *Eric R. Garen, Integrated Computer Systems, Inc.*
An Overview of Automated Office Technologies and Equipment *Vincent C. Rauzino, Datapro Research Corp.*
Structured Systems Analysis *Chris P. Gane, Improved System Technologies, Inc.*
Day of Renewal *Bernard H. Petrina, Executive-Management Renewal Programs*

Wednesday 8:30 A.M.-4:30 P.M.

Database Machines *David K. Hsiao, Ohio State University*
A Practical View of Computer Communications Protocols *John M. McQuillan, Bolt Beranek and Newman, Inc.*
Hands-on Microcomputer Software/Hardware Workshop *Eric R. Garen, Integrated Computer Systems, Inc.*
Comparing Text Processing Packages and Systems *Amy D. Wohl, Datapro Research Corp.*
Structured Systems Design *Trish Sarson, Improved System Technologies, Inc.*
Criteria for Selecting Processing Environments *James J. Joy, Joy Associates, Inc.*

Thursday 8:30 A.M.-4:30 P.M.

Human Engineering in Teleprocessing Systems *Thomas R. Baley, TRB Systems*
Recent Developments in Minicomputer Technology *John H. Carson, Carson Associates*
Implementing a Word Processing System *Robert M. Bloomfield, Marshall, Roberts & Company, Inc.*
Managing Structured Methodologies *Edward Yourdon, Yourdon, Inc.*
Computer Systems Performance *Jeffrey P. Buzen, BGS Systems, Inc.*

Separate registration required for each seminar.

Monday A.M.

Keynote Session 10 A.M., Monday, June 4
John R. Opel, President, IBM

Monday P.M.

Plenary Session: Computers in Society 1:15 P.M.-2:15 P.M.

2:30-4:00	4:15-5:45
Regulation or Antitrust — Competition in the Computer/Communication Marketplace *Edwin B. Spievack*	
Insurance Industry Automation *Peter B. Walker*	Trust & Securities Industry Automation *Junius W. Peake*
Software Performance Modeling & Analysis *Amrit L. Goel*	Measurement of Software Reliability *T.C. Wesselkamper*
Impact of Future Technologies on the Computer Industry *Robert Colten*	Mass Storage System Technology *George A. Michael*
An Assessment of Future Computer System Needs for Large-Scale Computation *Peter Lykos*	Array Processing: An Innovative Approach to Scientific Computing *Roy D. Gwin*
Unions in Data Processing *Richard Herzfeld*	Business & Entrepreneurial Opportunities in Computers *Stanley Klein*
	Database Machines *T.H. Bonn*
State of Art of Minicomputer Hardware/Software & Distributive Processing *Marvin Golland*	Computer Page Printing *Joel Cartun*
User Assistance in On-Line Systems *Richard L. Wexelblat*	Computers in Biological & Medical Simulation *Thomas G. Coleman*
Networks & Data: An Interim Report by the CODASYL Systems Committee *Bernard K. Plagman*	The ANSI Reference Model for Network Protocols *Helen M. Wood*
Developing Professional Standards *William P. LaPlant, Jr.*	Technical Aspects of Privacy Protection in Transnational Data Systems *Rein Turn*
Practical Applications of Data Encryption *Durrell Hillis*	Determining the Value of Computer Applications *Edward O. Joslin*

Personal Computing Festival

2:30	3:30-5:30
Personal Computing Pioneers *Sol Libes*	The Coming Small Computer Earthquake *Burchenal Green*

NOTE: Program and Festival sessions are subject to change.

8:30-10:00 Tuesday A.M.	10:15-11:45	2:30-4:00 Tuesday P.M.	4:15-5:45
Computers at Work in the White House, the Senate & the Federal Courts *John K. Swearingen*	Evolution of the Computer Communications Market in a New Technological Era *L. Dan O'Neil*	Computer Communications & the International Data Marketplace *L. Dan O'Neil*	Foreign Policy & National Security Restrictions on International Trade in Data Processing *Arthur T. Downey*
Commercial Banking Automation *William J. Deane*	EFT & Consumer Banking Automation *Robert V. Sabeck*	International Banking Automation *Derek G. Hall*	The Automation of Check Processing *Wayne B. Lewin*
Designing Distributed Systems *Dennis J. Frailey*	The Interface Between Database Management Systems & Operating Systems *Eduardo B. Fernandez*	Computer Systems Analysis & Evaluation *Victor L. Wallace*	Modeling of Program Behavior *David Kuck*
Data-Flow — Part I *Jack B. Dennis*	Data-Flow — Part II *Arvind*	Dynamic & Reconfigurable Architectures *Svetlana P. Kartashev, Steven I. Kartashev & C.V. Ramamoorthy*	Dynamic & Reconfigurable Architectures: Problems, Evolution & Applications *Svetlana P. Kartashev & Steven I. Kartashev*
Power Management in the Computer Facility *Robert R. Robbins*	Computer Facility Support Functions *Robert R. Robbins*	Impact of Security & Protection on Computer Architecture *Virgil D. Gligor*	Distributed System Control Architecture *Daniel Schutzer*
End User Training — Building the DP Interface *Vicki C. McConnell*	Why Managers Fail *James F. Towsen*	Factors for Innovating DP Professionals vs. Other Jobs in the DP Department *J. Daniel Couger*	White House Information Systems... Information For Decision Making in the Executive Office of the President *Edward K. Zimmerman*
Distributed Database Systems *S. Bing Yao*	Relational Database Systems *P. Bruce Berra*	Database Evolution *Dennis McLeod*	Database Management Systems Architecture *John Berg*
Management's Challenge: The Office of the Future *Frederick R. Amport, Jr.*	Benchmark Selection of Teleprocessing Systems *Gerald W. Findley*	Planning, Acquisition, & Implementation of Mini-computer Based Business Systems *Marvin Golland*	The Information Officer: Fact or Fancy? *James C. Emery*
Emulation Laboratories & Experience *Ingrid A. Eldridge*	Simulation Development Tools	Simulation of Industrial Processes *J. Talavage*	Simulation Languages *Tuncer Oren*
An Overview of Network Technology *Dixon Doll*	Measurement Phases of Computer Selection *Sandra A. Mamrak*	Economics of Networking *Norman R. Nielsen*	Assuring Database Integrity in the Networking Environment *Robert H. Thomas*
Privacy & Security in the 80's *H. Rex Hartson*	Data Security *George I. Davida*	Computer Security: Technology Vis-A-Vis Audit *Robert G. McKenzie*	Managing the Computer Security Problem *Robert P. Campbell*
Software Psychology: Exploring the Human Factor *Ben Shneiderman*	Social Effects of Computerized Conferences *Roxanne Hiltz*	The Status of Women & Minorities in Computing *Carolyn P. Landis*	Power, Politics, & Structure: Computers & Organizations *M. Lynn Markus*

Plenary Session: Future Directions in Computing 1:15 P.M.-2:15 P.M.

Personal Computing Festival

8:30	10:30-12:30	2:30-4:30	
Personal Robotics *Ralph Hollis*		Inter-Computer Communications *Charles Judice*	
Small Business Systems: What Can I Get For $... *Dan Ring & Bob Redmond*	Small Business Systems: Experiences With Microsystems *Roger Berger*	Meeting of Computer Retailers Assn. *Portia Isaacson*	
The Personal Computer In The Schools *Lou Frenzel*	The Personal Computer In Home Education *Karl Zinn*	Ethics & Crime *Oliver Smoot*	

Plus a Personal Computing Hardware/Software Symposium.

(*Continued on p* 126)

Preliminary Conference at a Glance (Continued)

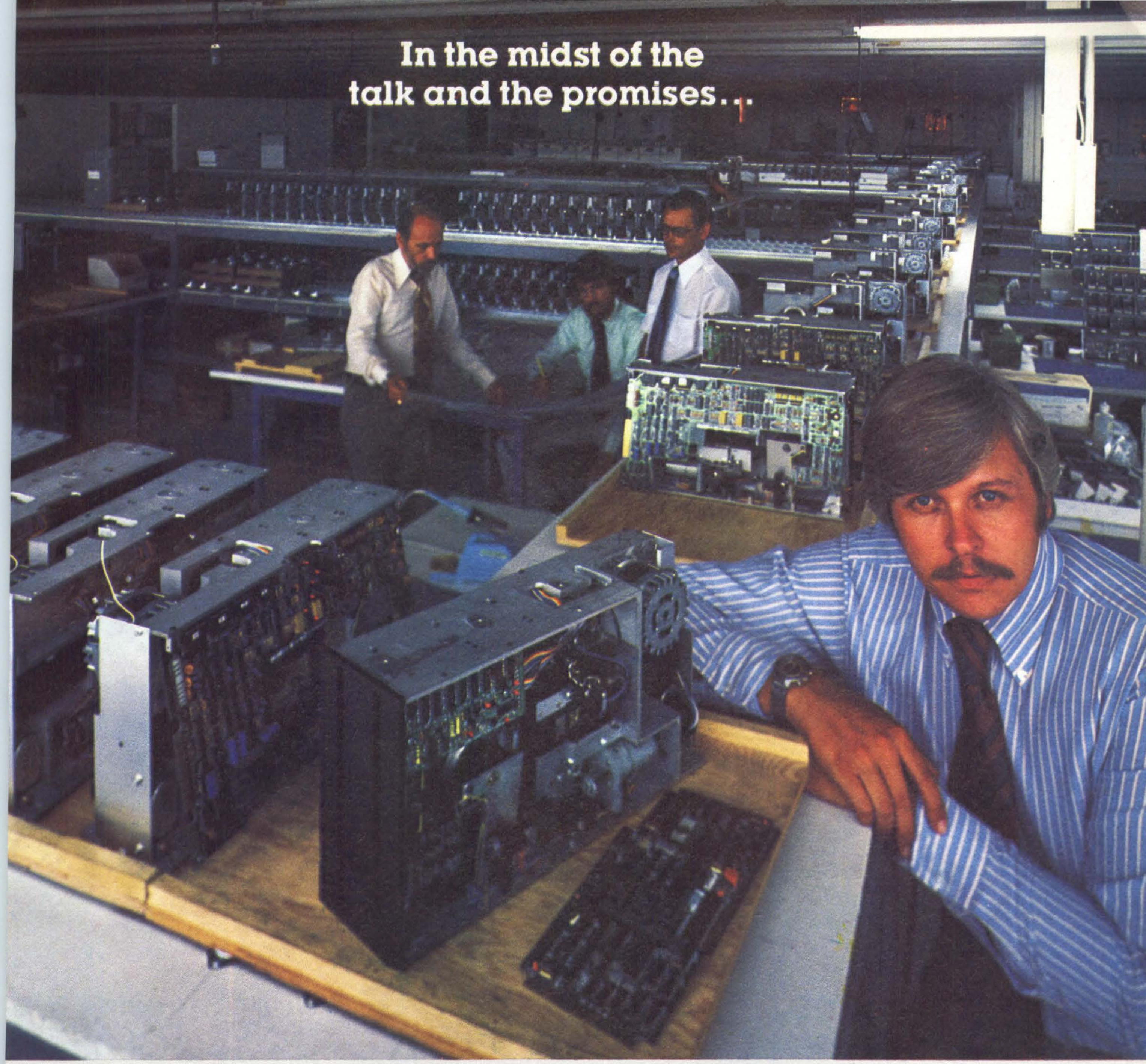
Wednesday A.M. 8:30-10:00	Wednesday A.M. 10:15-11:45	1:15 P.M.-2:15 P.M.	Wednesday P.M. 2:30-4:00	Wednesday P.M. 4:15-5:45
Conducting the Trial: Evidence in Computer Crime & Fraud Cases *Nathaniel E. Kossack*	No Patents for Software? If So, What Now? *John W. Behringer*	Plenary Session: Computers, Law and Public Policy	Software Tax: An Idea Whose Time Has Come… Or Gone? *John W. Behringer*	Legal Risks: Technical Decisions, Computer Experts & Business Sense *Lawrence Robertson*
Issues & Policy Concerns in Health Computing — Part I *Ruann E. Pengov*	Issues and Policy Concerns in Health Computing — Part II *Ruann E. Pengov*		Data Center Issues — Part I *E.R. Gabrieli*	Data Center Issues — Part II *E.R. Gabrieli*
Quantitative Measures of the Quality of Programs & Systems *Ned Chapin*			Case Studies in Software Development Techniques *J.E.K. Landstein*	
Employing Handicapped Computer Professionals *Roger Mills*	The Impact of New A/D LSI Technology on Systems *Rob Walker*		High-End Microprocessor Architecture *Bernard Peuto*	Database Design *Sham Navathe*
Fault Tolerant and Maintainable Systems *Jacob A. Abraham*	Testing & Fault-Tolerance in Digital Systems *Stephen Y.H. Su*		Advanced Industrial Robotics *John Albus*	Advances in Computer Graphics *Bertram Herzog*
Improving the Performance of the Data Processing Professional *Don B. Medley*	How to Sell New Technology to Management *Herbert B. Safford*		Computers for the Chief Executive Officer *Howard Lee Morgan*	Data Processing's "Proposition 13" — A Look at the State Software & Related Taxation Issue *Robert M. Sherin*
Database Models *Lorraine M. Duvall*	Database Applications *Gerard T. Capraro*		COBOL — Its Origin *Henry Tropp*	COBOL Retrospective *Nancy Stern*
Design Issues for Word Processing Systems *Amy D. Wohl*	Computer-Based Systems in Complex Organizations *Ben Tunkelang*		Special Computer Applications *Daniel Van Belleghem*	Computer Graphics in the Building Industries *Mary S. Cancian*
Simulation for Predicting Computer System Performance *Brian W. Unger*	Languages for Computer System Simulation *Brian W. Unger*		Simulation Results *John McLeod*	
Model-Based Management Support for Distributed Data Processing *Patrick V. McGregor*	Experiences in Local Area Networking *Ira W. Cotton*		Appropriate Level of Network Security *Gerald J. Popek*	Technological Issues in Supporting Network Access to Data *Stephen R. Kimbleton*
Advances in Secure Operating Systems Technology in the Department of Defense — Part I *Stephen T. Walker*	Advances in Secure Operating Systems Technology in the Department of Defense — Part II *Stephen T. Walker*		Risk Assessment Techniques *Steven Glaseman*	Sexual Barriers in Business & How to Overcome Them *Ida W. Mason*
Computers and Society Research and Education *Gerald L. Engel*	Databases in the Humanities & Social Sciences *Joseph Raben*		Women in Computer Management: Where Do We Go From Here? *Betty Niimi*	More for Less With Computers in Local Government — A Challenge to Users & the Industry *Barry Wellar*

Personal Computing Festival

8:30	10:30-12:30	2:30-4:30	
Personal Computing As An Aid To The Handicapped *Les Solomon & Harry Hedges*		Personal Computing As An Aid To The Handicapped *Les Solomon*	
Personal Computing In Investment Analysis *Reid Shay*	Art & Graphics *Bill Etre*	Music *Carl Helmers*	
Legal Aspects of Personal Computing *Harold Novick*		Personal Computing As A Tool In Other Professions	

Plus other Personal Computing Topics.

(*Continued on p* 131)



PerSci delivers the Dual-Headed Diskette Drive that works and the Double Density IBM Compatible Controller to back it up.

While everyone else was waiting and promising—PerSci did it! Designed the industry's first fully reliable, field proven, dual-head design—now available in a high technology dual diskette drive, the PerSci Model 299. The 299 has a total of four heads handling two double-sided diskettes—providing up to 3.2 Mbytes of data in a drive the size of a standard floppy. And because the Model 299 has voice coil positioning, this dual diskette drive can seek data four to six times faster than possible on two independent stepper motor drives. All offered by PerSci at a highly competitive OEM price.

To save time and money in systems design, PerSci backs up the 299 with the first available double density, dual-head flexible disk controller—the Model 1170—for all applications requiring IBM 2D, IBM 3740 or S-100 bus compatibility. The PerSci 1170 is Z-80 based, the smallest, most intelligent floppy disk controller on the market.

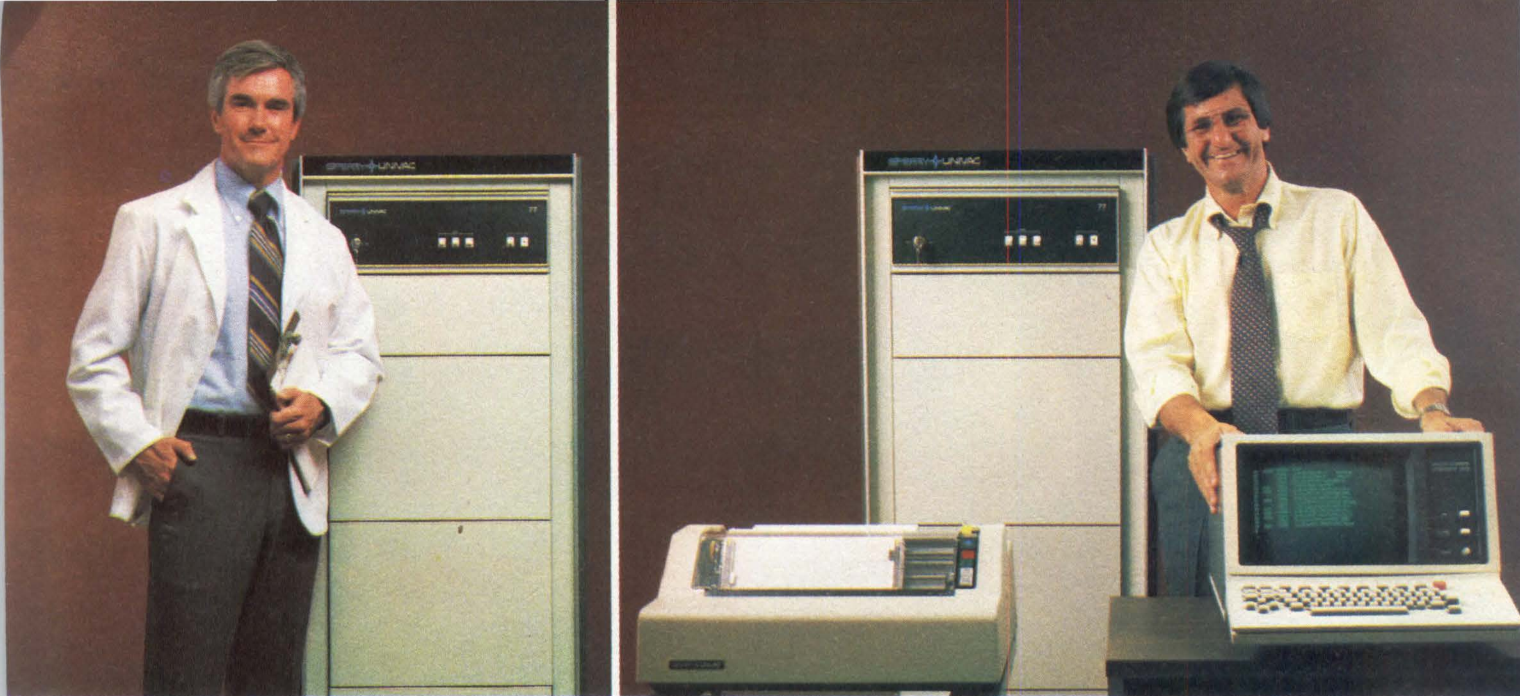
The PerSci 299 and 1170 controller are designed with the same advanced technology that has made PerSci number three in diskette product shipments (and moving up). Don't wait around for more talk and more promises. Call PerSci for full information.

PerSci, Inc., 12210 Nebraska Avenue,
West Los Angeles, California 90025.
(213) 820-3764.

PERSCI

Peripherals a Generation Ahead.

CIRCLE 72 ON INQUIRY CARD



Introducing the Sperry
Designed exclusively for three

The Sperry Univac V77-800 Miniframe is the newest and most powerful mini we've ever built—a high performance, multi-use, general-purpose minicomputer system designed for both commercial and scientific data processing. It has a memory range from 128K bytes to 2 megabytes (with error correcting memory) and a 150 nanosecond CPU with integrated cache of 1024 bytes. Plus 12K bytes of user programmable writable control store.

There's an optional new high speed 64-bit floating point processor that works in conjunction with a new globally optimized ANS '77 FORTRAN.

No wonder our three most important customers think so highly of it.

OUR OEM CUSTOMERS KNOW WE DESIGNED IT JUST FOR THEM.

The Miniframe is customer microprogrammable. So an OEM can implement his own firmware packages. And with the many software packages we offer, the OEM can add all the bells and whistles he wants.

The Miniframe comes with our largest instruction set ever. So OEM's with their own software have much more flexibility in design.

The Miniframe speaks PASCAL, the powerful new language for scientific, commercial, and system programming that most competitive systems still can't speak. And of course, it also speaks COBOL, FORTRAN and RPGII.

More good news is that the Miniframe is compatible with the rest of the V77 product line.

OUR SYSTEM HOUSE CUSTOMERS KNOW WE DESIGNED IT JUST FOR THEM.

Naturally, system houses want all the features OEM's do. And more.

So we gave them more.

More operating systems, for example. Choose from VORTEX or our new SUMMIT—an interactive, multi-terminal system with transaction processing and data base management. It gives you easy editing, screen formatting, and documentation aids. Plus speedy, comprehensive program development.

System houses also think PASCAL is important. Because it's more efficient, easier to maintain, expand, and modify.

The Miniframe brings systems builders a new query language called QL-77. It features inquire and report facilities. And interfaces

Univac V77-800 Miniframe.
of our very best customers.

directly to TOTAL,* the data base management system. So preprocessing and intermediate handling are a thing of the past. Finally, TOTAL also gives you complete data base access and file access security.

OUR END USER CUSTOMERS KNOW WE DESIGNED IT JUST FOR THEM.

Take all the features we designed in for OEM's and system houses and say ditto for the end user.

But we didn't stop there. We also pressed a few special hot buttons just for end users.

Consider QL-77, for example. End users will love our new query language because it reduces the amount of application programming. By storing query language procedures right in the data base file. Where they can be easily and quickly recalled and executed at any time.

Once again, SUMMIT, our new operating system, helps the end user handle transaction processing. Without any additional, expensive software. It's also the right answer for a multi-tasking, "fully-implemented" distributed processing system.

Finally, the Miniframe supports DCA and conventional protocols. So you can talk to both SPERRY UNIVAC and IBM hosts.

YOU'LL KNOW WE DESIGNED THE MINIFRAME JUST FOR YOU.

No matter what your application, no matter what your need, the Miniframe may just be the answer.

For more information, write to us at Sperry Univac Mini-Computer Operations, 2722 Michelson Drive, Irvine, California 92713. Or call (714) 833-2400, ext. 536.

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.

We're Sperry Univac.

And our new Miniframe is going to solve some very big problems.

SPERRY UNIVAC

SPERRY UNIVAC IS A DIVISION OF SPERRY RAND CORPORATION

*TOTAL is a registered trademark of Cincom, Inc.

CIRCLE 73 ON INQUIRY CARD

Thursday A.M. 8:30-10:00	Thursday A.M. 10:15-11:45	Thursday P.M. 2:30-4:00	Thursday P.M. 4:15-5:45
Information Privacy: Public Policy & Recordkeepers' Responsibilities *Francis M. Gregory, Jr.*	The International Privacy Debate: Laws, Licenses & Limitations *Alexander D. Roth*	Data Processing & the Provision of Legal Services in the Private Law Office *Haley Fromholz*	Data Processing & Litigation Support *Palmer Madden*
Implementation Factors in Hospital Information Systems *David J. Mischelevich*		Computer-Based Consultation and Ambulatory Patient Care: How Should It Be Implemented? Who Should Control It? *John Lackmann*	
Communications Technologies: Their Impact on Computing *David L. Mills*			
Performance Modeling & Evaluation of Database Management Systems *Larry Kerschberg*	Data Dictionary Systems *Henry C. Lefkovits*	Associative Processors — Why Are They Needed? What Can We Expect in the Future? *Tadao Ichikawa*	Associative Languages *Sue Eilers*
New Directions in Distributive Architectures *Frank Westervelt*		High-Level Language & Direct Execution Machines *Edward Feustel*	Documentation: The First Interface *Jef Raskin*
The Expanding World of Service *George O. Harmon*	People Power: The Key to Effective Management of Data Processing Projects *Loretta A. Pitchell*	Time Management for the DP Professional *Hudson E. Henry*	Finding Value in Used Computers *William S. Grinker & Marvin Lurie*
Computer Chess — The Next Decade *Dennis W. Cooper*	Computer Technology & the Movie Industry *Suzanne Landa*		User Microprogramming of Minicomputers *Joseph M. Austin*
What Can Pattern Recognition & Image Processing Do for the Society *King Sun Fu*	Computation Problems in Pattern Recognition & Image Processing *King Sun Fu*		Error-Correcting Codes: Application to Memory Systems *Raymond S. Lim*
Computing in Developing Countries *K. Vairavan*	Making Business Models Easy to Use *G.R. Wagner*	Applications of Computers in Criminal Justice Systems *Arthur B. Carroll*	
Network Performance Modeling *Vijay Ahuja*	AUTODIN II — Data Communication System *Sydney Gordon*	The Military Message Experiment *Duane Adams*	Current Topics on Information Retrieval *Carolyn J. Crouch*
Computer Fraud *Donn B. Parker*	Micro Computers in Technical Professional Development *Raymond G. Fox*	Management of Computer Centers by Contract *William P. LaPlant, Jr.*	Personal Career Planning for the Information Systems Professional *Peter McGregor*
		Computerized Control Systems for Automated Production Facilities *Leonard B. Gardner*	

Plenary Session: Personal Computing — Is It Worth It? 1:15 P.M.-2:15 P.M.

Personal Computing Festival

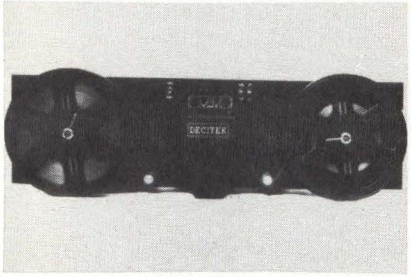
8:30	10:30-12:30	2:30-4:30	
Simulation, Modeling & Games *Stephen Smith*			
Computer Retailing *Alan Hald & Craig Tenney*	Personal Computer Maintenance *William Godbout & William Schenker*	Computer Speech Synthesis & Recognition *James Boddie*	
Personal Computers - Where Do We Go From Here? *Jack Nilles*	Personal Computing In Other Hobbies *Harold Buchbinder*	Recreational Mathematics *Abraham Waksman*	

Plus other Personal Computing Topics.

NCC PRODUCT REVIEW

Computer Design asked most NCC '79 exhibitors to supply advance information on truly new products to be introduced to attendees at the Conference. To the best of our knowledge, the following 72 are such products. However, because of the early copy deadline for this issue in respect to the dates of the Conference, some companies will display products on which they could not supply preview information.

MICROPROCESSOR CONTROLLED READER/SPOOLER



Reel motors of model 661C9 reader/spooler combination are microprocessor controlled, allowing each reel to operate independently and wind or read punched tape in both directions asynchronously. Low maintenance read head handles 5-, 6-, or 8-level tapes, center feed, and advanced feed without adjustments. Unit has single nonfocused, derated, 25,000-h light source, with fiber optics light distribution system. **Decitek,** 129 Flanders Rd, Westboro, MA 01581.

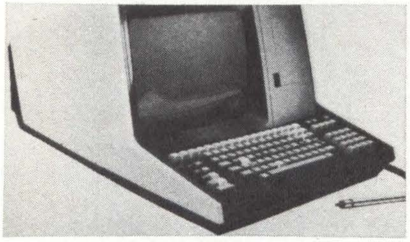
See at Booth 435
Circle 415 on Inquiry Card

WINCHESTER DISC DRIVES

FD 130 and FD 65 drives have an unformatted capacity of 132.4M and 66.3M bytes/drive, respectively. Specs for both include an access time of 6 ms track to track and rotational speed of 3000 r/min. Also available is the M2202 front loading cartridge drive with 83.3M-byte unformatted capacity. All 3 units have a transfer rate of 819k bytes/s. **Fujitsu America Inc,** 2945 Oakmead Village Ct, Santa Clara, CA 95051.

See at Madison Suite
Circle 416 on Inquiry Card

DESKTOP COMPUTERS



See at Booth 4806

The 3000 series with 13" (33-cm) CRTs and the 9000 series with 19" (48-cm) screen, offering a variety of configurations, feature a 1-piece molded cabinet with built-in keyboard and 8-color display. Both support high level languages. Options include built-in floppy or hard disc, graphics capabilities, lightpens, and asynchronous/synchronous communications. **Intelligent Systems Corp,** 5965 Peachtree Corners E, Norcross, GA 30071.

Circle 417 on Inquiry Card

SEMICONDUCTOR RAM MODULE

Pin compatible with DEC PDP-11/70 computers, PINCOMM 70S installs in the MK-11 memory chassis, which holds up to 16 modules and DEC memory cards without modification. Memory card capacity is 256k bytes. Also featured are sockets for RAM ICs and 2 onboard spare RAMs. **Trendata Corp, Standard Memories,** 3400 W Segerstrom, Santa Ana, CA 92704.

See at Booth 1312
Circle 418 on Inquiry Card

LARGE DISC CONTROLLER FOR LSI-11

Three models of the microprocessor based SC01 controller family are compatible with DEC software and allow users to add as much as 0.5G bytes of hard disc storage capacity to LSI-11 systems. SC01/A emulates DEC RP11/RP02/RP03 subsystems; SC01/B emulates RH11/RM02/RP04/RP05/RP06 subsystems; and SC01/C emulates RK611/RK06/RK07 subsystems. Incorporated are an automatic self-test capability plus extensive subsystem diagnostics in onboard firmware, and special operating functions. Two PC boards plug into any pair of std Q Bus quad slots. High speed bipolar technology and std SMD interfacing are included. Any 2 industry compatible drives may be integrated into a single subsystem, all operating at serial data rates up to 10 MHz. Fully buffered disc I/O circuitry permits operation at radial cable distances of 50 ft (15 m) and daisy chain cable distances of 100 ft (30 m). Microprogrammed error control functions allow std ECC/CRC operations to be performed at full data rates under all interlace methods. **Emulex Corp,** 17785 D Sky Park Cir, Irvine, CA 92714.

See at Booth 344
Circle 419 on Inquiry Card

INTERACTIVE EDITING TERMINAL

A 48-line (2 pages) up/down scrolling machine with editing capabilities including margin wrap on character insert and delete, the model 12 will accommodate 32 user programmed functions in a 2000-char nonvolatile function buffer. Variable I/O parameters are also programmable and nonvolatile. By displaying 5 or more field modifiers (protect, dim, blink, inverse video, and underline) in any combination, the unit provides a full 80 characters of data per line. Primarily an editing terminal, it doubles as an online interactive terminal and will be available in an emulator version. **Teleray Div, Research Inc,** PO Box 24064, Minneapolis, MN 55424.

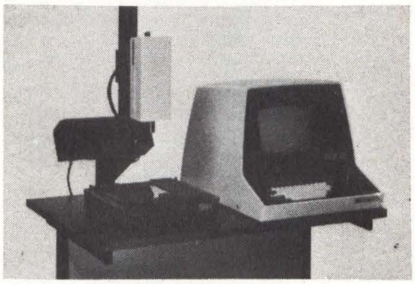
See at Booth 2006
Circle 420 on Inquiry Card

NOTE

Booths numbered 1000, 2000, 3000, and 4000 are located in the NY Coliseum on floors corresponding to the first digit; booths 300 to 999 plus suites are in the NY Hilton Hotel; and booths from 1 to 150 are in the Sheraton Centre Hotel at the Personal Computing Festival.

NCC PRODUCT REVIEW

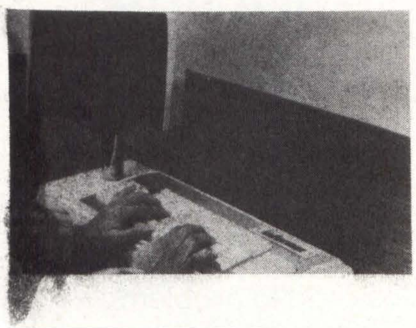
STANDALONE IMAGE PROCESSOR



A self-contained microprocessor combined with full resolution display makes picture analysis possible within the EyeCom II as a standalone system. Image processing software has been expanded to provide turnkey image processing systems. The system contains an alphanumeric terminal, high speed picture digitizer, high resolution display, joystick cursor, and microprocessor. Picture digitizer offers 640 x 480 resolution with true 8-bit digitization in <3 s with up to 5X video contrast enhancement prior to digitization. Display has 640 x 480 resolution with 8-bit gray scale and white graphics overlay. Hardware scroll and zoom up to 8X and hardware window transfers to processor are provided. Full typewriter keyboard allows for 4-level ASCII codes, 256 in all. Screen can display the 128-char ASCII set on 24 lines of 80 chars. **Spatial Data Systems,** PO Box 249, Goleta, CA 93017.

See at Booth 4036
Circle 421 on Inquiry Card

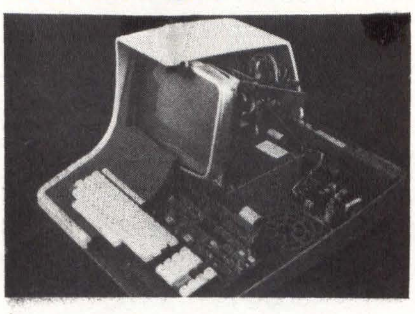
VIDEO DISPLAY TERMINALS



D304 is equipped with a sophisticated electronic package, designed for use in serially transmitting information to and receiving information from an interconnected data source at speeds up to 19,200 baud. Screen displays 80 x 24, 64 x 16, 40 x 12, or 32 x 16 lines of characters selectable from the keyboard. Memory stores 80 x 24—1 page, 64 x 16 or 40 x 12—2 pages, or 32 x 16—4 pages. Keyboard has standard layout plus 12-key numeric pad, and 14 function keys. Parity, number of char/line, and number of lines are switch selectable at keyboard. Used as interactive terminal in full duplex, each character including control characters is transmitted without affecting cursor location. In polled block mode terminal is assigned address that must be included in sequence to receive or transmit data. **Informer,** 8332 Osage Ave, Los Angeles, CA 90045.

See at Booth 2005
Circle 422 on Inquiry Card

VIDEO TERMINALS



Minimizing operator fatigue through typewriter oriented keyboard and clear display of outgoing and incoming data, InterTube displays 1920 char arranged in 24 lines with 80 char each. A 25th line (half intensity) displays terminal operating modes. Control section of the terminal is based on the Z80 microprocessor. Display module and driver circuitry consists of 12" (30.48-cm), high resolution, wide bandwidth CRT mounted in steel frame. Power supply is a solid state switching design. Transmission mode is half- or full-duplex, keyboard selectable. Keyboard has a std teletypewriter compatible layout, 18-key numeric pad, keyboard lock/unlock under program control, and special function keys. Self-diagnostic firmware testing routine provides a continuous display of data on the screen. **Intertec Data Systems Corp,** 2300 Broad River Rd, Columbia, SC 29210.

See at Booth 1237
Circle 423 on Inquiry Card

DISPLAY TERMINALS

Regent[R] series 20, 40, 60, and 300 range from simple display terminal to a clustered intelligent terminal. For use as a basic computer conversational device, model 20 has EIA and current loop interfaces, with u/lc on 12" (30.48-cm) CRT and control code display in a 24-line x 80-char format. Full incremental cursor movement and addressability and a std unidirectional auxiliary port are provided. Conversational model 40 also has extensive visual highlighting features, status line, numeric pad, function keys, and bidirectional auxiliary port, plus insert and delete line feature. Model 60, a smart, buffered display terminal, adds buffered transmission with editing capability to features of the 20 and 40. It can send a character, line, or page at a time, and offers bidirectional, serial, auxiliary interfaces with independent speed setting. Low cost clustered intelligent terminal model 300 includes 52k bytes of RAM, 2 diskette drives, up to 4 smart display terminals, printer interface, and asynchronous and synchronous (software selectable) communications interfaces. **Applied Digital Data Systems, Inc,** 100 Marcus Blvd, Hauppauge, NY 11787.

See at Booth 1322
Circle 424 on Inquiry Card

Many engineers are resisting fiber optics. We know why.

Most good engineers can't resist a good idea. (And fiber optics is a compelling idea, after all: optical communication cables carry more information in less space with less weight, and eliminate electrical interference, just for starters.)

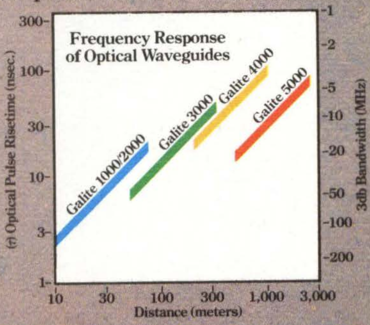
Some very good engineers see fiber optics in a different light. They point out that a good idea must also be a proven product. Their job is not to get trapped into testing new products, it's to take advantage of proven ones.

Quite right.

Which is why it may come as a surprise that there are more than 2,000,000,000 feet of our fiber optics in use today. Galileo has been manufacturing fiber optic products for nearly 20 years.

We offer the most complete line of optical communication cable in a range of attenuations, mechanical strengths and cost to meet your application requirements. In fact, you can probably find whatever Galileo Galite® fiber optic cable configurations you need from stock (not just our highly versatile Galite 3000).

You see, we make it all ourselves, from raw materials to finished cables. Which is why we can tell you and show you more about fiber optics than anybody else today. Including how to take advantage of it as a proven technology. (You'll find a complete line of connectors and electronic components available from Galileo, which makes application and installation very simple indeed.)



You can write to Galileo for a detailed information package that will give you a good idea of what fiber optics can do for you today. Or you can call Galileo's applications engineers at (617) 347-9191 for specific personal help on how... and where... fiber optics could fit into what you're doing today.

You'll find we offer more than fiber optics. We also offer know-how.

Galileo Electro-Optics Corp.
Galileo Park, Sturbridge, Massachusetts 01518

Progress made practical.

CIRCLE 77 ON INQUIRY CARD


IDC
Socket Connectors—
IDS Series
For pluggable termination of cable to header mounted on PCB. Single piece body for easy assembly, fewer parts to inventory. Cover latch and optional strain relief for operational reliability.
Transition Connectors—
IDT Series
Used to attach cable permanently to PCB, Has rugged single piece design for fast assembly and high reliability. Cover latch swivels for easy cable insertion.
Cable Plugs—IDP Series
Offer fast, easy plugging of cable to PCB directly or into DIP sockets. Tapered pins assure quick, easy insertion into DIP sockets. One unit design speeds handling and assembly. Cover latch swivels for easy cable insertion.
Headers—
IDH Series
Mounts permanently to PCB and accepts socket connectors. In straight or right angle mounting—for solder or wrap/pin termination. Handy ejector/latch available—when closed it locks socket into place and serves as ejector when open.
Laminated Flat Cable
RN offers both cable and connectors—your assurance of "single source" reliability. Available in white or color coded 100 foot rolls in 10 thru 50 conductor sizes.

RN has it now...a truly economical

flat cable system

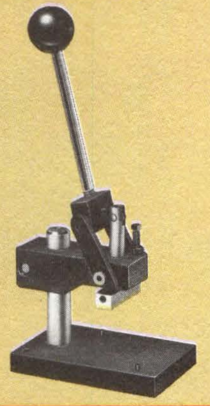
for high speed assembly using tooling you already have

This RN IDC System delivers what engineers want...

- Advanced automated manufacturing facilities enable RN to cut costs —pass the savings on to you
- Fewer pieces for faster assembly, reduced inventory
- Can be assembled with IDC tooling already in place
- Each connector made more rugged, more resistant to shock, vibration and cable strain
- Assured reliability and compatibility of cable and connectors— RN supplies both

Economical, easy to use—once properly adjusted, all RN IDC connectors can be assembled with a simple base plate change

Hand Held crimp tool for assembling IDP series Cable Plugs and IDT series Transition Connectors



Bench mounted crimp tool for assembly of *all* RN IDC connectors.

WRITE TODAY for new Robinson-Nugent Insulation Displacement Connector catalog with complete specifications and dimensions on the entire IDC product line.

RN® ROBINSON NUGENT, INC.

800 East Eighth Street, New Albany, Indiana 47150 • Phone: (812) 945-0211—TWX: 810-540-4082

CIRCLE 78 ON INQUIRY CARD

Intel Marches On

How we put military equipment manufacturers in command of the latest advances in microelectronics.

Designers of military and high reliability systems can depend on Intel for the latest in LSI technology. We deliver more advanced mil-spec microcomputers and semiconductor memory than anyone.

Here's our strategy. The fiercely competitive pressures of the industrial marketplace have driven us to push for higher and higher performance with greater and greater reliability. Last year alone Intel spent $41 million on research and development. That investment strengthened our decade of leadership in microelectronics. And it enables us to keep our commitment of bringing the world's most advanced LSI microcircuits to the military.

JAN-approved 8080A: leading edge of military LSI

Intel invented the microcomputer, and it's no surprise our 8080A was the first microprocessor to qualify for JAN approval and first for QPL Part I listing (M38510/42001 BQB). Now military designers can also take advantage of Intel's M8085A, military version of the most powerful 8-bit microprocessor ever. Or design with our recently militarized single-chip microcomputer, the M8048.

Intel also delivers the high performance memory you need for advanced military systems. A good example is our M2147, military equivalent of Intel's HMOS* industry standard 4K static RAM. Another is our 16K M2716, the highest density military EPROM on the market.

Enlist our entire family

Intel's military family gives designers a full range of state-of-the-art LSI solutions: RAMs, EPROMs, bipolar PROMs, microcomputers and peripherals. All processed to full Level B requirements of MIL-STD-883B, Method 5004 and quality conformance procedures of Method 5005. And they're all backed by the support and development systems you'd expect from the largest supplier of LSI devices.

Building up for the future

To expand your design capability even further, Intel is currently working with government agencies and military equipment manufacturers to upgrade more devices to military specifications. We stand ready to support your programs with additional JAN-approved components as slash sheets are issued.

For more information on Intel's complete family of military devices contact your local Intel distributor or write Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051. Or call (408) 987-8080.

intel delivers.

Europe: Intel International, Brussels, Belgium. United States and Canadian distributors: Arrow Electronics, Alliance, Almac/Stroum, Component Specialties, Cramer, Hamilton/Avnet, Harvey, Industrial Components, Pioneer, Sheridan, Wyle/Elmar, Wyle/Liberty, L.A. Varah and Zentronics.

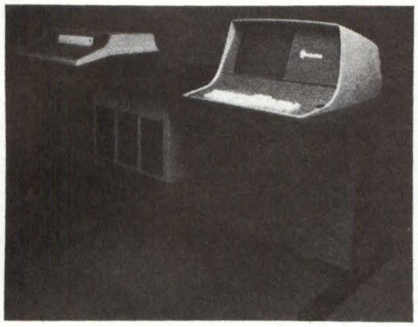
*HMOS is a patented Intel process.

CIRCLE NO. 79 FOR INFORMATION

See us at NCC, N.Y. City, June 4-7

NCC PRODUCT REVIEW

BUSINESS MINICOMPUTER



Up to 3 flexible diskettes with 615k bytes of storage and 32k bytes of MOS memory characterize the self-contained desk model configuration. Its full 24-line x 80-char video display terminal has a std typewriter and 10-key pad; the 150-char/s matrix printer features vertical forms control, tractor feed, and compressed print. The upward expandable Centurion Series 100 also contains multitasking and communications capabilities. **Warrex Computer Corp,** 1780 Jay E11 Dr, Richardson, TX 75081.

See at Booth 4111
Circle 425 on Inquiry Card

DOT MATRIX PRINTER AND LCD MODULES

The TP-80 80-col printer with electronics and case uses the company's model 3110 mechanism. Also introduced is a 5 x 7 dot matrix LCD module with a driver chip; 16 char are displayed on 1 line and 20 char on 2 lines. In addition, a phase transition mode, color LCD has no viewing angle restriction. **Epson America, Inc,** 23844 Hawthorne Blvd, Torrance, CA 90505.

See at Booth 3201
Circle 426 on Inquiry Card

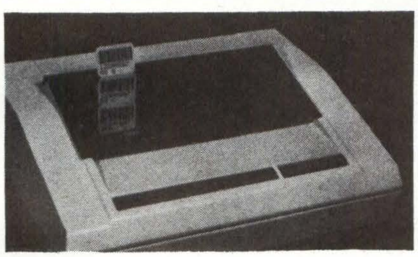
RANDOM VECTOR PROCESSOR

Accepting random vectors and symbols from a host mainframe, processor reduces the information to raster form, and outputs it to a variety of popular electrostatic and matrix plotters, including Versatec, Gould, Houston Instruments, and Trilog models. System design incorporates LSI technology, with MOS memory for vector and symbol storage. Microprocessor controlled ROM storage provides system logic, with high speed arithmetic implemented in TTL. Data input options include mag tape, serial asynchronous RS-232, IBM BiSync, and 8-bit parallel; system also accepts data in line printer format. Random vector and symbol output from mainframe is produced by machine independent FORTRAN drive program integrated into user's graphics application software. **KMW Systems Corp,** 8307 Hwy 71 W, Austin, TX 78735.

See at Booth 436
Circle 427 on Inquiry Card

HEAVY STOCK, BOTTOM FEED PRINTER

Designed for printing on tough surfaces such as steel, plastic, and cardboard,



IDS-7440 features a 7 x 7 dot matrix and bar code 39, an alphanumeric code used in government applications. It can also be used with multiple and variable sized forms. Two stainless steel rollers maintain registration and permit steel forms to be pulled up for alignment. An optical sensor determines presence of end cuts or indentions and perfectly positions the next label. **Dataroyal, Inc,** 235 Main Dunstable Rd, Nashua, NH 03061.

See at Booth 1316
Circle 428 on Inquiry Card

400-Hz SOLID STATE POWER SYSTEM

Power interface for computers meets most 400-Hz central processor requirements, including IBM 3032 and 3033 specs. Four configurations with increasing capability for upgrading are a frequency converter, UPS with storage battery, redundant UPS, and combination 400-Hz/utility frequency UPS. **Cyberex, Inc,** 7171 Industrial Park Blvd, Mentor, OH 44060.

See at Booth 4112
Circle 429 on Inquiry Card

NOTE

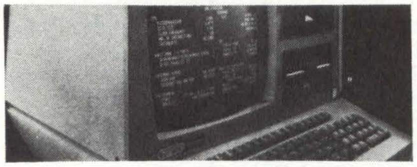
Booths numbered 1000, 2000, 3000, and 4000 are located in the NY Coliseum on floors corresponding to the first digit; booths 300 to 999 plus suites are in the NY Hilton Hotel; and booths from 1 to 150 are in the Sheraton Centre Hotel at the Personal Computing Festival.

INTERACTIVE ANSI COBOL COMPILER

Implementing Nucleus; Table Handling; Sequential, Relative, and Indexed I/O; Inter-Program Communication, and Library modules, enhanced version of CIS COBOL Compiler meets ANSI level 1 requirements for a COBOL compiler. Version 4 of the software package is designed to support interactive applications, is able to exploit features of a microcomputer, is oriented toward rapid program development, and is supported by intelligent utility programs. Designed to run on 8080 or Z80 based systems, compiler is supplied with full internal and interfacing documentation. Also shown will be Version 3. Supplied on both standard and mini-floppy diskettes, this version will run on any microcomputer with 32k or more bytes RAM that supports the CP/M operating system. **Micro Focus Ltd,** 58 Acacia Rd, St John's Wood, London NW8 6AG, England.

See at Booth 323
Circle 430 on Inquiry Card

SMALL BUSINESS COMPUTER



Z80 based Microsystem features dual 5" (12.7-cm) minifloppy drives with 320-byte capacity and internal 56k user RAM and 8k reserved RAM and ROM. Desktop sized cabinet also includes two RS-232-C asynchronous and synchronous serial I/O ports, 4-MHz clock, and 12" (30.5-cm) CRT. 94-key keyboard has number pad and 16 special function keys. Software includes business accounting package plus FORTRAN, COBOL, and E-BASIC. **Billings Computer Corp,** 2000 E Billings Ave, Provo, UT 84601.

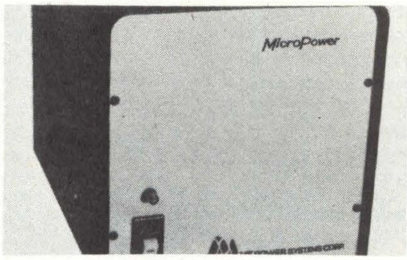
See at Booth 3223
Circle 431 on Inquiry Card

50-MHz MINI-SCOPE

Weighing <15 lb (6.75 kg), PS950A measures 4.2 x 8.5 x 15.4" deep (10.67 x 21.6 x 29.1 cm). Bright trace is attained by 7-kV acceleration potential on a mesh CRT with metallized screen. Internal graticule and small spot size give sharply defined trace. Mesh tube affords superior deflection sensitivities, eliminating dynamic range problems in vertical and horizontal amps. Trigger range is well above the 50-MHz vertical bandwidth. 7-ns risetime, bright trace, and trigger assure stable presentation of narrow low repetition rate pulses. Front panel controls are grouped by function with CRT separating vertical and display section from horizontal controls. Scope has 8 x 10-div display [0.25" (0.635 cm) /div]. Horizontal and vertical modules can be detached from scope by removing screws and unplugging PC connector. Power requirement is <35 W. **Vu-Data Corp,** 7170 Convoy Ct, San Diego, CA 92111.

See at Booth 2001
Circle 432 on Inquiry Card

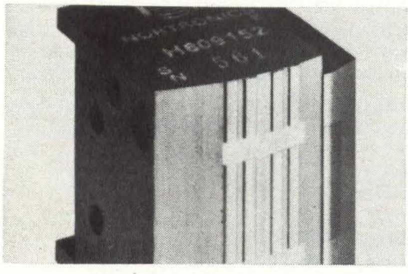
POWER INPUT ISOLATION/ REGULATOR



MicroPower™ series computer power interfaces isolate, regulate, and filter power output between std wall outlets and terminals, mini, or microcomputers. Interface reduces downtime due to power line fluctuation, disturbances, and transients. Brownout protection against all forms of low line voltage up to −20% of nominal line voltage is provided. Series will also protect against high line voltages to +20% of nominal. Additional features incorporated include Soft/Start™ capability which eases turn on/off stress in the connected equipment and common mode noise reduction. Power input to unit is by cord and plug connected to a suitable source of building power. Portable unit outputs 1k VA, single-phase with 120 Vac, 60 Hz. **Computer Power Systems Corp,** 3398 E 70th St, Long Beach, CA 90805.

See at Booth 304
Circle 433 on Inquiry Card

0.5" MAGNETIC TAPE HEADS



Streamer heads incorporate LTC® for long life, high reliability operation, and are capable of storing data from 1 IBM model 3370 disc drive (570M bytes) on 1500 ft (457 m) of 0.5" (1.27-cm) magnetic tape at a data transfer rate of 1.86M bytes/s. Low cost model DQ-91 is a 9-channel, 0.250" (0.635-cm) streamer head that is capable of recording at 10,000 fc/in (2937/cm). When used with GCR it provides a capacity of 32M bytes on 3M's DC-300A cartridge. Also shown will be the FFD-DST double-sided floppy disc head that reliably reads and writes on both sides of the disc maintaining precise alignment and compliance through use of an optical/mechanical alignment technique. Compatible with ANSI stds for flexible disc operation, the head extends data capacity of a single disc to 1M byte. **Nortronics Co, Inc,** 8101-10th Ave N, Minneapolis, MN 55427.

See at Booth 1110
Circle 434 on Inquiry Card

It's yours!

Here's the best alternative to fixed-head disk for cost-conscious users of PDP-11 & Nova computers.

- High speed random access.
- Solid state reliability.
- Pluggable modules of 0.524 megabytes each; expansion capability to 8.388 megabytes.
- 1.5 microseconds access time.
- Transfer rate of 525,000 words/second.
- Zero latency.
- No data loss in event of power failure.
- No moving parts. Low maintenance.

The MaxiRAM System is also available for use with other computer types.

Visit us at the NCC Show, New York, June 4-7.

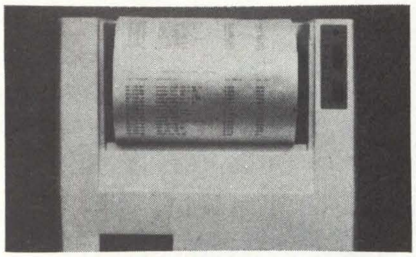
Order your FREE copy today! Find out how the MaxiRAM Storage System offers unmatched economy and performance for your memory requirements.

CIRCLE 80 ON INQUIRY CARD

Imperial Technology, Inc.
831 S. Douglas Street
El Segundo, California 90245
(213) 679-9501

NCC PRODUCT REVIEW

NONIMPACT PRINTER



Printing on electrosensitive paper 8.5" (21.6-cm) wide at 225 char/s, model 912 draws each letter and number from a 9 x 12 matrix using a precision printhead designed for service. The unit has minimum moving parts and reduced components count and is tooled for easy assembly in high volume production. Character set is std 96 ASCII set with upper and true lower case. Characters are 0.09" (0.22-cm) high. Controls and indicators include power on light, power on/off switch, online/offline/no print switch, self test/paper advance switch, and out of paper sensor with audio alarm. Programmable controls include paginate and continuous print mode. Unit has 256 bytes of buffer memory std (2048 bytes are optional). **Computer Printers International, Inc,** 280 Polaris St, Mountain View, CA 94043.

See at Booth 60
Circle 435 on Inquiry Card

BUSINESS COMPUTER WITH BUBBLE MEMORY

General purpose microcomputers include a BASIC language operating system, bubble memory mass storage, alphanumeric plasma display, and integral printer in a compact portable unit weighing <20 lb (9 kg). System 128 has 128k-bytes magnetic bubble memory for mass storage, expandable in increments of 128k. System 100 offers 90k bytes (expandable to 400k) of mass storage in a minifloppy disc housed inside the case. Built-in memory is the same as in the 128, and includes 48k bytes of dynamic RAM and 1k bytes of static RAM, expandable to >2M bytes, plus 8k bytes of ROM, expandable to 32k. External disc drives can be interfaced to provide additional storage. Serial, parallel I/O, and S-100 capabilities allow interfacing with a range of peripheral units. **Findex Inc,** 1625 W Olympic Blvd, Suite 707, Los Angeles, CA 90015.

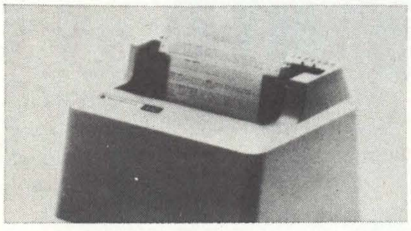
See at Booth 39
Circle 436 on Inquiry Card

STREAMING TAPE DRIVE

Low profile 0.5" (1.3-cm) tape moving drive supplies disc backup for small business systems. Operating in a high speed streaming mode without frequent stops and starts, the drive takes data on-the-fly in large blocks (up to a full disc) at 100 in (254 cm)/s, automatically inserting industry std interrecord gaps. In conventional stop/start mode, the drive performs at 12.5 in (31.8 cm)/s. The IBM and ANSI compatible device reads and writes data in 1600 bits/in (630/cm), phase encoded format. Up to 30M bytes (nom) of data can be accommodated on a 10.5" (26.7-cm) reel; total capacity of many disc files can be dumped into the tape drive in a single continuous operation. The drive includes formatting electronics. It occupies 8.75" (22.2 cm) of vertical rack space, or can be housed with a disc file and CPU in a desk cabinet. Up to 8 drives can be daisy chained on the company's industry std formatted interface. General specs include low speed variation that is $\pm$1% of nom and instantaneous speed variation that is $\pm$3% of long term. **Cipher Data Products,** 5630 Kearny Mesa Rd, San Diego, CA 92111.

See at Booth 3311
Circle 437 on Inquiry Card

TRACTOR FEED IMPACT PRINTER



Low cost printer has software selectable character sizes, full u/lc 96-char ASCII set, and 80- and 132-col formats. Model 440 Paper Tiger™ combines microprocessor, controls, indicators, and electronics on a single PC board. Std features include adjustable form width, forms control with 8 std form lengths, choice of 6 or 8 lines/in (2.3 or 3.1/cm) vertical spacing, software selectable character density, automatic multiline buffering, and both RS-232-C serial and Centronics compatible parallel interfaces. Multiple transmission rates from 110 to 1200 baud are switch selectable. A stepper motor paper feed insures fast reliable paper movement, and an automatic reinking mechanism extends ribbon life. **Integral Data Systems, Inc,** 14 Tech Circle, Natick, MA 01760.

See at Booth 4440
Circle 438 on Inquiry Card

THE MOSTEK

Because even engineers

When was the last time you had the "perfect" hardware design only to learn it now needs three serial I/O ports?

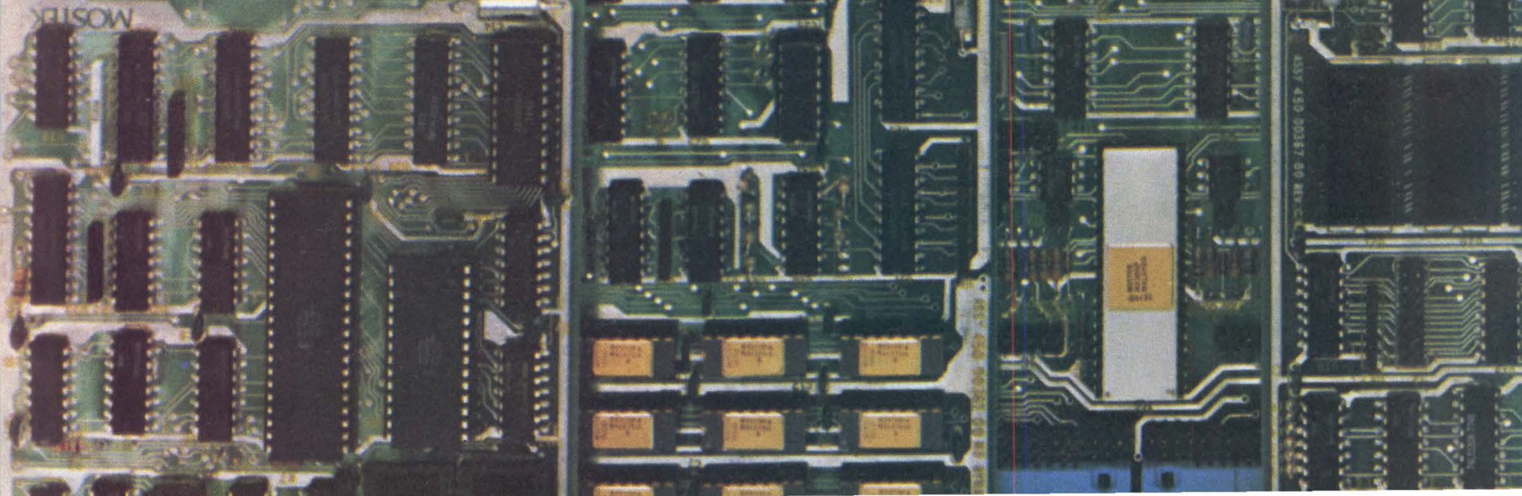
Our new Micro Design Series minimizes these problems and lets you quickly respond to changing product definition and market conditions. Here's how:

Any Card. Any Slot. Any Time.

First, decide what functions your system needs. Match the Z80-based, MDX functional modules to your design. Plug those modules into an MDX card cage. Then start writing your software.

Need to modify your system? Simply exchange, add or delete MDX modules at any time. The small 4.5" x 6.5" board size makes system packaging easier. And both 2.5 and 4.0 MHz versions are available.

You get this versatility because all MDX modules are STD-Z80 BUS compatible. This second-sourced, motherboard



MD SERIES™

can't predict the future.

interconnect system lowers system cost two ways: you buy only what you need, and you reduce hardware development time.

A Wide Choice of Z80-Based Systems.

Need a small but powerful single-board computer? In addition to the broad family of MDX modules, Mostek's MD Series includes a separate family of stand-alone boards designated MD. The MD single-board computers are also Mostek Z80-based and the same small size as the MDX modules.

More Coming in '79.

For even greater design flexibility, the MD Series will expand to include a hardware single-step module, 2-channel programmable serial I/O module, 32-bit programmable parallel I/O module, floppy-disk controller module, plus more MD single-board computers.

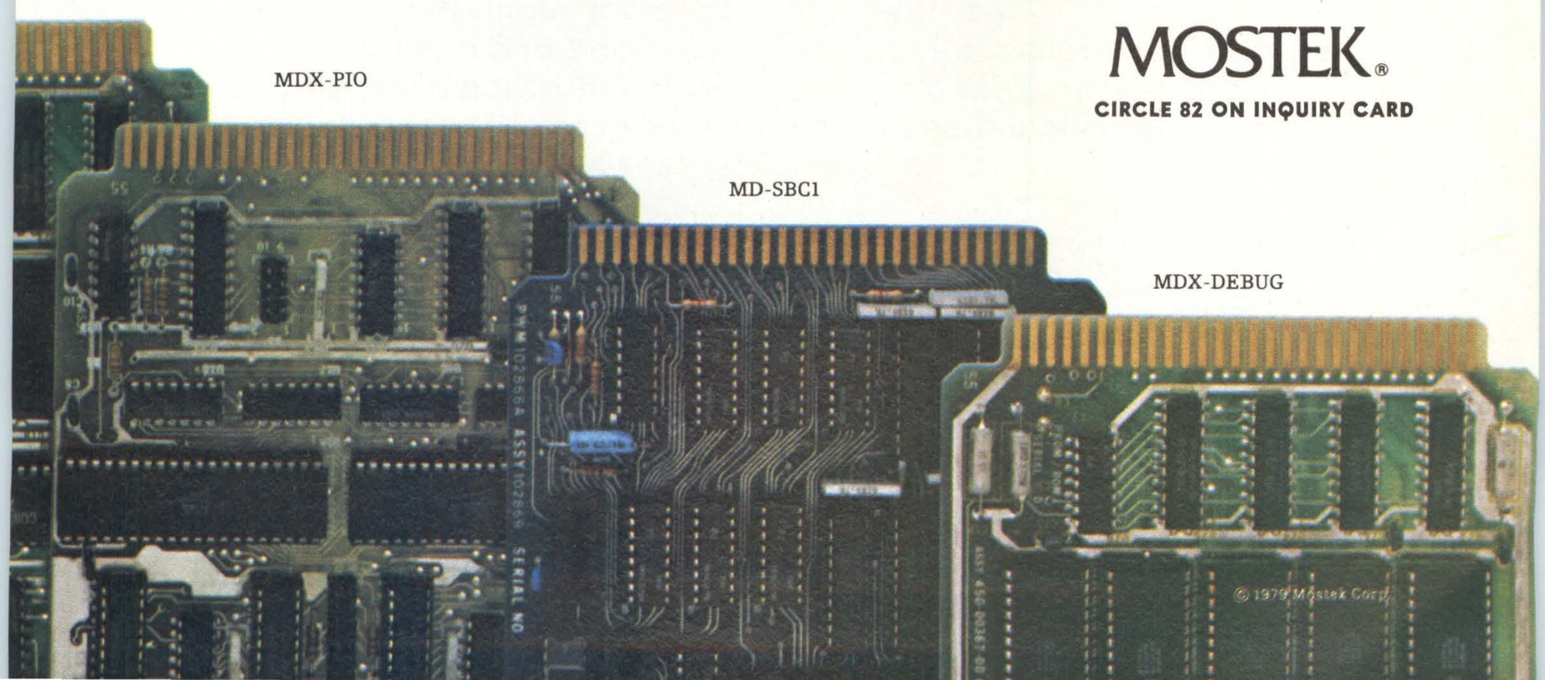
Start designing your MDX system with the MDX-PROTO kit. This powerful evaluation/prototyping kit is available now for only $1095.

Call or write us today for more information. Mostek, 1215 West Crosby Road, Carrollton, Texas 75006; phone 214/242-0444. In Europe, contact Mostek Brussels; phone (32)02/660.25.68.

MOSTEK®

CIRCLE 82 ON INQUIRY CARD

MDX-EPROM/UART



Computer-aided design, Management information systems, Medical/tomography, Command and control, Earth resource/land mapping, Reconnaissance photography, Training/simulation systems, Process control, Micrographics.

Aydin Controls, since 1967 the pioneer in computer graphics and imaging, can help you more efficiently, effectively, and creatively structure your man/machine interface with the 5216 Color Graphic/Image System.

Versatile, modular hardware — You can configure the 5216 for requirements from simple alphanumeric or graphic displays to sophisticated image-processing and analysis applications.

Flexible, easy-to-use software — The 5216 is available with the most comprehensive software package in the industry, including a highly efficient operating system, two- and three-dimensional packages, image analysis program, and interactive list processing software.

Extensive peripherals and accessories — Keyboards joysticks, track balls, graphic tablets, graphic printers, cartridge and floppy disk drives, and much more to come.

AYDIN CONTROLS

See us at NCC, Booths 3056 and 3058.

We make it easy to add Aydin IMAGE-ination

Our application engineers can help you add Aydin IMAGE-ination. Call or write for a demonstration or for more information.

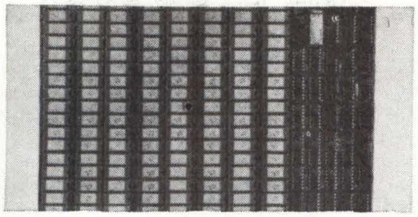
414 Commerce Drive Ft. Washington, PA 19034 (215) 542-7800 TWX: 510-661-0518

©Aydin

CIRCLE 83 ON INQUIRY CARD

AY-101

8M-BYTE SEMICONDUCTOR MEMORY SYSTEM



Packaged in a 15.75" (40.0-cm) chassis, basic Bulk Semi system unit is 2-board DR-129S system, consisting of controller (BSC) and array (BSA) boards. BSC supports up to 16 BSA boards and has capability of configuring available memory in 2- or 4-byte words. BSA is 128k x 43 (36 data and 7 ECC bits), or 512k bytes. Cycle and access times for a 36-bit word are 500 and 350 ns, respectively. In addition to normal control functions and error correcting, controller provides error logging. Controllers allow systems to be used as disc emulation systems for DEC, Data General, and Interdata minicomputers, and can be used for large capacity main memory expansions. **Dataram Corp,** Princeton-Hightstown Rd, Cranbury, NJ 08512.

See at Booth 1506
Circle 439 on Inquiry Card

COMPUTER GRAPHICS SOFTWARE SYSTEM

Contouring and business graphics options are available for DISSPLA[R] system. Extended device interfacing feature permits users to set up intimate relationship between system software and graphics hardware wherein software queries hardware to see what tasks it can perform, then shifts workload between the two accordingly. The device independent, integrated software system of FORTRAN subroutines are called up by the user's program to produce publication quality 2- and 3-dimensional graphics. Output is via plotters, CRTs, computer output microfilm units, flatbed plotters, or art generators. **Integrated Software Systems Corp,** 4186 Sorrento Valley Blvd, San Diego, CA 92121.

See at Booth 3102
Circle 440 on Inquiry Card

NOTE

Booths numbered 1000, 2000, 3000, and 4000 are located in the NY Coliseum on floors corresponding to the first digit; booths 300 to 999 plus suites are in the NY Hilton Hotel; and booths from 1 to 150 are in the Sheraton Centre Hotel at the Personal Computing Festival.

16-CHANNEL LOGIC STATE ANALYZER

PM3500 can operate with external clock from the system to acquire data in a synchronous manner or with its internal clock. A synchronous mode increases clock rate, allowing detailed study of timing relationships. A 20-position internal clock allows data to be sampled at speeds from 20 ms to 10 ns. A high speed circuit in each input channel monitors between-clock pulses, capturing high speed glitches. The unit will trigger on glitches, or can be triggered externally. State displays are presented in binary, octal, or hex; a mapping facility shows entire contents of captured block of 505 serial bits on up to 16 channels, displaying each stored parallel word as single dot. **Philips Test and Measuring Instruments, Inc,** 400 Crossways Pk Dr, Woodbury, NJ 11797.

See at Booth 3042
Circle 441 on Inquiry Card

MICROPROGRAMMED VIDEO DISPLAY TERMINAL

Designed for multidrop communications networks that incorporate Burroughs computers and displays, model 2830 offers enhanced emulation of TD831 and TD833 terminals. Std features include concatenation with auto bypass, TTY mode, integral numeric keypad, 7 x 9 char matrix, printer output, and data communications buffer operation. Also shown are 4050H and 4050U display terminals which emulate Honeywell and Univac terminals and computers. **Delta Data Systems Corp,** Woodhaven Industrial Pk, Cornwells Heights, PA 19020.

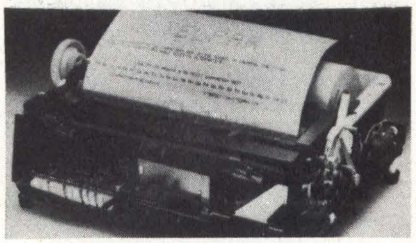
See at Booth 4107
Circle 442 on Inquiry Card

MINIFLOPPY DOUBLE-HEAD DISC DRIVES

Model 52 with 70 tracks has a track to track access time of 5 ms. Pulley-band design offers high temp stability, on-track repeatability, and accurate positioning. Single- and double-density (unformatted) units feature 218.8 x 10^3 and 437.5 x 10^3 bytes/disc, respectively. Rotational speed is 300 r/min $\pm 1.5\%$; avg latency is 100 ms. **Micro Peripherals Inc,** 21201 Oxnard St, Woodland Hills, CA 91367.

See at Booth 370
Circle 443 on Inquiry Card

80-COLUMN THERMAL PRINTER



Thermal RO printer model PPS-80E uses 5 x 7 dot matrix characters to provide 10 char/in (3.9/cm) at 6 lines/in (2.3/cm) on friction feed or perforated 8.5" (21.6-cm) paper. Signaling rates offered are serial mode up to 9600 baud (with option), and parallel mode up to 960 char/s; average throughput is 30 char/s. Unit interfaces with parallel format (TTL), or serial RS-232-C or 20-mA loop using a mass termination connection. Special functions include odd, even, or no parity, pulse to generate audible signal if desired, vector generator graphics, special status chars, and APL, Hebrew, Arabic, or custom character sets. Answer-back is an option. The unit measures 12.2 x 5.2 x 9" deep (30.9 x 13.2 x 22.9 cm), weighs 5.375 lb (2.419 kg), and operates at from 0 to 50°C. **Telpar, Inc**, 4132 Billy Mitchell Rd, Addison, TX 75001.

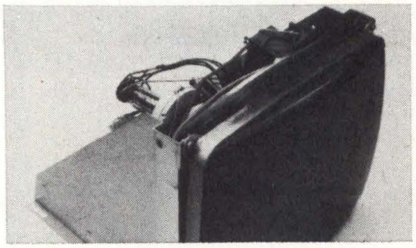
See at Booth 110
Circle 444 on Inquiry Card

STORAGE MODULE AND DATA CARTRIDGE CONTROLLERS

DC-233 storage module disc controller for DEC PDP-11 computers contains a miniature distributed processing architecture for handling up to 8 nonremovable and removable media multiplatter disc drives ranging from 50M to 300M bytes. It is software compatible to DEC operating systems having RM03 or RP05/06 support. The embedded device based on a bit-slice microprocessor houses the controller and 1 to 8 drive adapters together in the CPU or expansion chassis. Radial configuration isolates each drive; the drive adapter controls its drive's commands and status. The controller portion handles communications to CPU and implements data transfers and error correction coding and decoding. TC-170 0.25" (0.635-cm) data cartridge tape controller for Data General Nova computers and emulators controls up to 8 drives, emulates 0.5" (1.27-cm) mag tape systems, and is IRIS and RDOS compatible. The embedded unit uses 6400-bit/in (2520/cm) serial MFM, 1600-bit/in (630/cm) PE serial, or 1600-bit/in (630/cm) PE parallel formats. **Wespercorp, Western Peripherals Div**, 1100 Claudina Pl, Anaheim, CA 92805.

See at Booth 3046
Circle 445 on Inquiry Card

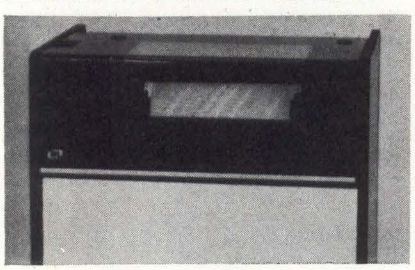
CRT MONITOR FOR CRITICAL DISPLAY APPLICATIONS



All solid state except for CRT, model DC 949 has a 15" (38-cm) diag, 100-in^2 (650-cm^2) display area, 110° deflection angle, and implosion protection. P4 phosphor is std; others are available. All electronic circuitry is mounted on one PC board, TTL input only, with separate horizontal and vertical drives. All inputs are 2.5 V to 5.0 V pk-pk. Logic 1 initiates black display. Power inputs required are 55 Vdc at 700 mA max, and 5 Vdc at 50 mA max. Video response is within 3 dB from 10 Hz to 25 MHz. Resolution is 900 lines center, 800 lines corners, with geometric distortion of 2% max. Scan frequencies are 34.2 kHz horizontal, 50/60 Hz vertical. The unit is 10.5" (26.6 cm) high, 12.38" (31.4 cm) deep, and 13.12" (33.3 cm) wide. Weight is 14.5 lb (6.5 kg). **Audiotronics, Video Display Div**, 530 Fifth Ave, New Brighton, MN 55112.

See at Booth 3107
Circle 446 on Inquiry Card

300-LINE/MIN DEMAND DOCUMENT PRINTER



Innovator 250 is designed for multiform applications where printed form is required immediately after printing. Immediate access to printed form is offered in addition to clear legibility of the fully formed char. Printer uses a tear bar located 0.250" (0.647 cm) from center of printed line so that paper is not wasted. Tractor feed mechanism is capable of printing 80 char/line on variable width and length multipart forms. Intelligent controller board mounted and accessible within cabinet provides for field selectable configuration via switch strapping. Centronics, Dataproducts, 20/60-mA current loop, and RS-232 compatibility are offered as std. Interfaces provide hardware and software transparency with existing host computer or terminal operating systems. **Innovative Electronics Inc**, 15200 Northwest 60 Ave, Miami Lakes, FL 33014.

See at Booth 1236
Circle 447 on Inquiry Card

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.

CIRCLE 84 ON INQUIRY CARD

SOROC TECHNOLOGY, INC.

165 FREEDOM AVE., ANAHEIM, CALIF. 92801

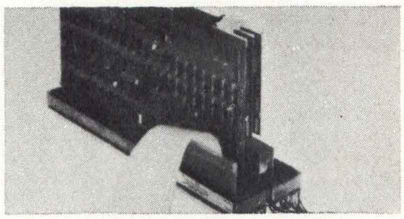
(714) 992-2860 / (800) 854-0147

80-COL BIDIRECTIONAL MATRIX PRINTER

The parallel interface bidirectional dot matrix printer with modifiable char set operates with any system having at least 1 parallel TTL input and 2 parallel TTL output ports, and a power supply capable of 3 A at ±16 Vdc and approx 0.5 A at 8 Vdc. Throughput speed is 84 lines/min. The printer draws its power from the mainframe. It is completely software driven, including char generation. The optional software driver comes on 2708 P/ROM. Since the driver is written in Z80 code, implementation of the printer can involve no programming in Z80 systems. A source listing is included in order to rewrite it or alter the char set. S-100 compatible products to be shown include a 12k P/ROM-1k RAM board with P/ROM programmer; fast scan TV digitizer that converts output from std TV cameras into 8-bit gray scale digital information and transfers it to RAM; and Bitstreamer II board featuring 3 serial I/O ports, interrupt request capability, realtime clock, and 2 parallel ports to interface terminals, printers, readers, and punches. **Vector Graphic, Inc,** 31364 Via Colinas, Westlake Village, CA 91361.

See at Booth 340
Circle 448 on Inquiry Card

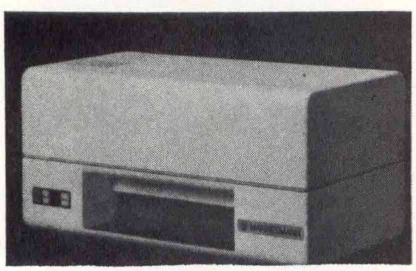
COMMUNICATIONS MULTIPLEXER FOR PDP-11



Microprocessor derived design of DV/16™ enables mixing synchronous and asynchronous lines in any combination of 4 or 8 while maintaining modem control and compatibility with DV11 related software. Line configuration can be changed as often as needed. Word transfer instead of byte DMA is used to gain speed of 76,800 char/s or to let user operate in one-half bandwidth required by DV11 data transfers. Four boards contain 16 channels; expansion to 32 channels takes up 7 standard SPC slots. Also shown, model 10047 Emuloader™, fixed console emulator (ODT), and bootstrap loader combined on single board for several PDP-11 computers. **Able Computer Technology, Inc,** 1751 Langley Ave, Irvine, CA 92714.

See at Booth 411
Circle 449 on Inquiry Card

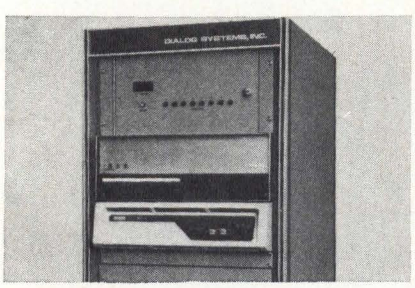
LINE BUFFERED SERIAL IMPACT PRINTER



Featuring an integrated cutting device for handling special forms such as airline tickets, statements, ledgers, checks, and labels, M78 service printer uses a continuous roll paper supply and automatically cuts off the completed form immediately after printing. The 80-col bidirectional unit prints at 200 char/s. A 7 x 7 matrix font is std, with 9 x 9, 9 x 7, and 12 x 9 available as options. Optional fonts allow the printer to produce negative print, OCR A and B, bar code, u/lc with descenders, elongated chars, and double width chars. The unit can accommodate 64-, 96-, and 128-char sets. The buffer can store a complete line of text. For forms compatibility or best readability, operator can switch from 6 to 8 lines/in (2.3 to 3.1/cm) spacing or switch character spacing from 0 to 12, 14, or 16.5/in (0 to 4.7, 5.5, or 6.4/cm). **Tally Corp,** 8301 S 180th St, Kent, WA 98031.

See at Booth 2021
Circle 450 on Inquiry Card

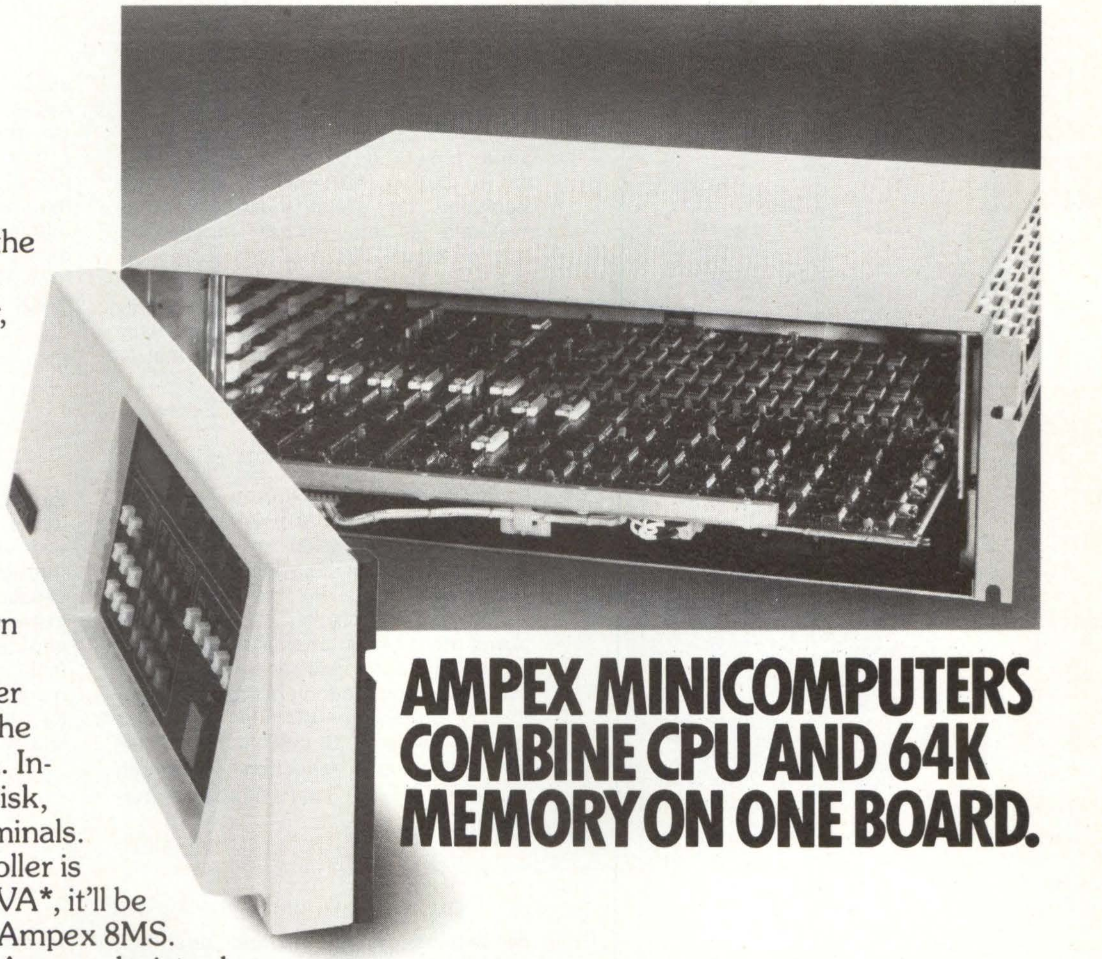
VOICE INPUT DATA ENTRY TERMINAL



Model 1800 allows users to send to or retrieve data from a computer by talking to it over any telephone line. System need not be trained to user's voice before calling. It can accommodate 8 users simultaneously and validates data entry by voice response and error correction procedures. The terminal operates by changing the received word into digitized form understandable to a computer. Standard vocabularies include approx 21 words, including 10 digits, and command words specific to the application. Voice response subsystem verifies input by repeating back to user at any point before initiating any action. Response vocabulary consists of approx 128 words. Interface is standard RS-232, asynchronous full-duplex up to 4800 baud or 20-mA serial current loop. Terminal can also emulate standard computer interfaces such as IBM 3271. **Dialog Systems, Inc,** 32 Locust St, Belmont, MA 02178.

See at Booth 381
Circle 451 on Inquiry Card

THE OTHER FOUR SLOTS ARE FOR YOU.

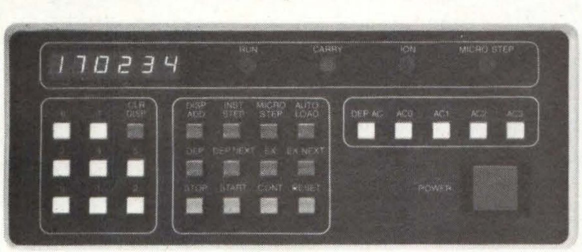


Behind the panel of the $5\frac{1}{4}$-inch high Ampex 8MS5 Minicomputer, there's an 800 nanosecond CPU and as much as 64K words (128K bytes) of memory. All on a single board.

Leaving four big slots for your own cards. 15 x 15 inch boards, with whatever you need to realize the goals of your system. Insert controllers for disk, tape, printers or terminals. As long as the controller is compatible with NOVA*, it'll be compatible with the Ampex 8MS.

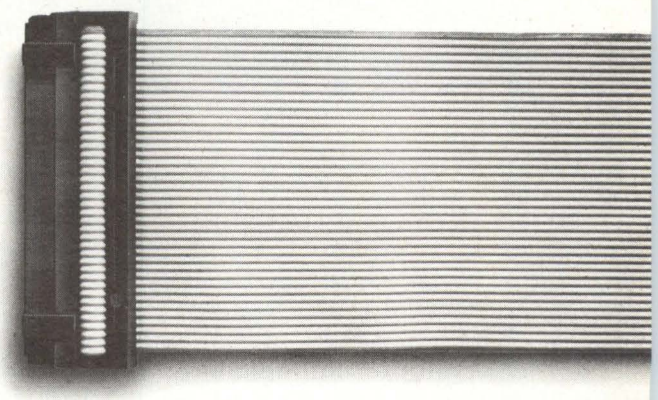
AMPEX MINICOMPUTERS COMBINE CPU AND 64K MEMORY ON ONE BOARD.

That's because Ampex designed this minicomputer to take full advantage of the environment that has grown up around NOVA computers. But *this* mini has some extras you never expected to see in a mini.



Like front access to all components. And a programmer's console with octal pad input, octal readout and LED indicators.

Plus a single bus structure.



Charley Penrose has some suggestions about achieving big system capability in the little 8MS cabinet. Call him at 213/640-0150. Or write to him at Ampex Memory Products Division, 200 North Nash Street, El Segundo, California 90245.

*NOVA is a trademark of Data General Corporation.

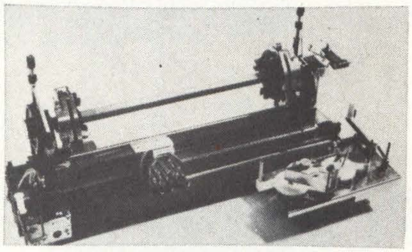
AMPEX MAKES IT EASY.

See the complete line of Ampex Products for Data Processing in Booth 2208 at NCC.

CIRCLE 85 ON INQUIRY CARD

NCC PRODUCT REVIEW

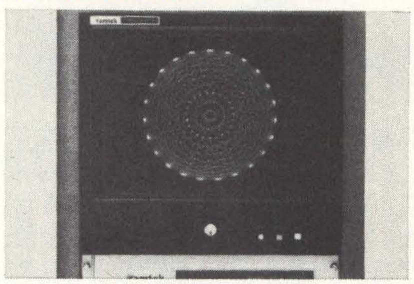
600-CHAR/s MATRIX PRINTER



Proprietary magnetic, stored energy print head prints 600 char/s with no duty cycle or page density restrictions. Open binary interface gives a 128-dot/in (50/cm) vertical and horizontal resolution for graphics and plotting. Available as the BNY-M mechanism only or model BNY, printer stores up to 4 print fonts, including a 2-pass high quality font, under program control. 7 x 8 matrix yields 230 lines/min with full 132-char lines; 15 x 16 matrix prints at 150 char/s. 96-char u/lc ASCII fonts have true underlining and elongated characters. Expanded characters for labeling are 2, 4, and 8 times normal character size. Other features include an OCR font, 890-char buffer, and multiple copies of 1- to 6-part forms. **Florida Data Corp,** 3308 New Haven Ave, West Melbourne, FL 32901.

See at Booth 507
Circle 452 on Inquiry Card

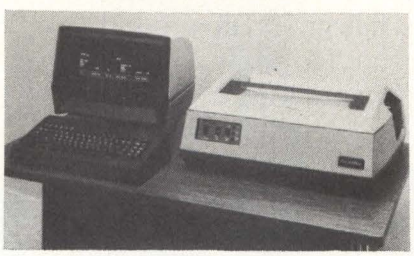
COLOR GRAPHICS DISPLAY SYSTEM



Featuring max resolution up to 1024 scan lines of 1280 elements and 128 bits/element, RM-9400 display generator has vector writing speeds of >16k vectors/s, based on an avg vector length of 50 pixels. Microprocessor based unit offers choice of 6 resolutions. An expanded internal display user memory and upgraded internal display processor, addition of 1 to 8 special purpose 16-bit bipolar microprocessors, and reduction of refresh memory access time increase performance. Each processing element performs specific functions, permitting overlap of functions to increase vector throughput. System decodes and processes a high level binary formatted instruction set. Instructions, transmitted and received via 16-bit parallel interface can be executed immediately or stored as subpictures in user memory for deferred execution. **Ramtek Corp,** 585 N Mary Ave, Sunnyvale, CA 94086.

See at Booth 4328
Circle 453 on Inquiry Card

INTERACTIVE TERMINAL WORKSTATION



Standalone system provides dual buffering, allowing terminal and printer to be independently addressed, and permitting data entry and retrieval while printout is in progress. Built-in diagnostic features allow operators to detect both hardware and software related problems without interrupting normal operations. Microprocessor based terminal consists of CRT, keyboard, and logic module. Using IBM BiSync 3275/3271 emulation, it communicates at speeds to 9600 bits/s over dedicated lines and 4800 bits/s over dial-up lines. Extended editing, highlighting, horizontal and vertical cursor controls, and other convenience features are offered. Freestanding CRT tilts and swivels and keyboard may be positioned to suit operator. **Racal-Milgo, Inc,** 8600 NW 41st St, Miami, FL 33166.

See at Booth 2200
Circle 454 on Inquiry Card

FIBER OPTIC ASYNCHRONOUS DIGITAL DATA LINKS

Data links perform serial transmission in simplex or duplex mode over transmission paths of up to 1.5 km. Serial data transfer is from 0 to 6M bits/s with bit error rates better than 10^{-9}. With TTL compatible I/O, std units are supplied with connectorized fiber optic cable. Connector is BNC or 25-pin miniature. Within the optical interface, the transmitter features an LED as optical source, operating wavelength of 820 nm nom, and output of −15 dBm typ; the receiver has a PIN diode as optical detector and a typical sensitivity of −40 dBm (at 300k bits/s) and −30 dBm (at 6M bits/s). Operating temp range is 0 to 40 °C. For standard models, measuring 8.9 x 20.3 x 25.4 cm, power requirements are 115/220 Vac, 50/60 Hz. Two types of fiber optic cable offered are graded index single (D1G-062) and twin (D2G-062) core for high data rate computer and industrial control applications. Fiber attenuation is to 12 dB/km max, and impact strength is 1.5 N•m with 8.5-mm radius hammer, 10 cycles without fiber breakage. Core diameter measures 0.0625 mm and fiber diameter is 0.125 mm. **Canstar Communications,** 1240 Ellesmere Rd, Scarborough, Ontario M1P 2X4, Canada.

See at Booth 4116
Circle 455 on Inquiry Card

IRIS

The Operating System for Business

and

POINT 4

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.

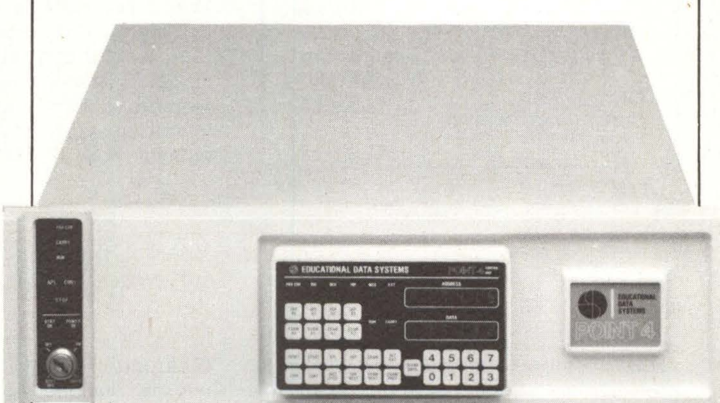
The POINT 4 is compatible with a wide range of commercially available peripheral devices, including our Mighty Mux DMA channel multiplexer and Micro-N microprogrammable processor.

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
CIRCLE 86 ON INQUIRY CARD

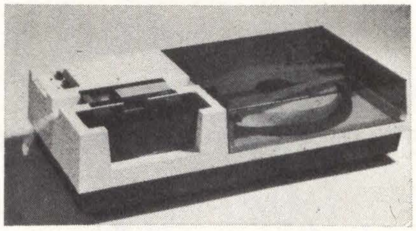


Name ______________________ Title __________
Phone ______________________________________
Company ____________________________________
Street _____________________________________
City ________________ State __________ Zip ________

SEE THE FULL EDS PRODUCT LINE AT THE NCC SHOW, BOOTH #4120/22

NCC PRODUCT REVIEW

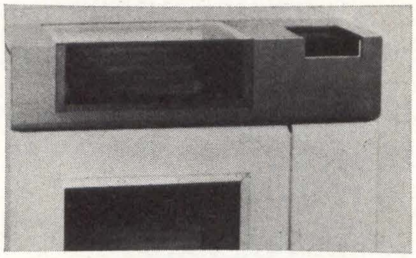
TAPE PUNCH STATION



Self-contained station punches paper or mylar tape with either 5- and 8-channel ISO or 6-channel TTS data according to the die block. Model 3601, a tabletop station, has 75- and 50-char/s versions. Microprocessor based TTL compatible interface accepts parallel data; RS-232 V.24 serial input is optional. Interface includes parity check, motor check, motor speed regulation, and automatic motor start/stop. Tape is perforated by punching needles, which are electromagnetically selected according to the input data. Data and feed signals are synchronized by a photoelectric timing generator. Two built-in test programs check function of the company's model 36 punch mechanism. **GNT Automatic, Inc,** 1560 Trapelo Rd, Waltham, MA 02154.

See at Booth 2004
Circle 456 on Inquiry Card

BAND TYPE LINE PRINTERS



ChainTrain[R] series 3001 printers feature high speeds with low noise. Models 3151, 3301, 3601, and 3901 have speeds of 150, 300, 600, and 900 lines/min, respectively, and offer a 10-char/in (3.9/cm) format as a std feature; 3151 and 3301 offer 15 char/in (5.9/cm) as a customer option. Larger in size to provide better cooling and equipped with a power supply of increased capacity to accommodate the faster line speeds the printers can be utilized to advantage in either a main computer room or a remote location. A 1200-line/min machine with high reliability construction the ChainTrain model 1200 is a horizontal moving font printer utilizing a carrier with interchangeable 8-char links riding on a monorail track. Unit accepts 6-part forms ranging in size from 3.5 to 19.5" (8.9 to 49.5 cm) in width. **Data Printer Corp,** 99 Middlesex St, Malden, MA 02148.

See at Booth 2017
Circle 457 on Inquiry Card

NOTE

Booths numbered 1000, 2000, 3000, and 4000 are located in the NY Coliseum on floors corresponding to the first digit; booths 300 to 999 plus suites are in the NY Hilton Hotel; and booths from 1 to 150 are in the Sheraton Centre Hotel at the Personal Computing Festival.

MONOCHROME DISPLAY MONITOR

Black-on-white, high density, high resolution raster display monitor is human engineered for daily use without eyestrain. The HRD-15 displays 6200 7 x 9 dot matrix characters on an 8 x 10.5" (20- x 26.6-cm) screen. High speed model H scans 60k horizontal lines/s, generating 1024 visible lines. Dot resolution is rated at 0.01" (0.254 mm). Monitor has a rise/fall rate less than 2 ns. Fast scanning and rise/fall rates improve clarity and density, eliminate "smear" at dot edges and create a dot with more edge contrast. Flicker-free performance is insured by the 60k noninterlaced scans/s. Horizontal and vertical sync are separate TTL signals; video is ECL. **CPT Corp,** 1001 S Second St, Hopkins, MN 55343.

See at Booth 362
Circle 458 on Inquiry Card

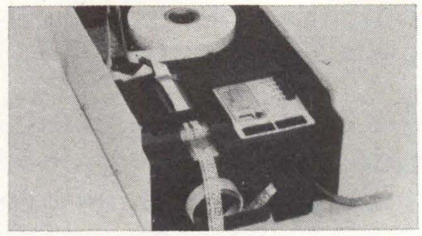
WIREWRAPPING TOOL

"Just Wrap™" is a wiring process and series of tools that produce wirewrapped connections without prior stripping or slitting of the wire insulation. Designed to wrap on 0.025" (0.63-mm) sq posts, each tool carries a 50-ft (15-m) spool of 30 AWG (0.25-mm) wire. It wires continuously through any number of pins (daisy chain). **OK Machine and Tool Corp,** 3455 Conner St, Bronx, NY 10475.

See at Booth 108
Circle 459 on Inquiry Card

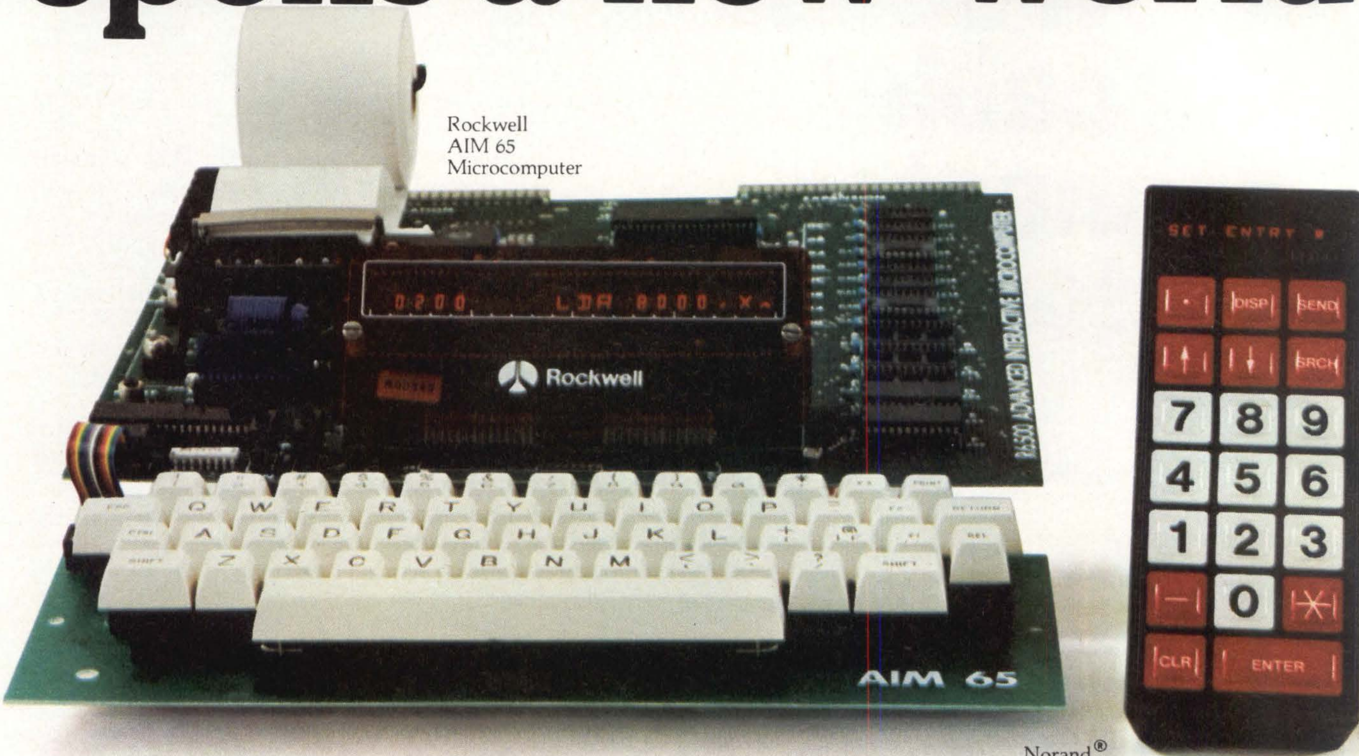
INTELLIGENT HIGH SPEED READER/PUNCH

Dual ported serial RS-232 SRP-750 system is designed to reduce line and operating costs by functioning as a high speed peripheral or standalone device. Features include 4k RAM buffer, auto diagnostics, full- or half-duplex, high speed edit or duplication capabilities, with selectable operating speeds up to 3000 baud, send or receive. Mechanism uses Mylar or paper tape interchangeably without needing registration readjustment. **Data Specialties, Inc,** 3455 Commercial, Northbrook, IL 60062.



See at Booth 1528
Circle 460 on Inquiry Card

How Litronix' opens a new world



Rockwell
AIM 65
Microcomputer

Norand®
Sprint 100 T.M.
Order entry terminal

Now designers have a communications peripheral perfectly matched in size and cost to the world of microcomputers.
Litronix invented the Intelligent Display* to give microcomputers a new way of "talking" to users in words, numbers or even sentences. And not surprisingly, these displays are already beginning to create a new class of microcomputer-based products.

Part Number	Features	Character Height	Horizontal Row Spacing	Vertical Row Spacing	Viewing Angle	Character Positions	Character Segments
DL-1416	Standard General Purpose Display	.160"	.250"	1.200"	±25°	4	16
DL-1414	Compact Display For Hand Held Equipment	.112"	.175"	.800"	±50°	4	16
DL-2416	Premium Display New Rugged Package	.160"	.250"	.800"	±50°	4	17

*Intelligent Display is a trademark of Litronix, Inc.

The Intelligent Display is an alphanumeric LED readout that incorporates ASCII decoder, multiplexer, memory and LED driver in a built-in CMOS IC. It interfaces simply and directly to any microprocessor bus, much like a RAM. Power is from a single +5V supply, and operating current is low enough for any battery powered device.

Litronix puts intelligent communications in the palm of your hand or anywhere panel space is limited. Three versions of the Intelligent Display are already available to fit a wide variety of applications. The smallest lets you fit 20 characters side by side in a space of only 3.5 inches.

Litronix' Intelligent Displays are already being used in the portable terminal, the low cost microcomputer and electronic translator above. They're also ideally suited for applications like control panel readouts. Handheld computer

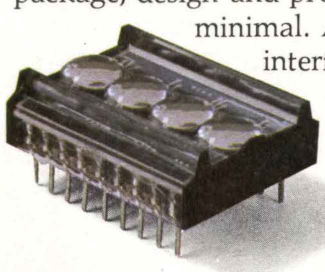
Intelligent Display™ of microcomputer applications.

Lexicon LK-3000 T.M. Electronic translator

terminals. "Smart" games and appliances. Educational products, and more.

Use Intelligent Displays in any product that calls for alphanumerics. They'll reduce component count and cut costs dramatically. Since everything is encapsulated in a single package, design and production costs are minimal. And because no display interface PC board is needed, component costs are typically reduced by 25%. Typical OEM volume pricing will range from $2 to $5 per digit, depending on display type. For easy breadboarding with Intelligent Displays, ask about our inexpensive, prewired Evaluation Kit. To get data sheets and a copy of our applications note on Intelligent Displays, or for a demonstration, phone or write Litronix, Inc., 19000 Homestead Road, Cupertino, CA 95014. Telephone (408) 257-7910.

Photograph of display actual size



litronix
AN AFFILIATE OF SIEMENS

MAKE YOUR NOVA PERFORM LIKE A FERRARI

...with the first Lifetime-Guaranteed Disc Controller

At Quentin Research, we don't call our revolutionary new Model N6010 Nova Compatible Disc Controller "The Cadillac of the Industry": it comes without "bells and whistles"... the luxury accessories you probably won't need and don't want to pay for.

Instead, Quentin's crack team of Advanced Technology Specialists has created a low cost, ultra-high speed controller that brings out the "Ferrari" in your basic Nova; permitting the computer to handle information at maximum disc speed: 9.67 MHz or 1.2 MBytes per second.

But in designing the N6010 as the fastest controller on the market, we haven't left off the important features: overlap seek, compatibility with RDOS, IRIS and BLIS/COBOL operating systems, and the capability to interface up to four CDC or other storage module disc drives with any Nova or Eclipse computer.

Unprecedented reliability? How else could we sell it with the industry's only "no strings" Lifetime Guarantee? And at a price that gives you a lot more byte for the buck.

Call us for more information, or make a date to visit our modern new Research Center and take the N6010 for a spin. Find out how we're putting tomorrow's technology into today's computers.

QUENTIN RESEARCH, INC.,
610 Hawaii St.,
El Segundo, California 90245
(213) 322-2912

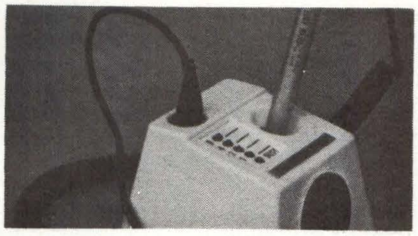
CIRCLE 90 ON INQUIRY CARD

QUENTIN
Research, Inc.

What will they think of next?

NCC PRODUCT REVIEW

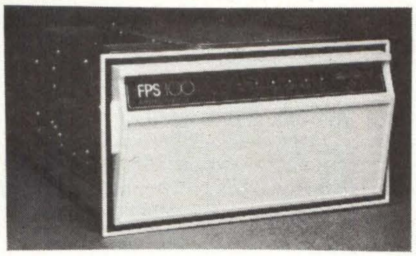
MULTISTATION BAR CODE READ SYSTEM



Allowing up to 10 remote scanning wands to operate from a single reader, Satellite Wand System model 9171 has LED status indicators for interaction with host computer; 9170 is a nonstatus indicator version that can be interconnected in a daisy chain or star configuration (9171 can be daisy chain connected only). Up to 500 ft (152 m) of cable can be used in the system. System operates on party line basis; when wand is removed from its receptacle, all other wand stations are disabled and their busy lights come on. Each wand station is equipped with speaker which emits audible beep for each valid label scan by the light pen. 9170 version is compatible with all of the company's readers; the 9171 with all status indicator readers. Unit mounts to wall or bench. **Interface Mechanisms, Inc,** PO Box N, Lynnwood, WA 98036.

See at Booth 3202
Circle 461 on Inquiry Card

HIGH SPEED ARITHMETIC PROCESSOR



Multiple accumulators, registers, and data paths along with high speed, high accuracy floating point arithmetic suit the FPS-100 to performing extended reiterative multiplication and addition algorithms. 38-bit floating point processor has 28-bit 2's complement mantissa, 10-bit biased binary exponent, and a dynamic range of 0.5×2^{-512} to $(1 - 2^{-28}) \times 2^{511}$. Registers consist of 64 36-bit floating point accumulators, 16 16-bit integer data registers, and 16 12-bit subroutine return stacks. 8k-, 16k-, 32k, or 64k 38-bit words of MOS main data memory; 1k or 4k 64-bit words of program source RAM; 2.5k or 4.5k 38-bit table ROM plus 1 word RAM; and optional 4k or 8k table RAM constitute the processor's memory. **Floating Point Systems, Inc,** PO Box 23489, Portland, OR 97223.

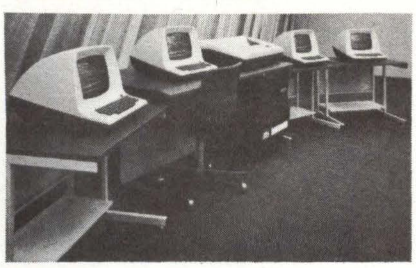
See at Booth 2231
Circle 462 on Inquiry Card

ECLIPSE DATA SYSTEMS ENHANCEMENTS

Software additions to the Eclipse® C/150 family provide improved compatibility and greater system performance. Included are Advanced Operating System (AOS) support; INFOS QUERY, a general purpose online inquiry utility easing access to AOS INFOS files; AOS text entry and editing system, an optional utility for text processing applications, featuring extensive cursor positioning, flexible text manipulation, search, and replace; a virtual data capability for COBOL under AOS, permitting arbitrarily large data elements to be defined in a COBOL program; and availability of the X.25 protocol on all RDOS/RTOS/DOS computer systems to access public packet switched networks. AOS COBOL's screen management extensions for screen definition, display, and field I/O improve compatibility between Eclipse and Commercial Systems families; a common development system can be used with both families. Hardware is enhanced with the announcement of models C/150 and C/350, providing memory of up to 1M and 2M bytes, respectively. **Data General Corp,** Rt 9, Westboro, MA 01581.

See at Booth 2117
Circle 463 on Inquiry Card

MULTIUSER SMALL BUSINESS COMPUTER SYSTEMS

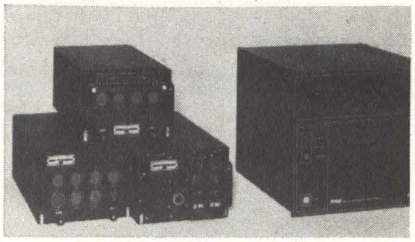


Designed for large scale programming in BASIC and COBOL, 1000/4 and /8 data systems consist of 16-bit CPU; 32k to 64k 16-bit words of dynamic RAM; 4 to 8 ADM-3A Dumb™ terminal consoles, respectively; bidirectional 180-char/s Ballistic™ printer, and 10M-byte cartridge disc memory. All electronics, CPU, memory, and disc are housed in a single desk. Multiuser capability allows up to 8 users at the same time. Operating system and application program are maintained on disc and automatically brought into main memory in segments as required, reserving memory for data in-process and resulting in high throughput. Educational Data Systems' IRIS and Information Processing Inc's BLIS/COBOL operating systems provide communications and multiuser capability to as many as 16 separate terminals. **Lear-Siegler Inc, Data Products Div,** 714 N Brookhurst St, Anaheim, CA 92803.

See at Booth 2526
Circle 464 on Inquiry Card

NCC PRODUCT REVIEW

COMMERCIAL/MILITARY ARRAY PROCESSORS



MAP-200 and -300 series 32-bit programmable, floating point array processors for use with 16- and 32-bit minicomputers reduce time needed to do strings of iterative arithmetic by several orders of magnitude. ATR and rack-mountable militarized units conform to MIL-E-5400 and MIL-E-16400, and are compatible with AN/AYK-14, /UYK-20, -41, and -42 minicomputers. All software developed for the commercial unit is transferrable to the militarized versions. Each MAP contains its own programmable CPU along with supervisory control software. Intelligent programmable interfaces and independent asynchronous bus structure permit host independent data I/O at transfer rates to 40M bytes/s. Processors provide 3 independent banks of memory and can be field expanded. **CSP Inc,** 209 Middlesex Tpk, Burlington, MA 01803.

See at Booth 421
Circle 465 on Inquiry Card

INTELLIGENT DISC DRIVE

Functioning as a disc drive, subsystem, or data management facility, the STC 2700 family features a microcomputer, Winchester disc technology with formatted capacities of 39M, 93M, and 200M bytes of fixed storage; dual ports; high speed, byte parallel data transfer; and bidirectional, full handshake communication protocol. Specs include track to track seek of 10 ms (worst case), and transfer rates of 0 to 2M bytes/s to user and 0.768M bytes/s to media. Avg seek and max seek, both including ontrack settling, are 25 ms (typ) and 60 ms (worst case), respectively. The traditional drive function replaces most hardwired servo logic for seek and head positioning, R/W circuitry, and speed control. At the subsystem level, the MC6801 based microcomputer performs device dependent functions, absolute address translation from relative address, error check and correction, and media defect handling. The integrated data management facility includes software tools—operating system, limited PL/1 compiler, editor, assembler, linker, loader, and batch command processor—for system programming. **Storage Technology Corp,** 2270 S 88th St, Louisville, CO 80027.

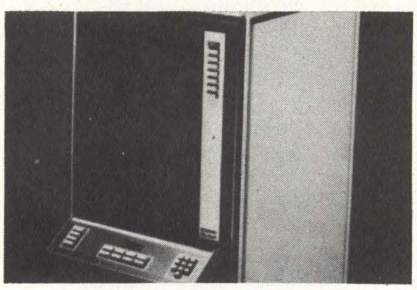
See at Booth 3614
Circle 466 on Inquiry Card

1200-BIT/s FULL-DUPLEX ACOUSTIC COUPLER

VA3434 designed around the VA3400 modem replaces present 300-bit/s couplers to increase data transmission by a factor of four, literally converting any telephone handset into an acoustic connection for a 1200-bit/s full-duplex data terminal utilizing 103-type modem protocol. Acoustic cups have a double flange seal to provide noise isolation. Handset to microphone coupling arrangement minimizes vibration problems. Electronics use low power CMOS and a crystal controlled oscillator. **Racal-Vadic,** 222 Caspian Dr, Sunnyvale, CA 94086.

See at Booth 1000
Circle 467 on Inquiry Card

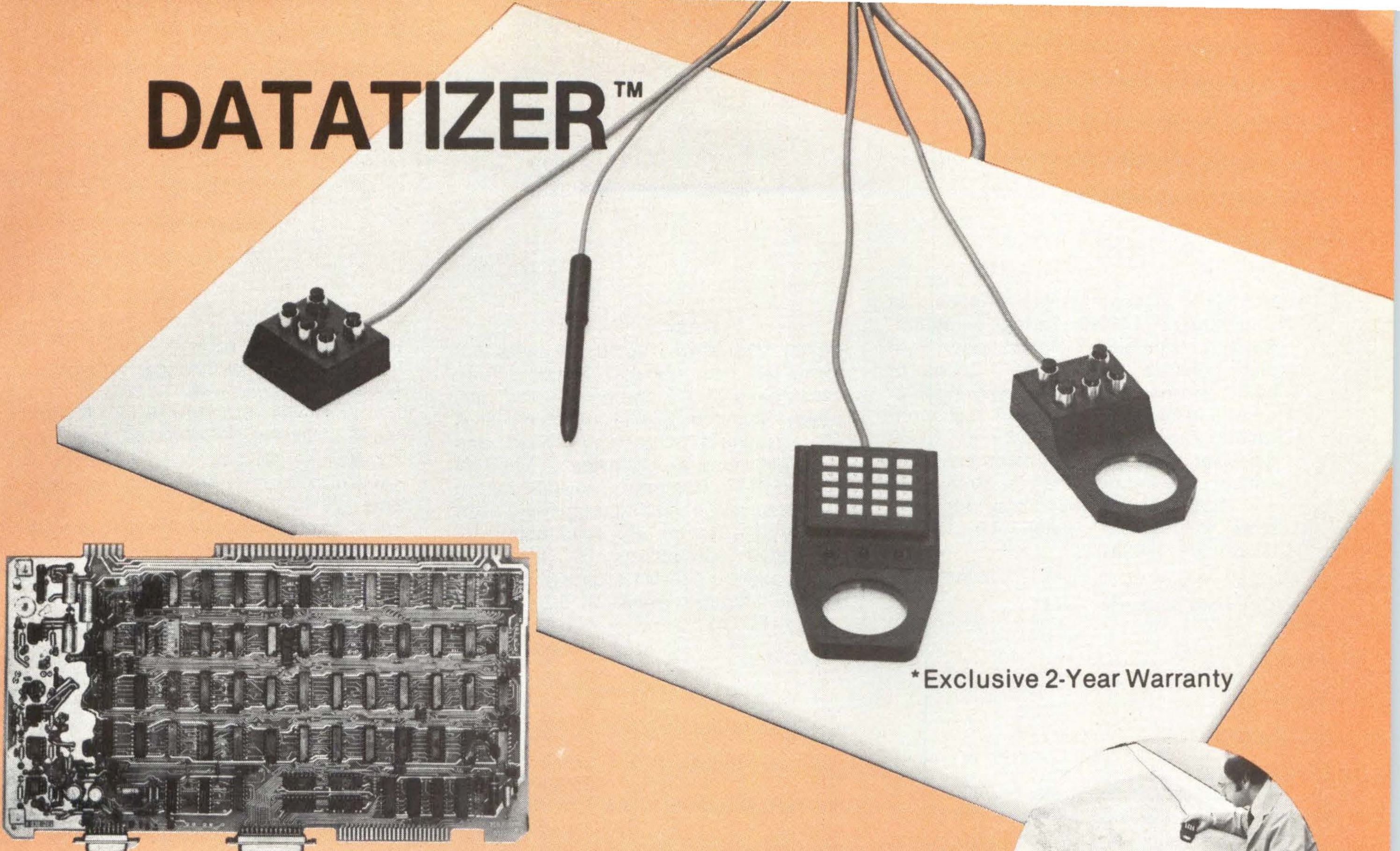
VECTOR INFORMATION PROCESSOR



V.I.P. offline Plotmaster™ system consists of microprogrammed, multiple microprocessor based vector information processor and up to 8 5000 series electrostatic plotters and printer/plotters of the same or mixed types. Inputs may be vector plot, raster plot, or print information, all of which can be stored on the same 9-track multifile tape and plotted or printed under system control. Standard IBM tape formats, labeled or unlabeled, are accepted. Double buffered memories (15k bytes/buffer std, expandable to 64k bytes/buffer) allow overlapped data input, processing, and plotter data transfer for max hardcopy output speed. PLOT 5000 graphics software can be used on IBM System 360/270 with DOS, DOS/VS, MFT, MVT, VS1, SVS, or MVS operating systems. Plot vector information can be spooled using std IBM output writers. **Gould Inc, Instruments Div,** 3631 Perkins Ave, Cleveland, OH 44114.

See at Booth 3015
Circle 468 on Inquiry Card

DATATIZER™



*Exclusive 2-Year Warranty

9 big reasons
why OEM's choose GTCO Digitizers & X-Y Tablets

Performance
GTCO DATATIZER X-Y tablets or digitizers give the best overall performance at the lowest overall cost.

Technology
Electromagnetic Absolute Ranging Digitizing (the superior operating principle) offers high performance digitizingthrough non-metalic material with up to a 1.0" thickness.

Simplicity
Only three items—tablet or digitizer work surface, cursor and a controller—represents a complete system.

Interfacing
Serial pulse or parallel data interface is standard. RS-232 and Micro/Firmware options available. Require +5V and ±12 to ±15V.

Options
Eight standard tablets sizes from 6" x 6" to 42" x 60" (all sizes compatible with any cursor and controller) Resolution 0.001" (0.025 mm, 0.1 mm) and 0.010" (0.25 mm, 1.00 mm) Accuracy ±0.005". Optional ±0.003" (1σ = 1 mil).
Backlighting
Rear Projection
Crosswire and Pen Cursors
Micro/Firmware
Stand Alone Systems

Trouble Free
No adjustments, no preventive maintenance and no detrimental environmental effects.
UL and CSA approval pending.

Reliability
Tablets* feature precision printed circuit grid for a lifetime of rugged, stable performance backed by an exclusive 2-year warranty.
Cursors feature rugged, high-impact case and operate at high signal levels without preamps. Cursor switches field replacable.
Controller contains all active DATATIZER circuits and uses common 7400LS IC's located on one small plug-in controller board.

Interchangability
All tablet sizes, cursors and controllers may be interchanged without requiring adjustment.

The Company
GTCO is an established graphic technology company with a better idea. We challenge you to evaluate and compare our technology and products and then join our Fortune 500 List of OEM users who are purchasing the new patented GTCO DATATIZER.

GTCO Corporation
1055 First Street, Rockville, MD 20850
Telephone (301) 279-9550, Telex 898471
Western Regional Sales Office (408) 996-8493

CIRCLE 91 ON INQUIRY CARD

HARD DISC FOR SINGLE BOARD COMPUTER

Contained in separate unit attaching to single-board 8000-6 series computer, Shugart Winchester technology hard disc provides 15M or 30M bytes of online storage. Z80 computer, double-density disc controller, hard disc controller, 2 Shugart 8" (20.3-cm) floppy discs, and control electronics are contained in computer chassis. Both units are mountable. **Altos Computer Systems Inc,** 2338A Walsh Ave, Santa Clara, CA 95050.

See at Booth 52
Circle 469 on Inquiry Card

TAPE STORAGE SYSTEMS

Model 1200 stores up to 2M bytes unformatted data using 3 model 200 2-track Minidrives™. System records 1600 phase encoded bits/in (630/cm) at a 30" (76-cm)/s write/read speed and transfers data at 6k bytes/s. Built in ANSI/ECMA formatter provides phase encoding and decoding, automatic error checking on write and read using 16-bit CRCC, bidirectional 30" (76-cm)/s read, and bidirectional 90" (228-cm)/s search. Modular design of 5.25 x 19 x 19.5" (13.3 x 48 x 49.5 cm) system allows mounting of from 1 to 3 drives and simplifies maintenance and service. System interfaces with RS-232, PDP-11, LSI-11, NOVA, SBC 80/10 or /20, and ROLM. Meeting MIL-T-21200 and MIL-E-16400, model 5100 also transfers 6k bytes/s. 5100 interfaces with same systems as 1200, but stores up to 4.2M bytes. **Qantex,** 60 Plant Ave, Hauppauge, NY 11787.

See at Booth 1607
Circle 470 on Inquiry Card

STATISTICAL NETWORK PROCESSOR

Microprocessor controlled data communications device functions as an intelligent concentrator and statistical time division multiplexer. The SNP-100 features multipoint option allowing the user to poll a number of remote sites along a single transmission line. Available in 2-, 4-, and 8-channel models, the processor maximizes operating efficiency by concentrating asynchronous inputs into a single high speed output. Features include error checking routines, downline loading that permits changes in remote site operation to be made from a central location, and continuous self-testing. Optional command and diagnostics port monitors all important system functions and can alter most system operation parameters. **Prentice Corp,** 795 San Antonio Rd, Palo Alto, CA 94303.

See at Booth 404
Circle 471 on Inquiry Card

NOTE

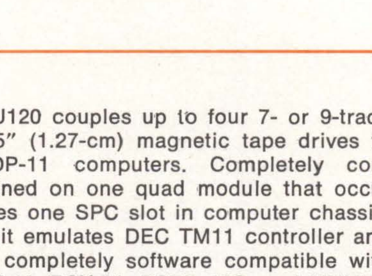
Booths numbered 1000, 2000, 3000, and 4000 are located in the NY Coliseum on floors corresponding to the first digit; booths 300 to 999 plus suites are in the NY Hilton Hotel; and booths from 1 to 150 are in the Sheraton Centre Hotel at the Personal Computing Festival.

VIRTUAL MEMORY COMPUTER SYSTEMS

The communications oriented 3200 series offers 5 32-bit, virtual memory models that are IBM/360 and /370 compatible, using the VPS operating system; 3 simultaneous operating modes are online interactive, remote job entry, and batch. The systems handle COBOL, FORTRAN, PL/1, APL, BASIC, and assembler language. **National CSS, Inc,** 187 Danbury Rd, Wilton, CT 06850.

See at Booth 514
Circle 472 on Inquiry Card

MEMORY ENHANCEMENT UNIT FOR NOVA 3

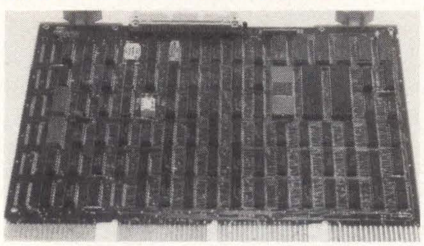


See at Booth 4003

A 15 x 15" (38 x 38-cm) memory expansion and hardware multiply/divide controller board for the Data General Nova™ 3 line of minicomputers extends the memory capacity of 64k bytes up to a max capacity of 256k bytes. Memory protect, memory parity, and hardware multiply/divide features are also available as options. **Custom Systems Inc,** 2415 Annapolis Ln, Suite 170, Minneapolis, MN 55441.

Circle 473 on Inquiry Card

SINGLE-BOARD MAGNETIC TAPE CONTROLLER



DU120 couples up to four 7- or 9-track 0.5" (1.27-cm) magnetic tape drives to PDP-11 computers. Completely contained on one quad module that occupies one SPC slot in computer chassis, unit emulates DEC TM11 controller and is completely software compatible with RT-11, RSX-11, RSTS, IAS, and MUMPS software systems. Single board design incorporates proprietary microprocessor that enables an automatic self-test feature to be used in isolating system malfunction. Automatic self-test constantly monitors controller for proper operation. Tape format is compatible with 7- or 9-track IBM and ANSI standards for DEC or IBM compatibility. Selectable tape speeds from 12.5 to 112.5 in (31.75 to 285.75 cm)/s are offered. **Distributed Logic Corp,** 12800-G Garden Grove Blvd, Garden Grove, CA 92643.

See at Booth 351
Circle 474 on Inquiry Card

Sorry Joe. It's custom MOS/LSI.

Chances are that in the fifties you were into custom cars too—who wasn't? But today you're designing systems, and custom means MOS/LSI.

If you're presently in production or breadboarding a system with discrete components and a batch of SSI and MSI integrated circuits, our high-density MOS processes will usually enable us to put your whole system on ONE CHIP at great cost savings. We've got high-voltage P-MOS technologies, as well as C-MOS capability. But, where we really shine is in our high-density n-channel silicon-gate COPLAMOS® technology, which virtually all our customers are now specifying for their high-performance, low-cost custom requirements. If you also need quick turn-around on mask-programmable options and patterns, we can combine COPLAMOS® with our most recent technological breakthrough CLASP™ (which stands for COPLAMOS Last Stage Programmability) to provide the solution.

Standard Microsystems is a total-capability supplier—all design engineering, wafer processing, assembly, and test is performed in our modern, Hauppauge, New York facilities. Our processes are usually compatible with current state-of-the-art processes used throughout the industry. Not only can we start your design from scratch, but we can enter the custom cycle at any point. If you have masks, we can process wafers, generate test procedures, assemble devices and final test.

So, the next time you have a need in the custom area, just peel out to Standard Microsystems and tell 'em Joe sent ya.

STANDARD MICROSYSTEMS CORPORATION
35 Marcus Boulevard, Hauppauge, New York 11787 (516)273-3100 TWX: 510-227-8898
The largest manufacturer of MOS/LSI data communication circuits

CIRCLE 92 ON INQUIRY CARD

A REAL TIME CLOCK FOR OUR 10th ANNIVERSARY

The 1845A Real Time Of Day Module features software selectable interrupts, sockets for up to 4K of optional EPROM memory (with the ability to jumper-select 4 EPROM types). Memory can be enabled or disabled, and the base starting address selected, by simply using the appropriate "on-board" switches. In addition to these features, counter output may be read in either hexidecimal or BCD code.

TIME CONTROL: The 1845A module gives you time control of software execution and processor operation. It provides timing for applications such as the real time monitor, executive software support, time-scheduled instrumentation programs, high resolution A/D support, process control monitoring and effective real time software development.

BATTERY BACK-UP: The battery back-up designed into our module can keep it running, even if power fails, for up to 30 days. The back-up power system features automatic recharging.

PCS/INDUSTRIAL MICROCOMPUTERS: The 10th anniversary of PCS celebrates 10 years of dynamic design and manufacturing experience that has led to one of the most complete lines of industrial microcomputers in the industry. So, whatever your industrial microcomputer requirements demand - complete systems, industrial microcomputer packages, or a broad line of modules, including super-intelligent microprocessor modules, memory modules and a wide assortment of interfaces, the PCS standard product line is the solution.

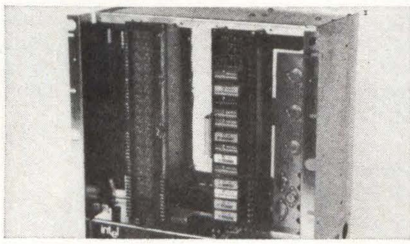
For complete information contact your local PCS representative or call the PCS HOTLINE (313) 429-4971.

pcs

Process Computer Systems Inc.
750 North Maple Road, Saline,
Michigan 48176
(313) 429-4971 TWX:810-223-8153

CIRCLE 94 ON INQUIRY CARD

MICROCOMPUTER PRODUCTS FOR CONTROL SYSTEMS



The iCS™ family includes iCS 80™ chassis to aid in design and assembly of industrial control systems, and 3 signal conditioning/termination panels to ease interfacing signals to and from controller. Chassis is mechanical and electrical framework on which user can assemble a single or multiple card 8- or 16-bit microcomputer system. Termination panels iCS 910, 920, and 930 provide analog, digital, and ac-dc signal conditioning, respectively, per user requirements, and interface the system to external signal wiring. Of key importance, iCS 80 is built around the MULTIBUS™ backplane allowing designers to use an array of 5 CPU products including iSBC 86/12™, using the 16-bit 8086 microcomputer, and all iSBC 80™ series SBC products. **Intel Corp,** 3065 Bowers Ave, Santa Clara, CA 95051.

See at Booth 1420
Circle 475 on Inquiry Card

PAPER MOTION MONITORS

Two monitors immediately signal a paper jam (or paper out condition) to avoid loss of data and eliminate retrieval time. Devices are mounted on the inboard side of XACTRON® tractors. Model PMP processor insures that paper actually responds to a line advance command; model PMD detector responds to every 0.080" (0.203 cm) of linear paper travel. **Precision Handling Devices,** 63 S Main St, Assonet, MA 02702.

See at Booth 4000
Circle 476 on Inquiry Card

SMART TERMINALS WITH PAGING OPTION

Independent paging added to the "Editor 1" line allows data to be input to a specific page rather than scrolled to another page of local storage. Data received from the host computer may be addressed from either page of the 2-page option without disturbing data contained on the unaddressed page. Data transmission to the host computer is also performed on an independent page basis, or both pages may be transmitted. **EECO, Computer Terminal Products Group,** 1601 E Chestnut Ave, Santa Ana, CA 92701.

See at Booth 1112
Circle 477 on Inquiry Card

FIXED MEDIA DISC DRIVE

Based on Winchester technology, model D800 has a max capacity of 20M bytes. Dimensions are 8.5" (21.6 cm) wide and 14.25" (36.2 cm) long. Mechanically interchangeable with 8.25" (20.96-cm) floppy disc drives, the unit can be mounted in most small business or multiterminal systems without changes. **Pertec Computer Corp, Peripherals Div,** PO Box 2198, Chatsworth, CA 91311.

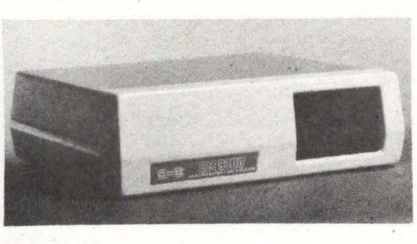
See at Booth 3300
Circle 478 on Inquiry Card

DOT MATRIX IMPACT PRINTERS

Models 830 and 8300 are 7-wire, 80-col bidirectional dot matrix printers. The 830 prints 125 char/s and 70 lines/min. Available as printer mechanism or self-contained printer, unit's sprocket paper feed accepts multi-ply pin feed paper from 3.5 to 8.5" (8.9 to 21.5 cm) wide. Paper can be loaded from bottom or from rear, and print line position is readily adjustable. The 8300 also prints 125 char/s but at 60 lines/min. 5 x 7 or optional 7 x 9 dot matrices form 96 ASCII characters in normal and double width. 8300 has 8-bit parallel interface and 1 line (80 normal width characters) buffer. Both print heads have a life expectancy of 100M char. **C. Itoh Electronics, Inc,** 5301 Beethoven St, Los Angeles, CA 90066.

See at Booth 358
Circle 479 on Inquiry Card

MICROPROCESSOR CONTROLLED COMMUNICATIONS PROCESSOR

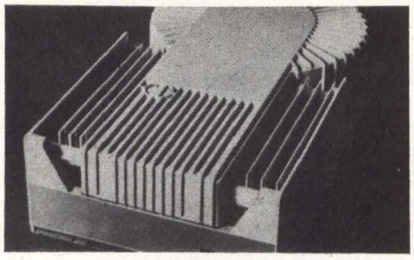


Software programmable CM 9100 processor concentrates from 4 to 32 synchronous and asynchronous data streams into one high speed link using statistical multiplexing. X.25 level 2 link protocol employs GO BACK N ARQ for error free transmission between units. 50- to 19.2k-bit/s port speeds with ASCII, Correspondence code, and EBCD; CTS/XON-XOFF buffer overflow protection; built-in self-diagnostics; per line status displays; and downline loaded line characteristics are std. Compatible with the CP 9000 multi-microprocessor, basic unit includes 4 asynchronous/synchronous ports, 1 SDLC/HDLC line, 16k-bytes buffer RAM, 12k-bytes RAM for application software, microprocessor, power supply, and chassis. **Digital Communications Corp,** 19 Firstfield Rd, Gaithersburg, MD 20760.

See at Booth 500
Circle 480 on Inquiry Card

NCC PRODUCT REVIEW

FIXED DISC DRIVE

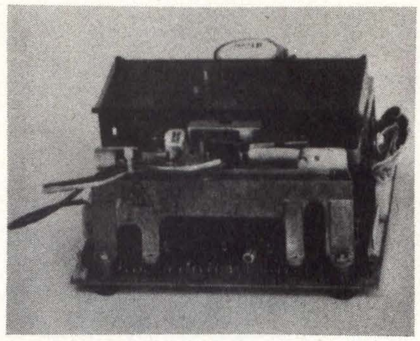


D160, fixed disc member of the D100 family, has 2, 3, or 4 discs, and stores up to 120M bytes in a volume of 5.6 x 12.2 x 21.8" (14.2 x 31 x 55.4 cm). Three drives can be vertically mounted in a standard 19" (48.3-cm) rack. The three versions provide 60M bytes on 2, 90M bytes on 3, or 120M bytes on 4 nonremovable discs, with 4, 6, or 8 low pressure heads contained in a sealed module. Head positioning is performed by reading servo data interlaced in each track. Heads automatically position themselves on required track. Densities exceed 7k bits/in (2.75k/cm) and 600 tracks/in (236/cm). MTBF is 8k h, and operating power consumption is 130 W. Drives are compatible with other D100 series units and can be intermixed on the same controller. **Cii-Honeywell Bull,** 200 Smith St, Waltham, MA 02154.

See at Booth 347
Circle 481 on Inquiry Card

MICROPROCESSOR BASED RS-232 CASSETTE SYSTEM

Storage system is composed of a master and from 1 to 3 slave drives. An 8035 microprocessor in the master handles all communication, data buffering, formatting, and drive control functions. Interfaces are RS-232-C or 20-mA current loop, with 8-bit parallel optional. Storage is up to 2M bytes/system. Search speed is 100" (254 cm)/s, with less than 10-s avg access time. 256 bytes of RAM buffer store is provided. Operation is totally asynchronous. **Analog & Digital Peripherals, Inc,** 815 Diana Dr, Troy, OH 45373.



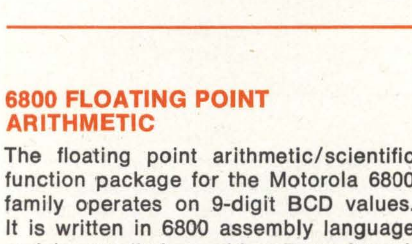
See at Booth 3111
Circle 482 on Inquiry Card

LSI-11/LSI-11/23 BASED COMPUTER SYSTEM

MICRO II, a general purpose, small business microcomputer, houses the DEC LSI-11™ or 11/23™ CPU and 2 floppy disc drives, single- or dual-density, in a 10.5" (26.7-cm) chassis. It can support a 5M- or 10M-byte hard disc subsystem. Floppy disc subsystem is compatible with DEC RXV11 and RXV21 subsystems. **Plessey Peripheral Systems,** 17466 Daimler Ave, Irvine, CA 92714.

See at Booth 4032
Circle 483 on Inquiry Card

SOLID STATE CAPACITIVE KEYBOARD



Featuring low profile contactless keys, this keyboard is enabled by custom designed NMOS encoder chip. Virtually any customer requirement can be custom built. Encoder requires 5 Vdc and provides encoding capability up to 10 bits for 110 keys, 4 modes/key. Any code, including ASCII, Baudot, and EBCDIC, may be selected. Estimated life is more than 300M operations. Externally adjustable scan time range is from 10 to 80 μs/key. Noise immunity circuit distinguishes between valid key depression and noise, and hysteresis circuit eliminates keyswitch "teasing." Burst rate speed capability is 1k char/s. Options include N-key rollover or lockout, repeat for all, no, or selected keys with repeat rate up to 900 Hz, and pulse or level strobes. **Cherry Electrical Products Corp,** 3600 Sunset Ave, Waukegan, IL 60085.

See at Booth 1022
Circle 484 on Inquiry Card

6800 FLOATING POINT ARITHMETIC

The floating point arithmetic/scientific function package for the Motorola 6800 family operates on 9-digit BCD values. It is written in 6800 assembly language and is supplied on either 7- or 9-track tape in both source and relocatable object form. Argument passing and calling protocol allows use with PL/W or assembly language programs. **Wintek Corp,** 902 N 9th St, Lafayette, IN 47904.

See at Booth 4022
Circle 485 on Inquiry Card

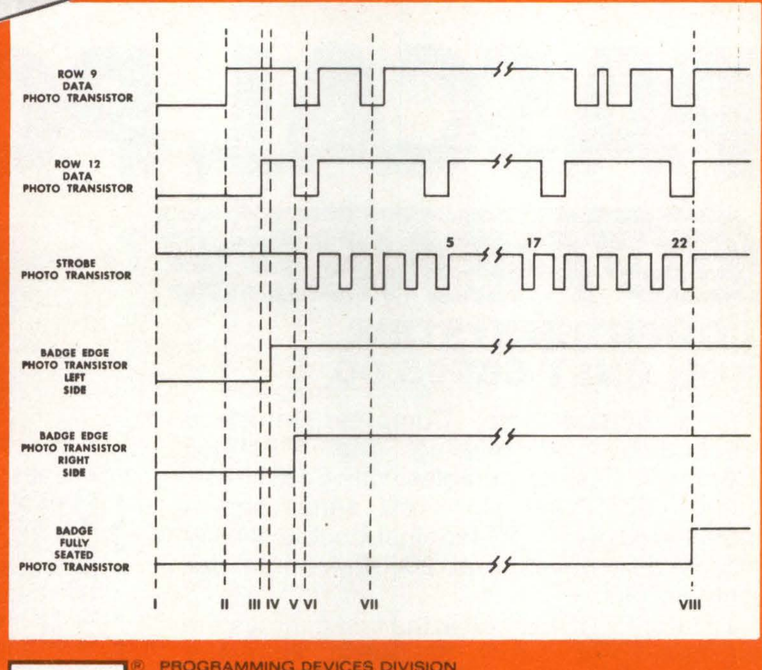
BAND PRINTERS

300-, 600-, and 900-line/min B-Series band printers each offer a variety of 69 easily interchangeable print bands in 22 languages. 64- and 96-char ASCII sets are std; 48- and 128-char sets are optional. Units print 132 char/line; 300- and 600-line/min models offer optional 15-char/in (6/cm) density. Features include operator control and fault indicator panel, 6-part forms capability, swing out yoke and inline paper tractors for easy forms loading, paper status detecting sensors, and automatic turn-off of print band drive motor following any 30-s nonprint period. Printers are plug-compatible with DEC, Data General, Hewlett-Packard, IBM Series/1, Interdata, and RS-232-C interfaces. **Digital Associates Corp,** 1039 E Main St, Stamford, CT 06902.

See at Booth 1106
Circle 486 on Inquiry Card

FOR MAXIMUM PERFORMANCE...
IN A MINIMUM PACKAGE...
EVERYONE AGREES...IT'S THE

DSR-100
BADGE READER



- ★ Completely solid state—maximum reliability and long-life.
- ★ Models for all standard punched badges.
- ★ Reads complete alpha-numeric code.
- ★ Complete validity check.
- ★ Absolute column count—regardless of punched data.
- ★ Low cost, small size.

This is the 100% punched badge reader. Provides complete read-out of all punched data with 100% reliability. Simple, compact unique design provides maximum interfacing capabilities.

Write for complete technical data

® PROGRAMMING DEVICES DIVISION

SEALECTRO CORPORATION

SEALECTRO

MAMARONECK, N.Y. 10543
PHONE: 914 698-5600 TWX: 710-566-1110
Sealectro West:
14011 Ventura Blvd., Suite 215, Sherman Oaks, Ca. 91423, (213) 990-8131
1901 Old Middlefield Way, Suite 19, Mountain View, Ca. 94043 (415) 965-1212
Sealectro Ltd., Portsmouth, Hants, England
Sealectro S.A., Zone Industrielle Toulon Est, 83087 Toulon Cedex, France

CIRCUIT COMPONENTS ■ R.F. COMPONENTS ■ PROGRAMMING DEVICES

NCC PRODUCT REVIEW

Many companies exhibiting at NCC '79 are showing products that have been announced previously or which were described in recent issues of Computer Design; *still others supplied information that was too late or too little for processing as "first time shown" products. The following briefs are a sampling of the products that NCC '79 attendees can expect to be exhibited by some of those companies.*

Applied Magnetics Corp (Booth 1312): Printed circuit boards, interconnection devices, precision magnetic heads, and specialized test equipment

---

Astrocom Corp (Booth 363): Microprocessor based tabletop keyboard/display terminal with ROM and various increments of RAM plus a single- or dual-floppy disc drive and matrix printer

Atlantic Research Corp (Booth 1129): Intershake diagnostic test system, Interview II standalone data monitor, portable data test sets, and patching and switching equipment for data communications maintenance

---

BASF Systems (Booth 4630): Single- and double-sided minifloppy disc drives and media, standard floppy disc media, rigid disc media, and 40M- and 80M-byte capacity storage modules

Boschert, Inc (Booth 4232): OL 153E self-contained power module for 115- and 230-V input Qume printers and line of switching power supplies from 25 to 400 W

Centronics Data Computer Corp (Booth 1121): High density dot matrix word processing printer plus serial dot matrix and fully formed character band line printers and nonimpact microprinters

---

Chromatics, Inc (Booth 4060): of 8-color graphic and alphanumeric readout systems based on Z80 CPU plus full memory and I/O structure

---

Compucorp (Booth 113): 625 Mark II business computer with extended BASIC language operating system and up to 64k bytes of internal memory; can also be used for data acquisition and scientific realtime applications

CIRCLE 96 ON INQUIRY CARD

Shortcut to Success.

Introducing iSBC 86/12,™ the single board computer that brings the power of the 8086 to the Multibus™ standard.

There's no quicker way to implement designs with the new 8086 16-bit microprocessor than our new iSBC 86/12. It's dramatic evidence of the architectural capability of the 8086, with unprecedented computing power, memory and I/O capacity on a single board.

Multibus™ architecture ensures success.

The Multibus standard is your path to success with the iSBC 86/12 board. Since we introduced it in 1976 it has become the industry standard microcomputer bus. Even then we were looking forward to the 8086 and designed the Multibus architecture to support both 8- and 16-bit computers in single or multimaster systems, and a full megabyte of directly addressable memory.

That gives you unlimited design flexibility, with immediate access to the complete iSBC family of 8-bit computers, memory boards, analog and digital I/O, peripheral control and communications boards.

Plus over 100 additional expansion boards from more than 40 independent suppliers. And Multibus compatibility means you can preserve your design investment as your application requirements grow from 8 to 16 bits.

iSBC 86/12™ designed from experience.

We drew upon all our design experience to make the iSBC 86/12 board the most advanced 16-bit single board computer available.

At its heart is our 8086 CPU that gives the iSBC 86/12 board ten times the processing power of our 8-bit single board computers. We added 32K bytes of dual port RAM, fully accessible by all Multibus masters in shared memory designs. There are sockets for up to 16K bytes of EPROM. And the advanced architecture of the 8086 addressses up to a full megabyte of system memory.

The iSBC 86/12 board has a flexible I/O structure, with 24 programmable parallel I/O lines and a programmable synchronous/asynchronous communications channel with RS232C interface and programmable baud rate generator. In addition, the iSBC 86/12 architecture provides nine levels of vectored interrupt control and two programmable interval timers.

More than a shortcut.

The iSBC 86/12 board is a fully assembled and tested computer, dramatically reducing development time compared to component level design. More important, lower hardware costs enable you to incorporate the iSBC 86/12 board in hundreds of performance-dependent applications where the size and cost of larger computer systems would be prohibitive.

And, with Intel, there's no penalty for success. When volume makes it more economical for you to build instead of buy your boards, we'll provide manufacturing drawings, pc artwork and a volume source for all the essential LSI components.

The same Intellec® Microcomputer Development System used with all Intel® microcomputers supports the iSBC 86/12 board with features such as ASM 86 assembler and PL/M 86 block-structured high level system programming language. You can debug your software right on your prototype system with ICE-86™ In Circuit Emulator or with the iSBC 957™ Interface and Execution package.

Attend an iSBC™ seminar in your area.

The best way to get started with this new-generation Single Board Computer is to attend the Intel iSBC seminar in your area. You'll learn about the iSBC 86/12 board and the rest of the iSBC product line. And we'll take you through the configuration and design cycle for several applications. For a seminar schedule and detailed information contact one of the Intel regional offices listed below.

And, for a free copy of our iSBC Configuration Planning Kit, or for on-site configuration or pricing assistance, write: Intel Corporation, Dept. 4-903, 3065 Bowers Avenue, Santa Clara, CA 95051.

intel® delivers.

Intel Regional Offices
Santa Ana, CA: (714) 835-9642 **Boston, MA:** (617) 667-8126
Chicago, IL: (312) 325-9510 **Dayton, OH:** (513) 890-5350

CIRCLE NO. 98 FOR CONFIGURATION PLANNING KIT
CIRCLE NO. 99 FOR CONFIGURATION AND PLANNING ASSISTANCE

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 96000 Baud with most minicomputers 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.

☐ **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.

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

Computer Devices, Inc (Booth 1550): Model 1206 Miniterm[R] portable computer that also operates as automatic send/receive terminal; integral, alphanumeric bar code reader; and double-density minifloppy disc drives

Computer Interface Technology (Booth 346): PASCAL Microengine[TM] computer system with stack oriented 16-bit processor, 64k-byte RAM, floating point hardware, and DMA floppy disc controller

Computer-Link Corp (Booth 3500): Magnetic tape and disc cleaners, testers, and degaussers

Computer Transceiver Systems (Booth 1026): Variations of Execuport 4000 and 4080 terminals

Conrac (Booth 1019): Model 480 microprocessor based CRT terminal and high performance color and monochrome video displays

Cortron Div of Illinois Tool Works (Booth 2618): Series III solid state keyboard using linear ferrite core design, for large computer, interactive terminal, and microcomputer applications

Cullinane Corp (Booth 2702): OLQ 2.0 English language query facility, IDMS/DC teleprocessing monitor integrated with database management systems, and IDMS 5.0 integrated database management system

Cutler-Hammer (Booth 416): Directrol[R] multiplexer system for up to 4096 signals in industrial control communications; functions alone or with DEC, Data General, or IBM computers

Data Electronics, Inc (Booth 368): 34M-byte Microtape[TM] 7-track digital cartridge tape drive using group code recording for 7200-bit/in (2835/cm) density

Data Processing Power Corp (Booth 379): MNIC series Powermobile, a self-contained movable power system with flexible shielded cables to conduct power to various computer components

Dataproducts Corp (Booth 3324): 80-char/s thermal and 340-char/s impact matrix printers; and 300- and 600-line/min shaped character band and 300- to 1250-line/min shaped character drum printers

Data/Switch Corp (Booth 434): CPS-1000 computer/peripheral switch system, DCS-2000 data communications switch, CTS-3000 coaxial terminal switch, and DACS-4000 direct access control system

Data Terminals and Communications (Booth 4807): Taskmaster totally integrated small business computer system with 8k ROM and 56k user RAM, dual-diskette drive, CRT, and daisy wheel printer

Deltec Corp (Booth 4200): 3-kVA model 5246A and DSU 710 uninterruptible power supply systems; model DLC 1260 line conditioner and triple-shielded model DT 250R1 with 150-dB common mode rejection

Diablo Systems Inc (Booth 2201): Models 1640 KSR and 1650 RO terminals, model 1355 word processing printer, model 3200 small business computer/intelligent terminal, and model 1380 wide bed printer

Di/An Controls, Inc (Booth 2035): Model 8510 hand inserted document printer and model 8180 push tractor printer

Digi-Data Corp (Booth 3708): Synchronous tape drives featuring imbedded microprocessor controlled formatters in NRZI, PE, and NRZI/PE, and tape speeds through 75 in (191 cm)/s

NCC PRODUCT REVIEW

Digi-Log Systems, Inc (Booth 2141): 1M-byte TapeTrap programmable network fault storage unit, DLM II digital monitor for diagnosing data line problems, and multiple monitor CRT display system

Digital Computer Controls, Inc (Booth 2101): Model 1550 small business computer system with 64k-byte memory, 30-char/s Dasher printer, and 10M-byte disc, plus model 3700 with 128k-byte memory

Digitech Data Industries, Inc (Booth 307): Enhanced Pacer-103 data communications monitor and protocol analyzer with up to 7k bytes of P/ROM and increased check character computation

DOSC Inc (Booth 440): SVB-80 bit mapped, Intel Multibus compatible video graphics board; TCB-85 single-board microcomputer with resident floppy disc and CRT controllers; and MID-85 microprocessor board

Dranetz Engineering Laboratories, Inc (Booth 425): Model 606 power line disturbance analyzer, model 616 dc/ac voltage disturbance analyzer, and System 22 sequence of events recorder

Educational Data Systems (Booth 4120): Point 4 minicomputer with 16-bit instruction set, 0.4-μs instruction execution time, and 64k-word memory

Elgar Corp (Booth 3724): Model 453-3 45-kVA, 3ϕ uninterruptible power system with static bypass switch; and 1ϕ and 3ϕ high isolation transformers for eliminating line noise

Emergency Power Engineering Inc (Booth 3001): Self-contained centers for isolation, distribution, control, and monitoring of ac power to computer systems in 15- to 200-kVA sizes

Emerson Electric Co, Industrial Controls Div (Booth 1332): 415-Hz uninterruptible power system for computers that cannot operate from standard utility service

Epic Data Corp (Booth 3114): Source data entry terminals and control units

Epicom, Inc (Booth 4024): Epiview data line monitors, Epitape data line recorders, and Epiaid digital breakout/analog level test devices

Evans & Sutherland Computer Corp (Booth 4431): 3-D line drawing graphics display with high resolution shadow mask CRT that produces 449 color selections, including blue

Facit-Addo, Inc (Booth 1316): Model 4540 serial page printer with printhead that uses hammers instead of wires; and model 4030 optical, bidirectional tape reader that functions at up to 120 char/s

General Robotics Corp (Booth 4221): Computer systems including Polaris (MVT/X3) with LSI-11/2 CPU, 61k bytes of RAM, and triple-floppy disc drive; Gemini with dual drive; Tristar (FD/X3); and Pegasus (CD/X3)

Grundy Terminals Inc (Booth 4416 H): Data Eez 2000 interactive display terminal comprised of display panel, integral power supply, microprocessor control communications, and fiber optic pen

Honeywell Information Systems (Booth 4530): Page printing system that provides hardcopy at 90, 140, or 210 pages/min (8k, 12k, or 18k lines/min) with 132 char/line

Infoton Inc (Booth 1228): 80-char/line, 25-line CRT terminals: model 400 has 128-char ASCII set and 9 × 9 dot matrix format, and model 100 has 96-char ASCII plus 32-line drawing char set and 5 × 9 format

Integrated Computer Systems, Inc (Booth 68): Microprocessor courses and workshops involving industrial, military, and aerospace systems

Interdyne (Booth 2629): Intelligent buffered terminals with RS-232-C serial interface: model 3801 uses cassettes; model 3901 uses minifloppy drive

Interstate Electronics Corp (Booth 4038): Voice operated intelligent terminals with single-station 800-word vocabulary or 4 channels of 200 words each; plus line of flat glass panel plasma terminal displays

Kennedy Co (Booth 2300): Model 5300 fixed disc drives with 14M-, 42M-, or 70M-byte unformatted capacities, models 9100/9300 vacuum column 7- or 9-track tape transports, and model 631 cartridge transport

Licon Div of Illinois Tool Works (Booth 2618): Series 39 miniature lighted pushbutton switches for high density applications, and series 05 lighted pushbuttons for complicated, low level requirements

LorTec Power Systems, Inc (Booth 1611): 50-Hz uninterruptible power systems rated at 12.5, 25, and 50 kW plus 60-Hz units rated for 15, 30, 60, and 125 kW

The Maine Manufacturing Co (Booth 3000): Data-Mate line of universal and specialty terminal furniture

Maxell Corp of America (Booth 1612): Single-sided/single-density, double-sided/single-density, and double-sided/double-density soft and hard sector floppy discs; and digital magnetic tape cassettes

Megadata Corp (Booth 4624): Multitask WorkStation 2001 standalone small business computer and line of applications oriented Systems 700 and 750 programmable intelligent terminals

Megatek Corp (Booth 3319): Whizzard 7000 and 5000 vector refresh graphic systems (see pp 46, 51)

Micro Computer Devices Inc (Booth 107): S-100 bus interface to Radio Shack TRS-80 microcomputer, with sockets for up to 32k bytes of memory expansion, parallel printer port, and provisions for floppy disc

Microcomputer System Corp (Booth 4125): MSC-05 and -06 plug compatible replacements for DEC RP-04/05/06 disc drives, and laser scanner for UPC and EAN symbol reading

Micro Switch Div of Honeywell Inc (Booth 1623): Hall-effect keyboard module that reduces current consumption by 60% (see pp 51, 54)

Micro-Term Inc (Booth 320): Mime-I and -II computer terminals have switch selectable software compatibility with company's ACT-IVB, Lear Siegler ADM-3A, DEC VT52, and Hazeltine 1500 terminals

Monolithic Systems Corp (Booth 2631): DEC compatible add-in and add-on memories for LSI-11, PDP-11, and PDP-8 CPUs, and Multibus compatible single-board microcomputers, plus hardware and software products

Multiwire New York (Booth 353): High density circuit boards for a variety of electronic applications

MuPro, Inc (Booth 2700): Intel iSBC 85/12 and Multibus compatible error correcting memory boards in 16k-, 32k-, 48k-, and 64k-word configurations are strappable for 16-bit word or 8-bit byte transfers

Northern Telecom Systems Corp (Booth 3400): Sycor model 445 and 405 and Data 100 distributed data entry and processing systems plus Sycor model 290 system and Data 100 keybatch system

North Star Computers, Inc (Booth 333): PASCAL language for the company's Horizon computer and Micro Disk

System, plus 32k RAM board that doubles memory capacity of Horizon

Okidata Corp (Booth 3610): Desktop printer for small computer systems, series of Winchester type disc drives, Slimline series line printers, and 3300 series disc drives

Paradyne Corp (Booth 3436): Data communications system that allows users to build full-duplex SDLC networks, plus high speed digital modems and Analysis network monitoring system

Perkin-Elmer Computer Systems Div (Booth 2027): Model 3220 full 32-bit microprogrammed minicomputer with 8M-byte DMA bandwidth, 4 external priority interrupt levels, and memory expansion to 4M bytes

Perkin-Elmer Memory Products Div (Booth 2077): Tape drives with NRZI or PE recording modes, and front and top loading Super series cartridge disc drives with 25M- to 200M-bit capacities

PerSci, Inc (Booth 4030): Double-density, dual-diskette drive with improved dual-head mechanism and microprocessor control (see pp 292, 294)

Plessey Microsystems (Booth 4416 D): Commercial and military versions of Miproc microcomputer with digital and analog interfaces and software development tools

Practical Automation, Inc (Booth 3704): DMTP-3 miniature alphanumeric impact matrix printer, -6 matrix tape printer, -6μP printer with integrated microprocessor controller, -8 forms printer. and -9 ticket printer

Processor Technology Corp (Booth 4048): Sol[R] small computer systems and business software packages; Helios II disc memory system; 16k, 32k, 48k, and 64k RAM boards; and WordWizard electronic typing system

Raymond Industries Inc (Booth 3212): Raycorder dual cassette terminal designed around a Motorola 6800 microprocessor and two cassette drives will read, write, or copy data in ANSI X3.48-1977/ECMA34 format

RDA, Inc (Booth 523): Enhanced version of LSI-11 based RD-11C microcomputer with up to 64k bytes of RAM (256k with LSI-11/23) and microfloppy disc subsystem providing over 700k bytes of online storage

Remex Div of Ex-Cell-O Corp (Booth 4057): Data Warehouse mass memory system, for microcomputer and small to medium minicomputer systems, incorporates Winchester fixed disc drive with two flexible disc drives

Rusco Electronic Systems (Booth 431): Card based management control identification network system with typical configuration of controller, reader/terminals, and output device

Sanders Technology, Inc (Booth 607): Media 12/7 strike-on printer constructs image from large number of ink dots; can create char sets of any language and can store 32 typefaces in internal ROM

Shugart Associates (Booth 1200): 14.5M- and 29M-byte unformatted capacity Winchester technology rigid disc drives with optional 144k bytes of additional head/track storage

Simplexity Software Systems, Inc (Booth 38): Software for Radio Shack TRS-80, Exidy Sorcerer, Commodore Pet, and Apple II microcomputers with programs for small business and educational uses

Sola Electric (Booth 3035): Uninterruptible power systems, microcomputer and minicomputer regulators, and constant voltage transformers

Sperry Univac (Booth 2408): V77-800 minicomputer, BC7-800 small business computer, and UTS-400 intelligent terminal

Tab Products Co (Booth 3601): System 700 key to diskette products with diskette to tape converter: 701 is single station/single drive; 702 is dual station/dual drive

Techtran Industries, Inc (Booth 3222): Line of buffered storage communications terminals including floppy discs and digital tape cassettes

Texas Instruments, Inc (Booth 2220): Silent 700 thermal printer, Omni 800 family impact printers, DS 990 commercial computer systems, and series 700 distributed processing systems

Thinker Toys (Booth 98): Dual-density floppy disc systems and other peripherals

Ultra-Violet Products, Inc (Booth 520): Memorase[R] C-90 EPROM erasing system features 7-min erasure of up to 600 chips in 1-step operation

Verbatim Corp (Booth 4606): Optima series storage products including 5M-byte diskette, personal computer cassette, and mini cartridge □

ROLM's Mil-Spec ECLIPSE® Data System... for operations on the move

Military operations at rugged, remote sites demand a reliable data system that provides answers to vital questions... with no waiting.

That's why ROLM developed the Mil-Spec ECLIPSE System incorporating Data General's ECLIPSE architecture and powerful software. The key feature is Data General's ADVANCED OPERATING SYSTEM (AOS), a modern multiprogramming operating system that simultaneously controls the three most common computer actions—real time, timesharing and multiple batch job streams.

ROLM's Mil-Spec ECLIPSE Computer has a state-of-the-art microprogrammed architecture, main memory capacity to 2 megabytes and a comprehensive instruction set tailored to data handling. The software support is impressive. FORTRAN 5. PL/1. DG/L™. COBOL. INFOS®. It's the first on-site system with the capability for sophisticated file management operations.

The Mil-Spec ECLIPSE System supports a variety of Mil-Spec and commercial peripheral devices and system interfaces, allowing you to tailor a system to match a field application... with no restriction to future expansion.

If you're designing a military system requiring a powerful data system with extensive operating software that's built to be on the move, investigate our Mil-Spec ECLIPSE System. It won't keep you waiting.

That's Why We're #1 in Mil-Spec Computer Systems

ROLM MIL-SPEC Computers

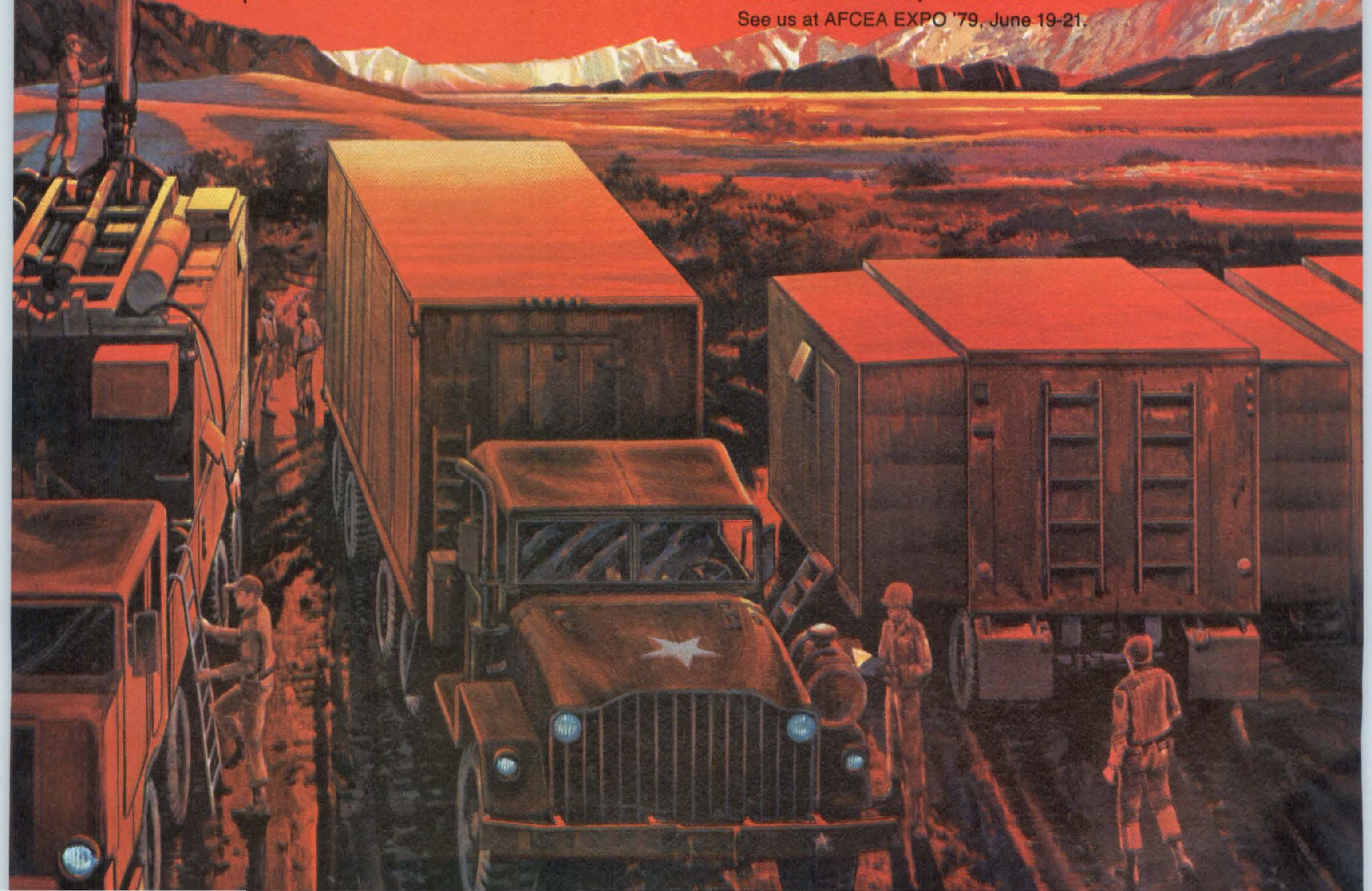
4900 Old Ironsides Drive, Santa Clara, CA 95050.
(408) 988-2900. TWX 910-338-7350.

In Europe: Muehlstrasse 19D-6450, Hanau, Germany, 6181 15011, TWX 4-184-170.

ECLIPSE and INFOS are registered trademarks of Data General Corporation.

CIRCLE 109 ON INQUIRY CARD

See us at AFCEA EXPO '79, June 19-21.



We've Earned Our Stripes

With The Only Plug Compatible Microprocessor I/O System In The Industry

Opto 22 combines the latest and best in I/O modules with plug compatibility to single board computers. Opto 22 I/O Systems are available in plug compatible racks holding eight, sixteen or twenty-four modules. These highest quality Input/output modules are available for 5, 15, or 24-volt logic—all employing 2500 volts RMS photo-isolation.

Simplified installation and maintenance are important features of the systems. Barrier-type screw terminals, LED status lights, pull-up resistors and plug-in fuses are mounted on the racks. Changes and replacements are easily made without removing wires.

Because we concentrate solely on photo-isolated SSR's, you get quality, reliability and innovation at the best prices.

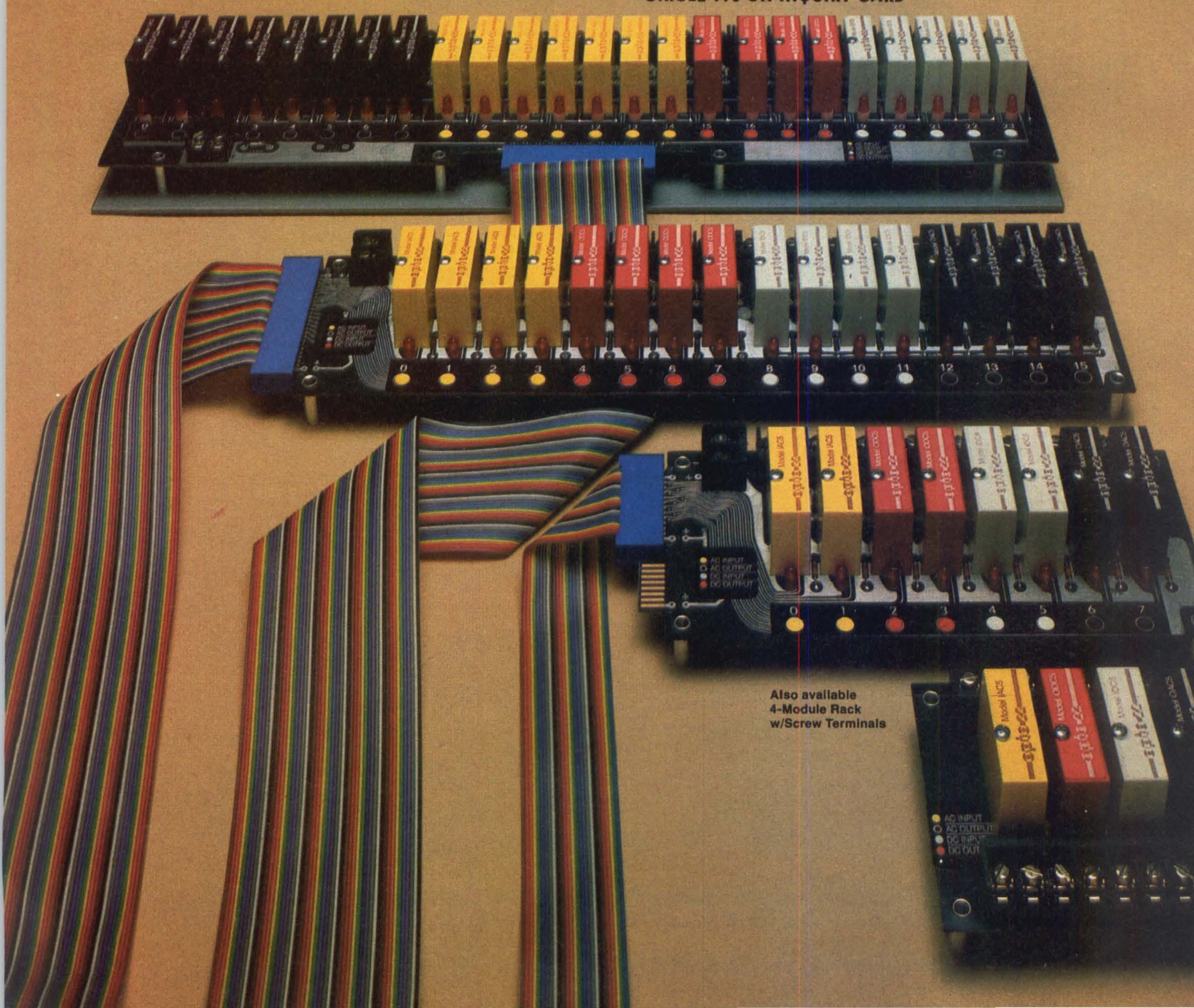
Plug compatability with:

- ☐ Intel
- ☐ Motorola
- ☐ Burr-Brown
- ☐ Computer Automation
- ☐ Control Logic
- ☐ Data General
- ☐ Digital Equipment Corporation
- ☐ General Automation
- ☐ Iasis
- ☐ Mostek
- ☐ National
- ☐ Texas Instrument
- ☐ Western Digital
- ☐ Zilog

opto 22

5842 Research Drive, Huntington Beach, CA 92649, (714) 892-3313

CIRCLE 110 ON INQUIRY CARD



Also available 4-Module Rack w/Screw Terminals

STANDARD MODULES OFFER FLEXIBLE MULTIPROCESSOR SYSTEM DESIGN

Configuration of a variety of simple to complex systems, including closely coupled multiprocessors and loosely coupled networks is simplified by use of standard hardware modules which communicate over an asynchronous bus

Alan D. Hirschman and Gamil Ali Compunetics, Incorporated, Monroeville, Pennsylvania
Richard Swan Carnegie-Mellon University, Pittsburgh, Pennsylvania

Designers have recognized that the microcomputer's attractiveness as a low cost source of processing power is often outweighed by its low speed and limited addressing capability. For complex applications that have some inherent parallel structure, however, a distributed system of microprocessors can result in exceptionally effective design solutions which circumvent these limitations. There is debate over the best implementation of distributed microprocessor systems since almost all designs implemented to date are highly application dependent. Some applications, for example, favor loosely coupled networks in which independent processors send and receive limited commands or data from a central processor, usually over long distance, low bandwidth channels. Memory sharing is neither essential nor practical in such systems. Distributed systems of this type, which generally incorporate several microprocessors as satellite controllers for a central processor, have been used commercially. Other systems require much closer coupling among processors in which interprocessor communication takes place over one or more high bandwidth channels to shared memory, usually without the aid of a central controller. This configuration characterizes a true multiprocessor as opposed to a network.[1]

A structural approach to multimicroprocessor system design uses computer modules based on the Texas Instruments TMS 9900 microprocessor as building blocks to configure systems ranging from limited standalone controllers, through loosely coupled networks, to closely coupled multiprocessors with up to 128M words of memory shareable among all processors. Modularity and expandability, the primary goals in the hardware design, are ultimately aimed at drastic reductions in design time and cost for customized systems of varying degrees of complexity.

An application in which five processor modules are put to work in a closely coupled multimicroprocessor to perform a realtime communications and control task uses four microprocessors, each servicing an independent synchronous communication channel that receives and transmits data over full-duplex serial lines at 4800 baud. The four microprocessors format data, check for errors, and initiate certain control functions. Communication among processors is done largely through memory sharing. A fifth microprocessor receives data from the other four microprocessors, maintains a direct memory access (DMA) channel to and from an external computer, and provides an asynchronous interface for operator monitoring and intervention through a front panel and a terminal. While this particular application could have been performed by one fast minicomputer with realtime multitasking capability, the modular multimicroprocessor approach results in considerable cost reduction and software simplification. Although the microprocessor is a relatively slow device, the parallelism obtained in closely coupled multiprocessors greatly enhances system speed and throughput. In addition, future expansion of the system is accomplished easily by adding more microprocessors, and without significant increase in overall cost.

Another attractive capability of the multimicroprocessor approach over the single multitasking minicomputer is the potential for increased system reliability. Reliability can be increased by allowing more than one microprocessor to perform the same critical tasks in parallel.[2] The increased hardware redundancy is not cost-prohibitive because processor modules are relatively inexpensive. In this application, reliability is achieved by having a duplicate multiprocessor system ready to take over if the online system fails or must be shut down for maintenance.

System Capabilities

Several capabilities that are highly desirable in a multimicroprocessor architecture are implemented in the microprocessor based modules. Fundamental to the design of a closely coupled multiprocessor system is the ability of all processors to share portions of physical memory. The design allows a processor access to a local physical memory that while reserved primarily for its own use may also be shared among other processors. (This use of shared local memory is similar to the structure used in CM*, a multiprocessor developed at Carnegie-Mellon University.[3]) Arbitration logic resolves competition for use of each processor's memory bus. The principle of "circuit switching," whereby a direct signal path is established between a source processor and a destination memory, is used instead of the "packet switching" technique in which data can be held at convenient nodes in the system while segments of the data path are established.[4] Although packet switching makes more efficient use of system resources, such as the interprocessor bus, the circuit switched design simplifies the hardware structure.

A memory map facility expands shareable address space from 32k to 128M words. Each processor requiring access to a large shared memory space has a map module. The map is implemented as a fast 16-word register which can be loaded under program control to translate a 2k page anywhere within the 128M-word shareable address space. (Note that total system address space, which includes private as well as shareable memory, can be considerab'y larger than 128M words and is, in fact, proportional to the number of processors in the system.)

Processors are linked together by a single interprocessor bus (IBUS) which carries address, data, and control lines. The use of a single bus shared by more than one processor places some constraints on the designer. The most important constraint requires that most of a processor's memory references should be to its local memory and that use of the IBUS should be minimized. Requests for IBUS are initiated by the need to access shared physical memory that is associated with another processor.

Contention for the IBUS is resolved by an asynchronous rotating priority technique. In this method, processors are organized in a closed ring, and bus control passes around the ring in one direction. The processor currently in control of the IBUS must wait until all other intervening requests have been serviced before it can gain control again. By giving all members of the system an equal chance to control the IBUS, this technique prevents "starvation" of low priority processors, which would otherwise occur in a fixed priority scheme. Also, unlike synchronous bus arbitration schemes, which allow a processor to access the IBUS only during a specific time slice, the asynchronous system ensures that the processor currently controlling the IBUS immediately conditions the logic for transfer of bus control to another requesting processor. Control is actually transferred when the current IBUS transaction is completed.

Additional hardware implements a lock function and a powerful method for initiating interprocessor control functions. A lock signal prevents simultaneous access by two or more processors to certain critical data structures in shared memory, such as stacks or queues. The hardware provides an indivisible test-and-set instruction which sets or resets the lock. Interprocessor hardware interrupts are initiated by writing into specific addresses in the physical memory associated with the destination processor. In the same way, certain control functions can be initiated so that a source processor can force the destination processor to go through an initialization sequence or to relinquish control of its address and data buses. The latter function is useful as a hardware diagnostic.

Basic Computer Modules

Fundamental building blocks for the modular system are the TMS 9900 16-bit microprocessor and a 2k memory, which may consist of some combination of random access and programmable read-only memory (2114 RAM and 93453 P/ROM) (or their equivalents, respectively). The microprocessor architecture lends itself to the realtime processing environment. Transfer of program control between realtime tasks (context switching) is done efficiently by maintaining most of the machine's working registers in memory. When a context switch is made, only three additional registers need to be stored to preserve machine state.[5] The basic processor/memory module can be expanded by adding more memory [2708 or 2716 electrically programmable read-only memory (EPROM)], synchronous and asynchronous communications controllers (TMS 9903 and TMS 9902), and 4-channel DMA controllers (Intel 8257 or TMS 9911). Each of these functional modules (Fig 1) is physically implemented on a 4.5 x 5″ (11.4 x 12.7-cm) double-sided printed circuit (PC) board, which is tied into the system through a wire-wrapped backplane. Address, data, and control lines

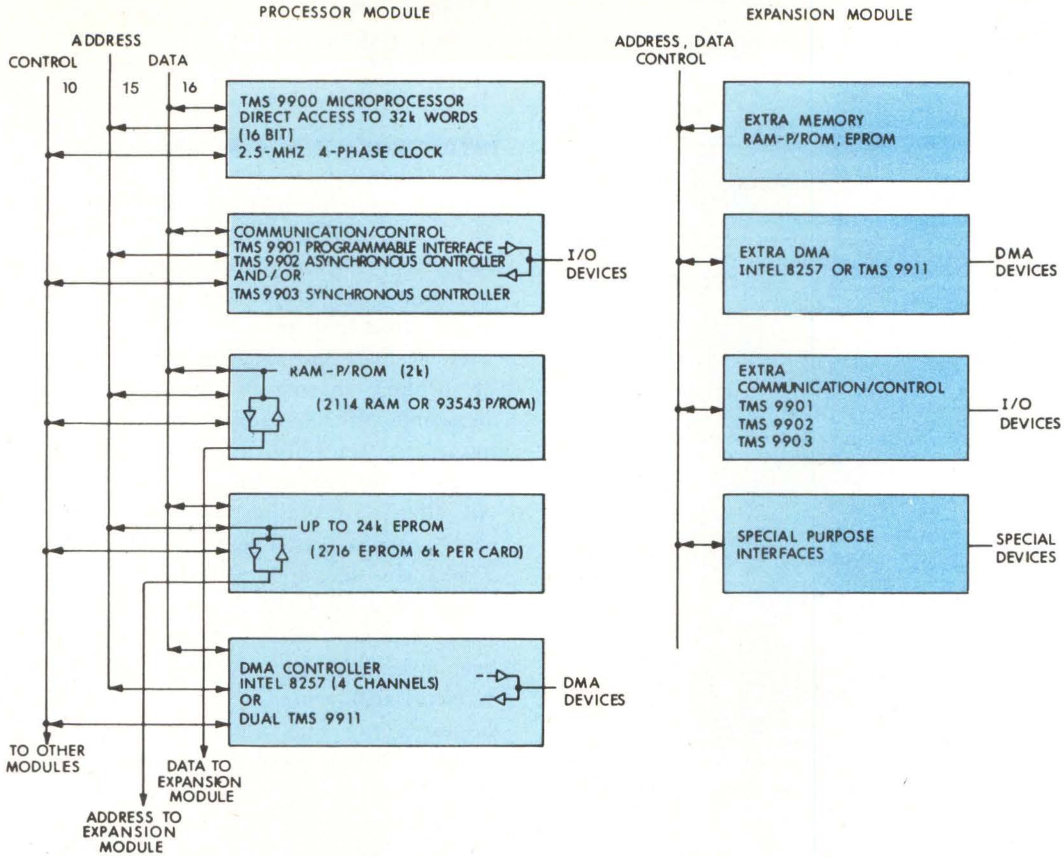


Fig 1 Basic modular system. Simplest system consists of two modules implemented on double-sided PC boards. First module contains microprocessor and support circuitry; second module contains up to 2k of 16-bit RAM and/or EPROM. Programmable I/O interfaces, DMA controller, and additional memory (maximum 32k) expand system capability. Address and data lines are buffered for expansion module which supports more memory, control, or special device interfaces

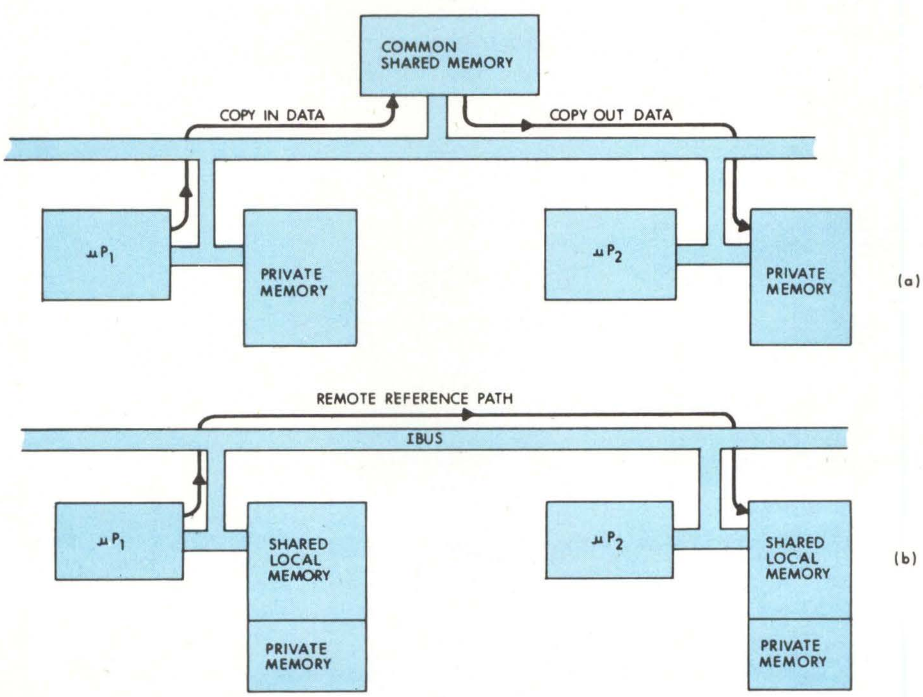


Fig 2 Memory sharing methods. Independent processors transfer data through common or shared memory (a) in some systems. Allowing a processor direct access to shared memory local to any other processor, system (b) requires one access to interprocessor bus (IBUS), while system (a) requires one bus access to transfer into common memory and second access to transfer out to destination processor

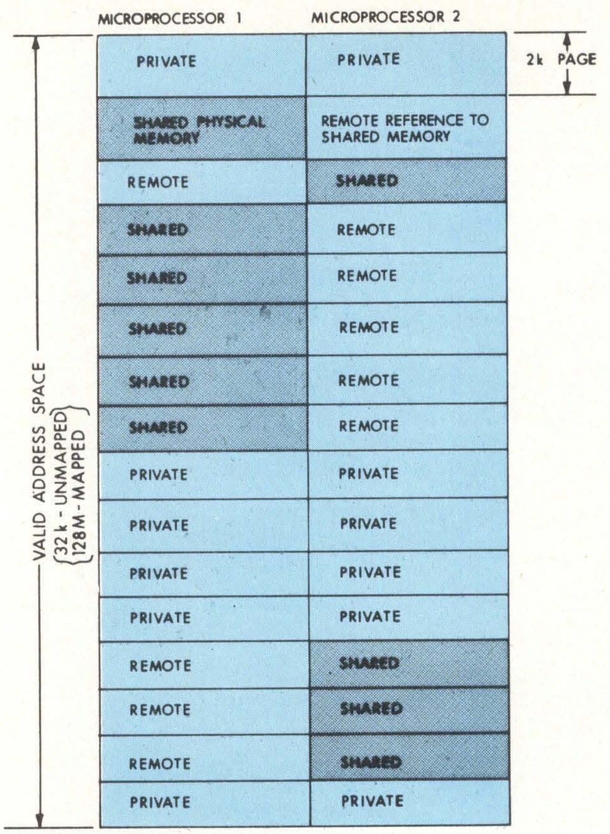


Fig 3 Multiprocessor address space assignments. Address space can be apportioned in multiprocessor system. Some memory references are to private memory accessible only to processor making reference. Remote references can be made via IBUS to shared memory, which physically resides in another processor module. Shared pages of memory are accessible to all processors in orderly manner determined by arbitration hardware. Unmapped systems can share up to 32k of memory; mapping expands this to 128M words. Total system memory including shared and private is proportional to number of processors

are buffered so that additional memory, communications controllers, DMA channels, and other specially designed interfaces can be added to the system in a modular fashion.

Interprocessor Communication

In many applications it is necessary that more than one processor have rapid access to data or executable code anywhere in the system. Closely coupled multiprocessors, which require much more rapid access to information than most networks, need to share memory over at least one high capacity channel. One method of memory sharing provides a common area which is accessible to all processors [Fig 2(a)]. Arbitration hardware, centrally located at the common memory, controls the use of the common system memory bus.[6] An alternative design associates shared memory with each processor module in a decentralized fashion [Fig 2(b)]. In this system, hardware associated with each processor module determines which regions of its memory space are shared, which are private, and which are accessible by reference to another processor's physical memory. The latter design is preferred, first, because only one access to the IBUS is required to transfer a data word to or from shared memory and, second, because its symmetry makes highly modular hardware possible.

Fig 3 illustrates how the address space of two processors can be apportioned. Some areas of physical memory are private, that is, accessible only by one processor module; shared memory is physically associated with one processor but is accessible to all modules; and remote memory is accessed by transfer over the IBUS to shared physical memory in another module. Since system performance is limited by the bandwidth of the single IBUS, the design is most effective if each processor makes reference primarily to its local memory and uses shared memory in other modules sparingly.

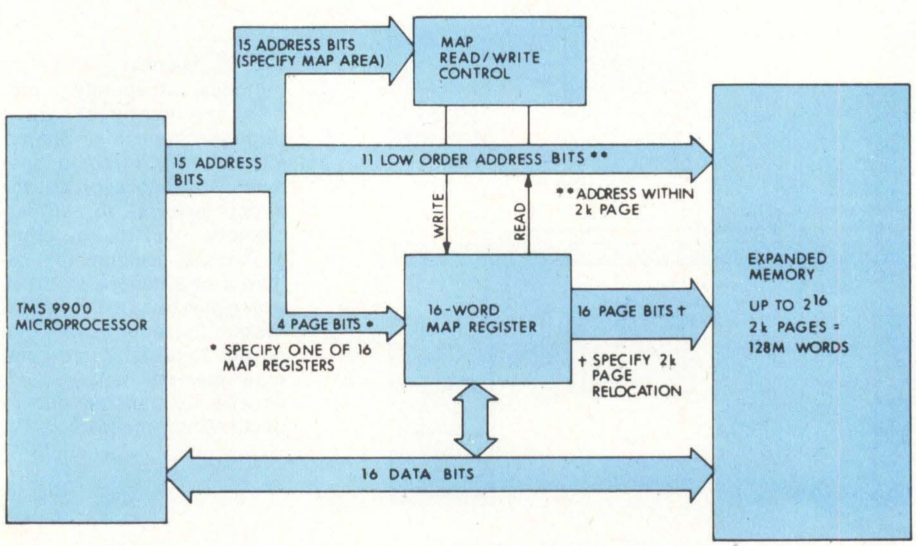


Fig 4 Memory map module. Hardware map can translate any 2k page from 32k address space into page in 128M-word space. Map is implemented as 16 registers which can be read or written under program control

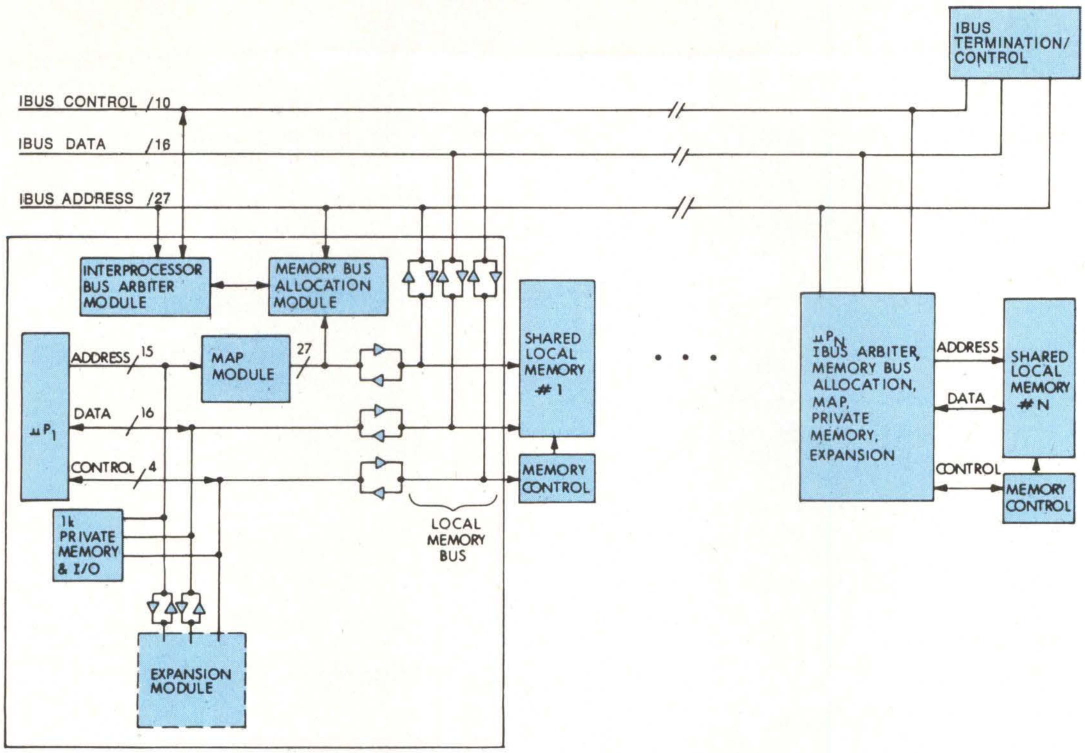


Fig 5 Modular multiprocessor architecture. Address, data, and control signals are carried over single interprocessor bus; access to bus is controlled by asynchronous rotating priority technique. IBUS arbitration and memory bus allocation modules control access to each processor's shared memory. Bus termination/control module asserts control of IBUS at power up and monitors bus activity

In this system design, 32k 16-bit words of memory are shareable, although the addition of private memory in each module implies that total system memory is proportional to the number of modules. To obtain a much larger memory space, a memory map module that is capable of translating any 2k page of memory into a 128M-word address space (Fig 4) is implemented on a single printed circuit (PC) card. Four page bits are used to address a 16-word register which appends 16 page bits to the processor's 11 low order address bits. During system initialization, each processor loads the map registers from a private 1k ROM; any time afterward, the map can be loaded under program control. The map can also be read by its associated processor for diagnostic purposes.

Modular Multimicroprocessor Architecture

Basic computer modules can be easily linked together to form a multimicroprocessor (Fig 5). Address, data, and control signals are carried over the single IBUS. A path to the local memory bus is established by a memory bus allocation module. This module's task is to determine upon every clock cycle whether the local processor or an external processor has access to shared local memory. Address, data, and control transceivers are normally disabled until a decision is made to allow a local or an external memory reference, after which the appropriate signal path is enabled. Remote references to physical memory in another module initiate action by the interprocessor bus arbiter module. If there is no activity on the IBUS, the processor module requesting a remote reference receives bus mastership. Only then is a path enabled foı data, address, and control from the local memory bus to the IBUS. The destination processor sees the memory cycle carried on the IBUS as an external memory reference, then completes its current local memory cycle, if any, and establishes a path to the local memory bus for the source processor.

These arbitration procedures eliminate the possibility of a deadlock, which occurs when two or more processor modules simultaneously allocate a single resource for themselves, effectively blocking the system. Consider the case in which module A makes a remote reference to local memory in module B and gains control of the IBUS. Suppose that module B now decides to make a remote reference to local memory in A and also establishes a path to the IBUS. Neither memory reference will complete under these conditions

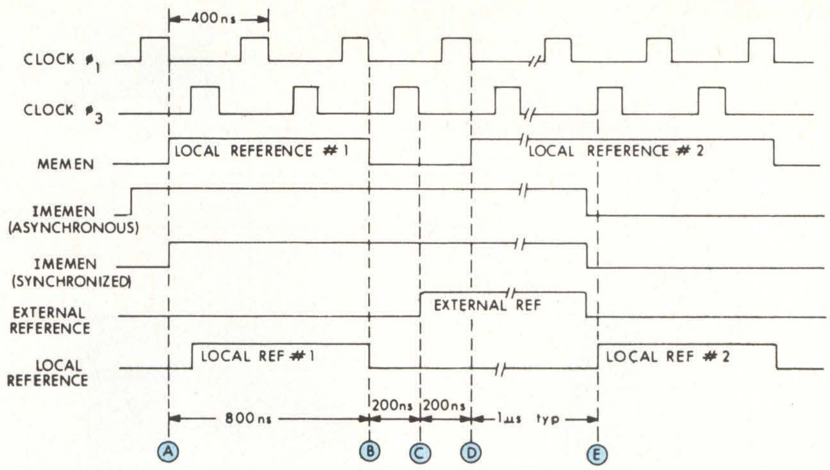


Fig 6 Local and external reference timing. (A) Source processor places IMEMEN on IBUS. Destination microprocessor (μP) starts local memory reference and synchronizes IMEMEM. (B) Local reference ends. (C) Destination μP allows path to local memory for source μP. (D) Destination μP starts new local memory reference but waits until external completes before gaining access to local memory bus. (E) External reference completes; local reference proceeds

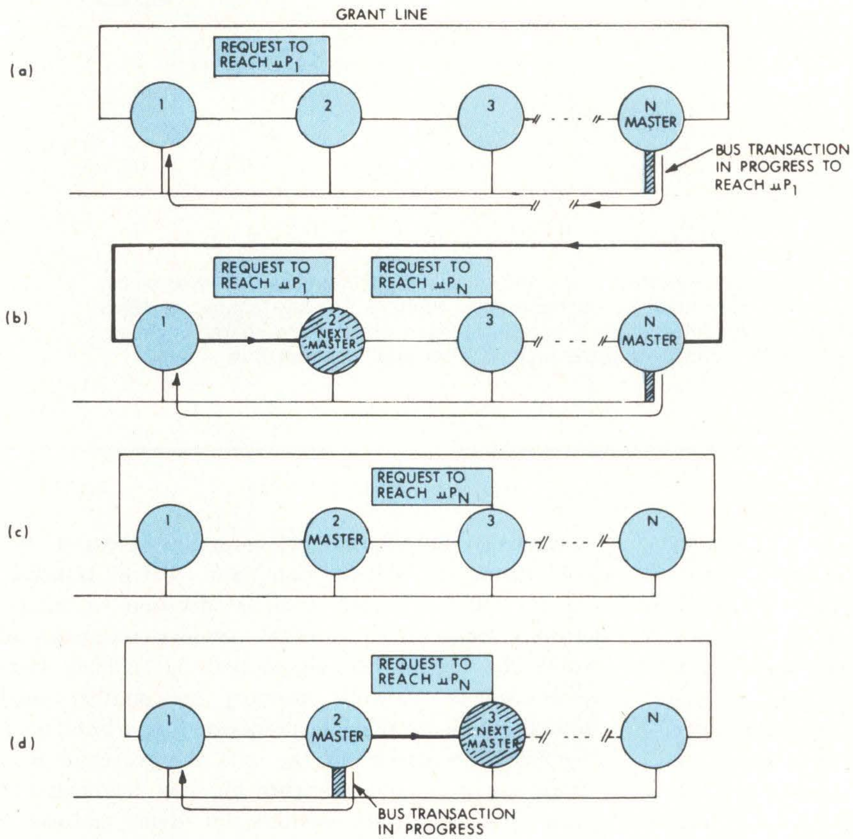


Fig 7 Interprocessor bus arbitration. Contention for interprocessor bus is resolved by rotating priority scheme. (a) Current master transfers data over IBUS while another processor sets request for bus usage; (b) Master immediately sends GRANT signal in response to request. First requesting processor in loop is established as next master. Processor 3 makes request but is blocked by next master from receiving GRANT. (c) Current master completes its bus transaction and mastership is transferred. (d) Requesting processor 3 receives GRANT from new master and is established as next master. Meanwhile, current master transfers data over IBUS

since deadlock will occur. The memory bus allocation module prevents deadlock during remote references by allowing a path from processor bus to IBUS only after IBUS mastership is obtained.

An important capability of this design is that memory control signals MEMEN (memory enable), WE (write enable), DBIN (data bus input/output), and READY (memory is ready) are carried over the IBUS between source and destination modules to control data flow to and from memory. The design also allows for the possibility of burst mode DMA transfers over the IBUS between devices and memories in different modules; in this case, memory bus allocation logic overrides the normal procedure that allows local memory cycles to resume after the external memory reference completes. In general, burst mode DMA over the IBUS is used infrequently because it blocks all other processors from the IBUS.

To achieve orderly allocation of the local memory bus, each processor uses its own system clock to synchronize local and external references. The timing diagram, Fig 6, illustrates how local memory is allocated when local and external references compete. An external processor has obtained mastership of the IBUS

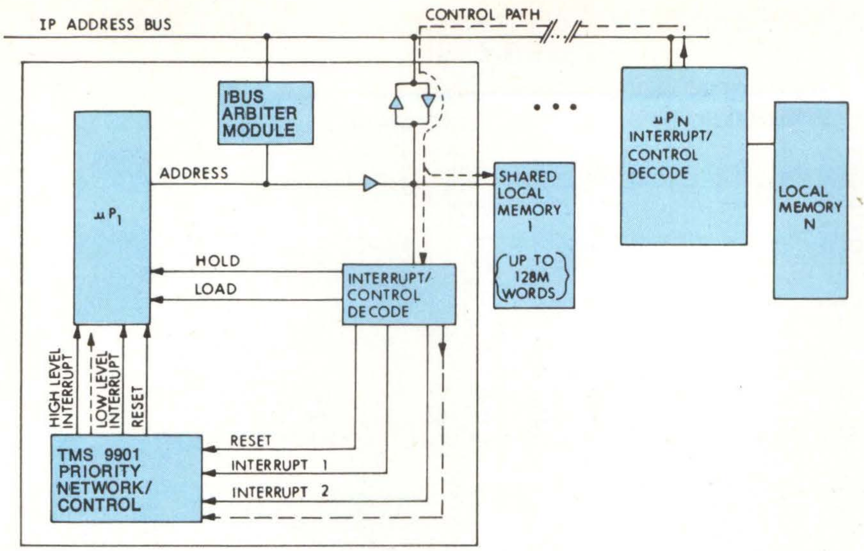


Fig 8 Processor control structure. Hardware uses address decoding to implement important control functions, allowing any processor to interrupt another on two priority levels by referencing unique address in destination processor's local memory. Address decoders then produce control signals to interrupt processor, force it through initialization sequence, or cause it to relinquish control of its address and data bus. Control path is enabled when μP_N interrupts μP_1 by writing into dedicated address in memory of μP_1

and seeks to obtain a path to the local memory by placing its MEMEN signal on the IBUS as IMEMEN. At the trailing edge of clock ϕ_1, a local memory reference begins (MEMEN active), and the external reference (IMEMEN active) is synchronized. At ϕ_3, the allocation logic allows the local reference to proceed. The external reference waits until the local reference completes. While the external reference proceeds, another local memory reference is attempted by the destination processor, but it must wait until the external reference completes.

Interprocessor Bus Arbitration

An asynchronous rotating priority scheme (Fig 7) arbitrates the use of the IBUS among contending processors seeking remote memory references. Processors are organized in a ring which is linked by a daisy-chained GRANT line. This structure is particularly suitable in multiprocessors without a centralized controller. The GRANT signal is passed around the ring from the current master to the processor with the earliest request. In the event of simultaneous requests, the processor physically closest to the current master will have its request latched and then will receive GRANT, thereby becoming the potential "next master." The GRANT signal passes directly through a processor which has no latched request, but goes no further than the "next master." When the current master relinquishes control of the IBUS, the next master immediately takes control. A processor can request use of the IBUS from itself if no other processor is actively requesting. The minimum time for transfer of mastership is dependent upon the greatest physical distance between two processors. In the present system, a minimum of 500 ns is required between a request for the IBUS and receipt of bus mastership.

At power up, a special module asserts initial bus mastership, although it is incapable of requesting the IBUS itself. The interprocessor termination/control module (Fig 5) provides resistor termination networks for the interprocessor bus, but it also monitors IBUS activity. If bus mastership is lost in the system due to noise or component failure in one or more processor modules, the interprocessor termination/control module asserts mastership after a switch-selectable timeout period and reinitializes the IBUS arbitration logic throughout the multiprocessor system. Without this capability, all IBUS activity could be blocked by a failure in one module.

Control Structure

System design makes use of the IBUS to transmit and receive control commands as well as data. As shown in Fig 8, by writing into a few user-specified remote memory locations, one processor can control the destination processor through hardware initiation of the following three actions:

Interrupt on two hardware priority levels—This process is useful for "handshaking" in which one processor must notify another that some action has been taken. The TMS 9901[7] on the communications controller module contains a network capable of prioritizing up to 16 hardware interrupt levels and generating 16 software programmable outputs that assert hardware interrupts or other controls. In an application where each processor must be able to interrupt any other, the number of direct hardwired connections will increase as the square of the number of processors. These connections are all eliminated, however, with the control structure shown.

Reset/load function—By the same method, the source processor causes the destination processor to go through one of two possible initialization sequences.

Hold function—Any processor can cause another to

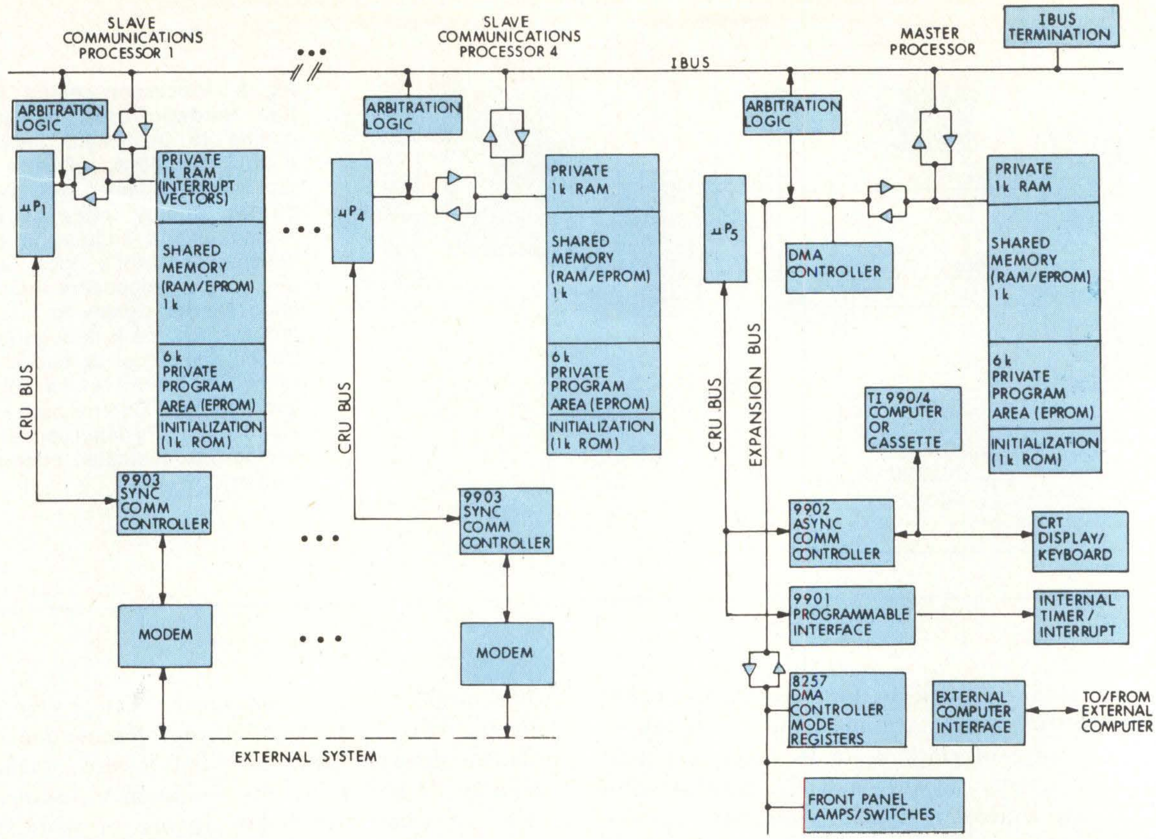


Fig 9 Multimicroprocessor application. In communications application data must be manipulated, formatted, and transferred to and from external computer and four independent full-duplex serial channels. Each of four slave communication microprocessors reformats data from serial channel and writes into shared memory of master microprocessor. Master sends data to external computer over DMA channel. Commands and data from external computer are written into shared memory of appropriate communications processor. Operator can inspect and modify activity anywhere in system through terminal maintained by master

relinquish control of its address, data, and control lines. The affected processor isolates itself from the remainder of the system by going into a high impedance state. Useful when a processor needs to suspend another in order to examine the suspended processor's local memory, this function is particularly valuable for obtaining "snapshots" of memory during program execution.

Multimicroprocessor Application

A complete communication system has been designed and built (Fig 9) based on the modular architecture described. The application is ideal for a multiprocessor system because of its highly parallel structure.

Hardware Structure

Four slave processor modules communicate independently with an external system through 4800-baud modems which are each interfaced through a TMS 9903 synchronous controller.[8] The controller transfers data to and from its associated processor over a special serial line called the CRU bus. Each slave communicates over the IBUS with a master microprocessor, which supervises activity of the slaves and provides a DMA channel to an external computer. The master uses shared memory in the slaves for two principal purposes: to write data from the external computer, which the slave then reformats and transmits to the modems; and to issue commands and data for use by diagnostic programs (memory and instruction tests) executed by each slave. Slaves, in turn, use shared memory in the master to write reformatted data received from the modems, as well as status words generated by slave diagnostic programs. Each slave operates primarily within its local memory; only 5 to 10% of all memory references require access to the IBUS. Total physical memory in this system (less than 32k) is partitioned among the five microprocessors. With the exception of the top and bottom 1k pages required for initialization of each processor, all memory is shared.

The master microprocessor maintains an asynchronous controller (the TMS 9902[9]) to load executable code from an FS 990 minicomputer on which all assembly level software is developed. Code that has been partially debugged on the disc based development system is loaded by the TMS 9902 over an EIA standard serial channel and distributed to RAM throughout the system for final checkout. Although fully debugged software resides on EPROMs in the operational multimicroprocessor, field changes to the software are necessary occasionally. Since the development system is unavailable in the field, a cassette tape unit is used to load programs into RAM, which is substituted for EPROM during software modification in the field.

A DMA controller based on the Intel 8257[10] is also maintained by the master microprocessor. The DMA controller services both an input and an output channel to an external processor. The 8257 controller transfers data only between shared local memory in the master microprocessor and the external computer's input/output channels; thus use of the IBUS for DMA transfers is avoided.

Software Structure

Modularity of the multiprocessor is reflected in the application software. Each communications slave microprocessor executes local code that is duplicated in each slave module. All slaves operate independently of one another but are allowed to receive and to issue commands, status words, and data during infrequent communication with the master. The beginning and end of important events are signaled by interprocessor interrupts. Master and slave microprocessors maintain very simple monitors which handle interrupts and take action upon receipt of status or command words. Processed data blocks from the slaves are queued by the master for transmission over a DMA channel to an external computer. In addition, the host maintains a debug monitor that runs concurrently with the real-time task. Through a terminal, an operator may examine activity anywhere in the system and intervene in the operation of any slave.

At system initialization, extensive checks are performed on system memory, instruction set, and integrity of the IBUS. A front panel alphanumeric display presents diagnostic information in the event of failure, permitting fault localization to the module level.

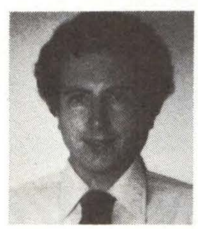
Summary

With system architecture that allows modular development of flexible designs from off-the-shelf PC cards, the multiprocessor system concept greatly extends the power of the individual microprocessor in those applications with inherent parallel structure. Principal benefits of this approach to system design are modularity, expandability, software simplification, and low cost. Circuit switched hardware provides functional capabilities that include memory in each processor that is accessible by any other processor in a system. Physical memory associated with a processor can be private (accessible only by the associated processor) or shareable by all processors in the system. The memory mapping facility expands shareable address space from 32k to 128M words. Total system memory, consisting of both shared and private areas, is proportional to the number of processors. Bus arbitration hardware uses an asynchronous rotating priority technique to allocate use of the interprocessor data, address, and control buses. Hardware achieves multilevel priority interrupts and other control functions among processors by decoding unique addresses on the interprocessor bus, eliminating the need for direct wire connections of interrupt and control lines.

One important limitation of this design approach is the use of the single interprocessor bus, which imposes constraints on the volume of communication traffic that can be supported. To prevent impaired system performance, each processor's executable code must have a high degree of "locality," requiring infrequent access to the interprocessor bus.

References

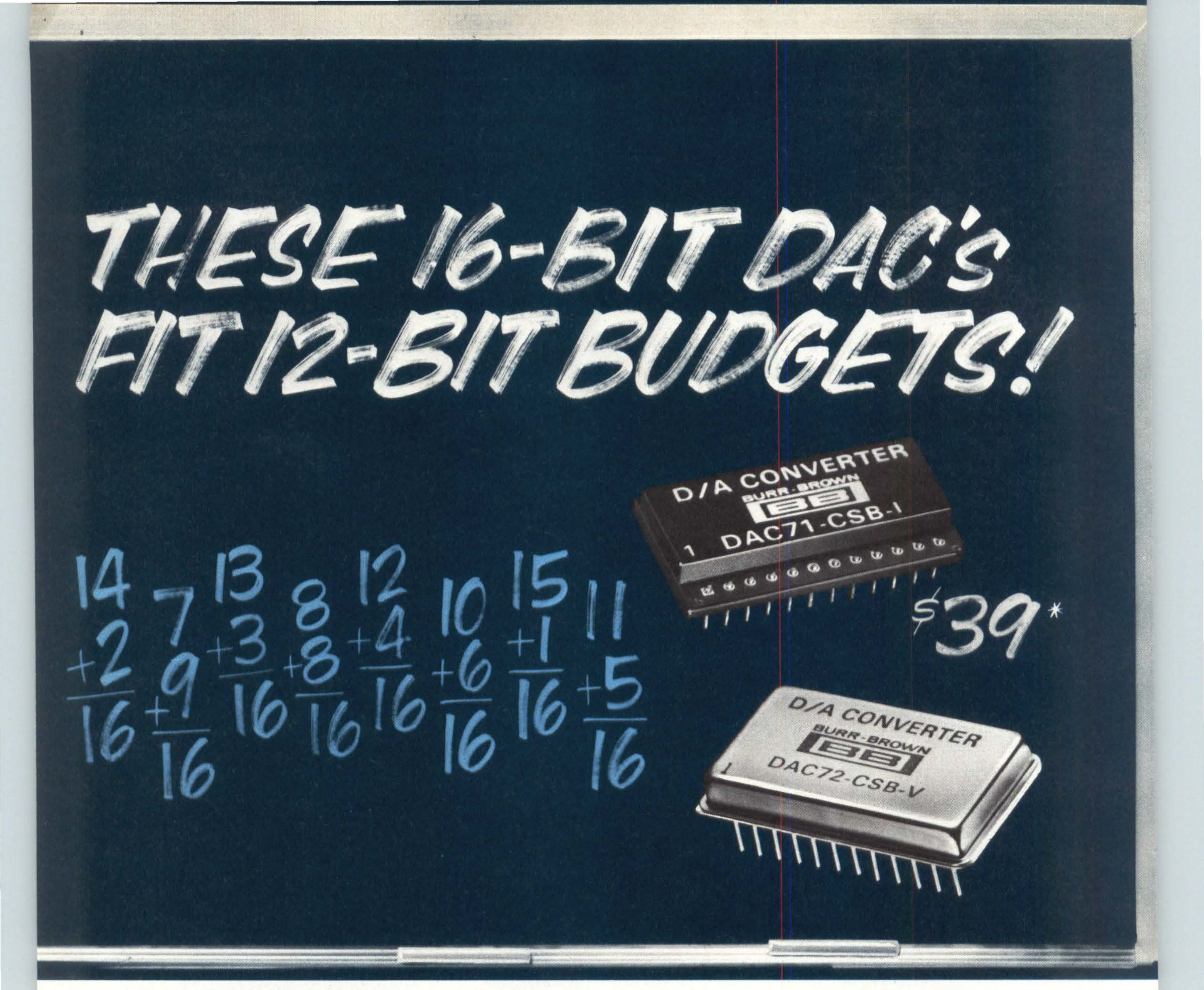
1. S. H. Fuller, *et al*, "Multi-Microprocessors: An Overview and Working Example," *Proceedings of the IEEE*, Feb 1978, pp 216-228
2. "Special Issue on Fault-Tolerant Digital Systems," *Proceedings of the IEEE*, Oct 1978
3. R. J. Swan, *et al*, "The Implementation of the CM* Multiprocessor"*AFIPS Conference Proceedings*, 1977, pp 645-655
4. "Special Issue on Packet Communication Networks," *Proceedings of the IEEE*, Nov 1978
5. *TMS 9900 Microprocessor Data Manual*, Texas Instruments, Inc Dallas, TX, 1976
6. G. Adams and T. Rolander, "Design Motivations for Multiple Processor Microcomputer Systems," *Computer Design*, Mar 1978, pp 81-89
7. *TMS 9901 Programmable Systems Interface Data Manual*, Texas Instruments, Inc, 1977
8. *TMS 9903 Synchronous Communications Controller Manual*, Texas Instruments, Inc, 1977
9. *TMS 9902 Asynchronous Communications Controller Manual*, Texas Instruments, Inc, 1977
10. *Intel Component Data Catalog*, Intel Corp, Santa Clara, Calif, 1978



Alan D. Hirschman received his undergraduate degree in physics from New York University and his PhD in electrical engineering from Carnegie-Mellon University where his research interest was in the area of optimal algorithms for waveform compression. He is presently employed by Compunetics where he is involved in research and development for multiprocessor systems.

Gamil M. Ali is a project manager at Compunetics. He holds a BSEE degree from the University of Cairo, Egypt and an MSEE degree from the University of Pittsburgh. He is a member of the IEEE.

Richard Swan holds a BS degree in computer science from the University of Essex, England, and has completed his PhD in computer science at Carnegie-Mellon University where he was principal designer of hardware implementation and architecture of CM. Currently holding the position of assistant professor at CMU, his research interests include parallel architectures, addressing structure design, hardware support for operating systems, and performance evaluation.*



*DAC71-CSB-I (100's)

...YOU ADD IT UP!

...linearity, ±0.003%; total accuracy drift, 15ppm/°C; settling time, <10μsec FS; complete with output amplifier and internal reference.

The sum of it all? DAC71/DAC72; compact IC's priced from $39.00.

With a highly effective price/performance balance and 16 times more resolution than 12-bit DAC's you gain significant system design flexibility. Eighteen models let you select from three codes (unipolar, bipolar, BCD)... voltage or current output...two temperature ranges (0 to +70° C or -25° C to +85° C)...and welded, hermetic metal or ceramic, 24-pin packages (1⅜" x ¾" x ¼").

In early 1975 we introduced DAC70, industry's first integrated circuit 16-bit DAC. Now, with fewer chips, an automatic laser trimmed single chip resistor network, and lots of experience, we've made 16-bit DAC's practical for demanding instrumentation applications where high performance at low price is specified.

Burr-Brown, P.O. Box 11400, Tucson, Arizona 85734.

BURR-BROWN

Putting Technology
To Work For You

AMSTERDAM, BOSTON, CHICAGO, LONDON, LOS ANGELES, NEW YORK, PARIS, SAN FRANCISCO, STUTTGART, TOKYO, TUCSON, ZURICH

CIRCLE 111 ON INQUIRY CARD

AN OVERVIEW OF MILITARY TACTICAL DISPLAY TERMINALS

Examination of an idealized modern military tactical display terminal and trends for the future are covered as well as objectives, applications, inputs, hardware, software, and display operation in a command and control environment

Edward W. Gennetten Naval Ocean Systems Center, San Diego, California

Basic functions of a tactical display terminal are to improve military decision making and to expedite human reaction time—key elements in a command and control environment. The increasing speed and sophistication of offensive weapons systems have substantially narrowed the time available to diagnose a threat and to take appropriate countermeasures. The military tactical display terminal must present complex data in a format that can be quickly, clearly, and correctly comprehended.

Fig 1 illustrates the general appearance of a model tactical display terminal. For purposes of perspective, a model of a simple command and control system configuration is shown in Fig 2, in which each system display terminal can be assigned a different mode of operation. For example, terminal 1 may be dedicated

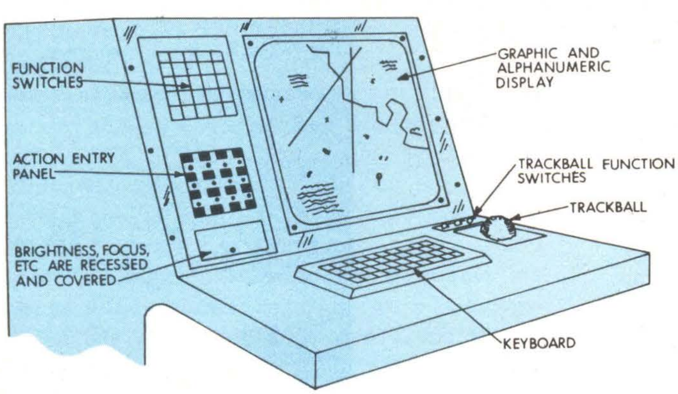


Fig 1 Representation of modern tactical display terminal. Display screen presentation contains alphanumerics and graphics depicting such imagery as coastlines, messages, and targets. Function switches, action entry panel, keyboard, and trackball provide operator with means to rapidly interact with display terminal software, to modify or manipulate display imagery

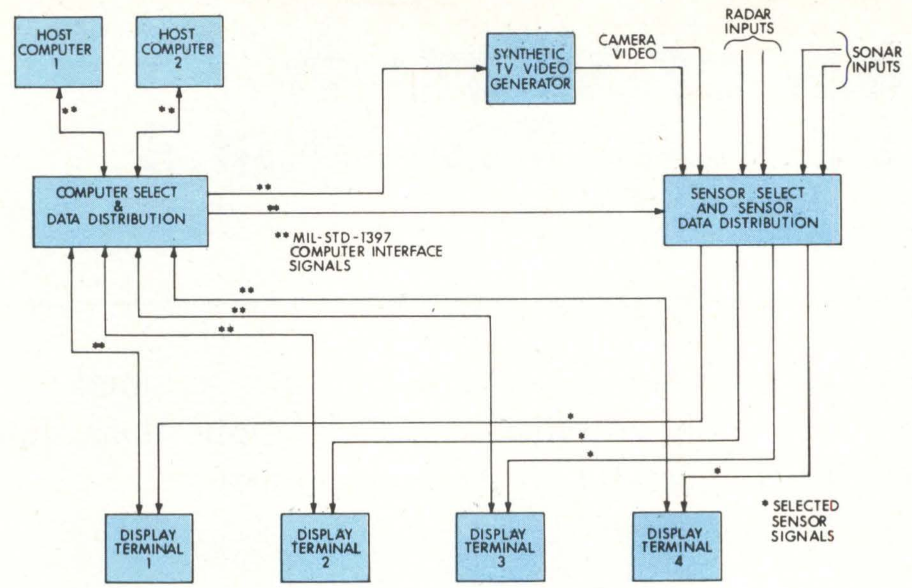


Fig 2 Simplified command and control display system. Connection of terminal to host computer is made in computer select and data distribution unit under software or manual control. Also, latter unit channels alphanumeric data into synthetic TV video generator and controls sensor select and sensor data distribution unit for choosing sensor data requested by terminal operator

to an air/surface tracker mode of operation, where the operator uses sensor returns (eg, radar), for tracking targets. Display terminal 2 may be dedicated to a target identification mode, where the operator analyzes input data and identifies target types. Display terminal 3 may be dedicated to an air intercept controller mode, where the operator dispatches and vectors friendly interceptor type aircraft toward unidentified targets. Display terminal 4 may be dedicated to a fire control coordinator mode, where the operator implements the selecting, loading, arming, and firing of a weapon.

Commonality between the system display terminals facilitates casualty backup procedures and system expansion, simplifies training programs, and reduces maintenance, acquisition, and other support costs. Significant differences in the system display terminals may reside only in software, but differences may also exist in hardware because of modular construction providing substitute capabilities. By interchanging read-only memories (ROMs), data entry devices, or computer and sensor interface modules, a display terminal can be adapted for different modes of operation within a single system display configuration. Currently, tactical systems predominantly utilize random scan cathode ray tube (CRT) displays.

Display Terminal Inputs and Outputs

Two primary sources of input information transformed into meaningful imagery by tactical display terminals are sensor data and computer data. Common examples of sensor data are radar, sonar, and television signals. Common examples of computer data are range, bearing, speed, and target course information.

To select sensor information (Fig 2), the display terminal operator initiates a request to a host computer for a sensor presentation. The host sends a switching message via the computer select and data distribution unit to the sensor select and sensor data distribution unit, which in turn couples the selected sensor signals to the requesting display terminal. Sensor inputs may be digital, analog, or a mixture of both.

Two-dimensional radar is a common sensor with inputs consisting of at least three component signals: video, main trigger, and azimuth. Radar video is usually analog, main trigger is a binary pulse, and azimuth is in one of three common formats: 5-wire synchro, azimuth change pulses (ACP)/azimuth reference pulse (ARP), and in recent systems a digital word of typically 12 bits. Three-dimensional or height finding radar has more complex video, trigger, and azimuth signals, as well as elevation signals.

Sonar signals, like radar signals, vary in complexity and nature from system to system. Typically, a set of sonar signals includes sonar video, bearing information in the form of ramp modulated sine and cosine functions, an unblanking signal, and a sound reference in the form of a sine wave with frequency variable over a small range.

Television video includes camera, video tape, and synthetically generated signals. In some systems, television video is redirected to an ancillary raster scan display mounted above the tactical display terminal for displaying alphanumeric messages relating to status information and alerts.

Computer data consist of serial and/or parallel words that usually range between 16 and 36 bits. There are four types of computer words in use. Two types, output data words and external function words, are employed to transmit information from the host computer to the display terminal. (The word "output" is referenced here with respect to the host computer and not to the display terminal to be consistent with the input/output (I/O) interface standard MIL-STD-1397[1].)

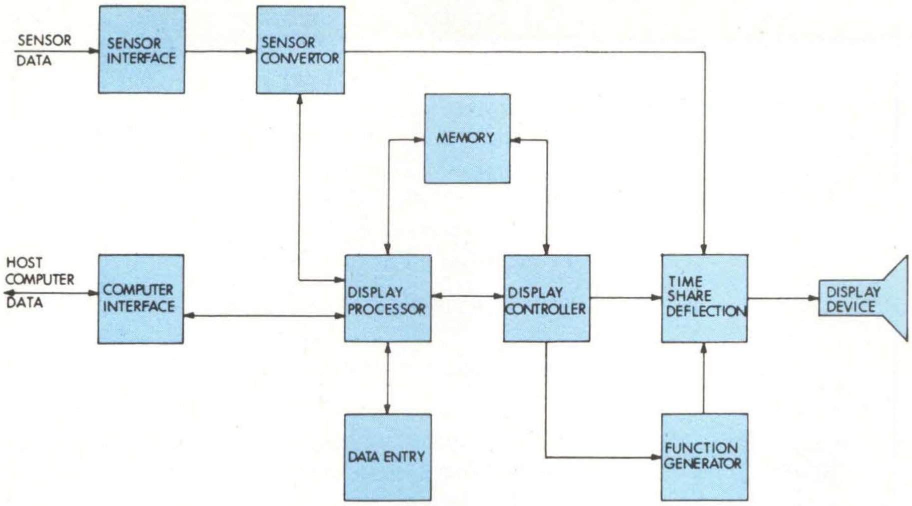


Fig 3 Tactical display terminal block diagram. From host computer, display processor receives display instructions and raw data, which are converted into display instructions by operational program. Display controller processes stored display instructions and couples results, less X, Y positions, to function generator. X, Y positions are coupled to deflection module and summed with function generator output. In turn, this result is time-shared with sensor information to produce composite display presentation

Output data words transmitted to the display terminal consist of instruction, data, and control words. Only instruction and data words are loaded into the display terminal memory, and a set of these is referred to as a message. Control words are not loaded into the display terminal memory, but perform functions such as determining which messages will be accepted by a certain display in a series of displays, perhaps where a certain message will be loaded in memory, and which legends will be illuminated on display control pushbuttons.

External function words from the host computer are used either to control or initiate the interrogation (polling) of a peripheral device. Control over a display terminal includes such actions as setting the refresh rate, selecting range scale, extinguishing a cursor, and enabling blocks of memory. Control over the computer select and data distribution unit includes requesting, forcing, and releasing control of various interconnections between computer and terminal.

Interrogation of a display terminal by the host computer involves gathering status information, such as the contents of selected registers, particularly those associated with data entry devices, eg, trackball registers. To start interrogation, an external function word alerts the display as to the nature of the request; the display terminal responds by transmitting status information back to the host computer, using input words, the third type of computer words. The fourth type of computer word, interrupt word, is also used to transmit status information from the display terminal to the host computer except that interrupt words are initiated within the terminal.

Display Terminal Architecture

A representative block diagram of a tactical display terminal is shown in Fig 3. In actual military displays the relationship between the blocks may be modified, and other blocks may be deleted or added.

Computer Interface

Host computer data enters the display terminal via the computer interface, which may contain one or more I/O ports. The most widely used computer interface employed in Navy tactical display terminals, as described in MIL-STD-1397, consists of four interface types:

(1) NTDS fast	parallel	−3 V	250k	words/s max
(2) NTDS slow	parallel	−15 V	40k	words/s max
(3) ANEW	parallel	3.5 V	250k	words/s max
(4) NTDS	serial	±3.5 V	10M	bits/s max

NTDS is an acronym for "Naval Tactical Display System," while ANEW is a designation. Voltage levels for logic 0 and 1 differ among these interfaces. Fig 4 illustrates input and output data lines and associated handshaking signals for the first three interface types. Before transfer from the host computer to the display terminal, a message and associated control words define a buffer within the host computer memory. The sequence of events occurring in the transfer of buffer contents to display terminal is given below for the output channel [Fig 4(a)]:

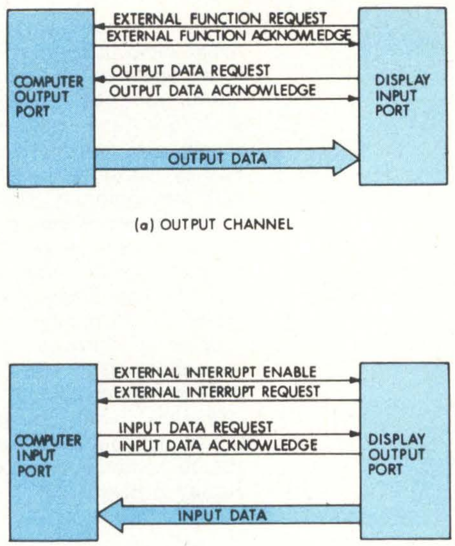
(1) Program control in host computer initiates output buffer for a given channel.

(2) Display terminal sets output data request signal when it is ready to accept data.

(3) Host computer detects an output data request signal.

(4) At convenience of host computer, first output word in buffer is placed on output data lines.

(5) Host computer sets output data acknowledge line, indicating that output word is ready for sampling.



(a) OUTPUT CHANNEL

(b) INPUT CHANNEL

Fig 4 Computer to peripheral interface signals. MIL-STD-1397 computer to peripheral parallel interface is in wide use in Navy equipment. This standard specifies three categories of equipment interface: computer to peripheral, computer to computer, and peripheral to peripheral

(6) Display terminal detects output data acknowledge.

(7) Display terminal may clear output data request at any time after detecting output data acknowledge signal.

(8) Display terminal samples data on output data lines.

(9) Host computer clears output data acknowledge signal.

All the steps in this sequence, except the first, are repeated for every output word until the number of words specified in the output buffer have been transferred. The host computer has the option of forcing any output word from the output buffer regardless of the state of the output data request line. A description of the sequence of events for transfers of an external function word buffer parallels the above description for the output word buffer.

Transfer of an input buffer or interrupt word over the input channel [Fig 4(b)] also follows a similar sequence except that the input data flow is from display terminal to host computer. The input data acknowledge line is common to both input transfer operations. The external interrupt enable line permits the display terminal to transmit interrupt words. In general, the host computer is the controlling device or master, while the display terminal is the controlled device or slave. The external function request and external interrupt enable lines are not available on all Navy systems.

The serial computer interface consists of one coaxial cable for an input, and one for an output channel. Serial transfers are accomplished by using two types of pulse trains. The first, called a control frame, consists of three bits—a sync bit followed by two control or handshaking bits (request and acknowledge type information). The second pulse train consists of 2 + n bits—a sync bit followed by a word identifier bit and, then, n information bits. The transmitting device sets the identifier bit as follows:

Display terminal:	0	input word
	1	external interrupt word
Host computer:	0	output word
	1	external function word

After the incoming computer data has crossed the interface boundary, it is level shifted and subjected to interface processing, which generally includes error detection, retiming, and distribution.

Display Terminal Processing

Instruction and data words transferred from the host computer are stored in the display terminal memory (Fig 3). Memory size in modern tactical display terminals ranges from 65k to 130k bytes. These large memories allow greater amounts of software resident in the display terminals, increase the processing capabilities of the terminals, and reduce the load on host computers.

Display terminal memory contains data words and two types of instruction words. The first type of instruction words consists of macroinstructions such as ADD, JUMP, SHIFT, and COMPARE. These instructions make up resident programs such as loader, debug, diagnostic, and operational programs. The data words contain information such as a missile's velocity and altitude, and are used by the operational program. This program generates a second type of instruction word called a display instruction. Display instructions determine the nature of the display imagery, which consists of alphanumeric and graphic data. Representative display instructions in terms of simple labels are TEXT, VECTOR, CIRCLE, and ELLIPSE. A set of display instructions is commonly referred to as a display file, or list, and is modified frequently in an operational environment. Operational programs in both host computers and display terminals process input information to create the display file.

The display processor (Fig 3) handles conventional processing operations such as those dictated by the operational program, eg, creating display instructions. This processor employs a bit slice bipolar microprocessor configured to give a 16- to 36-bit machine with a nominal instruction execution time of around 1 μs. Microinstructions stored in partially filled ROMs define the aforementioned macroinstructions and offer the capability to input additional macroinstructions.

The display controller (Fig 3) retrieves display instructions from the display file in a sequential manner, processes them, and couples the resulting data to the function generator, which generates the display imagery. This controller may be implemented with a microprocessor or microcontroller having general purpose working registers and an arithmetic logic unit. The controller may retrieve a subset of conventional instructions, such as JUMP, CONDITIONAL BRANCH, WAIT, and SUBROUTINE CALL, which increase the capability of the display in certain applications. In any case, the number of these instructions in a display file is limited, relative to the display instructions used by the display controller.

Periodic retrieval of the display file by the display controller involves display refreshing. If the refresh frequency is too low, the imagery will flicker. If the refresh frequency is programmable, the time duration per picture frame may range from 15 to 250 ms. Minimum refresh frequency to avoid flicker depends on phosphor persistence, ambient light level, electron beam intensity, writing rate(s), size of display file, and amount of timesharing with realtime sensor data.

Processing by the display controller includes manipulation and modification of the display file to increase display effectiveness. Examples of display file processing are translating, scaling, and scissoring. Translation involves the movement of the display presentation in the X, Y plane, scaling is the magnification or contracting of the display presentation, and scissoring is the filtering of the display instructions into two instruction sets. One set includes display instructions that create the display presentation seen on the physical screen. Depending on application, the number of picture elements (pixels) on the screen usually ranges from 512 × 512 to 2048 × 2048, with 1024 × 1024 the most common size. The second set represents those instructions that define imagery off the physical screen, that is, imagery in the virtual screen less the physical screen imagery. The virtual screen is usually four to eight times larger, depending on the number of range scales required. For example, the virtual screen may be defined by a field of 17 bits for both X and Y, which relate to a 128 × 128 mile area. If the physical screen is defined by 10 bits in X and Y, the range scale setting will determine which 10 adjacent bits out of 17 will be selected. The 10 most significant bits will define maximum range scale. Each successive shift of 10 adjacent bits, towards the least significant bits in the 17-bit fields, results in a 50% reduction in range scale.

Function Generator

The function generator consists of three component generators: character, vector, and conic. The character generator can produce numeric, alphanumeric, and special symbols with a typical repertoire ranging from 128 to 256 characters. Some characters may be RAM programmable with the remainder reprogrammable only by ROM modification. RAM programmable characters or symbols are created by a set of special display instruction words.

Numerous character generation techniques have been developed for random scan displays. The most common technique, the stroke writing method (Fig 5), involves sequentially coupling various X and Y deflection waveforms to their respective deflection circuits. Each stroke is contained within a clock time interval. Beam intensity is also blanked or unblanked by Z-intensity modulation of the CRT grid within a clock interval. The number of strokes used in producing a character typically ranges from 8 to 32. Character generators usually have the capability under computer/operator control to rotate characters by 90°, blink, change sizes (usually 2 to 4 sizes), and change brightness levels (usually 2 to 4 levels). The ratio of X to Y sweep (width to height) amplitude per stroke may also be programmable; this ratio in Fig 5 is 2:1.

Vector generators can also be implemented by several methods. All methods end up with positive or negative ramps applied to the X- and Y-axis deflection systems to produce a vector on the display screen. The two most common types of vector generators produce either a single vector having a wide range of possible lengths and orientation, or produce a chain of short vectors connected end to end. The latter type of vector is identified by names such as delta, augment, or contiguous. Vector generators normally are provided with the capability to dash, dot, blink, and change vector brightness levels.

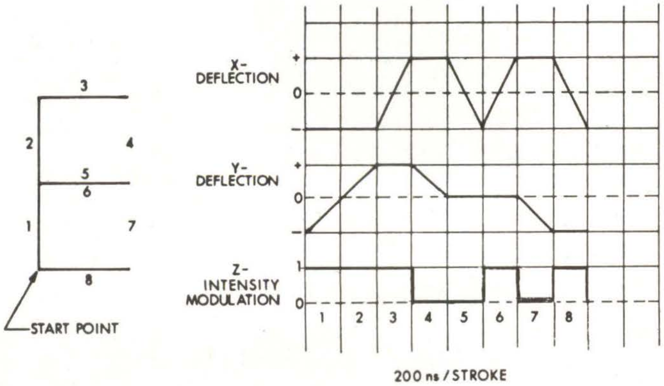


Fig 5 Stroke writing sequence for character "E". Generally, symbol code (n bits) is used to access symbol memory (mix of ROM and RAM for programmability) of a size $2^n \times m \times p$, where m is number of strokes and p includes Z-intensity modulation plus X and Y slopes. Output of symbol memory is coupled to step generators, whose step function output is integrated to provide deflection waveforms as illustrated. For character "E", m = 8, and p = 5 (±X, ±Y, Z). Typically, n = 8, m = 32, and p = 7 (±X, ±Y, ±2Y, Z)

Conic generators produce open or closed curves that are members of the conic family, such as circles, ellipses, and arcs. As with other function generators, numerous techniques exist for implementing conic generators. In some display terminals, a conic generator is not installed, and circles, ellipses, or arcs are developed on the screen using contiguous vectors. The main disadvantage of this technique is that a large number of display instruction words are employed relative to more conventional conic generators. As with vector generators, conic generators usually have the capability, under computer control, to dash, blink, and change conic brightness levels.

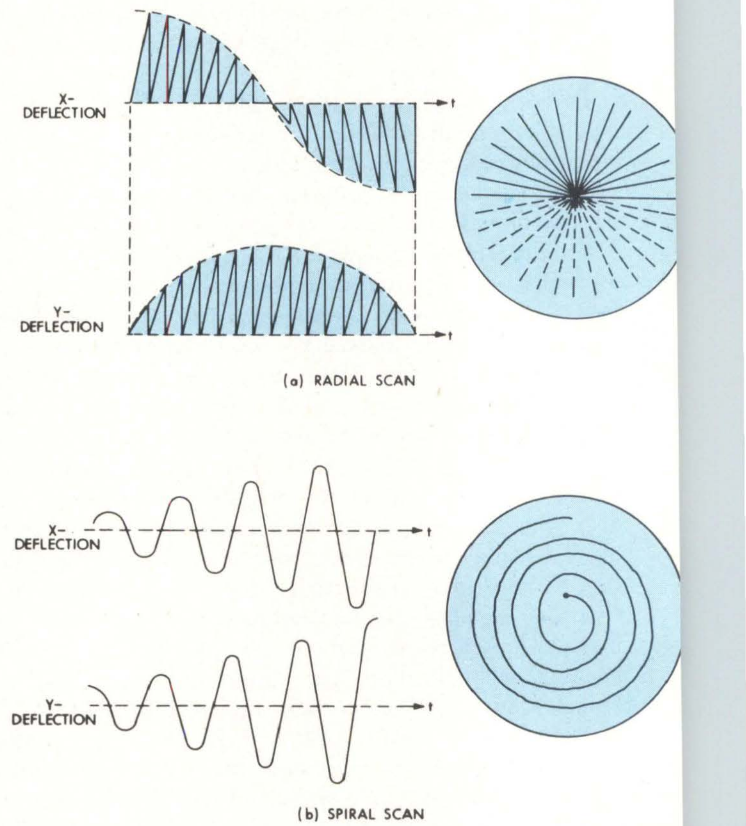
Some function generators incorporate automatic brightness compensation by modulating the Z-axis as writing speed varies. For example, a vector generator may produce any length vector within a definite time interval; without brightness compensation, shorter vectors are brighter than longer vectors. In the design of some vector generators, no Z-intensity modulation is required because the time to generate a vector is proportional to its length.

Sensor Interface and Conversion

The sensor interface receives sensor signals. After appropriately terminating the different signals associated with a sensor, the signals are conditioned before coupling them to the sensor converter. Signal conditioning includes clamping, filtering, level shifting, and amplitude changing.

The sensor converter operates on the signals to produce scanning signals that are coupled to the deflection amplifiers and control the movement of the electron beam over the viewing screen in a structured pattern. A conventional radar presentation employing a radial scan is shown in Fig 6(a). Several techniques are available for generating a radial scan; the net result is negative and positive ramps that are amplitude modulated by a sine function on the X-axis and a similar function phase shifted on the Y-axis by 90°. A conventional sonar presentation employing a spiral scan is shown in Fig 6(b). This scan mode is produced by a pair of phase shifted sine functions that are ramp modulated.

A horizontal raster scan is produced by a set of high frequency ramps and a set of low frequency ramps applied to the X and Y axes, respectively. A common raster scan pattern is shown in Fig 6(c). A low frequency ramp and an associated high frequency ramp define a field, and two fields define a frame. The two fields, shown as solid and dotted lines in Fig 6(c), are interlaced to prevent flicker and smearing of the associated display imagery. The human eye integrates consecutive fields of interlaced imagery so that motion appears to be continuous while using lower persistence phosphor to reduce motion smearing. Interlacing may not be necessary if the associated imagery is relatively static. A variety of other structured scan formats exists to enhance the presentation of imagery derived from advanced sonar and radar systems.



Timeshared Deflection

The timeshared deflection unit receives three basic inputs: structured scan patterns from the sensor converter; function generator scanning patterns for the generation of conics, vectors, and characters; and an unstructured or random scan [Fig 6(d)].

In random scan, the electron beam is positioned at any point on the viewing screen by applying a signal of constant level to both the X and Y axes. "0" levels of the X and Y deflection waveforms in Fig 6(d) correspond to the center of the associated CRT presentation. Transient time is the time interval between changes in successive positions on the screen. At a particular random scan position, such as A, B, C, or D in Fig 6(d), a character or vector may be written.

Random scan waveforms are the outputs of two digital to analog converters (DACs). These are located between the display controller and the timeshare deflection module. Digital inputs to the DACs originate from bit fields that define X and Y positions in the display instruction words (Fig 7). If the display imagery on the physical screen represents a translation on the

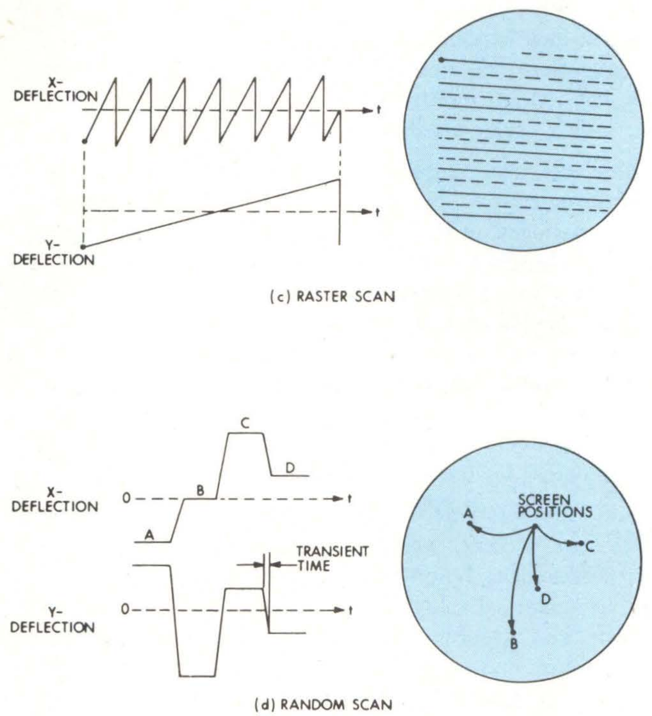


Fig 6 Scanning waveforms. Radial (a), spiral (b), and raster (c) are structured scans providing familiar display presentations for radar, sonar, and television, respectively. Variety of other structured scans exists for display of advanced sensor information. Random scan (d) is used to locate alphanumeric and graphic information on display screen; waveforms (d) represent D-A converted X, Y position bits (Fig 7) after adjustment for transformations, such as range scale change and offset

virtual screen, the display controller adds a fixed offset to each position bit field as the display instruction words are retrieved from memory. The 15 bits in each X-Y position bit field define a virtual screen; the physical screen may be defined by only 10 bits. Again, which of the 10 adjacent bits are used is determined by the range scale setting. Also, when a display instruction word is retrieved from the display file, the word identification (ID) bit field is used to direct the remaining part of the instruction word to the character, vector, or conic generator.

The function of the timesharing block is to multiplex and sum the various scanning signals. For example, within a refresh cycle, the random scan of Fig 6(d), along with a fraction of the radial scan of Fig 6(a), are time division multiplexed. During that portion of the refresh cycle when the random scan is activated, the function generator sums its inputs [see Fig 5(b)].

Data Entry Devices

Data input devices enable the operator to rapidly enter data into the display terminal, where they are acted upon by the operational program, resulting in modification or manipulation of the display imagery.

Data entry devices can generally be classified in two categories. First are those that transmit information to the host computer or display processor, such as function and keyboard switches. The second category contains devices, such as a joystick or a trackball, that can be used to point to and select alternatives listed on the display screen for subsequent processing; in some modes of operation, these devices are used in conjunction with function switches. A light pen and

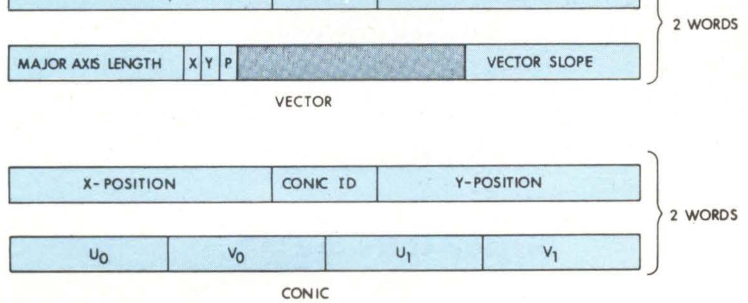


Fig 7 Typical display instruction words. Instruction words are each distinguished by an ID bit field. In TEXT, X and Y positions locate first character in string; assertion of bit "s" terminates TEXT mode. In VECTOR, X and Y positions locate starting point of vector; bits X, Y, and P determine orientation of vector. In CONIC, X and Y positions locate center of ellipse or circle. Letters U_0, V_0, U_1, and V_1 represent projections (length) onto X, Y axes of 1/2 semi-major and semi-minor axes of an ellipse oriented at an arbitrary angle with respect to the X, Y axes

a graphic input tablet can be placed in either category, depending on their mode of operation.

Function switches are usually grouped together. The output of a function switch is a code that is interpreted by software to initiate a logical operational sequence. Function switches range from the simple pushbutton to complex switches containing multimessage readouts under host computer or display processor control. A matrix of the latter is commonly called an action entry panel; functionally, it is a 3-dimensional matrix of switches. For example, consider a representative hardware/software implementation of an $m \times n \times h$ size matrix. Let $m \times n$ represent the physical array of multilegend illuminated pushbutton switches. Each individual switch in the array can take the place of up to 48 switches. Within each switch is a film chip containing 48 different brief messages. A particular message is selected by activating a miniature backlighted lamp. Each switch has a single code associated with it which is used to select a message. The third dimension (h) is defined by the software of the operational program. Let level h_0 define $m \times n$ classes of information where each class is differentiated by a brief message. Depressing a function switch results in examination by the operational program of the function switch code and the software description of level h_0. Responding to operational program instructions, the display processor changes all $n \times m$ readout messages. The new messages represent level h_1, designating subclasses of the selected class of information. If a function switch is again depressed, another examination by the operational program is initiated. The function switch code and the software description of level h_1 are translated as a JUMP to a service routine. This routine dictates an alphanumeric message to be printed on the CRT containing information pertinent to the selected class/subclass.

The keyboard, generally similar to a typewriter keyboard, has extra keys that enable the operator to perform functions such as edit, backspace, and delete. Adjacent to the keyboard, when emplaced, the joystick is an upright handle, and the trackball a rotatable ball mounted in a hemispherical socket. Movement of either device generates a changing set of X, Y coordinates for the operational software. The resulting coordinates are also used to generate an electronic marker or cursor. A light pen, when placed against a bright spot on the CRT screen, detects a pulse of light as the scanning electron beam passes. The resulting pulse can be translated into X, Y coordinates at the pen tip. A graphic input tablet consists of a flat area and a stylus. The stylus, which interacts with the tablet to specify X, Y coordinates, may function as a passive or active instrument depending on the technology employed in the design of the graphic input tablet.

Display Device

CRT capabilities typically include variable persistence, color, background generation, storage, and symbol generation. Other display devices, such as flat panels, presently lack capabilities and are expensive. Currently, the CRT offers superior capability in displaying a gray scale, color, high quality graphics, background information, and a large number and type of symbols.

Some displays employ penetration CRTs that have multicharacteristic phosphors. These tubes offer either dual persistence or 4-color capability. Both types have different phosphors deposited on the CRT faceplate in thin layers or in an onion skin manner. To excite the various phosphors, the impacting electrons must have different energies, as controlled by the accelerating voltages applied to the anode. Therefore, depending on the particular CRT construction, switching anode voltages provide a single persistence or up to four distinct colors for the second tube type.

With the first or dual-persistence tube type, two colors are present, green for short, and orange for long persistence; however, such displays are not classified as color displays. For example, if all alphanumeric and graphic information appears as a steady green color and radar targets appear as flashes of orange, the display presentation does not have the appearance of a color display.

Both penetration CRT types have significant limitations that have hindered their wide acceptance. Brightness suffers because of inefficient phosphors. To increase brightness, refresh frequency can be increased and writing speed decreased, but this technique reduces the amount of information that can be displayed. If the grid voltage is increased to brighten the display, the spot size grows and degrades the resolution. Other problems include anode power supplies in the kilovolt range that are physically large and power consuming.

A compromise approach to dual persistence with a monochrome CRT involves a phosphor mix that offers a measure of persistence but provides some smearing of moving graphic and alphanumeric information. For example, consider a block of alphanumeric data defining an aircraft in terms of identification, airspeed, and altitude. As the aircraft target and associated block of alphanumeric data move across the screen, the data block leaves a smeared trail while the radar target eventually fades out. Sometimes, radar targets are synthetically generated to render a solid appearing image.

Conventional TV color CRTs with mask structures cannot be used in a tactical display terminal that requires a variety of possible scan modes because of alignment problems between the mask holes and the scanning path of the electron beam.

Display Software

In general, system display terminal software consists of three programs: operating system, language processor, and operational. The operating system is a collection of programs that enables system programmers to efficiently create operational programs. These programs may include monitor, editor, file maintenance, and debugging programs. With the monitor program, the programmer can interface to system hardware and software from a keyboard, using a comprehensive set of English-type commands. An editor allows a programmer to create and modify text or programs. A file maintenance program provides a means to manipulate and maintain programs and data as files. A debugging program assists a programmer in uncovering and correcting program errors.

The language processor relates to high level and/or assembly language programs for translating a source program into machine code. The Navy currently makes extensive use of a high level language called Compiler Monitor System 2 (CMS-2) to perform data processing in tactical display systems.[2] CMS-2, consisting of a blend of languages such as JOVIAL, CS-1, and FORTRAN, is a problem-oriented machine-independent language; yet the programmer can include segments of symbolic machine language, at the sacrifice of some machine independence.

An operational program written for a display terminal dictates the mission of that terminal, and enables the operator to interact with the display system using data entry devices. Hence, display instructions that make up the terminal display file are created by the operational program in response to operator manipulation of the various data entry devices. Other display instructions are created by the operational program in response to other computer or sensor inputs beyond the operator's control.

In an operational ship environment, system software may consist basically of a set of operational programs, each of which is responsive to the specific task assigned to the display terminal. The operating system and language processor components of the system software may be found only at a few display system sites where operational programs are developed. The operation programs in a display system may be resident in the display terminal, host computer, or both, depending on the complexity of the display terminals and display system.

Future Trends

There is a trend towards the adoption of displays using a raster scan monitor as in conventional TV. These monitors are reliable, inexpensive, and ideal for changing display information such as TV signals which do not require refreshing. However, part of the information in a tactical display is static and requires refreshing. Combining the monitor with solid state memories provides a fundamental structure for a low cost display terminal. The increase in capability and falling prices of monitors and memories is the principle motivation supporting this combination.

Basic memory is organized as a 2-dimensional matrix of pixels, and is referred to as bit map memory. All but the simplest of these include a third characteristic: a number of bit map levels for encoded gray scale, color, and other information. The conventional display file may no longer exist; all characters and vectors are distributed in bit map memory and are sequentially read out line by line during refresh. Some raster displays may employ memory saving techniques such as a virtual bit map memory, in which the screen is partitioned into a grid of graphic cells, with each made up of a matrix of pixels. A display file contains a list of addresses of those graphic cells that carry information. In a typical picture many graphic cells are empty, thereby permitting a small memory capacity. Graphic cells are accessed much like conventional raster scan character generators.

Future raster display terminals may use dual bit map memories to enhance system capability. Primary use for the second bit map memory is to accept a picture from another source within the display system without destroying the contents of the first bit map memory. The operator can then select contents of the second memory for review. Further uses include casualty backup, auxiliary information storage, scratch pad function, and temporary storage during generation of a hard copy.

Other than memory, increasing interest in raster displays can be credited to advances in microprocessors and LSI character generation. An increasing application of microprocessors in raster displays is in the generation of graphics. Given input parameters, a succession of pixels defining a graphic structure is calculated and loaded into the bit map memory. Input parameters include such things as vector end points, center and radius of circle, and so on. LSI character generator circuitry like that used in commercial alphanumeric displays may be adapted for a text mode of operation; depending on the system philosophy for processing alphanumeric data, there may be no need to provide a separate buffer for alphanumeric information. A line of characters can be processed directly and the resulting video inserted into the bit map memory with other information.

A significant advantage of the raster scan display, relative to the random scan display, is availability of a wide variety of colors and solid area shading or coloring. Color coding of tactical data has long been favored by the military. The additional information furnished by color coding can reduce decision times when a large number of targets is being displayed. Recent progress in the development of the beam-indexing CRT offers the potential for providing high resolution color and less susceptibility to shock and vibration. This CRT uses a single electron gun controlled by electro-optical feedback.

At this time the principle limitation of raster scan versus random scan displays is resolution. The latter typically operates within a 1024 × 1024 matrix. To approach such resolution with a raster scan display means that the number of horizontal lines per frame must be increased beyond the TV standard of 525 to a little over 1024 lines per frame. So, the frequency of the horizontal raster line must be increased from 15 kHz to around 34 kHz. The active horizontal line time is partitioned into 1024 time intervals, each one pixel in "width." To accommodate such high horizontal resolution, some monitors have a video bandwidth up to 40 MHz.

At the system level, the raster scan approach offers capabilities far too complex or expensive to undertake in a random scan system. Some of these capabilities include video recording, frame capture, time compression, and hard copy. Raster scan display information, recorded by conventional video tape machines, is valuable for making measurements of display quality, maintaining display equipment, conducting postmission analyses, evaluating operator performances, and conducting training. Frame capture offers interesting capabilities. For example, a bulk memory of selected captured frames for distribution to remote terminals is of value in managing large amounts of critical information. Time compression of sensor information makes moving target identification easier. Such a system sequentially plays back in realtime the last 30 or so stored scan converted frames, where each frame represents one cycle time of a sensor. (An example of sensor cycle time is the time it takes for a radar antenna to make a complete revolution.) There are more advanced time compression techniques but they are currently proprietary. Hard copies of a selected video frame are possible using various types of hard copy devices. All that is required is connection of a single video cable and a stationary picture source. A selected picture (frame) in a dynamic display presentation can be captured, previewed, and copied from the second of the dual-bit map memories.

Sensor information can still be integrated with alphanumeric and graphic data by generating sensor information in a raster format using solid state scan converters, which overcome problems of calibration, reliability, and conversion time lost during the read mode of single ended tube scan converters. Scan converted sensor video is independent of sensor cycle time. Combining it with the computer generated video in the bit map memory poses no loading problems, ie, no flicker. Moreover, a multipersistence capability is available if desired. This is accomplished by decrementing pixel intensity periodically at a preset rate throughout the cycle time of the sensor. By changing the preset rate, the persistence can be made variable out to infinity if so desired. Reducing the need for long persistence phosphors for sensor data in raster displays enables the use of brighter and longer life phosphors. Command and control rooms can maintain a higher ambient light.

Conventional TV equipment can be integrated in with a raster scan system with appropriate A-D and D-A conversion as required. Video tape recorder and TV camera video can provide background information in a video presentation. Background video, long sought after by the military, can be mixed with output video from bit map memory. Typical background video might be a map having meteorological patterns, topographical contours, or roads. Background video can also be obtained from film and slides using conventional equipment. Special effect, remote video switching, timebase correctors, processing amplifiers, distribution amplifiers, and TV test equipment are further examples of conventional equipment that can be incorporated into a raster scan display system when appropriate. The use of some of this conventional TV equipment would, however, be incompatible with high resolution (1024 pixels × 1024 lines) raster systems.

Current raster display systems do not employ all of the above capabilities. However, complete integration is highly probable because of increased capability and cost reductions.

Summary

This article has discussed the state of the art in military tactical display terminal design. The terminal described must be understood to be an idealized model. Tactical display terminals currently in use are not as complete in every respect as the characterized model, which, in general, portrays what the industry is presently offering to meet military requirements.

For the future, it appears that technological improvements in raster scan display techniques, and cost reductions in the associated hardware, particularly microprocessors and solid state memories, are making raster scan display technology increasingly attractive.

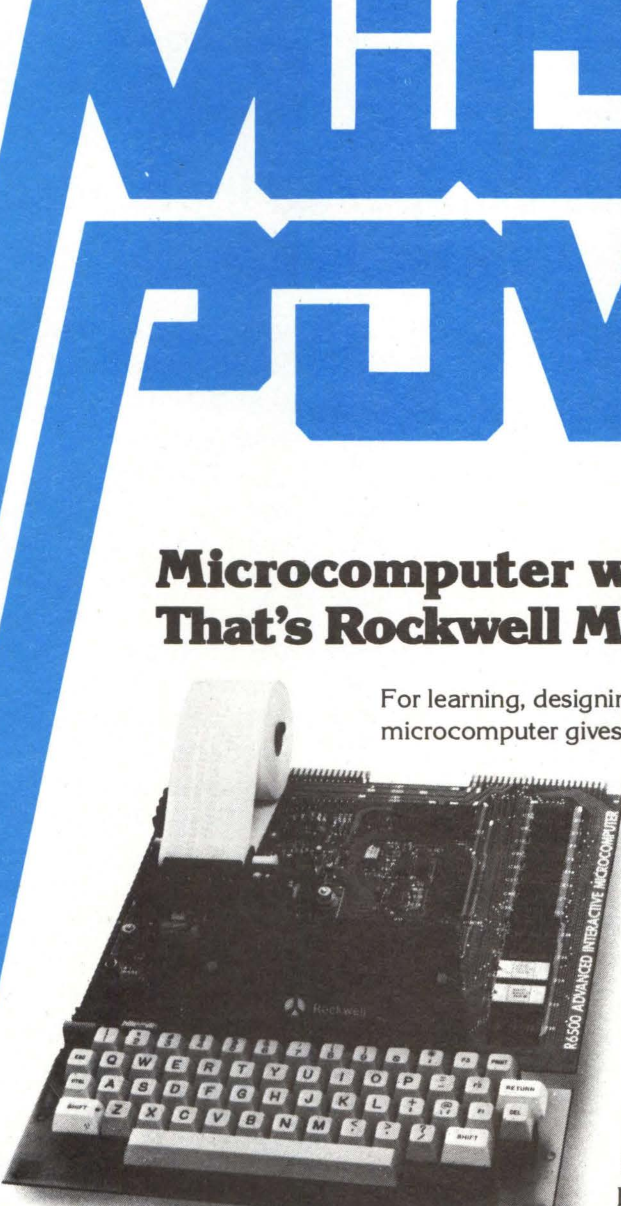
References

1. MIL-STD-1397 (SHIPS), Input/Output Interfaces, Standard Digital Data, Navy Systems, Dept of the Navy, Naval Ship Systems Command, Washington, DC 20360
2. UNIVAC/PX 10065, An Introduction to Compiler Monitor System, (CMS-2), NSSC/NavShips 0967-028-0130, Jan 1973

Edward Gennetten has had nine years' military display experience including five years at the Naval Ocean Systems Center, two years at Stromberg DatagraphiX, and two years at Norden Div United Technologies. He holds BSEE and MSEE degrees from the University of California at Davis.

Micro Power

Microcomputer with printer–$375.
That's Rockwell Micropower.



For learning, designing, work or just fun, Rockwell's AIM 65 microcomputer gives you an easy, inexpensive head start.

- 20-Column Printer and Display
- Dual Cassette, TTY and General-Purpose I/Os
- R6502 NMOS Microprocessor
- System Expansion Bus
- Read/Write RAM Memory
- PROM/ROM Expansion Sockets
- Advanced Interactive Monitor Firmware
- Big Terminal-Style Keyboard

For more on AIM 65 and how you can develop programs in assembly language or BASIC, write Microelectronic Devices, Rockwell International, D-727-A4, P.O. Box 3669, Anaheim, CA 92803 or phone (714) 632-3729, or contact your local Hamilton-Avnet office.

Rockwell International

...where science gets down to business

CIRCLE 112 ON INQUIRY CARD

LOGIC VARIABLE FORMAT TECHNIQUES FOR EFFICIENT PROCESS CONTROL I/O

Software coding schemes to process digital input/output variables minimize program memory and execution time requirements, achieving efficient throughput of a process control system

Rajiv Bhargava and Anil K. Chandra Bhabha Atomic Research Centre, Bombay, India

When used for process control, a computer acquires information about the state of process and delivers control signals to alter the state in a desired manner. The composite job to be performed by software comprises scanning the process inputs, generating command outputs based on an analysis of the inputs (performing logic operations), and delivering outputs to the process. Since the process under control runs continuously, the computer has to repeat this operation regularly. Software programs are thus structured to be executed completely in periodic cycles. The duration of these cycles is determined by the maximum period in which the control system must respond to any change in the process parameters.

Hardware/software designs have to be optimized to ensure that control system operations are completed within the allotted time. The time required to process digital inputs and outputs (I/Os) is determined by the format used to represent digital I/O variables. Conventionally, each logic variable is represented by one bit. This method speeds up input acquisition and output delivery, but slows down the software processing of logic inputs as microcomputers seldom provide proper bit manipulation instructions.

An alternative data formatting scheme allots each logic variable a full byte. Since most microcomputers provide extensive byte processing instructions, this scheme reduces program length and execution time, although larger data memory is required.

A microcomputer acquires signal inputs from a process through a digital input unit (DIU) and delivers control outputs through a digital output unit (DOU). Signal inputs from, and control outputs to, the operator console are routed similarly. Digital I/O data may comprise arithmetic variables, such as shaft encoder outputs, or logic variables, such as relay closures. In most process control systems, the time taken to read inputs and dispatch outputs is much less than the time taken to solve logic equations. The time required for solving logic equations is minimized by choosing a proper format to represent the logic variables.

In the logic equation LK = LA • LB • LC, the logic variables LA, LB, and LC represent the status of process components. Logic variable LK represents a control output. Obviously, the hardware solution for this equation requires a 3-input AND gate. In software, either of two algorithms—direct code or branch code—can be used to write a program to solve this equation.

Direct and Branch Code Schemes

The branch code scheme, on the other hand, is implemented as

```
LOAD    LA    /Fetch LA into accumulator
AND     LB    /AND accumulator with LB
AND     LC    /AND partial result with LC
STORE   LK    /Store result in LK
```

In this scheme, program execution time is independent of the actual logic state of any operand.

The branch code scheme, on the other hand, is implemented as

	TEST	LA	/Check status of LA
	BRZ	RESET	/Branch to RESET if LA = 0
	TEST	LP	/Check status of LB
	BRZ	RESET	/Branch to RESET if LB = 0
	TEST	LC	/Check status of LC
	BRZ	RESET	/Branch to RESET if LC = 0
SET	SET	LK	/Make LK = 1
	BR	FURTHER	/Continue further processing
RESET	RESET	LK	/Make LK = 0
FURTHER	—	—	/Code for further processing

Here, the state of each input variable is checked in turn. If any variable is false (ie, logic 0 state), output variable LK is reset to false without checking the states of the remaining variables. Output variable LK is set to true (ie, logic 1 state), if none of the input variables is false. Program execution time, in this scheme, depends on the logic states of the operands. The solution of the logic equation is obtained quickly if the first operand tested is false, but it is slow if all the operands have to be tested before effecting the state of the output variable.

Direct code implementation requires the use of LOAD, STORE, AND, OR, NOT, and XOR operations. Most microcomputers provide these as regular instructions for byte length operands, although possibly not for single-bit operands.

Branch code implementation requires the use of TEST LV, SET LV, and RESET LV operations, which are generally not provided in available microcomputers. These operations must be implemented in terms of the instructions available in a given microcomputer.

Eight Variables/Byte Format Scheme

This formatting scheme stores eight logic variables in a byte; ie, one bit is allotted to each logic variable. The true state of a variable is represented by 1 and the false state by 0. This scheme minimizes the time required for data transfers between the microcomputer and the process since it utilizes the entire microcomputer data bus width.

To solve a given equation, it may be necessary to use only a few of the logic variables stored in a particular byte. Most microcomputers, however, do not provide instructions to specify and operate on a particular bit of a word. Thus, the software program has to identify and extract variables relevant to the solution of an equation.

For example, to implement the SET LK operation in an 8085 based microcomputer system, output variable LK must be set to true. LK is stored in a memory location with byte address BA(LK), along with seven other variables. The contents of this location are XXXX LKXXX, the states of the remaining stored variables being immaterial. To identify LK, it is necessary to use a mask—BM(LK)—which in this case is 0000 1000. Thus, the specification of a variable requires a byte address and a byte mask. Operation SET LK is now implemented as

LDA	BA(LK)	/Load into accumulator the byte /containing LK
ORI	BM(LK)	/Set to 1 the bit representing LK
STA	BA(LK)	/Store modified byte

This piece of code occupies eight bytes in memory and takes 33 clock cycles for the 8085 based microcomputer to execute.

Using the branch code scheme, equation LK = LA • LB • LC is programmed as

	LDA	BA(LA)	/Fetch byte containing /LA into accumulator
	ANI	BM(LA)	/Extract bit representing LA
	JZ	RESET	/If LA = 0, reset LK
	LDA	BA(LB)	/Fetch byte containing /LB into accumulator
	ANI	BM(LB)	/Extract bit representing LB
	JZ	RESET	/If LB = 0, reset LK
	LDA	BA(LC)	/Fetch byte containing /LC into accumulator
	ANI	BM(LC)	/Extract bit representing LC
	JZ	RESET	/If LC = 0, reset LK
SET	LDA	BA(LK)	/If LA = LB = LC = 1, /fetch byte containing LK
	ORI	BM(LK)	/OR with mask and set /bit representing LK
	JMP	STORE	/Branch to STORE
RESET	LDA	BA(LK)	/If LA or LB or LC is false, /fetch byte containing LK /into accumulator
	ANI	$\overline{\text{BM(LK)}}$	/Clear bit representing LK
STORE	STA	BA(LK)	/Store modified byte
FURTHER	—	—	/Code for further processing

In each case, the program extracts the relevant input variable by proper masking, and resets LK if any input variable is false. It sets LK to true if none of the input variables is false. The code for this program occupies 40 bytes in memory. The minimum time for solution of this equation (63 cycles) is achieved if LA is false. The program executes in a maximum time (124 cycles) when all three variables (LA, LB, and LC) are true. On the average, the program executes in 84.2 clock cycles (Table 1). The time taken to solve the logic equation depends on the states of the operands. Assuming a random distribution, the average execution time is obtained as the weighted sum of the execution times for various input combinations. Weight W for an input combination is the probability of that combination's occurrence. When using the eight variables/byte format, it is not feasible to use the direct code scheme for solving logic equations, as bit-manipulation instructions are not available.

One Variable/Byte Format Scheme

Only one logic variable is stored in each byte of data. In general, any two distinct 8-bit patterns may be chosen to represent true and false states. If the patterns use more than one bit out of the eight for coding the state of the logic variable, the hardware for generating the pattern in DIU and detecting it in DOU

TABLE 1

Calculation of Average Execution Time Using Branch Code Scheme

Input Variables			Output Variable	Weight	Execution Time
LA	LB	LC	LK	(W)	(Clock Cycles)
0	—	—	0	½	63
1	0	—	0	¼	90
1	1	0	0	⅛	117
1	1	1	1	⅛	124

Average Execution Time = (½ x 63) + (¼ x 90) + (⅛ x 117) + (⅛ x 124)
= 84.2 clock cycles

becomes complex. However, from hardware and software points of view it is immaterial which of the eight bits is chosen for coding and whether true is represented by a logic 1 or 0. For example, the two states may be represented as

True ≡ 0000 0001

False ≡ 0000 0000

The choice of hexadecimal 00 code to represent false leads to easier coding and more understandable programs. However, the use of this format increases the time required for data transfers between the microcomputer and the process. It also requires increased data memory space to store all the variables.

Since each data byte stored in the microcomputer memory now represents only one logic variable, it is not necessary to extract a variable before utilizing it. Thus, a variable is completely specified by a byte address. Operation SET LK is now implemented as

```
MVI     A,01H       /Load accumulator with code for true
STA     BA(LK)      /Store accumulator in LK
```

This piece of code occupies five bytes in memory and takes 20 clock cycles for the computer to execute.

Using the branch code scheme, the equation LK = LA • LB • LC is programmed as

```
         LDA    BA(LA)    /Load LA into accumulator
         ANA    A         /Set condition codes
         JZ     STORE     /Result = LA, if LA = false
         LDA    BA(LB)    /If LA = true, then
         ANA    A         /Test LB
         JZ     STORE     /Result = LB, if LB = false
         LDA    BA(LC)    /If LA = LB = true, then
                          /result = LC
STORE    STA    BA(LK)    /Store result in LK
FURTHER  —      —         /Code for further processing
```

In each case, the program obtains the relevant input variable and tests its state. It resets output variable LK to false if any input variable (LA, LB, or LC) is false. It sets LK to true if all the input variables are true. The program executes in a minimum time (40 cycles) if LA is false and a maximum time (74 cycles) if LA and LB are both true. On the average, the program executes in 55 cycles. The program occupies 20 bytes in memory.

Using the direct code scheme, the same equation is programmed as

```
         LDA    BA(LA)    /Load LA into accumulator
         MOV    B,A       /Move contents of accumulator
                          /to B register
         LDA    BA(LB)    /Load LB into accumulator
         ANA    B         /Perform AND operation
                          /between LA and LB
         MOV    B,A       /Move result into B register
         LDA    BA(LC)    /Load LC into accumulator
         ANA    B         /Perform AND operation
                          /between LC and partial result
         STA    BA(LK)    /Store result in LK
FURTHER  —      —         /Code for further processing
```

In this implementation, the program fetches each variable in turn and performs the desired logic operations directly. The program occupies 16 bytes in memory and executes in 68 cycles regardless of the actual logic states of the input variables.

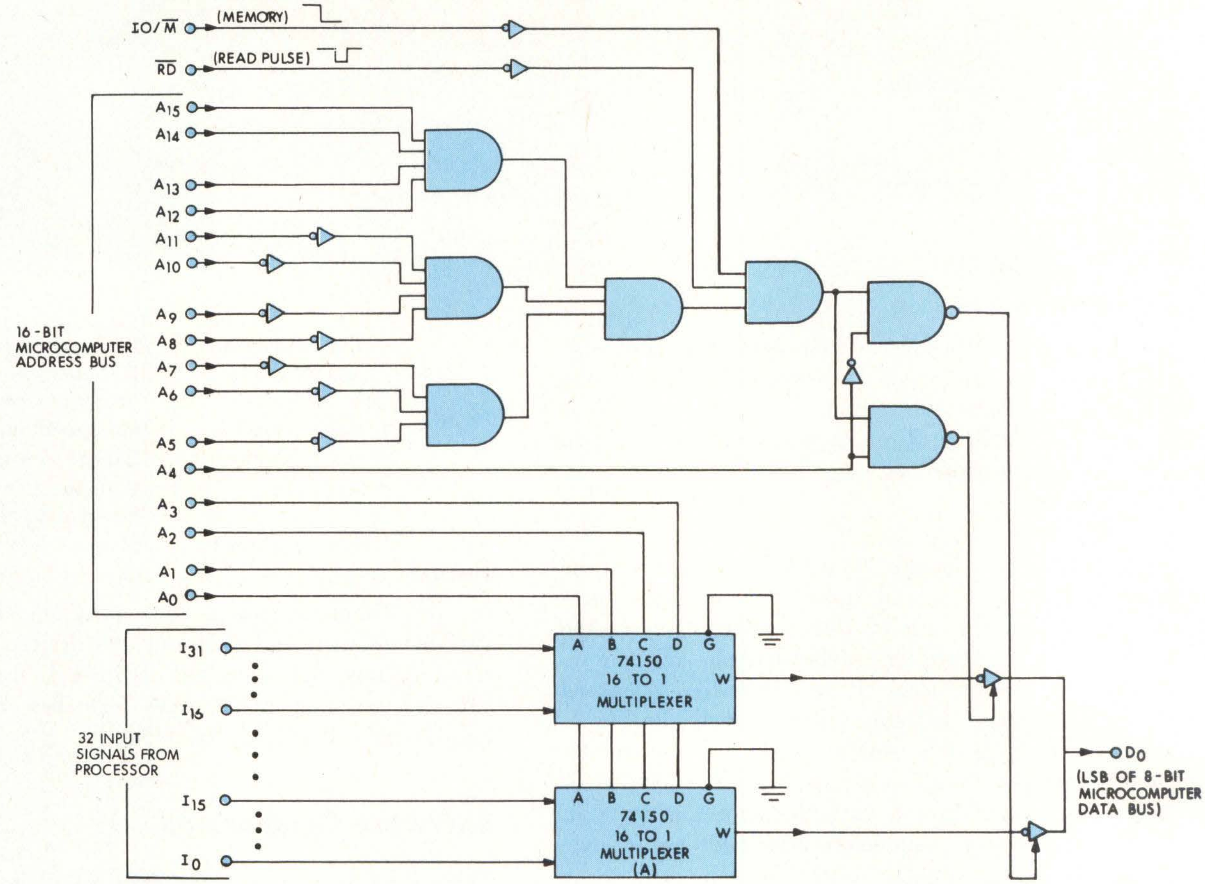
Software Comparison

Table 2 contains a representative list of logic equations encountered in typical process control applications. In this table, LA, LB, LC, LD, LE, and LF are operands, and LK is the result of a logic equation. Variable LK may be fed directly to the process or may be treated as an intermediate variable to be used as an operand in other equations. Similarly, operands LA through LF may be logic inputs representing the states of process

TABLE 2

Representative Logic Equations For Process Control System

(1) SET LK
(2) RESET LK
(3) TEST LK
(4) LK = LA
(5) LK = $\overline{\text{LA}}$
(6) LK = LA • LB
(7) LK = LA • LB • LC
(8) LK = LA • LB • LC • LD
(9) LK = LA + LB • LC
(10) LK = LA + LB • LC • LD
(11) LK = LA • LB + LC • LD
(12) LK = LA + LB • LC • LD • LE
(13) LK = LA • LB + LC • LD • LE
(14) LK = LA + LB • LC • LD • LE • LF
(15) LK = LA + LB • LC + LD • LE • LF
(16) LK = LA • LB + LC • LD • LE • LF
(17) LK = LA • LB + LC • LD + LE • LF
(18) LK = LA • LB • LC + LD • LE • LF



(a)

TABLE 3
Comparison of Three Processing Schemes

	Eight Variables/Byte (Branch Code)				One Variable/Byte (Direct Code)		One Variable/Byte (Branch Code)			
		Time in Clock Cycles				Time in Clock Cycles		Time in Clock Cycles		
Equation Number	Length	Avg	Min	Max	Length		Length	Avg	Min	Max
1	8	33	—	—	5	20	5	20	—	—
2	8	33	—	—	4	17	4	17	—	—
3	5	20	—	—	4	17	4	17	—	—
4	24	67	63	70	6	26	6	26	—	—
5	24	67	63	70	8	33	8	33	—	—
6	32	78	63	97	11	47	13	45	40	50
7	40	84	63	124	16	68	20	55	40	74
8	48	87	63	151	21	89	27	59	40	98
9	40	87	63	124	16	68	20	55	40	74
10	48	91	63	151	21	89	27	59	40	98
11	48	112	93	151	21	89	27	75	64	98
12	56	93	63	178	26	110	34	62	40	122
13	56	117	93	178	26	110	34	82	64	122
14	64	94	63	205	31	131	41	63	40	146
15	64	105	63	205	31	131	41	73	40	146
16	64	119	93	205	31	131	41	86	64	146
17	64	136	90	205	31	131	41	98	64	146
18	64	129	93	205	31	131	41	94	67	146

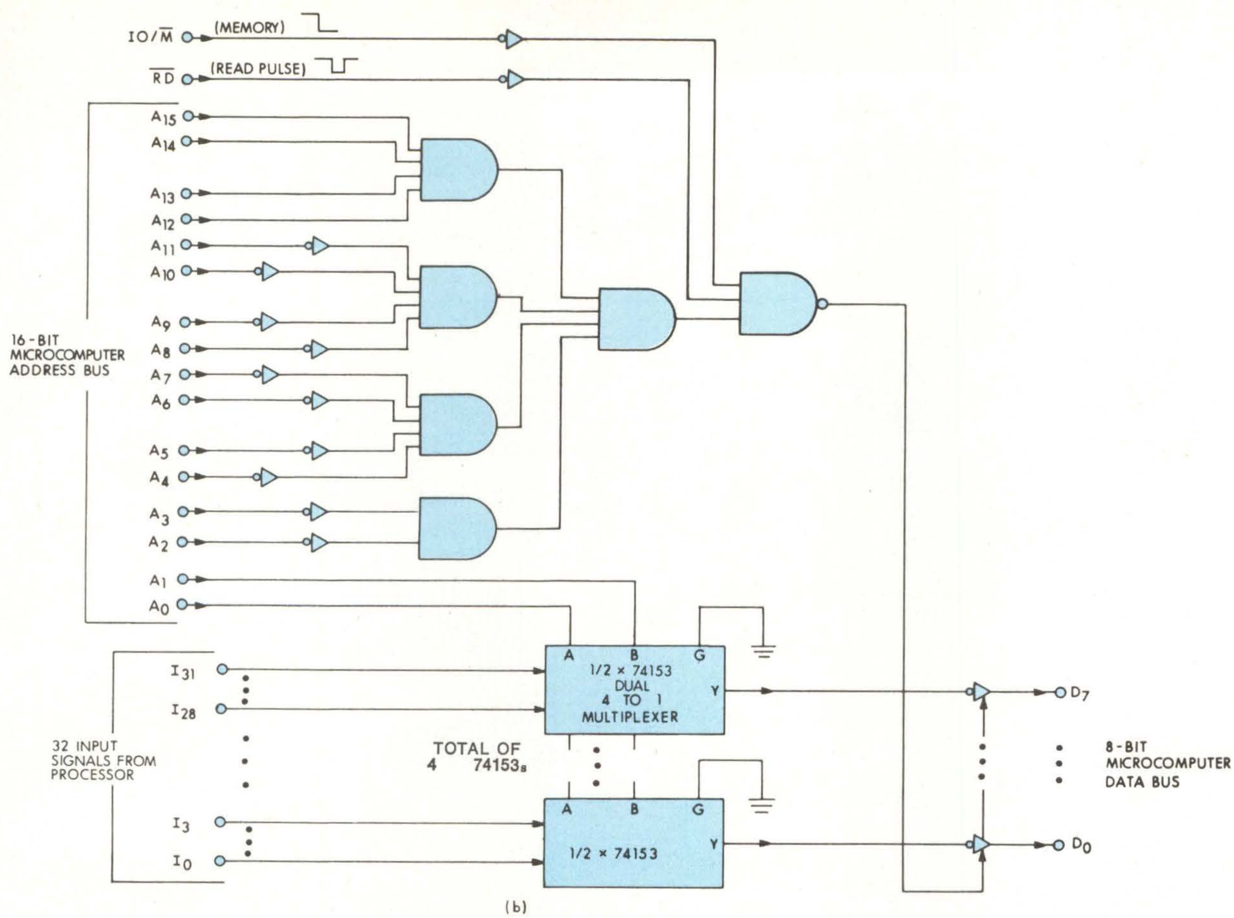


Fig 1 Memory mapped DIU. Modules can acquire 32 input signals (I_{31} to I_0) from process and can be implemented in either of two modes. In one variable/byte scheme (a), five LSBs of address bus (A_4 to A_0) are used to multiplex 32 signals onto one bit (LSB, D_0) of data bus. In eight variables/byte scheme (b), input signals are acquired as four groups of eight bits

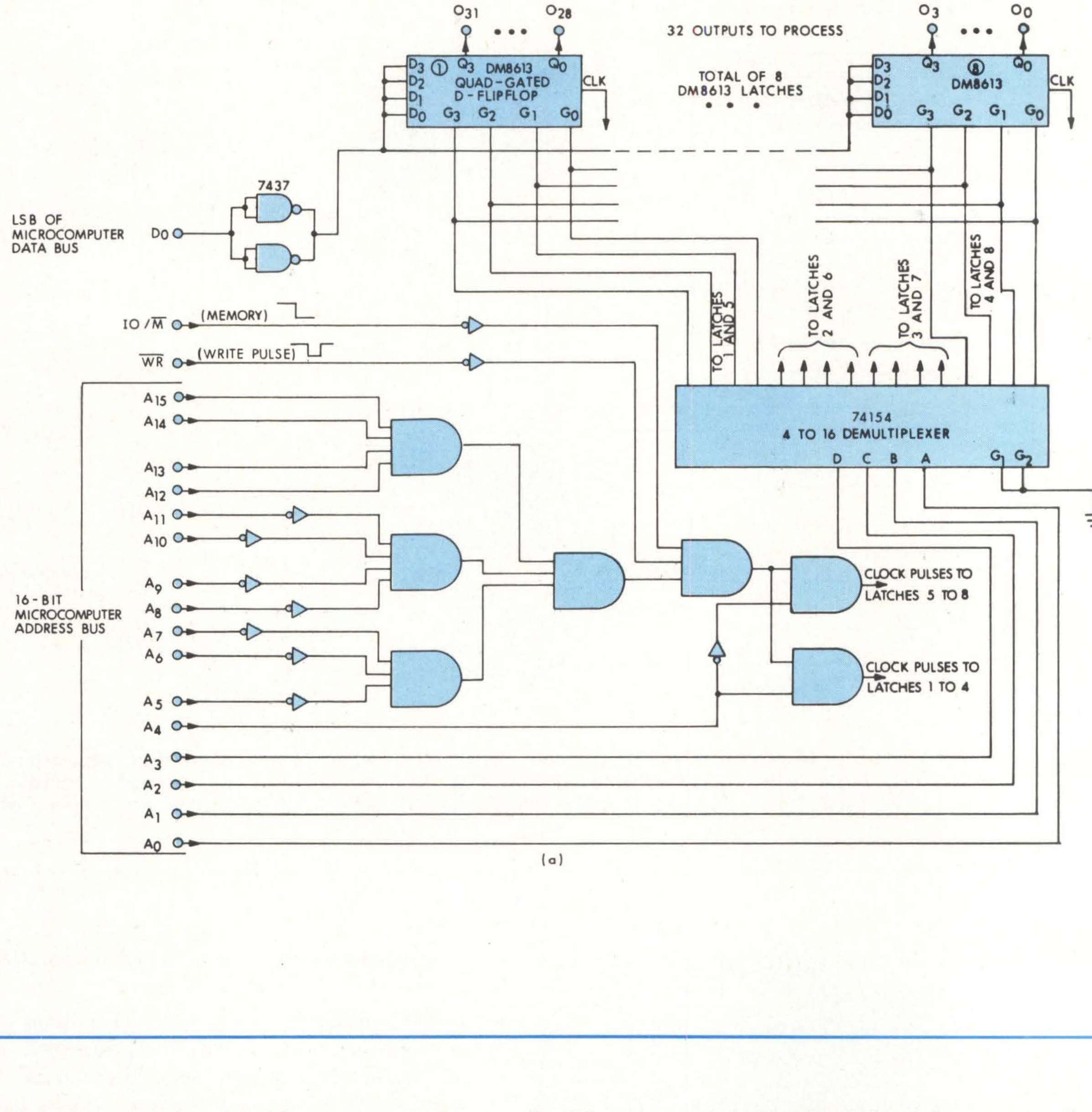
TABLE 4
Distribution of Logic Equations

Equation Type	Number of Equations
1	—
2	—
3	—
4	53
5	22
6	50
7	97
8	17
9	5
10	5
11	3
12	3
13	—
14	1
15	1
16	—
17	—
18	1
Total Number of Equations	258
Number of Input Variables	185
Number of Output Variables	216

components or may be intermediate variables obtained as results from other equations.

The equations are presented in a "sum of products" form. The solutions to equations expressed as "product of sums" are different only in terms of the specific instructions to be used. Program lengths and execution times, however, remain identical. As logic equations can be expressed in either of these two forms, it is sufficient to analyze only one form. The complemented states of logic variables are also not considered. It is assumed that such states are redefined as new intermediate variables. Even if complemented states are included in the list of equations, the branch code scheme calculations for the eight variables/byte scheme remain unaffected since only the branch condition must be changed from zero to nonzero, and vice versa. In the direct code and branch code schemes for the one variable/byte format, however, program length and execution time increase by a constant slight amount for each complemented variable.

Table 3 lists the program lengths and execution times for solution of each equation in Table 2, according to either code scheme, for an 8085 based microcomputer.



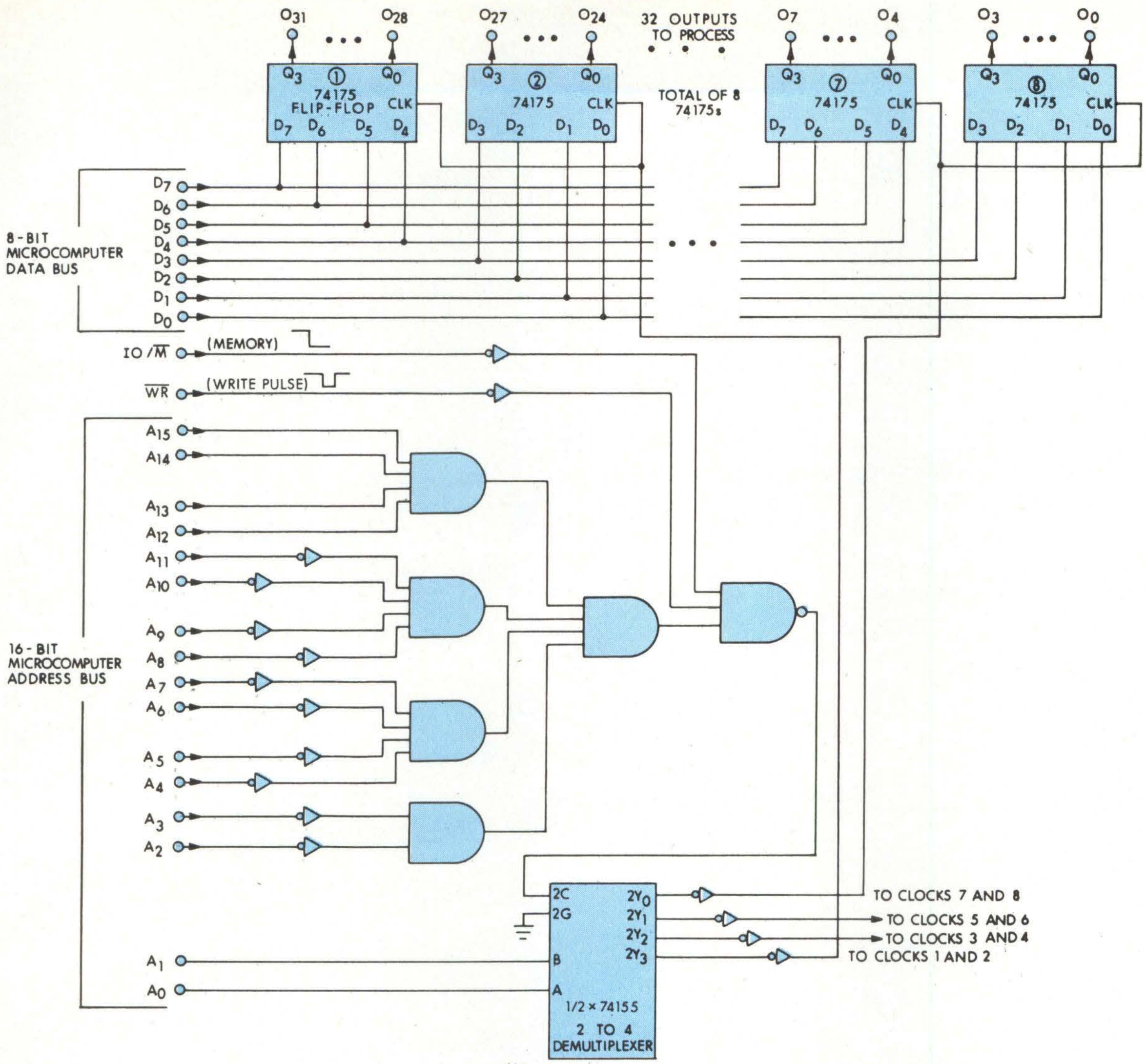
(a)

Both parameters—program length and program execution time—are better for the one variable/byte scheme for all equations. Using one variable/byte, the branch code scheme, compared with the direct code scheme, provides faster average execution times (17% less) at the cost of extra program length (21.2% more).

Hardware Comparison

The DIU can be implemented to accommodate each of the two format schemes (Fig 1). In this control system, 32 process input signals (I_{31} to I_0) are to be multiplexed onto the 8-bit data bus. In the one variable/byte scheme [Fig 1(a)], the 11 most significant bits (MSBs) of the address bus (A_{15} to A_5) are decoded to identify the module. The remaining five bits (A_4 to A_0) are decoded to choose a particular process signal and to place its status on the data bus. Consider the case when it is necessary to acquire the status of signal I_{15}. Signal I_{15} is wired to address 1111 0000 0000 1111. The microcomputer places this address on the address bus and also forces the IO/$\overline{M}$ line to zero, indicating that this is a memory address. The status of signal I_{15} appears at the output of multiplexer block A. After a proper delay, the microcomputer issues a read pulse ($\overline{RD}$) which causes the status of I_{15} to appear at line D_0 of the data bus; the microcomputer reads this status into the accumulator.

In the eight variables/byte scheme [Fig 1(b)], 14 address bits (A_{15} to A_2) are decoded to identify the module. The remaining two bits (A_1 and A_0) are decoded to choose a particular group of eight process signals and to place their status on the data bus. For example,



(b)

Fig 2 Memory mapped DOU. Module can effect status of any one of 32 process outputs (O_{31} to O_0). In one variable/byte scheme (a), five least significant address bits (A_4 to A_0) are decoded to select output to be controlled according to status of one data bit (LSB, D_0). In eight variables/byte scheme (b), status of eight outputs is effected at one time

if it is necessary to acquire signal I_{15} in this design scheme, the microcomputer sends out the relevant address (1111 0000 0000 0011) on the address bus and forces the IO/$\overline{M}$ line to zero. After a delay, the microcomputer sends the $\overline{RD}$ pulse. The byte containing I_{15} is read into the microcomputer, and the software program can then extract I_{15} to examine its status.

The DOU can be similarly implemented (Fig 2). In this control system, the state of any of 32 process outputs (O_{31} to O_0) is to be controlled. In the one variable/byte scheme [Fig 2(a)], the 11 most significant address bits (A_{15} to A_5) are decoded to identify the module. The remaining five bits (A_4 to A_0) are decoded to enable the relevant gate input (G_n) according to the particular output intended to be controlled. The status of the selected output is effected corresponding to the data on the least significant bit (LSB)—D_0—of the microcomputer data bus. Consider an example where it is necessary to set output O_3 to a logic 1 state. Output O_3 is wired to address 1111 0000 0000 1111. The microcomputer places this address on the address bus and places a one on the D_0 line of the data bus. It forces the IO/$\overline{M}$ line to zero, and after a proper delay, issues a write ($\overline{WR}$) pulse. This pulse is routed to the clock inputs of all DM 8613 latches. However, only gate input G_3 corresponding to output O_3—in block A—is enabled because of the decoding function performed by 74154. Accordingly, O_3 is set to one, without any of the remaining outputs being affected.

In the eight variables/byte scheme [Fig 2(b)], the $\overline{WR}$ pulse effects the status of eight outputs at a time according to the data on the data bus. Fourteen address bits (A_{15} to A_2) are decoded to identify the

TABLE 5

Comparison of Memory Requirements

	Memory Requirement In Bytes		
	Eight Variables/Byte (Branch Code)	One Variable/Byte (Direct Code)	One Variable/Byte (Branch Code)
Program memory	9040	3372	4084
Data memory	30	227	227
Input program length with straight input scheme	16	16	16
Input program length with change based input scheme	—	46	46
Total memory requirement with straight input scheme	9086	3615	4327
Total memory requirement with change based input scheme	—	3645	4357

Reduction in memory requirements using one variable/byte (direct code) scheme with change based inputs instead of eight variables/byte (branch code) scheme $= \frac{9086 - 3645}{9086} \times 100 = 59.9\%$

Reduction in memory requirements using one variable/byte (branch code) scheme with change based inputs instead of eight variables/byte (branch code) scheme $= \frac{9086 - 4357}{9086} \times 100 = 52.0\%$

TABLE 6

Comparison of Execution Times

	Time in Clock Cycles		
	Eight Variables/Byte (Branch Code)	One Variable/Byte (Direct Code)	One Variable/Byte (Branch Code)
Time taken to scan inputs with straight input scheme	984	7424	7424
Time taken to scan inputs with change based input scheme (One change/cycle)	—	1570	1570
Equation solution time	20385	14337	11903
Total time with straight input scheme	21369	21761	19327
Total time with change based input scheme	—	15907	13473

Saving in time using one variable/byte (direct code) scheme with change based inputs instead of eight variables/byte (branch code) scheme $= \frac{21369 - 15907}{21369} \times 100 = 25.6\%$

Saving in time using one variable/byte (branch code) scheme with change based inputs instead of eight variables/byte (branch code) scheme $= \frac{21369 - 13473}{21369} \times 100 = 37.0\%$

module. The remaining two bits (A_1 and A_0) are demultiplexed into four outputs and these outputs are used to route the $\overline{WR}$ pulse to the relevant eight outputs being controlled. Consider, for example, that outputs O_7 through O_0 are to be controlled according to pattern 1100 1010. Outputs O_7 through O_0 are wired to address 1111 0000 0000 0000. The microcomputer places this address on the address bus and the control pattern on the data bus (D_7 to D_0). Next, it enables the IO/$\overline{M}$ line and then issues a $\overline{WR}$ pulse after a delay. The $\overline{WR}$ pulse causes outputs O_7 through O_0 to be set according to the data pattern on the data bus. No significant difference exists in the extent of hardware required to implement DIU and DOU in either formatting scheme.

Additional Considerations

Before commencement of processing logic equations, the software program has to first acquire input variables from the process. After completion of logic processing, the program has to dispatch the output variables to the process. This necessitates consideration of several additional system design factors, such as mapping mode, frozen I/O, and change based inputs schemes.

Acquisition and delivery of I/O variables can be conducted by mapping the relevant hardware units in either I/O space or memory space.* Memory mapped I/O transactions are faster, and relevant programs occupy less space in memory.

An input variable may often be required in the solution of more than one equation. During the course of a particular cycle, an input variable should present the same status to each relevant equation. It is thus necessary for the software program to freeze (hold) the status of the process inputs at the start of a computation cycle. This holding is done by scanning the inputs and storing them in memory. However, it is seldom necessary to synchronize the dispatch of outputs to the process. The resulting solution of a logic equation can thus be delivered directly to the process, eliminating the necessity of a separate program for dispatching outputs. Dispatching is incorporated in a distributed manner in the logic equation solution programs.

A controlled process generally demands attention only when any of its parameters undergo a change. Typically, the number of inputs changing per cycle is small. In such cases, it is much faster to check for a change in a group of inputs and update only the changed inputs in one variable/byte format than to scan each input individually in this format.

In change based inputs scheme, the status of inputs is stored in both one variable/byte and eight variables/byte formats. In a particular computation cycle, the inputs from the process are scanned in groups of eight and compared against their status of the previous cycle stored in eight variables/byte format. If a change is detected, the state of corresponding variables in both formats is changed. Variables stored in one variable/byte format are utilized in solution of logic equations. Thus, this scheme exploits both formatting schemes in an advantageous way.

Application Example

As a typical application example, Table 4 shows the distribution of each type of equation in an actual process control application. A total of 216 output variables are determined by the solution of 258 equations containing 185 input variables. These variables also include the I/O and processing for the operator console. It is necessary to freeze the input status at the commencement of the computation cycle. The output delivery, however, does not need to be synchronized and the digital I/O units are memory mapped. Average number of inputs changing state in one computation cycle is less than one.

Tables 5 and 6 compare the total memory—sum of all program lengths and data memory—and execution time requirements, respectively, for various implementations of this application example. The processing schemes considered are eight variables/byte format with branch code, one variable/byte format with direct code, and one variable/byte format with branch code. Input scanning schemes are straight inputs and change based inputs. Choice of input scanning scheme has little effect on memory requirements, but the change based input scheme requires much less time to execute than the straight input scheme. Using one variable/byte instead of eight variables/byte format reduces overall memory requirements by 50 to 60% and, in conjunction with change based inputs scheme, reduces total time for one computation cycle by 25 to 37%.

Summary

A process control system must be designed to respond promptly to any changes in process parameters. If only logic parameters are considered, the required processing time depends on which of two possible formats is chosen to represent the logic variables. If only one variable instead of eight is stored in a full byte, there is an increase in the length of data memory as well as the time required to acquire the state of all variables from the process. However, there is a significant saving in the length of program memory and the time of program execution—sufficient to compensate for the larger data memory needed and the longer time required for scanning inputs.

Often, a large number of process parameters are represented by arithmetic variables. It is desirable that identical digital I/O units be used for transfers of arithmetic as well as logic variables. It is wasteful, however, to read an 8-bit arithmetic number one bit at a time; this number is best read as an integral byte. One solution is to read all digital variables as bytes; ie, arithmetic variables are read as a full 8-bit number/byte and logic variables as eight/byte. Software programs utilize arithmetic variables directly, and convert and store the logic variables as one/byte in memory.

This strategy also works well when systems are based on the change based inputs scheme. In this scheme, the software program reads logic variables as eight/byte, checks for a change against the previous stored status, and effects change in the one variable/byte table only if a change is detected. The latter scheme is the most efficient.

Acknowledgements

The authors wish to thank their colleagues for many helpful suggestions. Special thanks are due to Shri A. D. Marathe for supplying the data for the example cited.

Working as a scientific officer in the Reactor Control Div of the Bhabha Atomic Research Centre, Rajiv Bhargava has handled system design and software development of both computer based data logger systems and an operator training simulator for nuclear power plants. He holds a BS degree in physics from Meerut University and an MS degree in mathematics from Bombay University.

Anil Chandra also serves as a scientific officer in Bhabha Atomic Research Centre's Reactor Control Div. He has performed system design and hardware development for nuclear power plant computer based control systems. His Bachelor of Technology in electrical engineering is from the Indian Institute of Technology, Delhi.

*A. D. Marathe and A. K. Chandra, "Hardware/Software for Process Control I/O," *Computer Design*, Mar 1978, pp 122-126

We want you to always have a perfect record.

Ours.

Maxell has the best quality control record in the industry. So we're certain to always give you the best Floppy Disks in the world.

Some reasons why Maxell is so good.

Every Maxell Floppy Disk is guaranteed to be perfect. We tolerate no ifs, ands, buts, excuses, or dropouts. It's that simple . . . and that tough.

In fact we have developed innovative manufacturing techniques that actually slow down certain processes, sacrificing speed to gain quality. And our unique binder system, developed by our own engineers, applies the magnetic oxide with amazing uniformity and surface smoothness.

Ten out of ten: a perfect record.

Of course, Maxell Floppy Disks conform to ISO and IBM specifications. They also have been recommended by major OEMs, because Maxell works best with their hardware.

So open a box, and know in advance that it holds ten perfect floppys. You're right to not settle for anything less. Neither do we.

Maxell offers the full range of Floppy Disks, from standard 8-inch to 5¼-inch, plus Data Cassettes. *Dealer inquiries invited.*

maxell®
DATA PRODUCTS
The Quality Alternative

Maxell Corporation of America, Data Products Group
60 Oxford Drive, Moonachie, NJ 07074 Tel. (201) 440-8020

DESIGN NOTE

Programmable Timer Provides Accurate Interval Measurements

With minimal hardware parts and software overhead, monitor design measures each time interval of recurring beat-to-beat event sequences independently, rather than as average of longer time interval

Fred H. Carlin and James A. Howard University of California, Santa Barbara, California

A common equipment approach for monitoring repetitive events uses a counter that accumulates the number of events over a known time or base period. The advantages of this approach are simplified hardware and straightforward software, but since the total number of counts received during the base period is usually specified as ±1 count for most available systems, measurement accuracy, as well as hidden abnormalities detection, may compromise critical applications.

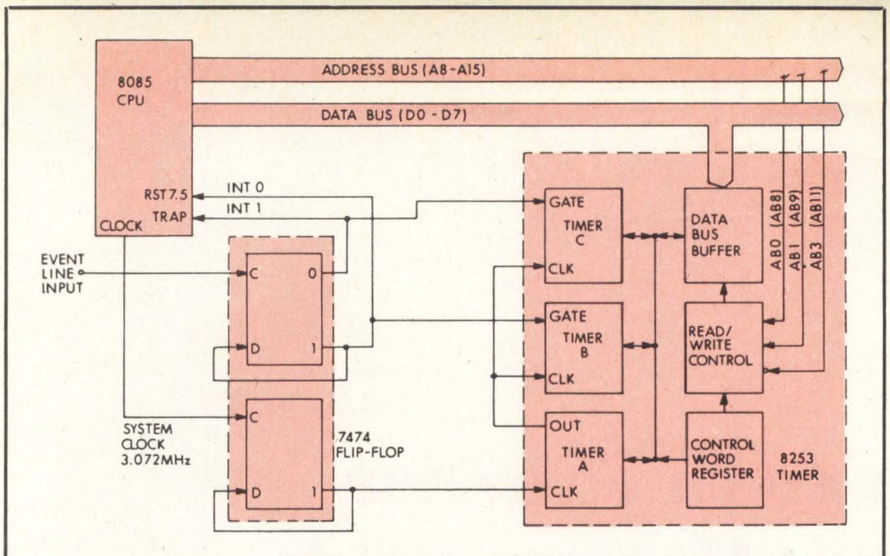
This 8253 programmable interval timer[1,2] is designed into a double buffer counter system. The highly accurate monitor system requires only two chips, exclusive of address selection logic. Software overhead is minimized since this counting system executes an interrupt service routine prior to the occurrence of each event. The counting system is readily assigned tasks of counting events with both slow and fast repetition rates. Applications include monitoring of cardiac and respiratory rates and other frequency encoded data such as neurological activities.

Hardware Principles

In the Figure the 8253 timer, comprising three independent 16-bit counter/dividers,[3,4] data buffer, control word register, read/write logic, and internal bus, is interfaced to an 8080/8085 microcomputer bus by a 7474 flipflop. The control word register stores the constants used to specify the operation of each counter/divider. The data buffer links the internal bus and the microcomputer 8-bit data bus. Read/write logic supervises the flow of data on the internal bus and through the data buffer.

Not shown in the Figure is the address selection logic since, in small systems, a bit selection scheme may be employed, thus eliminating the need for this logic. Bit selection is accomplished by assigning each chip select ($\overline{CS}$) line to its own bit in the address selection byte. In the Figure, $\overline{CS}$ would be tied to an address line, eg, AB3. To select the timer chip, the address would be 111101xx. The lower two address bits (xx) specify inputs to the read/write logic. Bit 3 (marked by a 0) specifies the timer. Bits 7 through 4 and bit 2 are filled with 1s since each of these may specify another device or chip.

Used as a divider, timer A pro-



Timer block diagram. System clock is divided by ½ 7474 flipflop and applied to timer A. Timer A then divides this signal to provide clocks for timers B and C. Event line input toggles ½ 7474 flipflop which gates on either timer B or C and also raises edge-sensitive interrupt input to 8085 CPU. Counts from timers B and C are gated to system data bus. Since I/O device addresses are mirrored on high address byte, AB0, AB1, and AB3 of 8253 timer are connected to 8085 address bus lines AB8, AB9, and AB11, respectively

vides a primary count frequency to timers B and C. The frequency source to timer A is typically the system clock. If a system clock frequency of 3.072 MHz is used (eg, in an 8085 microcomputer system), frequencies as low as 25 Hz may be obtained by division. The external divide-by-two 7474 flipflop is required because the maximum counting rate of the 8253 timer is about 2.6 MHz.

Timers B and C utilize the output from timer A to accumulate counts between events. Timer A may be programmed to provide a wide range of frequency outputs, hence a corresponding range of resolving power. If, for example, timer A is programmed to provide a frequency of 1 MHz, events with a period of up to 65,536 μs could be measured with ± 1-μs accuracy. If, on the other hand, timer A is programmed to provide a frequency of 25 Hz, events with a base period of up to about 43 min (65,536 x 0.04 s) could be measured with an accuracy of ± 40 ms.

The counting system is designed so that either the B or C timer is active, at any one time. The event input line toggles the 7474 flipflop which, in turn, stops the currently active timer and activates the currently dormant timer. The latter begins counting the frequency provided by timer A. Simultaneously, the counter that has just been stopped generates an interrupt. The interrupt is the signal for the microprocessor to read the timer and reset it to zero, thus reinitializing it for the next count interval.

Spurious signals that may be encountered could grossly upset any

PROGRAM 1

Initialization Routine

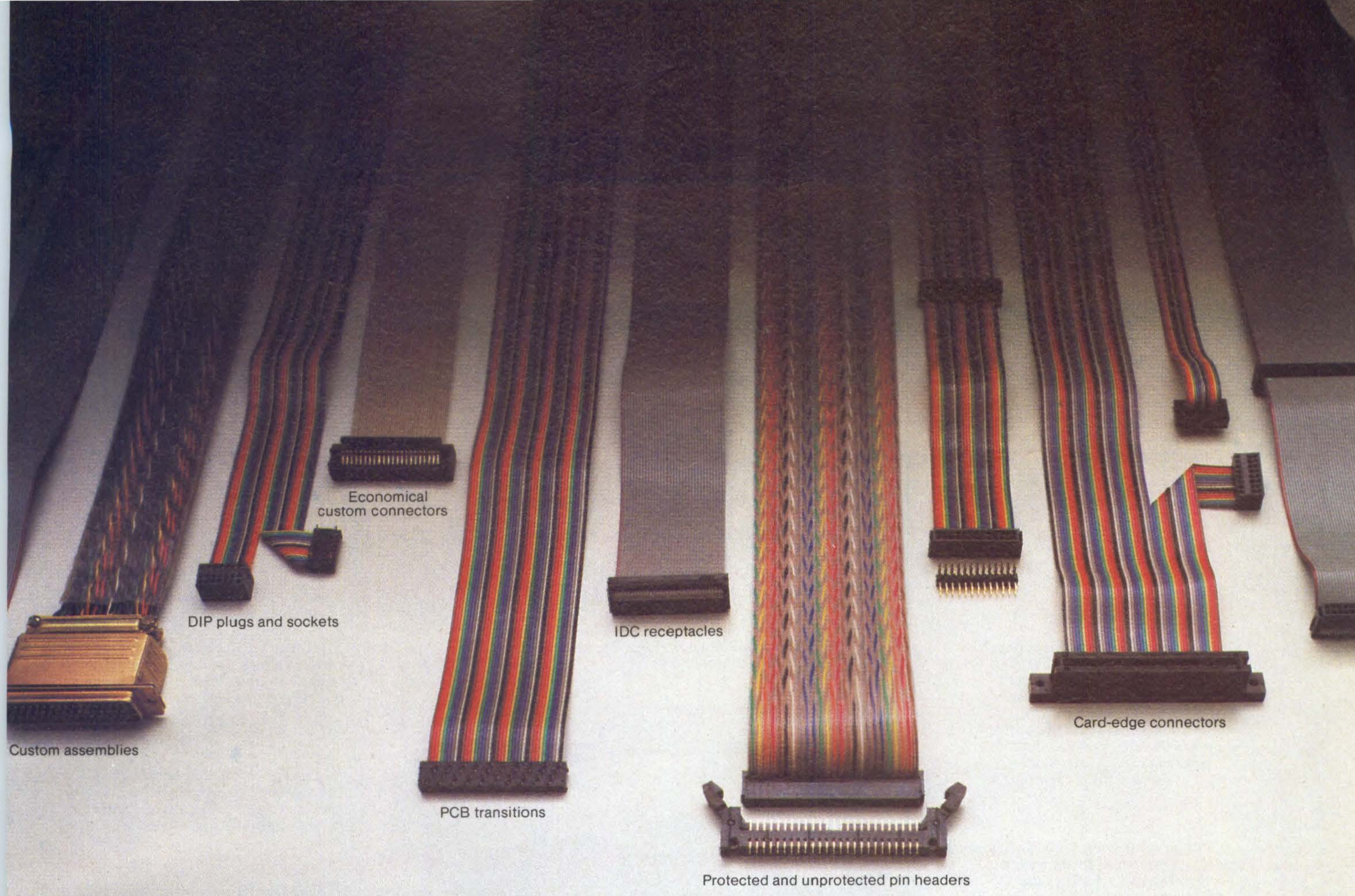
```
INIT:  MVI   A,36H    ;GET MODE CONTROL WORD
                      ;  FOR TIMER A
       OUT   OF7H     ;OUTPUT TO TIMER A
       MVI   A,7OH    ;GET MODE CONTROL WORD
                      ;  FOR TIMER B
       OUT   OF7H     ;OUTPUT TO TIMER B
       MVI   A,0BOH   ;GET MODE CONTROL WORD
                      ;  FOR TIMER C
       OUT   OF7H     ;OUTPUT TO TIMER C
       MVI   A,0      ;LOAD DIVISION CONSTANT
                      ;  INTO TIMER A, LSB FIRST
       OUT   OF4H     ;LSB TO TIMER A
       MVI   A,6      ;GET MSB OF DIVISION
                      ;  CONSTANT
       OUT   OF4H     ;MSB TO TIMER A
       MVI   A,0      ;GET A ZERO
       OUT   OF5H     ;ZERO COUNTERS B AND C
       OUT   OF5H     ;
       OUT   OF6H     ;
       OUT   OF6H     ;
       RET            ;RETURN TO CALLING ROUTINE
```

Note: Calling routine must enable interrupts

PROGRAM 2

Interrupt Service Routine

```
INTO:  PUSH  H        ;SAVE H,L REGISTERS
       PUSH  PSW      ;SAVE ACCUMULATOR AND
                      ;  FLAGS
       LHLD  .TBL     ;GET ADDRESS OF TABLE
                      ;  INTO H,L
       MVI   A,7OH    ;GET MODE WORD
       OUT   OF7H     ;OUTPUT TO TIMER
       INX   H        ;BUMP H,L
       IN    OF5H     ;GET FIRST BYTE OF COUNT
       MOV   M,A      ;STORE IN MEMORY
       INX   H        ;BUMP H,L
       IN    OF5H     ;GET SECOND BYTE
       MOV   M,A      ;STORE IN MEMORY
       SHLD  .TBL     ;PUT POINTER TO TABLE
                      ;  BACK
       MVI   A,0      ;GET A ZERO
       OUT   OF5H     ;ZERO COUNTER
       OUT   OF5H     ;
       POP   H        ;RESTORE H,L
       POP   PSW      ;RESTORE ACCUMLATOR
                      ;  AND FLAGS
       EI             ;REENABLE INTERRUPTS
       RET            ;RETURN
```



Put an end to it all.

IDC mass termination never had it so good, because now you can get all the connectors you need from a single source.

And, if we don't have the standard IDC connector you need to solve your mass termination problem, we'll invent one that will.

We'll take total responsibility for all your interconnect needs from jumpers and flat cables to IDC connectors and ready-to-go custom and standard planar assemblies, so check us out. You'll quickly see why so many happy endings begin with a call to us.

For the name and number of our nearest distributor or rep, write Spectra-Strip, an Eltra Company, 7100 Lampson Avenue, Garden Grove, CA 92642. Or call (714) 892-3361 today.

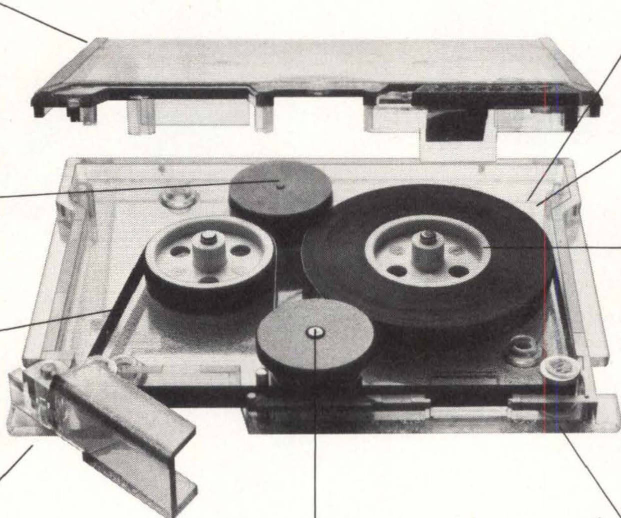
When you're down to the wire

CIRCLE 115 ON INQUIRY CARD

Why Verbatim® re-invented the wheel.

Our patented "Belt Driven Floating Roller" is the key engineering design element in the TC-150. The Verbatim TC-150 offers at least ten improvements over the other design.

TC-150 mini data cartridge, shown actual size.



1. Our **unitized construction,** consisting of symmetrical shell halves, provides structural stability and the strength of advanced polymer. Construction is simpler and less expensive, yet the entire shell has thermal consistency. No differing rates of expansion to stress critical tape paths.

2. Our simplified Floating Roller design, employing fewer moving parts, **reduces variability** caused by environmental changes, age and use.

3. Our TC-150 mini data cartridge uses Verbatim's unique **gamma ferric oxide digital** tape. This special formulation has been extensively field proven to have long life and low head abrasion.

4. Each cartridge is **completely certified** after final assembly to be 100% error free before packaging.

5. Our Floating Roller design, which eliminates the unstable function characteristics of corner rollers, **improves recording quality** by producing repeatable tape tension across the read/write head.

6. Our metal-free advanced polymer shell design **resists static buildup.** A metal baseplate can cause damage from static electricity as the cartridge is inserted into the system. Synthetic carpets can build up big charges.

7. The Verbatim TC-150 mini data cartridge has a **broad operating temperature range.**

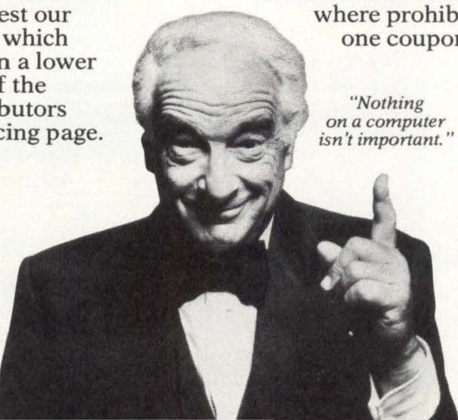
8. The tape hub material was formulated to produce a rate of thermal expansion that exactly matches the tape's. This **prevents "pack shift"** and uneven tape wear.

9. **Less power is consumed** when driving our Floating Roller cartridge because the elimination of corner rollers dramatically lessens friction.

10. Since we have **eliminated the corner rollers,** we don't need the metal baseplate which is subject to warping, dents and burrs.

Any resemblance between the Verbatim TC-150 mini data cartridge and the old fashioned 3M DC-100A and HP 9162-0061 cartridges it replaces, ends with the form factor. We completely re-engineered this useful byte-oriented data cartridge, for the good reasons noted above. You'll want to test our improvements, which happily result in a lower cost. Call any of the Verbatim distributors listed on the facing page.

Special Limited Offer: Buy a sample order of at least five Verbatim TC-150's and our distributor will give you, on delivery of your order, a coupon redeemable for one of our mini data cartridges **free.** This offer is only available through participating Verbatim distributors and is void where prohibited by law. Limit one coupon to each customer.



"Nothing on a computer isn't important."

Our distributor will also be delighted to supply you with quality Verbatim diskettes and cassettes.

Verbatim Corporation.
323 Soquel Way, Sunnyvale, CA 94086.
(408) 245-4400.
TWX: 910-339-9381.

CIRCLE 116 ON INQUIRY CARD

PEOPLE WHO PLAY THE COMPUTER

Specify Verbatim.

accumulated counts. In practice, these signals are optimally filtered out by the transducer and related electronics. If, however, only the majority of disturbances is eliminated, sufficient capability remains in the counting system design to discern these abnormal counts by software means. The system design described allows more microprocessor time to be devoted to detection and correction. Schemes using the measurement of the total number of counts over a given time period (eg, 10 s) are disadvantageous since an extra count or two during the collection period would be detected simply as an increased rather than an abnormal rate.

Software Principles

Basic software requirements that must be accomplished are (a) initialization of the timer chip, whereby the chip is specified as a divider and two counters, (b) loading of the divider with a division constant, and (c) collection of beat-to-beat data under interrupt control. Initialization is accomplished by a short sequence that sets up timer A as a simple frequency divider and timers B and C as simple counters. Divider A is loaded with an appropriate divisor to obtain a frequency that has a period equal to or less than the resolution desired. Upon the enabling of interrupts, beat-to-beat data are collected.

At reception of each interrupt, the corresponding counter is read and the contents are reset to zero, thus readying the counter for the next count period. Time available for servicing the interrupt is up to the full period of the incoming waveform. Data outputs are direct measures of the length of the intrabeat periods.

Application Example

A typical application of the beat-to-beat monitor is in the measurement of cardiac rate. Sample routines that implement the initialization and interrupt service routines are listed in Programs 1 and 2, respectively; these routines are programmed for the 8080/8085 microcomputer.

Program 1 gets and stores control words and initialization constants for each of the three timers. The 16-bit division constant for timer A is also loaded, and the B and C timers are set to zero. The calling routine is expected to set up and enable interrupts.

The interrupt service routine reads timer B and places the result in table TBL. Pointer to table is updated and timer B is reset to zero. A similar routine is required for timer C. The technique of placing collected data in a table is not mandatory. The resulting short routine enables the microprocessor to service the beat-to-beat timer in about 100 μs; the processor is then free to perform other processing chores during the remaining time. The resulting numbers stored in table TBL are a measure of the beat-to-beat intervals. With a system clock frequency of 3.072 MHz, the sample program produces counts in 1-ms increments for each beat period. Since the maximum count of the B or C timer is 65,536, the maximum interval that may be measured is 65.536 s which is sufficient to cover all heart rates.

Summary

The monitor design gathers event-to-event timing data with minimal hardware and software overhead. Hardware minimization saves cost and space, especially if several such counters are to be included in a packaged system. Minimal software requirements are paramount in applications where repetitive events occur rapidly, for example, in the investigation of neural activity. Time intervals are measured separately and independently, giving accurate measurements even if events have a wide variation from beat-to-beat.

References

1. Intel Corp. *Components Data Catalog*, Santa Clara, Calif, 1978
2. J. Beaston, "Interval Timer Serves as a Baud Rate Generator," *Computer Design*, Aug 1978, pp 112-119
3. D. G. Larsen, *et al*, "Microcomputer Interfacing: Characteristics of the 8253 Programmable Interval Timer," *Computer Design*, Feb 1978, pp 136-140
4. D. G. Larsen, *et al*, "Microcomputer Interfacing: A Demonstration Program for the 8253 Timer," *Computer Design*, Mar 1978, pp 134-136

DESIGN NOTE

Optical Link Design and Component Selection

Careful selection of light source, detector, optical modems, couplers, and optical cable enable single-fiber half-duplex link between remote and local coaxial connected key station systems

Norman Goldberg and J. A. Eibner Sperry Univac, Blue Bell, Pennsylvania

An optical data link for connecting five computer-aided data entry key stations to a processor has been designed, built, and tested (Fig 1). The resulting system accepts keyboard-entered source data from a maximum of 32 operator keystations and produces validated data records for mainframe processing. System requirements included a data link length of up to 1.6 km, operation at 10^6 baud, a signal-to-noise ratio corresponding to a bit error rate of less than 10^{-15}, and half-duplex data transmission. A single fiber optic cable was selected for the link interface because it offered many advantages over coaxial cable, ie, low transmission losses, immunity to electromagnetic interference, and freedom from noise and pickup problems associated with ground loops. Moreover, an optical cable is smaller, weighs less, and is more secure. Various combinations of optical, mechanical, and electronic components were investigated to achieve the desired performance level.

Component Selection

Lens System

Since the data link for computer-aided data entry (CADE) operates in a half-duplex mode, data terminals can be interconnected by a single

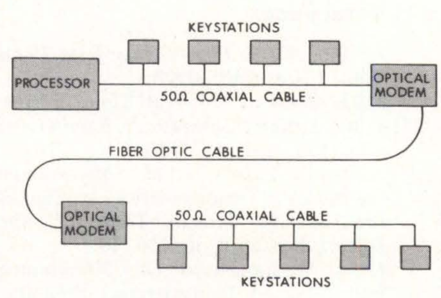


Fig 1 Block diagram of CADE system installation. Optical modem connects optical cable to previously installed coax cable, which connects four key stations to processor. Five additional key stations are connected at other end of optical cable via second optical modem

fiber cable. This adds the complication of a T-coupler at each end of the optical cable, but the significant cost saving of 1.6 km of fiber made the complication acceptable. Each T-coupler couples light from a light emitting diode (LED) source into the cable and from the cable to a detector (Fig 2). A dielectric beam splitter divides the incident light into a reflected and a transmitted beam. Lenses project the LED radiation onto the cable end and radiation from the cable end onto the detector.

Focal length of the source lens had to be on the order of 5 mm to keep the T-coupler compact and still have space enough to insert a beam splitter between the lens and the cable. An f-number as low as 0,5 was desirable so that a large fraction of radiation from the LED source would be projected onto the cable end. Low cost aspheric lenses, which also have little spherical aberration, are ideally suited for this application. They are somewhat astigmatic, but this does not significantly affect the radiant power inserted into the cable. A pair of identical aspherical lenses with their aspheric surfaces in contact is used for the source lens. The individual lenses each have a focal length of 8.5 mm and a diameter of 12 mm. The combination (or symmetric doublet) has a focal length of 5.0 mm and an f-number of 0.5.

In the fiber input coupler (Fig 3), the radiation emitted by the LED source of diameter d_s at an angle θ_s is focused to an image of diameter $d_i = Md_s$, and makes an angle $\theta_i = \theta_s/M$ at the image position. M is the magnification and the angles are assumed to be small, ie, $\theta \approx \sin \theta$. If the f-number of the lens is small enough to collect all radiation emitted up to the angle θ_s, the lens increases the acceptance angle by a factor of M, and therefore the solid angle coupled into the fiber, which is proportional to the square of the acceptance angle, is increased by a factor of M^2. If source and image diameters are both larger than fiber diameter, which is true in this application, the fraction of the source radiation projected onto the fiber is reduced by a factor of M^2. As a result, the radiation coupled with the lens is the same as the radiation coupled by direct butting of the LED against the fiber, except for losses due to reflections at the four surfaces of the lens doublet.

In testing the lens doublet operation, 175 μW were coupled into the fiber, and 205 μW were coupled by butting the same LED source directly to the fiber. The reduction in power is in agreement with the losses expected by reflections from the lens. In the source lens system, magnification is 1.7 and the image of the source is appreciably larger than the fiber core. This arrangement is relatively insensitive to small displacement of LED, lens, or fiber. Up to 100-μm displacement of the fiber in any direction reduces the power coupled into it by less than 10%.

The detector lens system focuses the fiber core onto the detector, whose active area diameter is 0.76 mm — three times larger than the fiber core. A pair of identical planoconvex lenses with the convex vertices in contact are used for this lens system. The individual lenses have a focal length of 8.1 mm and a diameter of 4.3 mm. The combination has a focal length of 4.1 mm, and an f-number of 1.0. In the detector lens system, magnification of the lens is 2.2, and the numerical aperture (NA, the sine of one-half the acceptance angle) of the lens is 0.4. Since this NA is larger than the NA of the cable (see Optical Cable section) and the image of the fiber core is smaller than the active area of the detector, all the light from the fiber reaches the detector except for reflection losses at the lens and detector surfaces.

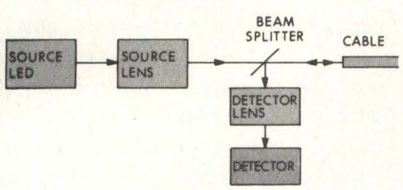


Fig 2 Simplified T-coupler representation. Source lens focuses source LED output through beam splitter onto optical fiber core. Beam splitter reflects optical radiation from fiber and focuses it onto detector via detector lens

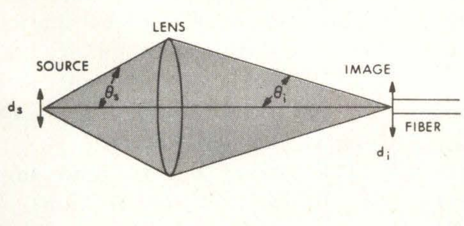


Fig 3 LED source to fiber coupling. Lens magnifies source, which is larger than core of fiber, to an even larger image, reducing fraction of emitted radiation impinging on fiber core. Decrease is compensated for by increasing acceptance angle of LED radiation, so that radiation coupled into fiber with lens is about equivalent to that coupled by direct butting of source against fiber

LED vs Injection Laser

It was determined that system requirements could be met with an LED source or an injection laser. The LED was chosen because injection lasers are expensive, require either precise temperature control or a feedback system to keep the power level constant, and have shorter lifetimes.

Optical Cable

Power that can be coupled into a fiber from an LED source is on the order of −10 dBm (power in dB relative to 1 mW). A minimum loss of 6 dB is introduced by the beam splitters used in the T-coupler. Average power required to achieve a signal-to-noise ratio corresponding to a bit error rate (BER) of 10^{-15} at 1 MHz with an avalanche photodiode (APD) and the system preamplifier is about −60 dBm. Therefore, loss in the fiber cable must be less than 44 dB (60 − 10 − 6 dB), or 27 dB/km for a 1.6-km link length. Thus, a relatively low loss cable is required. A plastic covered silica fiber (PC-10), which costs less than glass-on-glass fiber, meets this requirement. Its specifications are optical attenuation of <20 dB/km at a wavelength of 800 nm, steady-state 3-dB numerical aperture of 0.22, and core diameter of 250 μm. Actual measurements determined that the attenuation of the 1.6-km cable is 16.8 dB/km at 800 nm and the steady-state 3-dB NA is 0.12. NA is below specification, which adds about 5 dB power loss. This loss is almost recovered in the 1.6-km cable by the lower than specified attenuation.

Several tradeoffs were considered in selecting PC-10 fiber. Important positive factors were its low cost and large core diameter. The latter increases the insertion power of low cost LEDs, which are all large. When low cost small LEDs become available, large core area will be of less importance.

Negative tradeoffs concerned the effect of a humid environment and the difficulty of bonding a connector to the silicone cladding. No degradation of optical properties was observed in a 60-m test length after being submerged in water for 38 days, nor in a 900-m test length after six months in a usually flooded underground duct. Similar results have been reported for longer test periods.[1] The bonding problem is still not completely solved, but bonding is satisfactory for long cable lengths where the stress at the fiber connector bond is not as large as it is in short cables.

LED Source

The selected radiation source is an HLP-20 LED with a wavelength of 800 nm, which is close to the minimum attenuation wavelength of PC-10. Optical power of the diode with a current of 200 mA is 20 mW. The hemispherically-shaped LED source has a diameter of 460 μm. Intensity of radiation is essentially constant over an angle of ±40° from the optical axis.

Optical Detector

The selected TIED 88 optical detector circuit consists of a silicon APD and a reference diode. Breakdown voltages and temperature coefficients of the diodes are closely matched. The reference diode is used in a temperature compensating bias circuit that holds the avalanche gain of 100 constant over wide temperature variations. Active area of the APD has a diameter of 750 μm.

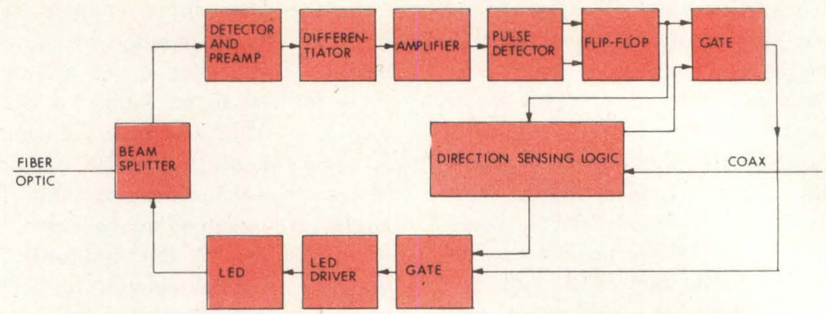


Fig 4 Optical modem block diagram. When local LED source is transmitting, receiver is blocked. LED source cannot be turned on when signals are being received. Data recovery scheme allows for recovery of all NRZ patterns with ac coupling between gain stages

Data Recovery

Format for the transmitted data was determined by the existing data entry system in which the optical link is used. Data are transmitted in asynchronous start-stop nonreturn to zero (NRZ) format in half-duplex mode at a modulation rate of 10^6 baud. The system uses a polling protocol, ie, the central processor sequentially polls the key stations, and a key station can transmit only after it has been polled. System design allows for a response to be generated as early as 2 μs after an incoming signal is completed. Because the optical link will be used only for distances greater than 2000 ft (610 m), it will take at least 8 μs for a response to be received after a transmission is completed.

These system considerations imposed restrictions on the data recovery scheme. First, the receiver must function with arbitrary data patterns, including long strings of 0s and 1s. Second, transients caused by saturation of the receiver due to scattered light from the transmitter at the same end had to decay in less than 8 μs. Finally, decision-making logic was required to determine the direction of transmission and disable the transmitter or receiver to prevent interference.

The preamplifier is a simple 2-stage, bipolar transimpedance circuit. Predominant noise contributors are shot noise in the first transistor's base junction, which is proportional to the base current, and thermal noise in the feedback resistor (R_F). Base current is inversely proportional to the collector resistor (R_C). Thermal noise is inversely proportional to R_F; thus, by increasing R_C and R_F, noise spectral density can be reduced. Bandwidth (BW) is limited by the detector's capacitance and the amplifier's input resistance, which is proportional to R_F. Similarly, the first transistor's collector capacitance and R_C can also limit bandwidth. Therefore, by increasing R_C and R_F, bandwidth is reduced. By careful design, noise can be reduced in direct proportion to BW rather than by $\sqrt{BW}$, which might have been expected. Measured results for the preamplifier with PIN detectors over the range of 0.8 to 30 MHz show the predicted linearity. The noise equivalent power (NEP) at 1 MHz is 1 nW (−60 dBm). An additional 10-dB improvement is obtainable with an APD.

The NEP of the APD and amplifier is 0.11 nW (−70 dBm). To achieve a BER of 10^{-15}, the peak-

DATARAM PRESENTS THE 8.0 MEGABYTE SOLUTION

Now you can have up to 8.0 megabytes of memory in a single 15¾″ chassis to meet your disk emulation and main memory requirements.

It's available today in BULK SEMI, from Dataram Corporation, the people who pioneered BULK CORE.

And because Dataram designed BULK SEMI to be compatible with its popular BULK CORE modules, you can take advantage of the wide range of existing BULK CORE controllers to use BULK SEMI as main memory or in disk emulation systems for DEC®, Data General, or Interdata minis.

Dataram's 15¾″ BULK SEMI system consists of a BULK SEMI Controller board and up to 16 BULK SEMI Array boards. With each BULK SEMI Array board being 512KB, the maximum chassis capacity is 8.0 megabytes.

Error correcting is standard, as are the reliability, performance, and economy of BULK SEMI. From Dataram. And only Dataram.

I'd like to learn more about BULK SEMI for my

______________________ minicomputer.

☐ Please send more information.
☐ Please have a salesman contact me.

Name ______________________

Title ______________ Phone ______________

Company ______________________

Address ______________________

City ______________ State ______ Zip ______

Also send me information about
☐ BULK CORE ☐ BULK MINI

DEC is a registered trademark of Digital Equipment Corporation

DATARAM CORPORATION

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

Canada: Ahern & Soper Ltd., Alberta, British Columbia, Ontario, Quebec • **Finland:** Systek OY, 90-737-233 • **France:** YREL, 956 81 42 • **Italy:** Mactronics Italia, 02/35 36 041 • **Netherlands:** Technitron b.v., 020-45 87 55 • **Sweden:** M. Stenhardt AB, (08) 739 00 50 • **Switzerland:** ADCOMP AG, 01/730 48 48 • **United Kingdom/Ireland:** Sintrom Ellinor Ltd., (0734) 85464 • **West Germany/Austria:** O.E.M.-Elektronik GmbH, 07 11-79 80 47 • **Australia/New Zealand:** Anderson Digital Equipment, (03) 543 2076 • **India:** Industrial Electronic Instruments, 79281 • **Israel:** K.D.M. Electronics, 921513 • **Japan:** Matsushita Electric Trading Co., Ltd., 03 (435) 4501 • **Taiwan/Republic of China:** Syscom Computer Engineering Co., (02) 7022156

CIRCLE 117 ON INQUIRY CARD

to-peak signal to rms noise ratio must be 15.9 if the noise is assumed to be Gaussian.[2] Therefore, required power is 1.7 nW or −58 dBm. A more sophisticated amplifier circuit could result in an even lower input power requirement.[3] Data recovery is accomplished by differentiating the preamplifier output, amplifying the differentiated signal, detecting positive and negative pulses, and using them to set and reset a flip-flop (Fig 4). This scheme allows for recovery of all NRZ data patterns with ac coupling between gain stages. The ac coupling time constant can be very short, preventing long recovery times when the receiver is overdriven.

System Results

In a prototype system, the LED source with drive current of 100 mA emitted 10 dBm. Coupling loss into the fiber was 21.5 dB. Loss in 1.6 km of cable was 26.9 dB (16.8 dB/km); the two beam splitters added another 6.2 dB loss, and detector coupler loss was 1.4 dB, with resulting input power to detector of −46 dBm (25 nW). Allowing for a time degradation of 3 dB and an additional 3 dB for degradation of LED and receiver sensitivity by temperature variation, the system was estimated to have an excess power of 6 dB.

After a successful system checkout with a fiber cable on a reel, the cable was installed on site. The fiber optic cable length was actually 3200 ft (975 m) and was connected by an optical modem to a previously installed 3300 ft (1006 m) of coaxial cable, which runs to the CADE processor. Coaxial cable also connects four local CADE key stations to the processor. The other end of the fiber optic cable is connected via a second optical modem to five remote CADE key stations (Fig 1). The optical cable runs through manholes, under a bridge, and through a subway tunnel. New cable procured for this installation had an attenuation of 9 dB/km. Two cable breaks occurred, one during the pulling of the cable and the second a month later. In both cases, unplanned splices were made by terminating the broken ends with available connectors and joining the connectors with coupling fittings. These splices introduced an excess loss of 12.5 dB. However, this loss was offset by the lower loss of the new cable. The total cable loss is 24 dB, which is less than the 26.9 dB loss of the cable in the prototype system. Except for fiber breaks because the cabling is not tough enough for the harsh manhole environment, the system has operated reliably. Preliminary results with a more rugged replacement cable promise to correct the breakage problem.

Acknowledgement

The assistance of Mr Richard Lawrence in the design and construction of the electronic portion of the system is gratefully acknowledged.

References

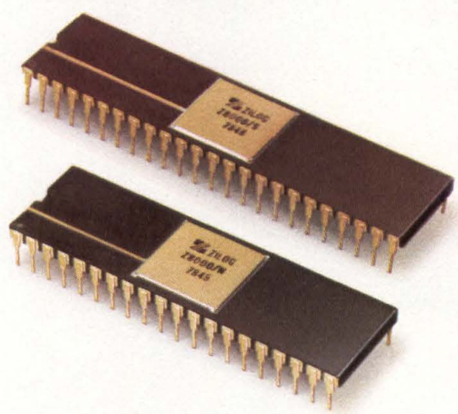
1. Inado, *et al*, *Second European Conference on Optical Fiber*, 1977
2. J. R. Biard and L. L. Stewart, *IEEE Electromagnetic Compatibility Symposium Record*, p 12, 1974
3. S. D. Personick, *Bell System Technical Journal*, 52, p 843, 1973

IMAGINE

Zilog rockets out in front again to launch a new generation.

For the first time, the architectural sophistication and data processing capabilities of large, main-frame computers has been captured in the cost-effective, easy to use format of the microprocessor. Now you can have the freedom to create entirely new, innovative systems, unhindered by the primitive architectures of previous microprocessors.

Flexibility soars to new heights.

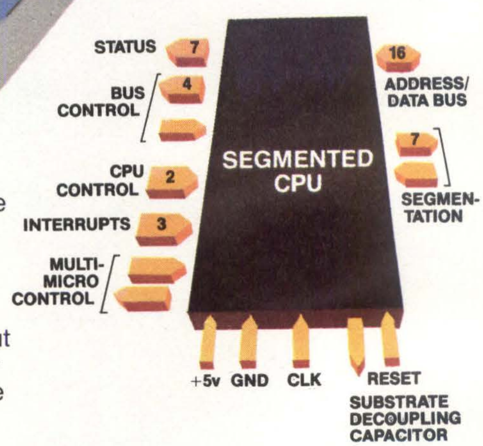


The Z8000 allows you to directly address up to 8 MB of memory. All 16 registers are a full 16 bits wide and are completely general purpose. The powerful, problem-solving instruction set supports 7 different data types from bits to 32 bit words, has 8 addressing modes and 418 usable opcode combinations.

The general register architecture helps avoid the well-known bottlenecks inherent in dedicated register designs. When this architecture is combined with the powerful instruction set, the Z8000 system throughput is an explosive 50% greater than any other 16 bit microprocessor available today.

A revolution in sophistication.

The Z8000 has been designed from the ground up with options to fit your application needs exactly. For the full 8 MB addressing capability, choose the 48 Pin DIP version. Its companion device, the Memory Management Unit, opens the way to dynamic relocation, memory protection and multi-tasking applications.



IMAGINE

A REVOLUTIONARY NEW WAY TO THINK ABOUT MICROPROCESSOR SYSTEMS. INTRODUCING ZILOG'S Z8000.

For smaller, less memory-intensive applications, select the 40 Pin version of the Z8000. It's software compatible with the 48 Pin Z8000 but addressing is limited to 64KB in each of its six address spaces. It comes in a standard 40 Pin package.

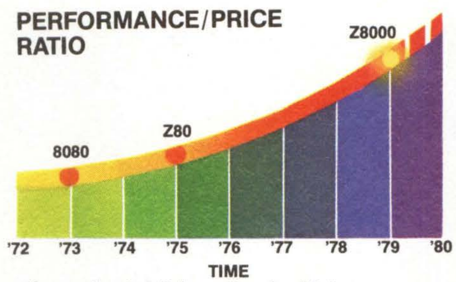
Wait 'till you meet the family.

We're starting off this new microprocessor era with a bang, but it's just the beginning. Soon to come are the Memory Management Unit, peripheral interfaces, FIFO buffer elements, universal peripheral controller and memories for any application you might have.

And, all the new I/O chips, memories and, of course, the companion Z8, take advantage of the flexible Z-BUS architecture to maximize performance, ease of interconnection and minimize PC board area.

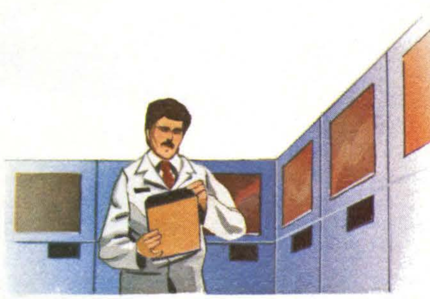
Zilog delivers on the next generation of microprocessors. Again!

With the introduction of the Z8000, microprocessor technology explodes to new heights. Bursting with a rich and sophisticated architecture, the Z8000 not only opens the way to revolutionizing your next generation



of products, it has the built-in growth potential to carry your product development efforts out to totally new and unexplored horizons.

Imagine the possibilities, then light your own fuse!



Sound exciting? It is. Get your own fireworks blazing by placing your order today with your nearest Zilog distributor.

In the meanwhile, give your engineering staff a headstart on the fireworks by ordering the Z8000 literature package; in the U.S. order directly from Zilog, elsewhere from your Zilog distributor.

10460 Bubb Road, Cupertino, CA 95014
(408) 446-4666 TWX 910-338-7621
EASTERN REGION: (617) 667-2179
MIDWESTERN REGION: (312) 885-8080
SO. WESTERN REGION: (714) 549-2891
NO. WESTERN REGION: (408) 446-4666
EUROPE (ENGLAND): (0628) 36131/2/3
WEST GERMANY: (08106) 4035
JAPAN: 03-476-3010

An affiliate of
EXXON ENTERPRISES INC.

Zilog

SEE US AT NCC

CIRCLE 219 ON INQUIRY CARD

THE RIGHT CHOICE!

أصلح الترمنالات الكومبيوتريه

If your next job involves a turn-key computer based project for the Middle East, then call us. Comterm offers a wide range of computer terminals specifically designed to handle Arabic or Farsi data, thus freeing your systems development group from the many problems inherent in the processing of data in Arabic and Farsi.

Highlight Features

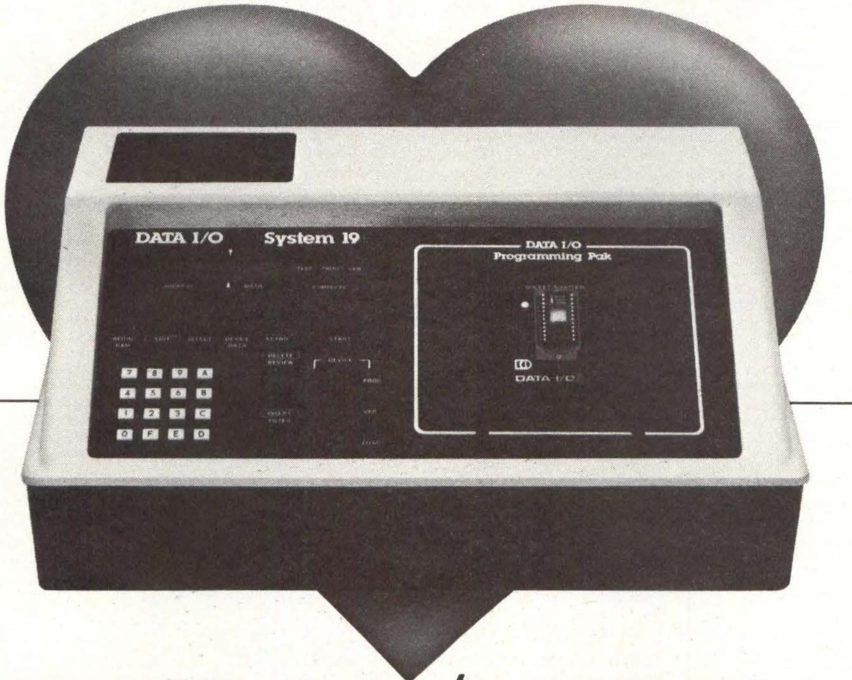
- Full bilingual capability (Arabic/English or Farsi/English)
- High-quality display of Arabic data respecting the curvaceous nature and precise calligraphy of the Arabic script
- Simplified entry of Arabic data using a reduced keyboard where only one key position is used for each basic character of the Arabic alphabet
- Simplified transmission of Arabic data using a reduced code set where only one code is used for each basic character of the Arabic alphabet
- Automatic expansion of reduced representation of an Arabic character to its appropriate shape through a microprocessor controlled contextual analysis
- Natural entry of data in either language
  - — Arabic text — right-to-left
  - — Arabic numbers — left-to-right
  - — English text — left-to-right
- Simple convenient procedures for selecting the entry language and for switching from one language to the other
- Models compatible with:
  IBM 3270 protocol (standalone or cluster)
  Honeywell VIP 7700 protocol
  ASCII Teletype protocol (character mode or block mode)
- Optional peripherals
  - — bilingual printer
  - — light pen
  - — mini-floppy discs

COMTERM

545 Delmar Avenue, Pointe Claire, Québec, Canada H9R 4A7 Telephone: (514) 694-3031 Telex No.: 05-821812

CIRCLE 131 ON INQUIRY CARD

DEAR DEVELOPMENT SYSTEM:



You'll love letting Data I/O's System 19 do your programming while you do the important things.

Once you've developed a PROM program on your development system, simply download it into a Data I/O System 19. This frees your development system for the next person who needs it.

Later, if you discover that a statement has been left out, or you need to edit the program, you can use the System 19 to make all the necessary changes without once interrupting work being done with the development system. And your System 19 can program every kind of bipolar and MOS PROM—not just the few MOS PROMs that most development systems program.

The System 19 saves you time by eliminating the need for you to build software packages so your development system can transmit data to the programmer. System 19 offers all these development system object code formats in a single package:

RCA Cosmac, Motorola Exorcisor, Intel Intellec 8/MDS, Signetics Twin, MOS Technology, Fairchild F8 Formulator, Tektronix 8001, and Zilog MCZ-1.

Best of all, Data I/O System 19 is priced within just about everyone's budget.

You haven't shopped around until you've looked at Data I/O. Let us show you the difference. Circle the reader service number or contact Data I/O, P.O. Box 308, Issaquah, WA 98027. ***For answers fast, call toll free: 800-426-9016.***

Good idea! DATA I/O

Programming systems for tomorrow...today.

CIRCLE 120 ON INQUIRY CARD

INTERFACING FUNDAMENTALS: MULTIPLEXED LED DISPLAYS—PART 2

Peter R. Rony and David G. Larsen
Virginia Polytechnic Institute and State University

Jonathan A. Titus and Christopher A. Titus
Tychon, Inc

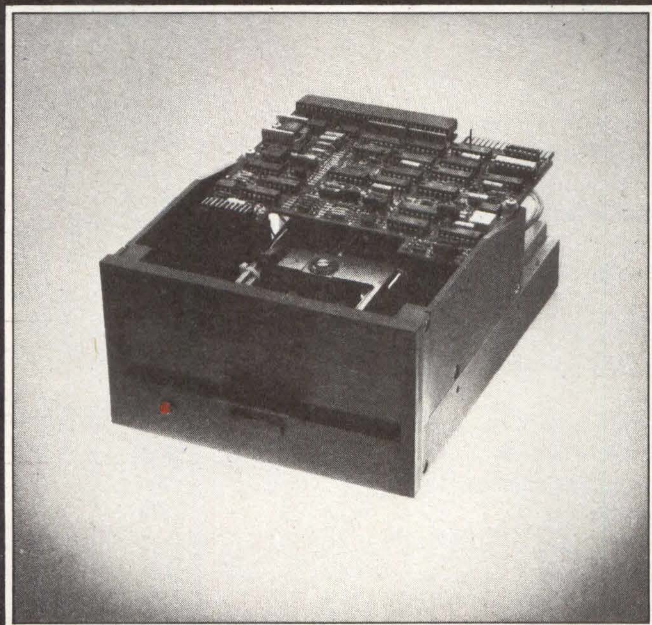
Microcomputers can be interfaced to 7-segment displays by a number of means. Two methods, discussed in Part 1 (*Computer Design*, Apr 1979, p 128), are latching and multiplexing—usually used only with multidigit displays. Alternatives to these are provided by software techniques.

When the microprocessor constantly updates the light emitting diode (LED) display (with digit enable codes and data values output to the display every millisecond), the microcomputer is unfortunately tied up so that it cannot perform any other tasks. The Program For 10-Digit Number Displayed on Multiplexed LED (contained in Part 1, Apr 1979, p 136) could, of course, be converted to a subroutine. If it is called every 15 or 20 ms, the 10-digit number will still be displayed at a reasonably fast rate. However, it may be difficult to program the microcomputer so that the DISPLA subroutine is called this often.

An interrupt can solve this problem. Whenever the 8080 microprocessor is interrupted, it outputs a numeric value to the next consecutive digit in the display. The microcomputer has to be interrupted at least 400 times every second for the display not to "flicker." Therefore, the 10-digit number will be displayed 40 times every second. To interrupt the microprocessor so that it "services" the display this often, a low frequency oscillator (400 Hz) can be wired to one of the interrupt interfaces previously discussed. [1,2]

The program that services the interrupt and outputs a new 8-bit value to the display interface is similar to the software used in Fig 2 (see Part 1, Apr 1979, p 132); however, because of its length, the listing has not been included. The difference between the two programs is that the microprocessor has to store the digit enable code and the address of the memory location that contains the next digit to be displayed. These values must be stored in memory, because register pair H and register D may be used by the interrupted program. Therefore, each time the oscillator interrupts the microcomputer, it has to read from memory the address for the next digit to be displayed and its corresponding digit enable code. After the number is displayed, the digit enable code and memory address are incremented and stored back in memory. To simplify this software, the 10-digit number can be stored in 10 memory locations, one digit per memory location, rather than "packing" the binary coded decimal (BCD) data.

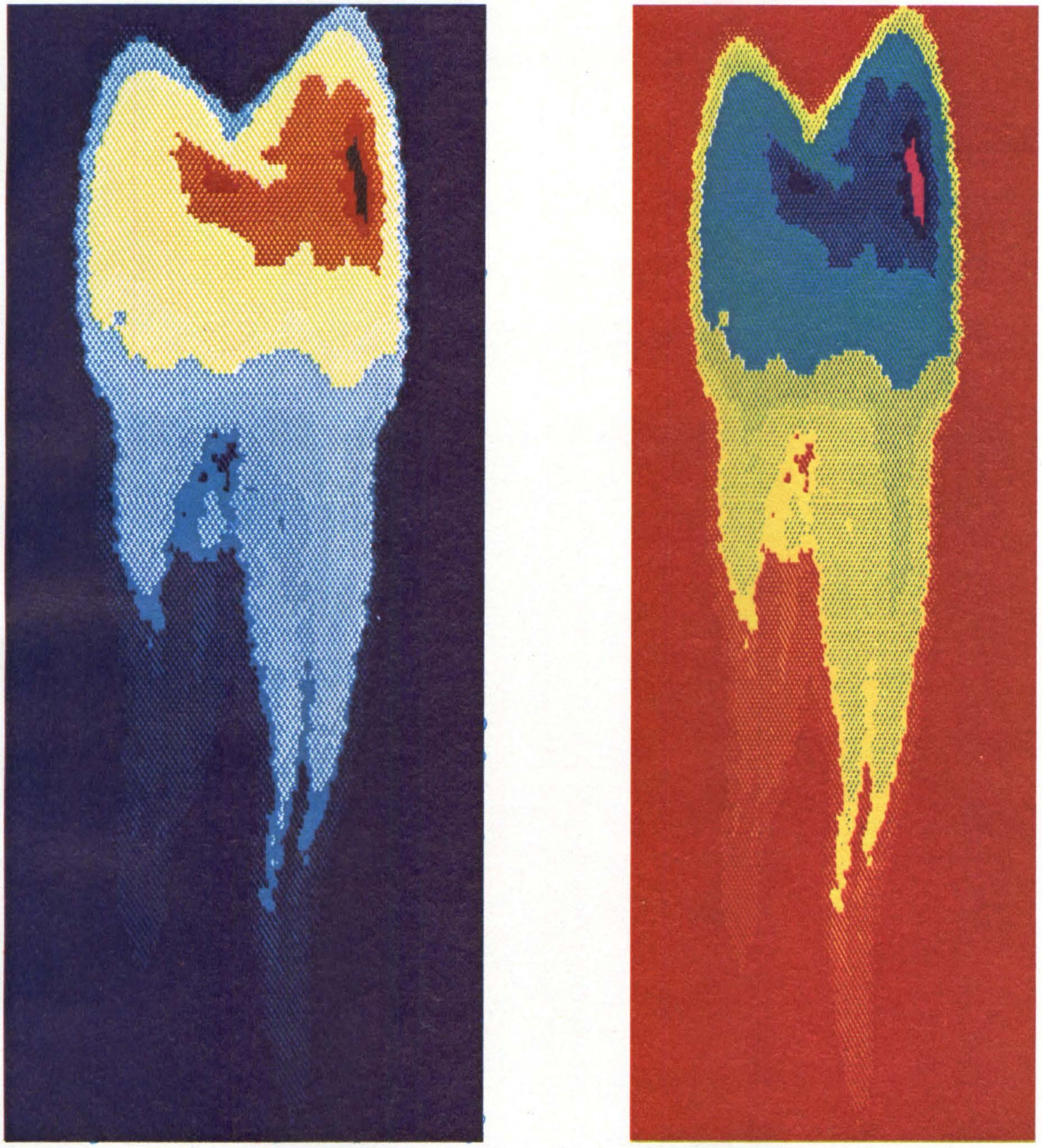
This interface, however, is limited by the DS8857 to display the numbers 0 through 9; it cannot display the letters A through F, which are needed for hexadecimal numbers or message codes such as HELP or Error. To do this, the DS8857 must be replaced by a device that can drive any combination of individual segments. The UDN-2981A (Sprague Electric Co) contains eight individual drivers for use in the display interface. This device has eight inputs and eight outputs, with each input interfaced to an individual data bus line by means of a latch circuit and each output wired through a current-limiting resistor to one segment input of the display (A to G). If desired, the last driver in the integrated circuit (IC) can drive the decimal point in the display. Since the UDN-2981A has eight inputs, an 8-bit output



Lookup Table For Multiplexed LED Display

```
/This program drives a 10-digit, multiplexed, 7-segment
/display. A lookup table is used to convert BCD numbers to
/appropriate 7-segment code.
DISPLA,  LXIH     /Load register pair H with memory
         120      /address where BCD digits are stored
         004      /004 120 = hex 0450
         MVID     /Load D with first digit
         000      /that will be enabled
DISPL1,  CALL     /Display first two packed
         DIGIT    /BCD digits
         0
         INXH     /Increment memory address
         MOVAD    /Get digit enable word into A
         CPI      /Compare it to
         012      /eleventh digit enable count
         JNZ      /Haven't displayed all 10
         DISPL1   /digits yet, so do two more
         0
         JMP      /Have displayed all 10 digits,
         DISPLA   /so display them all again
         0
DIGIT,   MOVAM    /Get packed BCD word into A
         CALL     /Then use lookup table to
         OUTIT    /determine proper sequence
         0        /of ones and zeroes
         MOVAM    /Get same word again
         RLC      /Rotate four MSBs into
         RLC      /four LSBs
         RLC
         RLC
OUTIT,   ANI      /Save only four LSBs
         017      /(017 = hex 0F)
         PUSHH    /Save register pair H on stack
         LXIH     /Load register pair H with
         BINSS    /base address of lookup table
         0
         ADDL     /Add LO address to the number in A
         MOVLA    /Save the result in register L
         JNC      /There is no carry, so leave the
         OKASIS   /content of register H alone
         0
         INRH     /Increment register H by one
OKASIS,  MVIA     /Output an invalid digit enable code
         377      /so that display is blanked
         OUT
         125
         MOVAM    /Get 7-segment code into A
         POPH     /POP register pair H off of stack
         OUT      /Then output value to
         126      /interface (7475 and UDN2981)
         MOVAD    /Get digit enable code
         OUT      /and output it to interface
         125
         INRD     /Increment digit enable
INTENS,  MVIE     /Load E with a number
         200      /200 = hex 80 = decimal 128
INTEN1,  DCRE     /Decrement the number
         JNZ      /If it is nonzero, execute
         INTEN1   /JNZ instruction back to INTEN1
         0
         RET      /When E = 0, return
BINSS,   077      /7-segment code for 0
         006      /7-segment code for 1
         133      /7-segment code for 2
         117      /7-segment code for 3
         146      /7-segment code for 4
         155      /7-segment code for 5
         174      /7-segment code for 6
         007      /7-segment code for 7
         177      /7-segment code for 8
         147      /7-segment code for 9
         000      /7-segment code for 10
         000      /7-segment code for 11
         000      /7-segment code for 12
         000      /7-segment code for 13
         000      /7-segment code for 14
         000      /7-segment code for 15
```

Laser printing direct from computer output!



X-ray images scanned into a computer to produce a pseudo-color map of the image. Print made on Xerox 6500* Color Graphics Printer.

The Tropel OEM Laser Scanning System used in the Xerox 6500* Color Graphics Printer provides hard copy images from computer output. This is one example of a variety of laser scanners designed and manufactured at Tropel. Other laser scanning systems can be tailored to suit *your* OEM product specifications and configurations.

Tropel's expertise in the broadly based laser printer technology will save you months of development time. Off-the-shelf designs are available *now* to fit a wide variety of your production needs.

For information about your application, write or call: Tropel, Inc., 1000 Fairport Park, Fairport, N.Y. 14450, (716) 377-3200.

TROPEL

A COHERENT Subsidiary

*Xerox® and 6500® are trademarks of Xerox Corporation.

CIRCLE 123 ON INQUIRY CARD

Now supports F8, 3870, 3872.

A chip builder's business is building chips. Yours is designing with them. So is ours.

port (latch) will have to be used to interface it to the microcomputer. This means that one output port will be used to output the sequence of ones and zeroes that specify the sequence of segments to be turned on or off. A 4-bit output port allows the digit enable code to be output and stored in the interface.

A recent column[3] discussed lookup tables and their application in converting BCD numbers to 7-segment codes. The Lookup Table For Multiplexed LED Display (see program listing) accomplishes this. The first difference between this program and the one displayed in Part 1 can be seen at DIGIT. After the packed BCD word is moved from memory to register A, the OUTIT subroutine is called. This means that the first BCD digit to be displayed is in bits D3 through D0 of the A register. At OUTIT, bits D7 through D4 of the A register are set to zero. The content of register pair H is then saved on the stack and the pair is loaded with the base address of the lookup table. The BCD number in the A register is added to this address. MVIA and OUT instructions at OKASIS cause the display to be blanked by writing an invalid digit enable code out to the display interface. While the display is blanked, the microprocessor moves the bit pattern for the number to be displayed from memory to the A register (MOVAM). Register pair H is then popped off of the stack and the 7-segment bit pattern is output to port 126. Register A is then loaded with the digit enable code, which is output to port 125. Execution of the OUT 125 instruction turns on the specified digit in the display. The microprocessor executes an intensifying time delay loop before returning to the MOVAM instruction just after DIGIT.

MOVAM loads the A register with the same packed BCD word that contained the previously displayed digit. However, the BCD digit in bits D7 through D4 must now be displayed. Therefore, bits D7 through D4 are rotated into bits D3 through D0 of register A before the 8080 executes the instructions at OUTIT that cause the required bit pattern for the 7-segment display to be fetched from the lookup table. The bit pattern, followed by a digit enable code, is then output to the interface. The remaining instructions in the two programs are the same.

An additional display method is the use of an external display controller IC with the multiplexed display. Intel Corp manufactures a number of these ICs—compatible with the 4004/4040, 8080, and 8085. These are the 4269, 8279, and 8279-5. National Semiconductor Corp also has two display controller ICs for use with 6-digit displays. One of the devices (MM74C912) displays 0 to 9 and the other (MM74C917) displays hexadecimal numbers. Ref 4 suggests additional hardware and software information on multiplexed LED displays.

References

1. D. G. Larsen, *et al*, "Microcomputer Interfacing: Microcomputer Interrupts," *Computer Design*, Nov 1976, pp 142-143
2. J. A. Titus, *et al*, "Microcomputer Interfacing: The Vectored Interrupt," *Computer Design*, Dec 1976, pp 112-114
3. J. A. Titus, *et al*, "Interfacing Fundamentals: Lookup Tables," *Computer Design*, Feb 1979, pp 130-132, 134
4. C. A. Titus, *et al*, *8080/8085 Software Design*, Howard W. Sams & Co, Inc, Indianapolis, Ind, 1978

This article is based, with permission, on a column appearing in *American Laboratory* magazine.

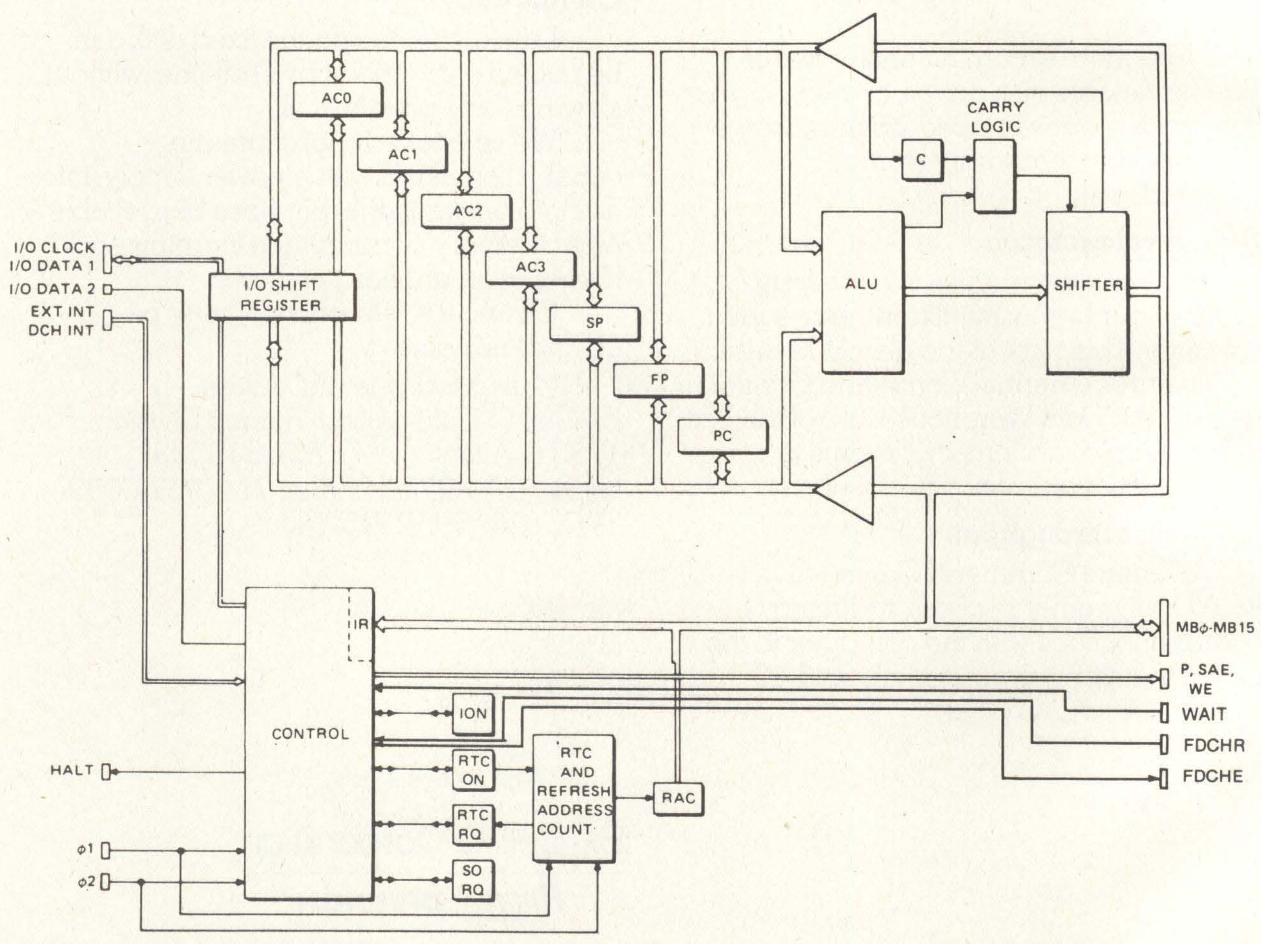

UP
DELICATE INSTRUMENT
FRAGILE-GLASS
UP
REMEX
Peripheral Products
EX-CELL-O CORPORATION
REMEX

Microcomputer Family Integrates Functionality and Performance at Multiple Levels

Product line integration at any level—chip, board, box, or system—is the key to the MicroNOVA™ family of 16-bit microcomputers, allowing upward growth. Offerings of the MP/100 family are the mN602 microprocessor chip; MP/100 system processing unit (SPU), a board-level computer; and MP/100 packaged computer, a fully configured MP/100 SPU in an 8-slot chassis. In the MP/200 family are the MP/200 SPU board-level computer; MP/200, an MP/200 SPU computer packaged in an 8-slot chassis; and MP/200 based system in half-bay cabinet with peripherals. Improvements in functionality, performance, packaging, and economy characterize the compatible families.

The mN602 microprocessor, an enhanced version of the mN601, features full NOVA® multifunction instruction set with frame oriented stack support and 16-level priority interrupt facility. Included on the 40-pin NMOS DIP are a realtime clock, 16-bit multiply/divide, power fail/auto restart, support for up to 128k bytes of memory—RAM, P/ROM, or EPROM—of which the upper 64k bytes are user implemented, and standard and high speed (2M-byte/s) data channel (DMA).

For system builder and product OEMs in instrumentation, remote data acquisition, and process control, the MP/100 SPU combines the microprocessor with asynchronous interface, automatic program load, and soft control panel on a 7.5 x 9.5" (19 x 24-cm) board. This soft control panel allows any ASCII console to



High performance 16-bit microprocessor, mN602 provides central processing functions for Data General's MP/100 family of microcomputers. Differentially driven serial I/O bus maintains reliable operation in noisy environments, while mN613 I/O controller integrates bus interface and protocol logic for each I/O device. Microprocessor provides 2.08-byte/s parallel data channel via memory bus and supports 128k bytes of memory

Single or dual track, MFE is the driving force in cassette transports.

We revolutionized the digital cassette industry by making the first simple, reliable tape drive.

Now we offer that reliability in a full line of transports, both single and dual track.

The Single-Track 250B. With just two moving parts (no mechanical adjustment, ever) the 250B offers a record of performance no competitor can match: an MTBF of 15,000 hours. The 250B also has the widest ANSI/ECMA-compatible read/write speed range on the market (5-40 ips) and data transfer rates up to 32K bps.

The Dual-Track 450B. This new model gives you up to 720,000 formatted character storage, and features the exclusive TACHLOK™ servo speed control—for constant tape speed. Like the 250B, the 450B has data transfer rates up to 32K bps and needs no mechanical adjustment. Both models are available with a variety of interface options.

The Single-Track 250BH—for hostile environments. This incredibly rugged version of the 250B can handle just about any condition. Operating temperatures from −40°C to +70°C, for example. And all kinds of shock and vibration. The 250BH has been field proven in some of the toughest applications you can name. Indoors and out. In a wide range of industries.

All three models are available in volume, ready to ship. And we can customize to meet your exact design requirements.

Call toll free 800-258-3884. MFE Corp., Salem, N.H. 03079.

In Europe: MFE Limited, West Lothian, Scotland, Tel. (0589) 410 242. MFE Products Sa, Vevey, Switzerland. Tel. 021 52, 80, 40. (MFE has complete worldwide representation. Contact us for the rep nearest you.)

MFE

*MFE Corporation

CIRCLE 130 ON INQUIRY CARD

Computer Terminals

We'll translate your next computer terminal design into the right ICs.

We make it our business to know your business. We have to. Because we know your future depends on it.

It's no secret that things change fast in your business. Or that success or failure depends on how well you use semiconductor technology in your next computer terminal design.

That's where we come in.

Our people speak your language. They know how to save you time. And money. By helping you select the right ICs for your design. Every time.

Signetics wants to help keep you ahead in the terminal design game. Because if you're not ahead, you're not even a player.

That's why we give you more than just the right product. We also give you the Signetics Commitment. We don't publish specs on it. And it's not scribed on our ICs. But we do market this extra, personal commitment. And it's free.

Our professionals in IC technology and market support are backed by Signetics' six integrated divisions. That means we can combine our total resources in both MOS and bipolar technologies to give you the edge in computer terminal OEM design.

For example, our MOS Microprocessor Division's 2652 is the fastest multi-protocol communications controller in the world at

Rudi Willers, Signetics sales engineer (left), talks terminals with Bo Fredricsson, Qantel's director of R & D.

Spoken Here.

2Mbits/second. It's right at home with most high-level protocols.

Every computer terminal OEM looks for unique logic functions. With the smallest amount of random logic practical. And Signetics wants to make it easy for the designer.

Working together, our Logic and Bipolar Memory Divisions have responded to the terminal OEM's demands for speed and flexibility.

We've gone beyond LSI to give the terminal OEM the 8A2000 I^2L Gate Array. It's got 2000 gates. And you can customize the 8A2000 to your proprietary needs without losing LSI benefits.

In fact, all you stand to lose is the need to use 50 to 75 random logic packages by going with the 8A2000 in your design.

With our family of field programmable logic, including the FPLA, FPGA, and ROM patch, we make it easy for you to out-design the competition.

And more design freedom's on the way. We'll soon be offering the world's first Field Programmable Logic Sequencer.

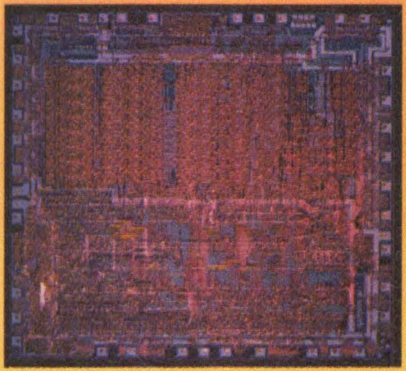
Responding to your needs, our Logic Division created the bipolar 8X300 μP. Its blazing speed of 4 million operations/second and control-oriented architecture make it ideal for adding state-of-the-art peripherals to your terminal system.

While our field professionals help computer terminal OEMs translate difficult design choices into the right ICs, other Signetics professionals are applying the most advanced technologies into devices to meet the OEM's future demands.

Talk to a Signetics professional. We've bridged the communications gap between terminal OEM and IC manufacturer.

To learn how our leading-edge technologies are making innovation simpler for terminal OEM designers, write us today.

We've got a brochure that tells you how you can put our advanced ICs to work for you. On your own terms.



2652 multi-protocol communications controller

signetics

a subsidiary of **U.S. Philips Corporation**

Signetics Corporation
P.O. Box 9052
811 East Arques Avenue
Sunnyvale, California 94086
Telephone 408/739-7700

To: Signetics Information Services, 811 East Arques Avenue
P.O. Box 9052, Sunnyvale, CA 94086

☐ Please send your brochure that describes the full range of ICs and capabilities available to the computer terminal OEM.

☐ My need is urgent. Please have a Signetics professional phone me at (_____)______________

Name ____________ Title ____________

Company ____________ Division ____________

Address ____________ MS ____________

City ____________ State _____ Zip _____

CD579

supervise program execution, examine and modify RAM locations and CPU registers, and support automatic program load from any device. Supporting memory boards are 32k- and 64k-byte RAM, 16k-byte P/ROM, and 8k- and 32k-byte RAM with sockets for 32k-byte EPROM. Thus, a complete 64k-byte 16-bit computer is configured on two boards as compared with the previous six.

Extending microcomputer performance into the range of minicomputers, MP/200 performs a 16-bit multiply in 4.92 μs and an addition in 0.84 μs, tripling the speed of previous microNOVA products. It features 16-bit multiply/divide and support for up to 64k bytes of memory. In addition to the standard data channel, the high speed channel has a transfer rate of 3.7M bytes/s. Extensions to the NOVA instruction set include byte operations and signed multiply/divide. An optional basic controller board adds an asynchronous interface with full modem control, power fail/auto restart, automatic program load, programmable real-time clock, and soft control panel. Its computational ability suits the computer to commercial, scientific, industrial, and communications environments.

To complement the MP/100 and MP/200, Data General Corp, Rt 9, Westboro, MA 01581, has introduced an array of packaging comprised of a 4-slot card cage for OEM mounting, half-bay cabinets, and a 5.25 x 14" (13.34 x 36-cm) 8-slot chassis. Packaging accessories include card frames, extender cards, power supplies, and cables.

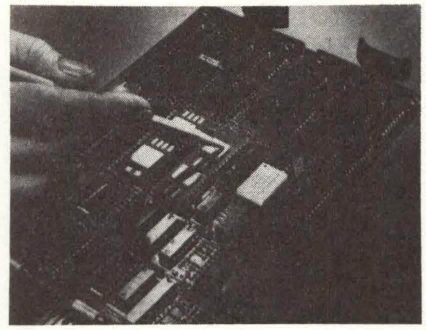
Software support for the families under DOS and RTOS are Extended BASIC, Business BASIC, FORTRAN IV, and DG/L structured programming language. Communications and sensor I/O utilities, communications software emulation packages, and support utilities are supplied.

A line of communications, sensor I/O, and terminal interfaces, as well as microNOVA peripherals are compatible with the family. The microprocessor is priced at $56.10 (100 quantity). For packaged systems with 64k bytes of memory, the MP/100 costs $2800 and the MP/200 is $3700 in single quantity. Various priced configurations are offered.

Circle 330 on Inquiry Card

Powerful Microcomputers Offer Functionality of Minicomputers

Small board size and high component density of the LSI-11/23 microcomputers allow their use as build-in elements for complex instrumentation or as central elements of special business oriented systems. With the hardware functionality and software compatibility of a midrange minicomputer, the microcomputer consists of only two 5.2 x 8.9" (13.2 x 22.6-cm) boards and backplane.



Digital's LSI-11/23 processor board uses 16-bit word length microprocessor with speed increase of 2.5 times over LSI-11/2. Memory management chip permits four times greater memory capacity. Floating point processor chip is optional

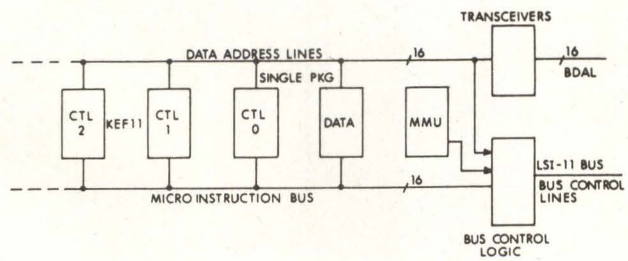
The fourth generation member of the PDP-11 family from Digital Equipment Corp, Maynard, MA 01754, features 256k bytes of memory—four times greater than that of the low end LSI-11/2. It uses the full instruction set of the PDP-11/34 minicomputer, as well as the software supported memory segmentation and protection features of the RSX-11M and -11S multitasking, multiuser operating systems. Employing the LSI-11 bus structure with asynchronous operation, the family has a cycle time of 290 ns (CPU) and 500 ns (memory); memory access time is 210 ns.

A multifunction board option includes ROM, RAM, serial I/O, and crystal clock functions. An optional floating point processor chip executes from 5 to 10 times faster.

In addition to RSX-11M and -11S software, the microcomputers run all LSI-11 family software without modification including the RT-11 operating system and high level languages such as BASIC, FORTRAN IV, and FOCAL. Software debugging aids include hardware implemented ODT function (microcoded). Software also permits protected program space and multiuser operations.

In 100-unit quantities, the unit is priced at $1758. A rack mountable, packaged PDP-11/23 version, priced at $4500 in 100 quantity ($6800 for single units), measures 19 x 5.19 x 22.7" (48.3 x 13.2 x 57.8 cm). Customer evaluation shipments are scheduled for late summer. A P/ROM board for $300 and P/ROM programmer for $1975 support P/ROM intensive LSI-11 applications.

Circle 331 on Inquiry Card



LSI-11/23 CPU module (model KDF11-AA) consists of MMU chip with 11/34 compatible memory management, floating point accumulators, and scratchpad and working registers; fast access control chip with 552 words of micromemory; and data chip with registers, 16-bit data path, and ALU. KEF11 option provides single/double-precision, FP-11 compatible, floating point instructions

Rugged Microprocessors Are Produced for Military Uses

Meeting MIL-STD-883C requirements, the military version of the Am8085A guarantees operation over a −55 to 125 °C temperature range and ±10% of power supply range. Advanced Micro Devices Inc, 901 Thompson Pl, Sunnyvale, CA 94086, is producing the device in a 40-pin molded DIP. Prices start at $105 in 100-unit lots.

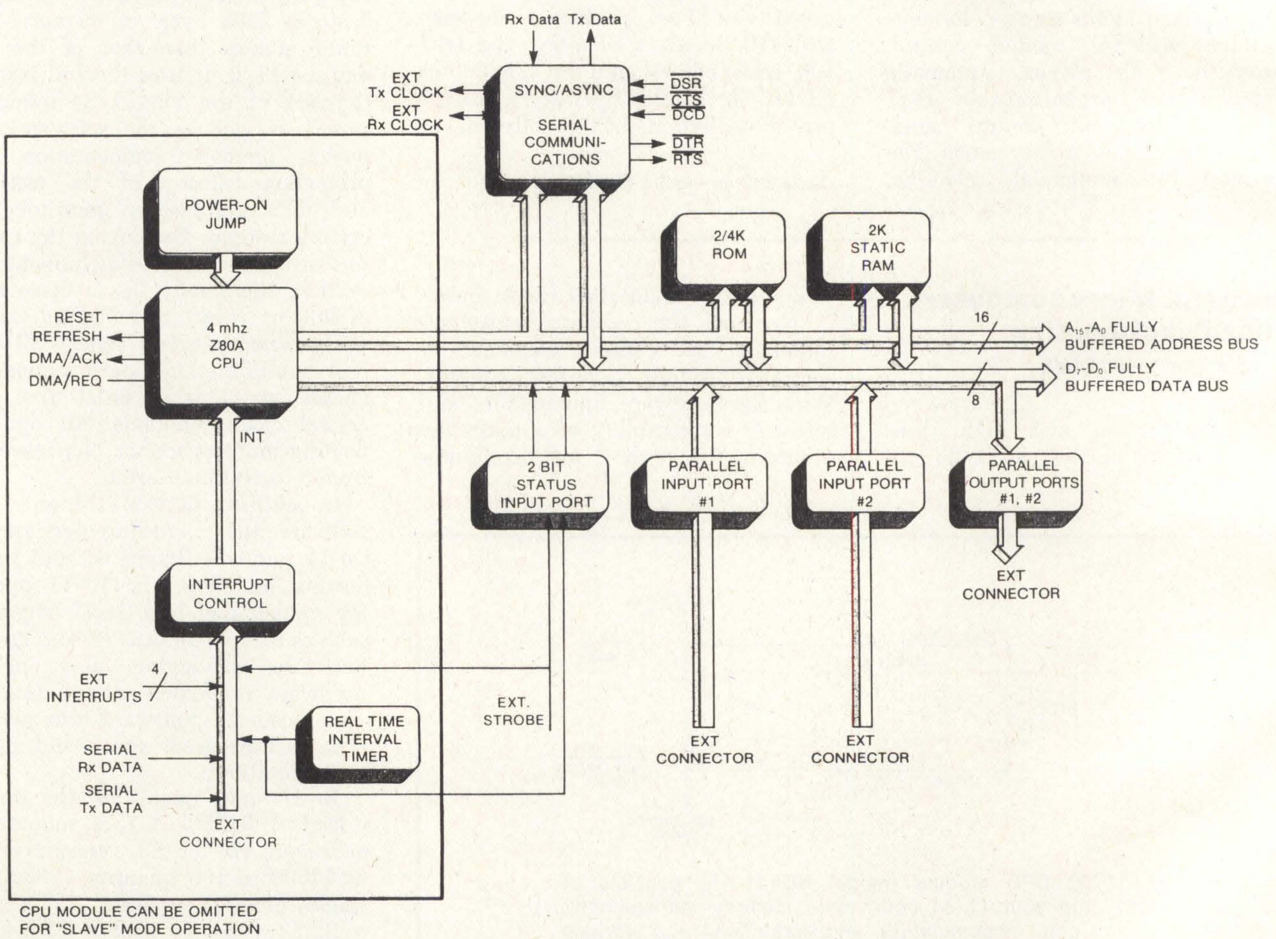
The processor operates from a 5-V supply, addresses up to 65k bytes, and incorporates the features of the Am8224 clock generator and Am8228 system controller. It uses a multiplexed data bus with address split between 8-bit address bus and 8-bit data bus.

Circle 332 on Inquiry Card

Single Board Houses Communications Computer for OEMs

The S-100 board computer, Micro-Slice, contains a 4-MHz Z80 module with power-on jump to any 256-byte boundary, eight software prioritized interrupt inputs, and realtime clock. Its communication capabilities are enhanced by its support of the IBM Bisync protocol; it also features X.25 or X.75 level one compatibility. Memory handles up to 8k of ROM and 2k of static RAM.

Other features that enable the board's use for OEM, business, and hobby applications are an asynchronous/synchronous serial port with 16 software selectable baud rates (50 to 19.2k), two fully buffered bidirectional parallel ports, common output buffer, four bidirectional USART control ports, two realtime clock control ports, two single-bit status ports, and fully buffered bus drivers. Slave mode operation permits multiple Micro-Slices to run on the same bus under one CPU. Micro Diversions, Inc, 8455-D Tyco Rd, Vienna, VA 22180, supplies front panel software either as a listing or preprogrammed on EPROM.



Logic diagram protrays Micro-Slice™ single-board communications computer. Z80 based system from Micro Diversions features software selectable parity, stop bits, and number of data bits; break detection and generation; local or remote maintenance loopback; transparent or nontransparent mode; and full- or half-duplex operation

Circle 333 on Inquiry Card

NOW

NCC Show
Visit us in booth 2631 to see our full line of MULTIBUS® compatible microcomputer products and DEC compatible, multi-purpose and custom memories.

Savings.
We've priced these memories to be the best values ever, consistent with full spec. memory elements and our rigid quality assurance programs. Listed prices are single quantity, U.S. only. Substantial OEM discounts available.

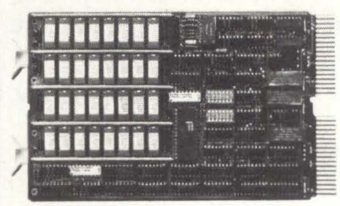
48 hour delivery
We'll ship all single quantity orders within 24 hours of receiving your written purchase order. And we'll ship airfreight. With many models, OEM quantity orders (25 or more) can be filled just as fast. Check with us for details.

FOB you.
We'll pay the airfreight on any of these memories, anywhere in the U.S.

But hurry!
These offers apply only to the specific models shown and may be withdrawn without notice.

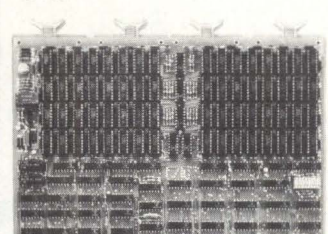
Satisfaction.
Field proven reliability and our **full year** warranty on parts and labor will keep you satisfied.

LSI-11
For high density LSI-11 memory expansion the dual height MSC 4601 gives you 32K to 64K bytes, with on-board distributed refresh, in a single option slot. Provision for battery backup. Addressable in 2K byte increments. Only $935 for the 64K byte version.



MSC 4601

The MSC 4501 gives you up to 32K bytes in 8K increments in a single quad slot. Distributed or burst refresh modes are on-board switch selectable. $450 for 32K bytes is our best price ever.

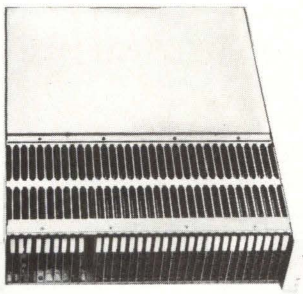


MSC 4501

IS THE BEST TIME TO BUY OUR LSI-11, PDP®-11 & PDP-8 MEMORIES. HERE'S WHY:

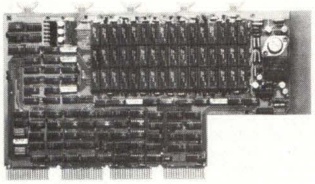
PDP-11

For expanding PDP-11/04 to 55 memory, the MSC 3302, with built in power supply, provides 32K to 248K bytes, with or without parity. Can operate with two CPU's, either singly or simultaneously. $7,370 for 248K bytes with parity.



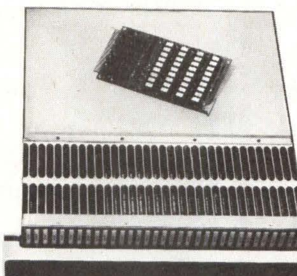
MSC 3302

The MSC 3303 fits 24K bytes into any, single DD-11 small peripheral slot. Works with PDP-11/04 to 55. A special version provides clearance for use with PDP-11/15's and 20's. Lower power and low price of $995.



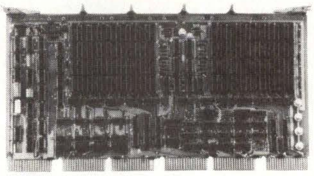
MSC 3303

Our "intelligent memory" for PDP-11/70's has up to 4MB in 64KB increments, with ECC. Nonvolatile with battery backup. Built in microcomputer monitors and locates single bit and parity errors. At $35,210 for 2MB it's cost per byte is less than $0.018.



MSC 3602

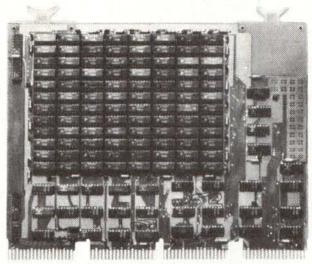
PDP-11/04/34 users can have 32K to 128K bytes, with or without parity, in a single, modified SPC slot. Provision for battery backup. On-board DIP switch assigns address start position on bus. $1,945 for 128K bytes with parity.



MSC 3603

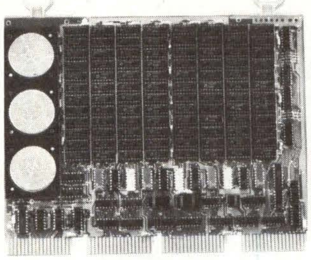
PDP-8/A, E, F, or M

Get 8K words in a single OMNIBUS® slot for only $553. And our special price of $2,146 for four MSC 3102's gives many PDP-8 users full memory capacity.



MSC 3102

If you need a nonvolatile, low power memory, the MSC 3201 gives you 8K words with on-board batteries for $761. Our four board price is just $2,972. Has 30 day data retention and requires only 3.3 watts per board.



MSC 3201

Call us now. 800-525-7498

is our toll free sales hot line. In Colorado call 303-770-7400 collect.

DEC compatible memories . . . from the first.

Monolithic Systems corp

14 Inverness Drive East
Englewood, CO 80112
303/770-7400

DEC, PDP and OMNIBUS are registered trademarks of Digital Equipment Corporation.

CIRCLE 134 ON INQUIRY CARD

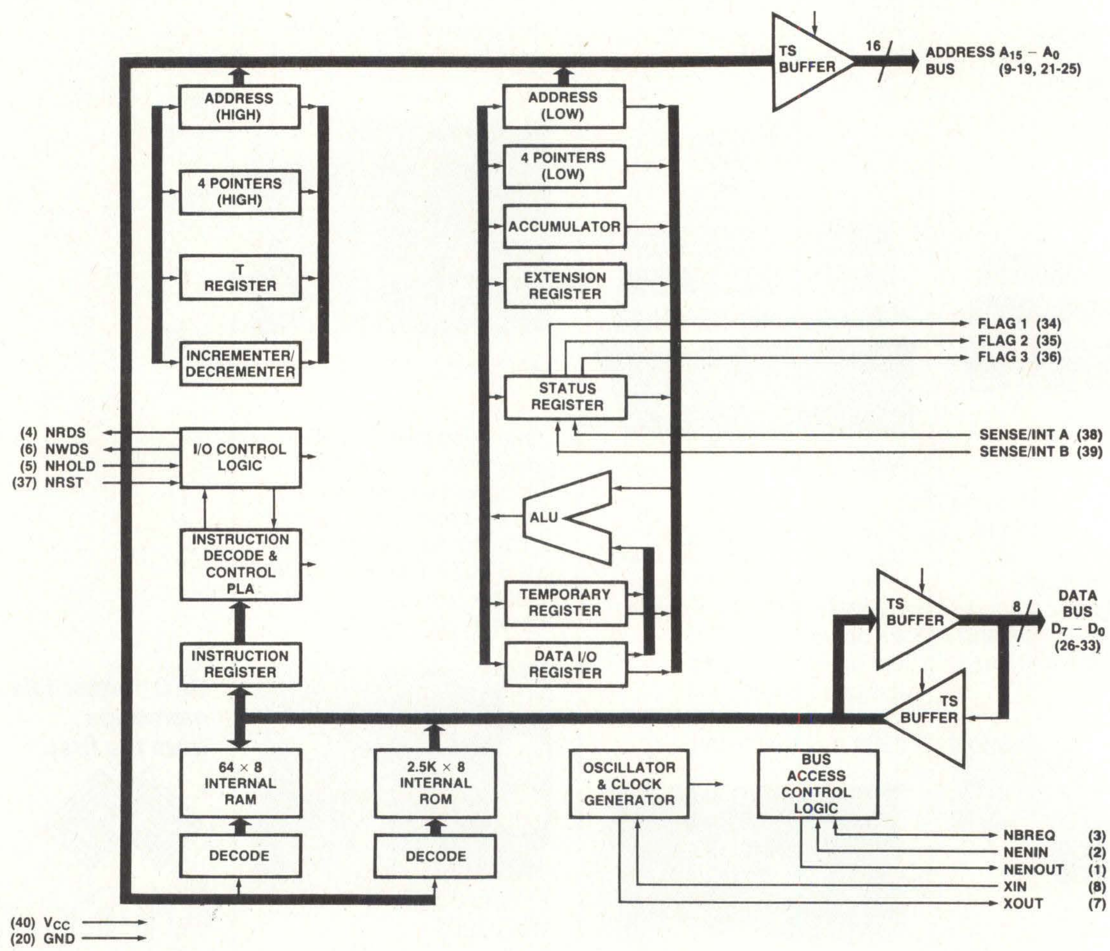
Single-Chip μComputers Are Configured With Bus Oriented Architecture

System designs requiring single-chip economy, flexibility of multiprocessing bus architecture, and power of a comprehensive set of 16-bit arithmetic operations are fulfilled by the 70-series of single-chip microcomputer devices. First members of the INS8070 family are the INS8070, a minimum system containing 64 bvtes of RAM and no onchip ROM; INS8072 with 64 bytes of RAM and 2.5k bytes of ROM; and INS8074 with 64 bytes of RAM and 4k bytes (32k bits) of ROM. The 16-bit instruction set with stack operation is suited to control system applications, as well as high level language execution.

Fabricated by National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95051, using n-channel MOS technology, the devices are housed in a standard 40-pin DIP and require only 5 V. Communications between the devices and external memory or peripherals are effected via a 16-bit dedicated address bus and 8-bit bidirectional data bus. Handshake bus access control on the chip handles multiprocessing and DMA operations. Separate strobe inputs indicate when valid I/O memory or peripheral data are present on the 8-bit bus. The remaining I/O signals are dedicated to general purpose control and status functions.

Other features are simplified programming with multiple addressing modes, ASCII to BCD conversion in one instruction, character search instruction, onchip generation, two interrupt/sense inputs, and three user accessible control-flag outputs.

INS8070 is MICROBUS™ compatible. All voltage levels, drive capability, and timing are fully defined, thus any compatible microprocessor or peripheral may be interfaced and those that are not entirely compatible may be adapted.



INS8072 is National Semiconductor's single-chip microcomputer system containing 64 bytes of RAM and 2.5k bytes of ROM. 70-Series features bus oriented architecture for ease of implementation in standalone, direct memory access and multiprocessing applications

★ In Half the Space ★ Up to 25% Savings ★

RX02-Compatible Double Density Floppies for the LSI-11/2

And Have it Your Way

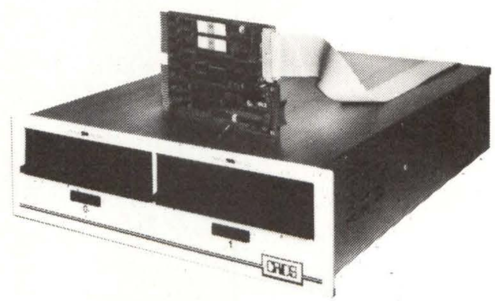
With the LSI-11/2 built-in: The MF-211 Dual Floppy/LSI-11/2 does everything the 11V03-L will do . . .

The MF-211 Dual Floppy/LSI-11/2 System, using the CRDS Double Density Controller, is functionally identical to the DEC 11V03-L, but using only 10½″ rack space. The MF-211 is the perfect low-cost answer to your 11V03-L requirement.

Check These Additional Features:

- Functionally identical to DEC's 11V03-L
- Double and Single Density Operation
- Complete Software/Media Compatibility with LSI-11/2
- Over One Megabyte Storage Per System
- Available with 4 Quad Slot or 8 Quad Slot Backplane
- DEC Software and Interface Cards available as options
- 30K Addressable Memory
- Considerable Dollar Savings

To go with your LSI-11/2: The FD-211 Dual Floppy System is the perfect plug replacement for your RX02 . . .



The FD-211 Double Density Floppy Disk System, using the CRDS Double-Density Controller, is totally software/media compatible with the Digital Equipment RX02 Floppy Disk System. It provides a compact, low-cost and highly reliable solution for all RX02 applications.

Check These Additional Features:

- 5¼″ Low Profile Chassis
- Dual Shugart Drives
- 512K Bytes Per Drive
- Front Panel Write Protect Switches
- Photocell Write Protect
- Complete Instruction Manual

Why CRDS Products Give You So Much:

In addition to providing complete RX02 instruction set compatibility, the CRDS floppy disk controller card offers DMA data transfer by sector, bootstrap loader (eliminating need for DEC's REV-11 or BDV-11), IBM 3740 formatter, self-diagnostic, and interface electronics, all contained on a single dual-height card which plugs directly into the H9270 backplane. To design and package sophisticated controller electronics on a single dual-height card is a unique CRDS achievement, unmatched by any other controller supplier in the industry.

- RX02 Double Density and Single Density Operation
- Complete RX02 Software/Media Compatibility with LSI-11/2
- Integral Bootstrap Loader
- Built-In Self-Diagnostic, Formatter
- Dual-Height Controller for LSI-11 or LSI-11/2 Backplane

For more info on our FD-211 and MF-211 Double-Density Floppy Disk Systems, just call or write:

Charles River Data Systems, Inc.

CRDS

4 Tech Circle, Natick, MA 01760 Tel. 617 655-1800 TWX 710 386 0523

Boards Operate at 4 MHz In OEM Subassemblies and Industrial Control

A family of four microcomputer boards introduced by Zilog, Inc, 10340 Bubb Rd, Cupertino, CA 95014, can be incorporated by OEMs into computer subassemblies and high performance industrial control systems. The main board in the series is the Z80 microprocessor based MPB. It contains four I/O peripheral components configured to support a line printer interface, DMA control, and two independent full-duplex serial communication channels implemented with the Z80A serial I/O and buffered for RS-422 or -423, interface.

The other boards include memory, floppy disc controller, and I/O. The Z80A ROM/RAM board has either 16k or 64k bytes of dynamic RAM, with sockets for up to 8k bytes of nonvolatile P/ROM or EPROM. The single-board Z80A FDC directly controls up to eight single-density floppy or mini floppy disc drives; double-sided drives are also supported. Although interfacing to Shugart's 400, 450, 800, and 850 series, the controller's control and data port bits are I/O programmable.

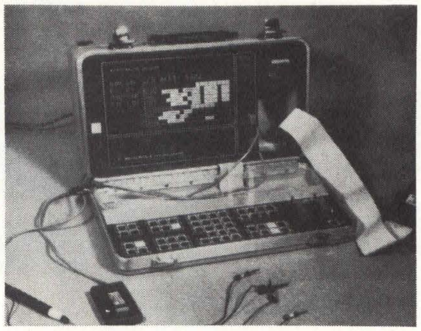
The Z80A IOB provides the 4-MHz boards with programmable I/O port capability. Four uncommitted PIO circuits support 64 bidirectional I/O lines; unused board space contains plated holes for insertion of wire-wrap devices.

Circle 334 on Inquiry Card

In-Circuit Emulation and Signature Analysis Locate Faults At All Levels

Faults at the system, module, and component levels in 6800 microprocessor based products are located by the portable, standalone Microcomputer Analyzer (μCA) which combines the power of two diagnostic techniques—in-circuit emulation and signature analysis. Test points or data generation does not have to be built into the product under test, because the test instrument uses a microprocessor within the analyzer as the data generator, and the microprocessor socket of the system under test as the standard common test point for system analysis.

Using 110 V, 60 Hz, M68UCANA1 is enclosed in an attache style case measuring 19 x 10.5 x 7.5" (48 x 26.7 x 19.1 cm) and weighing 21 lb (9.5 kg). Both the alphanumeric display and keyboard are under software control and can be modified through program changes. Additional memory, communications interface, or other microprocessor emulator modules can be added to the multiple position card cage. Motorola Microsystem, PO Box 20912, Phoenix, AZ 85036, has priced the unit at $3750 each in quantities of 1 to 5.



Motorola's Microcomputer Analyzer (μCA)—M68UCANA1—is packaged in portable attache type case. At left is signature analysis and time domain test probes, as well as control pod with test leads, and at right is emulation pod and cables to microprocessor

In-circuit emulation is implemented by connecting the system under test to the analyzer through an umbilical cord and a 40-pin connector that plugs into the microprocessor socket. Customer supplied test programs thoroughly exercise all system components and provide data used to locate faults—at the module or functional level—in circuits, memory, and interfaces to the microprocessor.

At the component level, signature analysis locates faults by probing test nodes. The technique detects bit streams generated by the in-circuit emulator, compresses them, and displays hexadecimal representations of their values. The emulator cycles through its test program generating identical bit streams and the same hexadecimal values appear at nodes. Hexadecimal values obtained are compared against known good values to locate faults.

Circle 335 on Inquiry Card

Total Hardware/Software Concept Forms Universal Development System

AMDS-AFD offers development tools for 8080, 8085, 6800, 6802, or Z80 microcomputer systems for design and testing. The station integrates the CPU processor and 48k bytes of static RAM, universal logic analyzer, CRT, and keyboard.

Hardware development capabilities are realtime in-circuit emulation to 5 MHz; 48-channel logic analyzer with 256-state trace buffer, three hardware break registers, loop counters, and delay counters; dual, double-density disc drives with 1M-byte storage capacity; and over 20k-char/s, 24 x 80 CRT display. With 256 x 48 bits of storage, the logic analyzer traces realtime systems, using complex or simple break conditions.

Relocatable macro assembler, object program linker, screen based editor, interactive debugger, and command control language are the software development set on diskette. Futuredata Computer Corp, 11205 S La Cienega Blvd, Los Angeles, CA 90045, has priced the system at $16,500.

Circle 336 on Inquiry Card

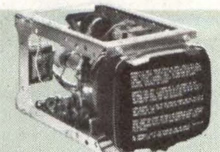
Chip Set and Development Computer Execute PASCAL Object Programs

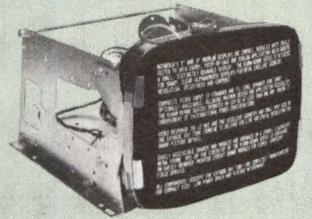
A 16-bit computer chip set, developed by Western Digital Corp, 3128 Red Hill Ave, Newport Beach, CA 92663, is claimed to directly execute PASCAL object programs at least five times faster than is possible with conventional system software and eliminates the need for the host operating system and interpreter. The PASCAL MICROENGINE™ line includes both the chip set and a software development system for OEMs and personal computing stores.

The chip set standardizes the University of California at San Diego version of PASCAL. The software system includes a PASCAL operating system: PASCAL compiler, BASIC compiler, file manager, screen oriented editor, debug program, and graphics package, all written in PASCAL.

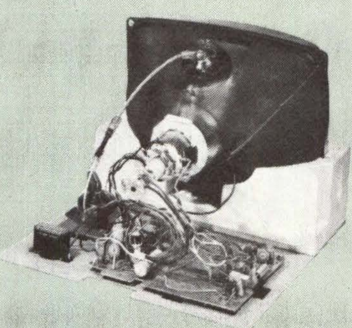
Key to the system is the pseudo machine (P-machine) implemented

IF YOU DON'T SEE IT HERE, ASK!

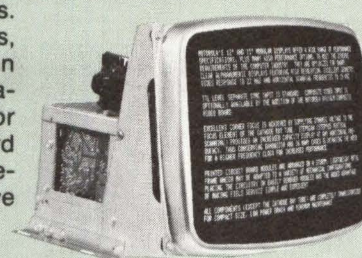




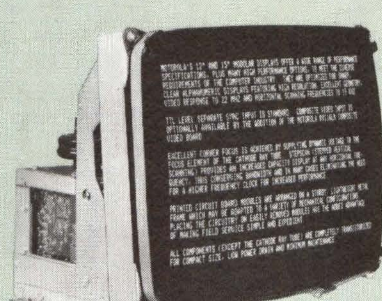
M1000/M2000 series 5-inch and 9-inch display modules. These highly reliable displays testify to the effectiveness of measured rather than calculated MTBF. Samples of every complete Motorola CRT display module are life-tested for a minimum of 10,000 hours at 55°C. Customers report some of our displays logging more than 40,000 hours and still going strong.



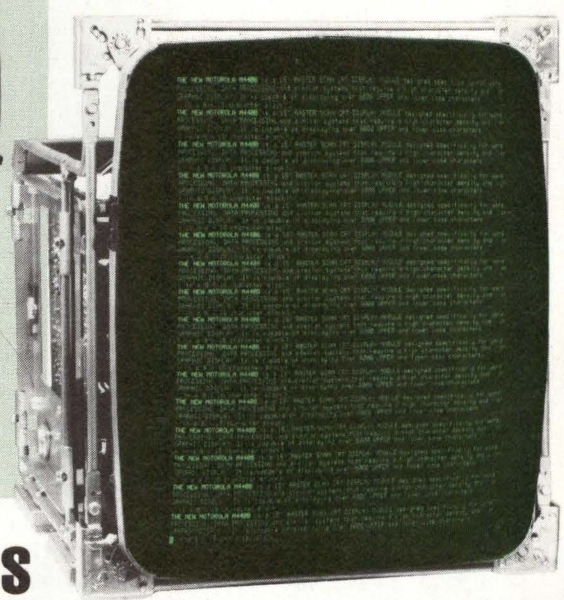
M3500 series 12-inch display modules in chassis or kit form (shown). Cost saving, plus no metal boundaries to inhibit your own layout.



MD3000 series 12-inch display modules. Between the MD3000 and M3500 series, you can have your 12-inch display in any of several ways: chassis or kit, separate sync TTL level, composite video or direct drive inputs, choice of standard EIA phosphors, choice of scan frequencies, with or without anti-reflective faceplate.



MD4000 series 15-inch display modules. Up to 3,440 upper and lower case characters in a 7 x 9 dot matrix. Every line is sharp . . . even in the corners. StepScan™ 22 MHz bandwidth and customer adjustable dynamic focus are standard in the MD3000 and MD4000 series. If looks on the screen are important—and when aren't they?—a Motorola display is what you want.



The M4408 15-inch module displays a full page horizontally (132 x 46) or vertically (96 x 66, shown). High character density and low cost, too—raster scan technique with standard TTL logic interface gives you economy twice: once in purchase price and again in design costs. A technology leader.

There's more. We make more than 65 different CRT display module variations. So the chances are that we already manufacture a CRT display module that fits your application.

But if we don't—and if your volume justifies it—we have the know-how and experience to design and build for you.

That's just one more area in which experience—our experience—can benefit *you.*

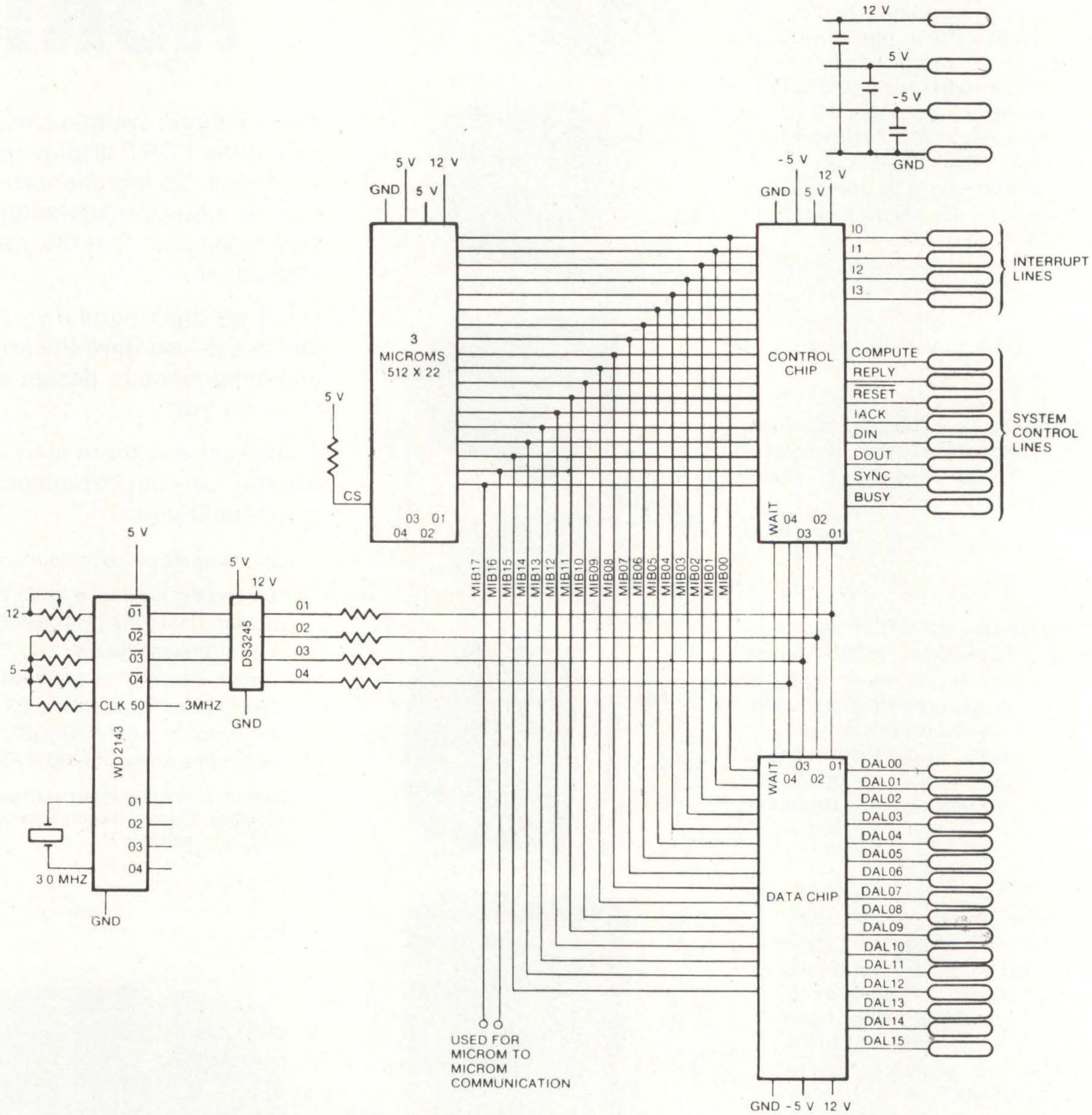
Call the sales office in your area:

Sunnyvale, California (408) 744-1277
Tustin, California (714) 838-5621
Carol Stream, Illinois (312) 690-1400
Dallas, Texas (214) 233-2006
Salem, New Hampshire (603) 898-5921
Shrewsbury, New Jersey (201) 544-9541
Baltimore, Maryland (301) 821-0062

Overseas, ask for International Sales Manager, Carol Stream, Illinois (312) 690-1400.

BENEFIT FROM EXPERIENCE . . . OURS

MOTOROLA INC. **Display Systems** 1155 Harvester Rd., West Chicago, IL 60185



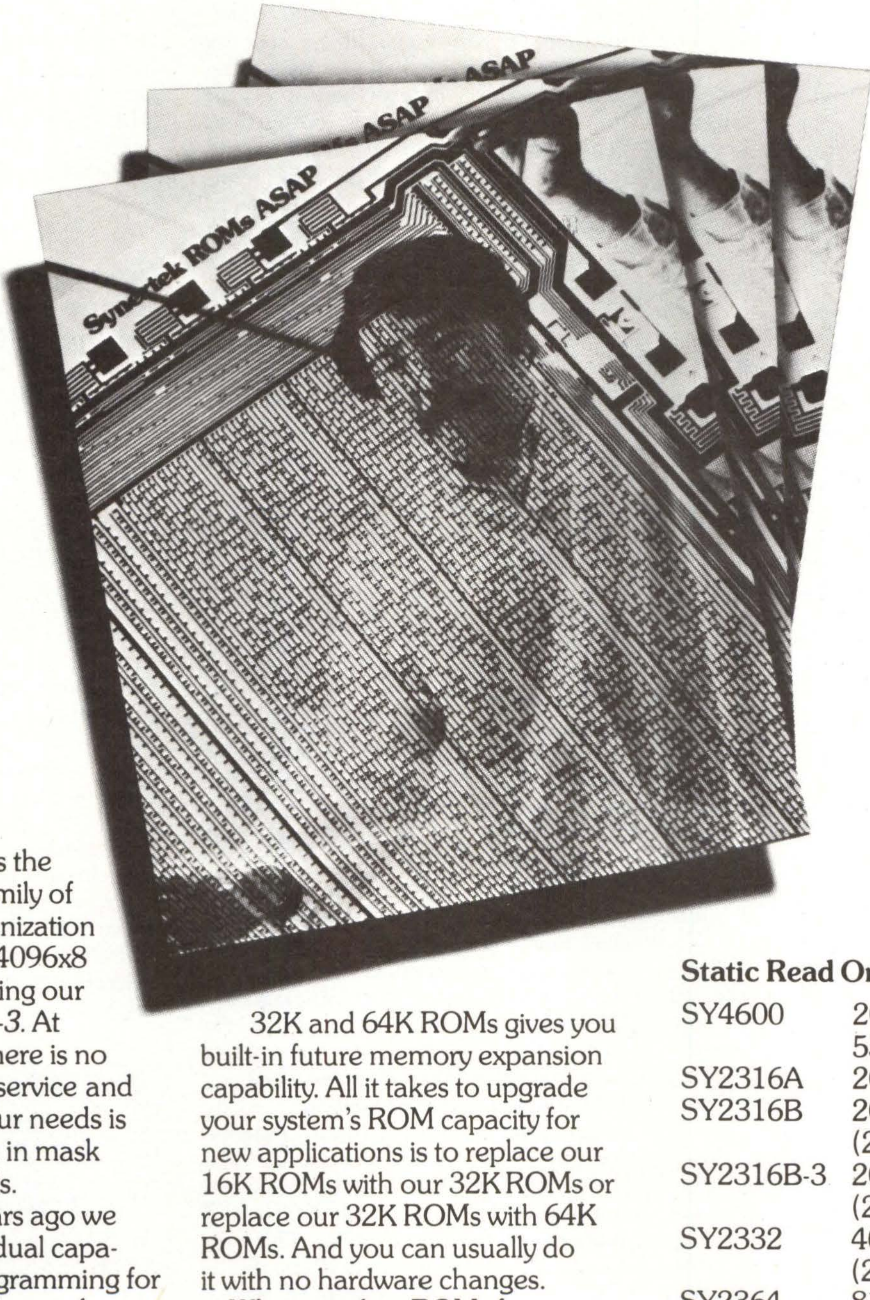
WD9000 16-bit microprocessor from Western Digital is designated PASCAL MICROENGINE. Chip set consists of five LSI components. Arithmetic component contains ALU, microinstruction decode, register file, and processor control path. Control processor holds macroinstruction decode, portions of control circuitry, microinstruction counters, and I/O control logic. Three high speed 512 x 22-bit custom MICROM components implement P-code instructions

directly in a chip set using LSI technology. An engine has been built that drives existing software; further increases in the performance level of microcomputers and lower cost of computer power are also achieved.

Four MOS LSI components comprise the chip set. The arithmetic chip contains microinstruction decode, ALU, and register file. A microsequencer chip contains macro instruction decode, portions of control circuitry, microinstruction counters, and I/O control logic. The two MICROM chips (each 22 x 512) contain the microinstruction ROMS along with microdiagnostics.

Additional features are user defined bus configuration, four levels of interrupts, single- and multibyte instructions, hardware floating point, stack architecture, 3.0-MHz 4-phase clock (75 ns/phase), and TTL compatible 3-state interface. Basic desktop computer WD/900 features the MICROENGINE processor, 64k bytes of RAM, DMA control functions, floppy disc controller, two RS-232 asynchronous ports, and two 8-bit parallel ports on a single board, with

The ROMs you need. When you need them.



On-time delivery puts the punch in our total family of ROMs. With the organization you need—8192x8, 4096x8 and 2048x8—including our new *300nsec 2316B-3.* At Synertek, we know there is no product area where service and responsiveness to your needs is more important than in mask programmable ROMs.

That's why two years ago we pioneered a unique dual capability—first mask programming for lowest cost and smallest real estate, last mask for fastest delivery to meet critical production schedules and get you results now. We can even combine first mask and last mask to get you into production today—and still save you money tomorrow.

Pin compatibility on our 16K, 32K and 64K ROMs gives you built-in future memory expansion capability. All it takes to upgrade your system's ROM capacity for new applications is to replace our 16K ROMs with our 32K ROMs or replace our 32K ROMs with 64K ROMs. And you can usually do it with no hardware changes.

When you buy ROMs from Synertek, you know you're buying total service. Contact us now for samples, data sheets and our comprehensive folder, "Synertek ROMs ASAP." Synertek, Inc., 3001 Stender Way, Santa Clara, California 95051. (408) 988-5611. TWX: 910-338-0135.

Static Read Only Memories.

SY4600	2048x8 or 4096x4, 550nsec
SY2316A	2048x8, 550nsec
SY2316B	2048x8, 450nsec (2716 compatible)
SY2316B-3	2048x8, 300nsec (2716 compatible)
SY2332	4096x8, 450nsec (2716 compatible)
SY2364	8192x8, 450nsec, 24 pin

Synertek, Inc.

CIRCLE 137 ON INQUIRY CARD

three power supplies in a 5.25 x 16.25 x 13.5" (13.3 x 41.3 x 34.3-cm) enclosure. The WD/90 PASCAL MICRO-ENGINE computer for program development and OEM applications is comprised of the single-board computer, power supply, system enclosure, documentation, and floppy diskette containing UCSD PASCAL operating system.

The chip set is priced at $195 for a single set, $97.50 each at 10,000 quantity. The single-board computer costs $1995. The system retails at $2995; OEM single-quantity price is $2495.

Circle 337 on Inquiry Card

Microcomputer Speaks Through Use of Speech Synthesizer Modules

Voice response is now possible using either of two speech synthesizers that have been designed to interface to Radio Shack's TRS-80 microcomputer. One of the modules utilizes phonemes, while the other operates in either phonetic or direct parameter control modes.

Phoneme Module

Votrax, a div of Federal Screw Works, 500 Stephenson Hwy, Troy, MI 48084, has designed the electronic voice response synthesizer as a plug-in peripheral to the microcomputer, providing speech in English and limited foreign languages. The package is complete with an audio amplifier and speaker. A ribbon cable, emerging from the back of the 12 x 6.2 x 4" (30.5 x 15.6 x 10.2-cm) cabinet, is long enough to allow the cabinet to rest on top of the video display.

The synthesizer converts the computer output into electronically synthesized speech, using the 62 phonemes to produce words and phrases. To produce a phoneme, the user supplies the synthesizer with the ASCII character corresponding to the phoneme symbol. Integrating these phonemes creates smooth, intelligible speech.

Both Level I and II BASIC can be used. BASIC programs can be created or modified to include computer voice response using a specialized print statement as an output command. The last 32 print locations on the video display, into which the interface has been address mapped, is the window. After opening the window, the user should first send a pause (which is silent) to synchronize the module when it has been idle. While the window is open, any character printed into it is copied into the synthesizer's input buffer. After the transmission, a pause should be sent as the last phoneme before closing the window; the window then is closed to prevent accidental outputting. The synthesizer produces the sound and the LED goes off. The voice module's input buffer is 32 phonemes deep; duration of a phoneme varies from 40 to 160 ms. Power requirements are 120 Vac, 60 Hz, 0.10 A.

Circle 338 on Inquiry Card

Direct Parameter Control Phonetic Mode Synthesizer

Model CT-1T is an S-100 bus compatible speech synthesizer packaged by Computalker Consultants, 1730 21st St, Suite A, Santa Monica, CA 90404, in a 6 x 4 x 12" (15 x 10 x 30-cm) chassis with a 110-Vac power supply. The interface circuit board contains a 2-W audio amplifier, an S-100 connector for the CT-1 speech synthesizer board, and a Radio Shack compatible edge connector. A cable connects the unit to the TRS-80 bus connector on either keyboard or expansion interface. Standard phone jacks connect to external speakers, headphones, or external amplifier (not provided).

The high quality voice generator operates with a microcomputer which has Level II BASIC and a min of 16k RAM (32k is recommended). Control of perceptually and physiologically fundamental aspects of speech is via nine acoustic/phonetic parameters transmitted on the computer's bus.

Direct parameter control mode sends data to the synthesizer's nine output ports at the rate of 900 bytes/s from a predetermined speech parameter file to give intelligible and natural sounding speech. This requires a rate of approx 100 frames/s. Characteristics and language variations of the speaker are retained in the output. A parameter data frame consists of a sequence of nine output instructions which update each of the nine parameter values. After addressing any of the ports, a min of 20 μs must be allowed before addressing another port.

In phonetic mode, the CSR1 Synthesis-by-Rule software converts ASCII phonetic text strings into speech parameter data, which are sent to the synthesizer to produce speech. The GENPRM subroutine uses tables of parameter values for each English phoneme.

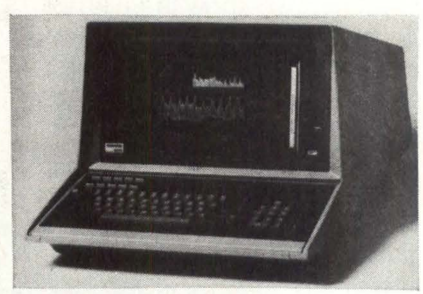
Software supports both modes. The basic set consists of CTEDIT parameter data editor, speech parameter data files (HELLO, LETTERS, DIGITS), and CSR1. They are available on 5.25" (13.34-cm) diskettes or standard cassettes.

Circle 339 on Inquiry Card

Extended Systems Span Range of Low Cost to Intensive Graphics

Two desktop graphic computing systems added to the 4050 series create a 3-member family with language, storage, and software compatibility. Tektronix, Inc, PO Box 500, Beaverton, OR 97077, extended the 4051 system with models 4052 and 4054, featuring a new processor and special memory architecture for speed. BASIC and Plot 50 software, allowing system expandability to multiuser configurations, operate on the systems. The 4052 is directed at areas of research and management reporting. For engineering and design areas, the 4054 handles complex diagrams and high density interactive graphics.

Features that are standard among all three units are a direct view storage tube, internal magnetic tape drive with 300k bytes, and an IEEE Std-488 (GPIB) interface. A 16-bit microprogrammed processor with microcoded floating point instructions



Extended series of Tektronix graphic computing systems add 4052 (pictured) and 4054 to model 4051. Two new systems have 32k bytes of memory, processor for high performance computing and graphics, and data sharing with host computer at up to 9600 baud. Model 4054 offers 19" (48-cm) display along with other graphics enhancements

A Cut Above the Other

Able comes up with a 16-line DV11 replacement that puts the PDP-11 user back in control.

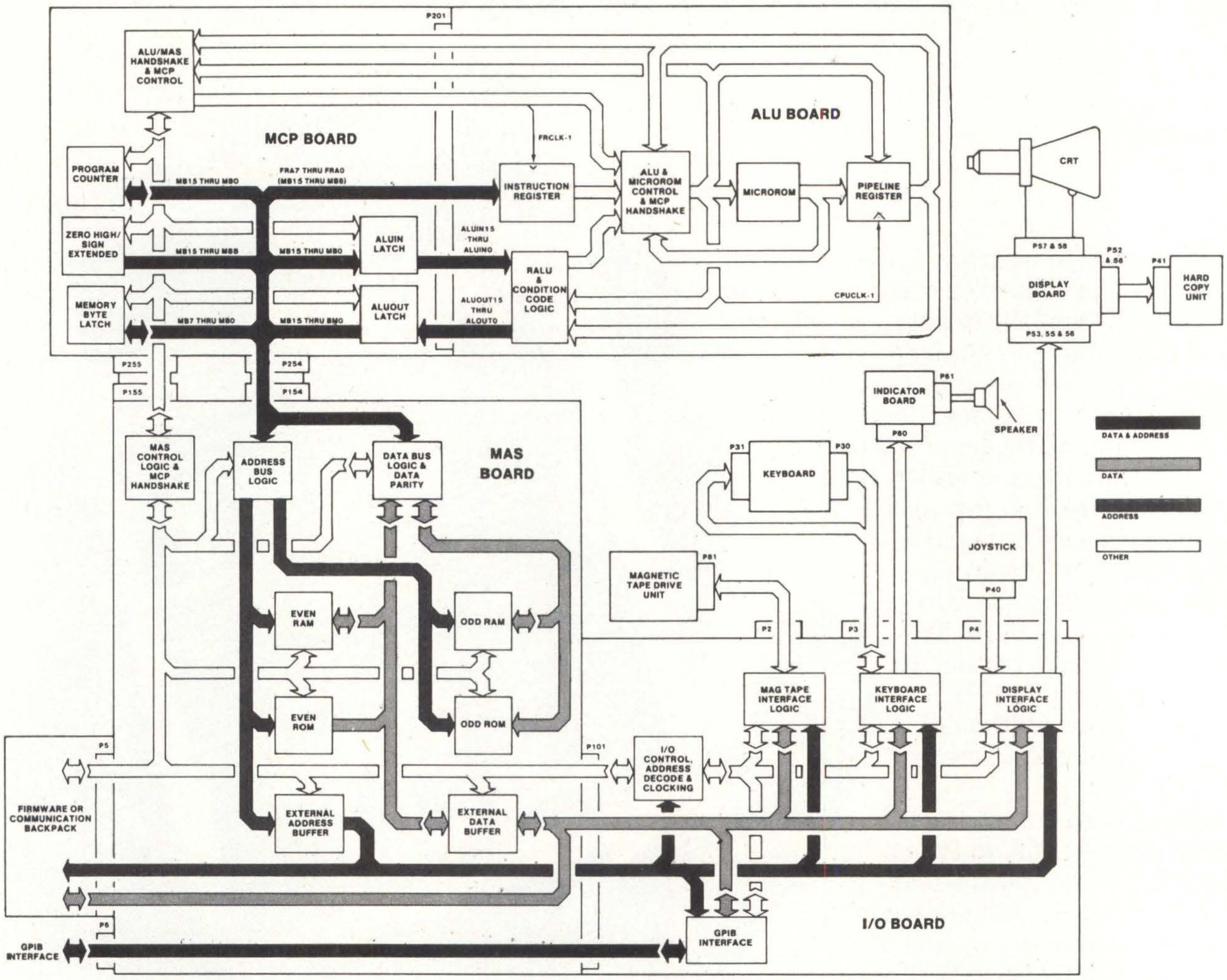
You don't have to be stuck again with fixed sync/async line controller configurations in your PDP-11. Our DV/16 puts you back in control with a unique microprocessor-derived flexibility that lets you mix sync and async lines in any combination of four or eight while maintaining modem control and compatibility with established DV11-related software. You get 16 channels on only four boards compared to a filled up nine-slot mounting module required by the DEC equivalent. Expansion to 32 lines takes up only 7 standard SPC slots in your PDP-11 compared to the addition of two full 9-slot backplanes for the DV11's.

We use word transfer instead of byte DMA to either gain a two to one speed advantage (76,800 characters per second) or let you operate in one half the bandwidth required by DV11 data transfers. Power requirements are more than fifty percent lower, too. The DV/16 is a cut above the other all right, but the price doesn't show it. Ours is a very cost effective alternative, delivered off the shelf as usual. We've made the cut. Now it's your deal! Write for details. We'll show you why our customers call us the leader among manufacturers of DEC enhancements.

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

Able, the computer experts.

CIRCLE 138 ON INQUIRY CARD



Graphic computing system. Block diagram highlights model 4052, consisting of four board sections. Solid black lines are data and address, darker shaded lines are address, and lightest areas are data lines. All 4050 series products are compatible in language, software, storage, and GPIB peripheral devices

has been used in the 4052 and 4054 to increase throughput over the 4054 for generation of dense, mixed graphic and alphanumeric displays. Memory is 32k bytes, expandable to 56k bytes. Data processing and communications speeds also are increased; the Option 1 interface offers rates up to 9600 baud.

Graphics enhancements to the 4054, not offered in the other systems, are a vector character generator (as opposed to dot matrix); four character sizes; constant-rate vector generator to draw dotted, dashed, and solid vectors; and thumbwheel controlled crosshair cursor. The 19" (48.3-cm) screen has over 13M addressable points to support 133 character lines of text.

Binary loading and matrix commands, standard on the 4052 and 4054, can be accessed on the 4051 by inserting the respective ROM packs. Added ROM packs for the two systems are the 4052 R06 editor, 4052 R07 signal processing ROM pack, option 10 printer interface, and ROM pack for the 4907 file manager.

Options and peripherals are a joystick, matrix printers, hardcopy unit, interactive digital plotters, file manager, digital cartridge tape drive, and graphic tablet. Prices are $5995 for the 11" (28-cm) 4051, $9800 for the 11" (28-cm) 4052, and $16,500 for the 19" (48-cm) 4054.

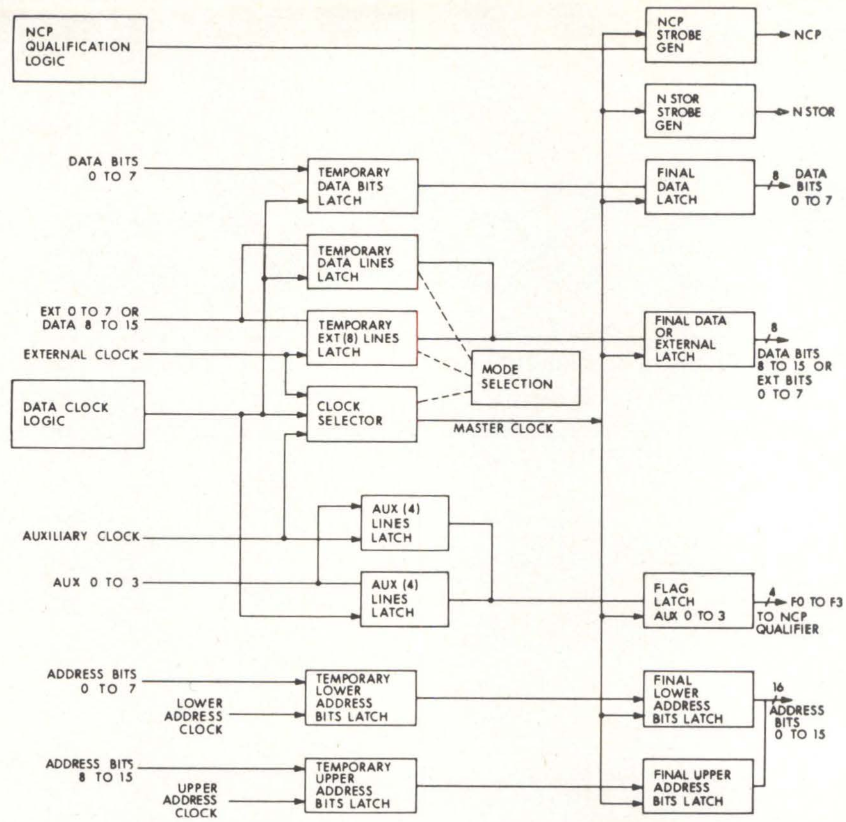
Circle 340 on Inquiry Card

4-MHz 16-Bit Family of Microprocessors Increases Throughput

Separate address and data buses maximize performance of the TMS9900-40 microprocessor by avoiding multiplexing delays. The 16-bit MPU features a minicomputer instruction set and memory to memory architecture. Texas Instruments, Inc, PO Box 1443, Houston, TX 77001, supports three I/O techniques—DMA, memory mapped, and CRU (for optimum control line manipulation without using memory space). CRU provides single-command page switching for memories larger than 65k bytes.

The current family includes the 9900-40 CPU ($41.25/100 units), 9904-40 clock generator/driver ($7.20), 9901-40 peripheral systems interface ($7.06), and 9902-40 asynchronous communications controller ($5.63). A universal emulator for the Advanced Microprocessor Prototyping Laboratory supports the microprocessor. Floppy and hard disc based systems with high level language development options are available.

Circle 341 on Inquiry Card



Activity on most microprocessors is monitored by Hewlett-Packard's model 1611A logic state analyzer when model 10264A general purpose module (diagrammed) is attached. Address field uses 16 bits; data field is set for 8-bit bus, with 8-bit external and 4-bit auxiliary fields for other buses or control lines

General Purpose Module Connects Logic Analyzer To Most Microcomputers

Realtime viewing of system operation is obtained when the model 1611A logic state analyzer is connected to virtually any microprocessor—current, new, or special purpose—via the model 10264A general purpose module. It is available from Hewlett-Packard Co, 1507 Page Mill Rd, Palo Alto, CA 94304, as an option or installed in the analyzer. The 36-bit wide display monitors several buses simultaneously on both 8- and 16-bit microprocessors. Address has 16 bits reserved; the data field can be set for an 8-bit bus, leaving 8-bit external and 4-bit auxiliary fields open for other buses or control lines.

Front panel controls can combine the 8-bit external field with the 8-bit data field to display 16-bit microprocessor variables, leaving the four auxiliary bits free to monitor control lines. Seven clocks latch multiplexed information on common bus structures into the analyzer inputs at the appropriate time for display. Each 8-bit half of a multiplexed 16-bit address bus and a 16-bit data bus are clocked separately into the analyzer. A separate clock interrogates an added 4-bit auxiliary bus at another time.

A listing shows absolute code being executed with respect to established trace parameters. Display formats for address and data fields are in hexadecimal or octal. External and auxiliary fields may be in binary, or the base chosen for the data and address fields.

With the general purpose module installed, the analyzer's mnemonic key is inhibited since mnemonic code is microprocessor defined and therefore cannot be displayed. Connection to the system under test is universal, with two pods, individual leads, and miniature probes for each of the data, clock, and qualifier inputs.

Circle 342 on Inquiry Card

μProcessor Analyzer and Clip-on Probe Broaden In-Circuit Testing

Microprocessor analyzer capabilities have been extended from 8080 and 8085 systems to include the Z80. One instrument, using three separate clip-on probes, offers direct user interaction with all memory locations and internal microprocessor registers, and compatibility with all 8080, 8085, and Z80 system configurations. Current AQ8080 analyzers (see *Computer Design*, June 1978, p 161 and Sept 1978, p 154) can be factory updated by AQ Systems Inc, 1736 Front St, Yorktown Heights, NY 10598, to include the -Z version capabilities. The analyzer costs $2795.

Interactive register access functions include the Z80's background (alternate) register set, and index registers IX and IY. The operator accesses the foreground or background register set, independently of the register set in use by the program.

Programs may be single-stepped by machine cycle or instruction set, or run at an adjustable speed of 1 to 4000 steps/s while examining memory or registers. The program trace recorder stores 128 instructions. Debugging features include breakpoint and realtime monitor functions.

Circle 343 on Inquiry Card

Almost perfect.

Our new ADM-42 doesn't have quite everything. But it comes so close, you might never notice.

Because it's a complete, semi-intelligent terminal for just about any application you can name. And it does just what you want it to do, just when you want it done.

The ADM-42 is completely self-contained, and provides you with flexibility of format, security, editing, interface, and transmission. It also features a full two-page display as standard equipment. Not as an option. And it comes with a truly staggering array of options.

THE MORE YOU USE IT, THE SMARTER IT SEEMS.

We gave the ADM-42 a bright, easy-to-read 2000 character display. A full 128 ASCII character set. 16 function keys for 32 separate commands. And five separate cursor control keys.

The 42's behavior modification gives you a factory installed personality for an alternative ESC sequence lead-in—in addition to the standard ESC. And End Block character. A New Line character sequence. A field separator. And even a function sequence preamble.

Its status displays on the screen give you a conveniently wide range of information at a glance. While its special symbols indicate the entry of control characters in memory. Also, all control characters can be stored using the escape sequence or program mode. And the Field Protect Mode allows rapid data entry into forms or instruction pages.

THE ADM-42 WILL HAND YOU ANOTHER LINE.

The terminal's displayed data is formatted in 24 lines per page, 80 characters per line. And, to top it off, it comes with a 25th line established and reserved exclusively for status indicators and messages of up to 79 characters.

As if all this weren't enough, the ADM-42 has an impressive list of options. Like synchronous transmission with various line protocols. An extended memory capable of adding data space up to a maximum of 8 pages. And programmable function keys, to name but a few.

THE ADM-42 IS ONE TOUGH ACT TO FOLLOW.

The ADM-42 has just about everything. Including a microprocessor that increases reliability and ease of operation. Any way you look at it, in fact, it's one pretty smart buy.

So if you're thinking of upgrading to a more intelligent terminal, at a more than reasonable price, call us today. Or better yet, contact your local distributor.

We'll show you how easy it is to move up to the ADM-42.

The terminal that's so smart, you'll swear it's got a mind of its own.

ADM 42
Getting smarter all the time.

LEAR SIEGLER, INC.
DATA PRODUCTS DIVISION

Lear Siegler, Inc./Data Products Division, 714 Brookhurst Street, Anaheim, CA 92803; (800) 854-3805. In California (714) 774-1010. TWX: 910-591-1157 Telex: 65-5444.

Computer/Terminal Combination Produces Business Microsystem

Configuration of the System B microcomputer manufactured by Vector Graphic, Inc, 31364 Via Colinas, Westlake Village, CA 91361, uses the Z80 based Vector MZ and 12" (30.5-cm) diagonal Mindless Terminal. The MZ has 158 instructions, two quad-density Micropolis floppy discs, disc controller board, bit streamer I/O board, 32k RAM, and 12k 2708 P/ROM-RAM board with extended monitor. The terminal incorporates the keyboard and monitor.

Other features are the Flashwriter II video board displaying 80 characters x 24 lines with an 8 x 10-character matrix. The 48k dynamic RAM board contained in the business system uses 16k-bit chips.

Software includes MDOS with Micropolis BASIC and the company's MZOS disc operating system (see *Computer Design,* Dec 1978, p 142), as well as CP/M. A Z80 assembler ZSM facilitates interactive program customization. Suggested retail price is $4750.

Circle 344 on Inquiry Card

µComputer System's Power Accomplishes Small Business Applications

The self-contained SDS 420 desktop system consists of a 2-MHz 6502A 8-bit microprocessor; 32k bytes of memory expandable to 56k; from 1.25M to 10M bytes of floppy disc storage on PerSci dual-diskette, single/double-density drives; and a Ball Brothers 12" (30.5-cm) CRT display with 25 lines of 80 characters/line and 2k bytes of refresh memory. A 71-key alphanumeric detachable keyboard has a decimal pad, cursor control, reset and interrupt keys, and three user programmable keys. Memory cycle time is 250 ns. Dual-head drives are optional; up to four drives are supported by the system.

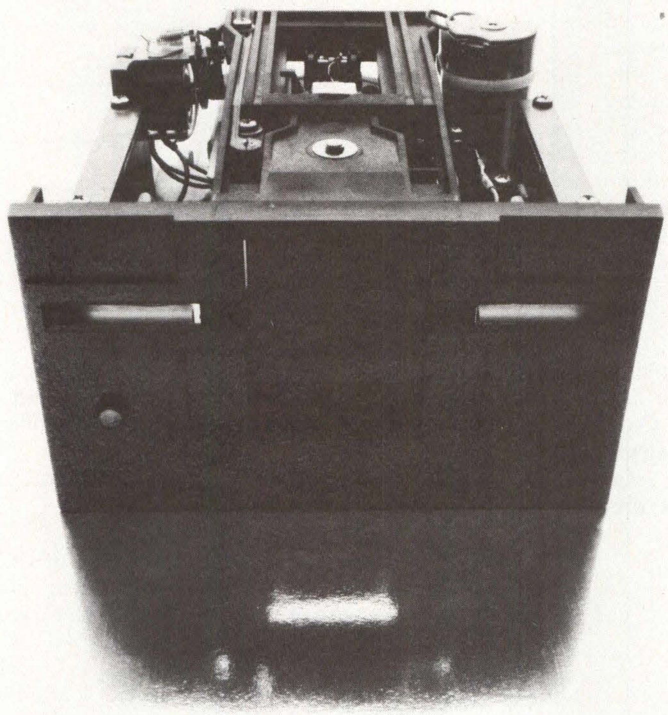
A single 9 x 12" (23 x 30-cm) board, mounted beside the memory board, houses the processor chip (with instruction times of 1 µs min and 3.5 µs max), two LSI chips for logical interface with subroutines, 1k bytes of ROM for bootstrap program storage, 2k bytes of RAM containing the CRT's current display, controllers, and two RS-232 I/O ports. A communications interface and parallel interface are optional. Single-unit price is $7700.

Scientific Data Systems, Inc, 12640 Beatrice St, Los Angeles, CA 90066, has equipped the system with an extended 12k BASIC interpreter—an advantage for performing business applications. Features of standard BASIC are improved upon with the addition of commands for formatted printing; input and manipulation of commands; file interface to random, sequential, and keyed files; I/O device handling; error handling; screen window management; and source file editing. Users can write database manipulation programs with the keyed file interface.

The operating system, modeled on large computer systems, controls the system through simple unambiguous commands. It supports program segment overlays, dynamic disc space allocation, flexible file size and organization, and device independent I/O. Utility programs handle file directory listing, diskette initialization and copying, handling of sequential files, and a resident assembler.

Circle 345 on Inquiry Card

The double-headed 5-1/4" floppy with a big difference.



It's available now!

PCC has them. In quantity. Ready for shipment.

Double-headed floppies that are compatible with Shugart down to the last screw hole.

It's the PCC FD-250, the double-headed version of our own FD-200. It can replace the Shugart SA 400 and quadruple your capacity (to as high as 437.5K Bytes).

What the FD-250 means is that right now you can fill up those empty boxes in your systems that are waiting for floppy drives. And you can upgrade from single- to double-sided immediately.

All without re-machining a single screw hole.

For more information on the PCC FD-250—or better yet, to order it in whatever volume you need—call your nearest PCC sales office.

Why wait? Your competition won't.

So. California-(213) 996-1333
No. California-(415) 349-9184
Illinois-(312) 253-2380
Texas-(214) 387-2817
Connecticut-(203) 348-3949
Pennsylvania-(215) 265-8310
New York-(716) 271-2710
Florida-(305) 647-6150
England-(0) 734-582115
Headquarters-(213) 999-2020

PCC PERIPHERALS
PERTEC COMPUTER CORPORATION

SOFTWARE

Program Development System Capabilities Operate Simultaneously

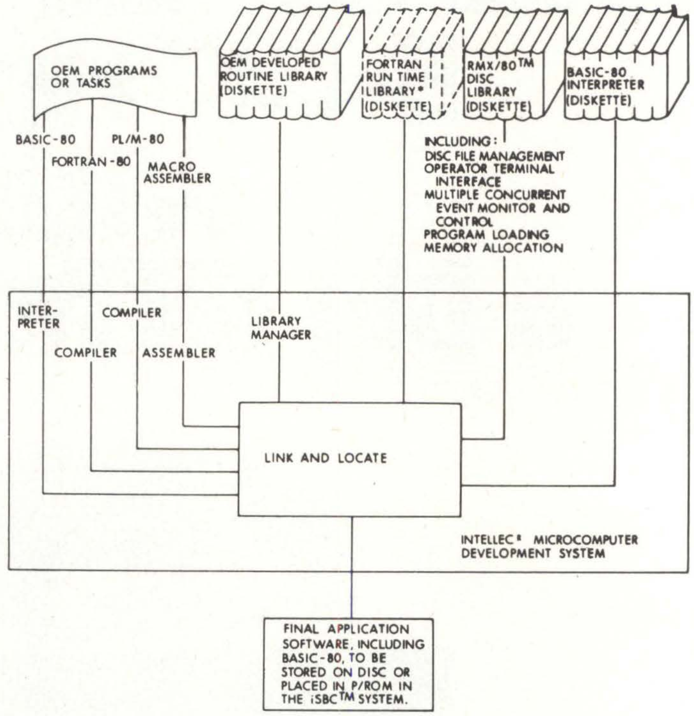
Text editor, assembler, link loader, and simulator facilities comprise the MicroSim program development system for Intel 8080/8085 or Zilog Z80 target microprocessors. It reduces debugging time for assembly language programs since it assembles a program as it is entered.

Features that the Digital Products Group, 350 Sharon Pk Dr, Q23, Menlo Park, CA 94025, has incorporated are byte segregation and an internal clock. Thus, the system can distinguish bytes of storage containing data, instructions, and addresses. The counting of machine cycles allows the user to determine the realtime duration of target program execution.

If an error is discovered during execution of the program, it is corrected immediately using editing commands within the simulator that modify the source program text. Each line of text that is entered is also checked for syntax errors and is assembled into machine code. Once corrections are complete, a single command reloads all program segments into memory and restarts program execution.

Circle 346 on Inquiry Card

OEMs Can Build High Level Language Into Microcomputer Systems



With Intel's microcomputer development system, OEM system designers choose appropriate software modules from various libraries to develop single-board system software. Time can be spent on software that relates to application. Addition of BASIC-80 package expands commercial and industrial capabilities

OEMs can supply BASIC-80 as part of their software for the iSBC 80 single-board computer systems with the iSBC™ 802 BASIC-80 interpreter package. The software is tailored to the actual system configuration by the OEM, by the service organization in the field, or by the customer. Meeting minimal BASIC standards of ANS X3.60-1978 and ECMA-55, the language is documented and interpretive, serving commercial, control, and industrial applications. Intel Corp, 3065 Bowers Ave, Santa Clara, CA 95051, designed the software to run under the RMX/80™ Realtime Multitasking Executive.

Two forms are a relocatable version and predefined version. The relocatable version operates with an iSBC 80/10A, 80/20, 80/20-4 or 80/30 system equipped with an I/O terminal, 48k of RAM, and normally including a disc drive (the BASIC, alternatively, could be stored in ROM-P/ROM).

An Intellec® Microcomputer Development System can store the BASIC-80 interpreter as a library of routines on a diskette. To add the language, the designer specifies the end-use system parameters. The development system retrieves the applicable components and produces a minimum size, full feature BASIC-80 configured to the specific OEM system. The development system also houses FORTRAN-80, PL/M-80, and/or macro assembler languages.

Routines can be selected from other user supplied diskette files of the FORTRAN runtime library and RMX/80 realtime multitasking executive library. The development system links and relocates these routines with other software components into a complete software solution in machine level code. It is then loaded into the iSBC system and stored on disc or on P/ROMS.

Automatically loading BASIC-80 and the needed RMX/80 components, the predefined version operates with a specific hardware system configuration that includes the iSBC 80/30, 32k bytes of additional RAM, the iSBC 204 disc controller board, a disc drive, and compatible terminal. Two P/ROMS are plugged into the computer board to provide the bootstrap loader.

A software package contains both a single- and double-density diskette, each containing the configurable and preconfigured versions. BASIC-80 configurable RMX/80 disc based interpreter is copyrighted and licensed by Intel. The one-time price is $4995.

Circle 347 on Inquiry Card

Software Support Enhances Debug/ Development System

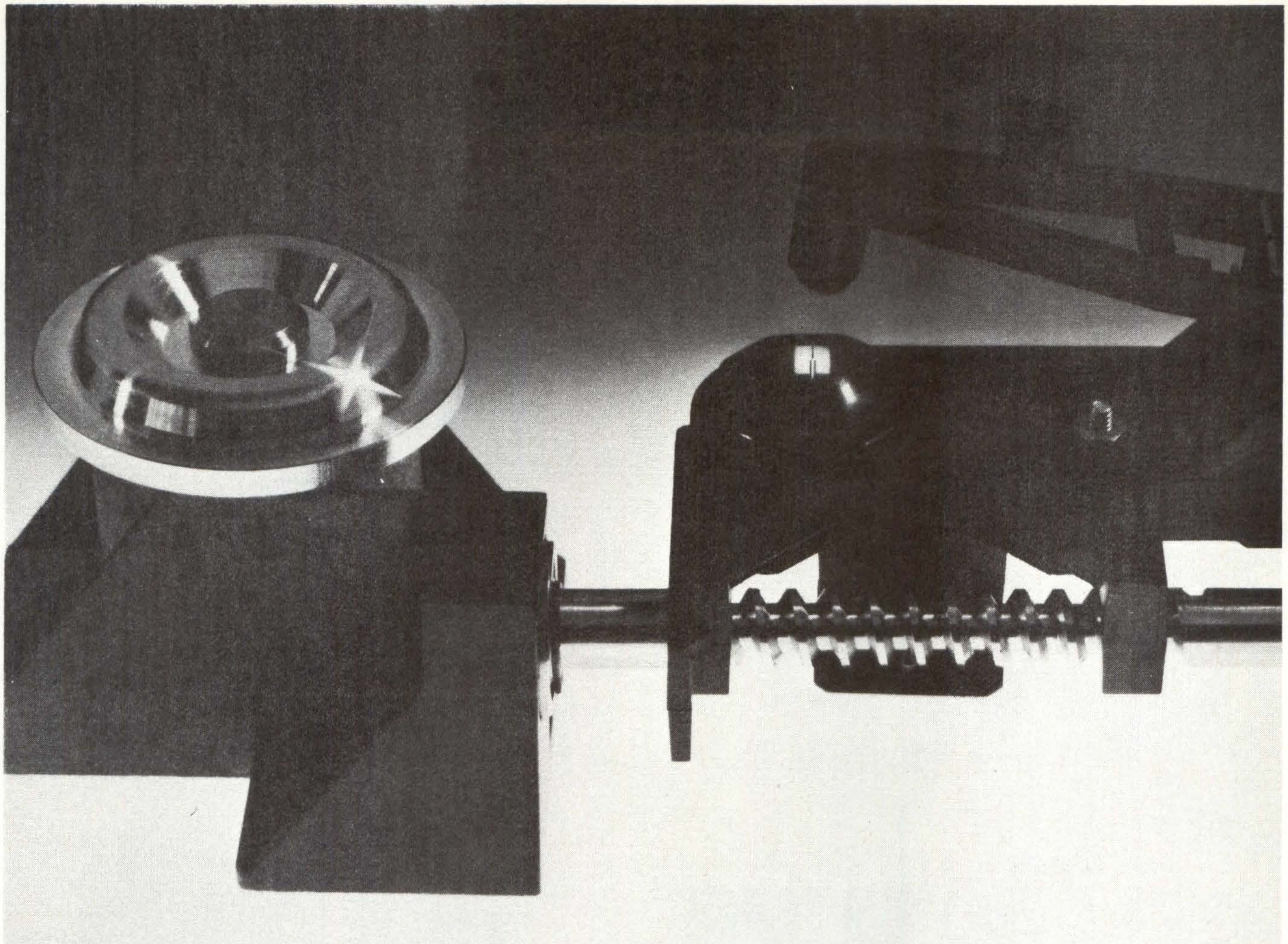
To speed and ease the software development cycle, an array of software supports the Z80, floppy disc based AID-80F™ development system. This device (see *Computer Design*, Apr 1978, p 174) develops and debugs the microcomputer product line produced by Mostek Corp, 1215 W Crosby Rd, Carrollton, TX 75006 FLP-80DOS (version 2.0) is the operating software.

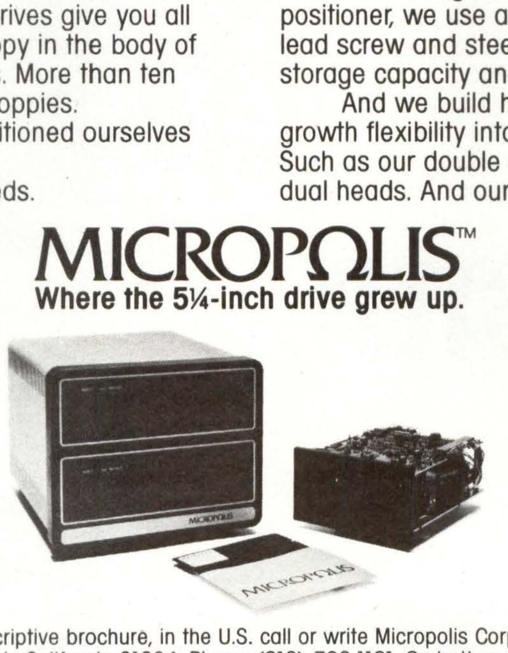
Augmenting the operating software and system capabilities are two macro assemblers, BASIC, FORTRAN IV, and a software library. The Mostek Z80 macro assembler, MACRO-80, is an upgrade of the FLP-80DOS assembler (ASM). MACRO-70 has advanced from the FLP-80DOS assembler for the 3870 microcomputer (FZCASM). Fully upward compatible, both assemblers provide for nested conditional assembly and symbol lengths of any number of characters in addition to macro capabilities. They support global symbols, relocatable programs, a symbol cross reference listing, and unused symbol reference table.

The company's BASIC, an implementation of Microsoft BASIC for the Z80 microprocessor, acts as an interpreter and is suitable for user interactive processing. Features include long variable names, substring assignments, and hexadecimal and octal constants. Arrays have up to 255 dimensions, with runtime allocation and deallocation. Editing, error trapping, and trace facilities simplify program debugging.

Comparable to mainframe and minicomputer FORTRAN compilers, FORTRAN IV provides a microprocessor FORTRAN and assembly language development package that generates relocatable object modules. Subroutines may be compiled separately and stored in a system library. Also featured are calling Z80 assembly language subprograms from FORTRAN programs and compiling several hundred statements/min in a single pass. The final enhancement is the FLP-80 DOS software library (volume 1) containing 23 programs designed to run on the operating system. It is supplied on two diskettes, with both source and object code. □

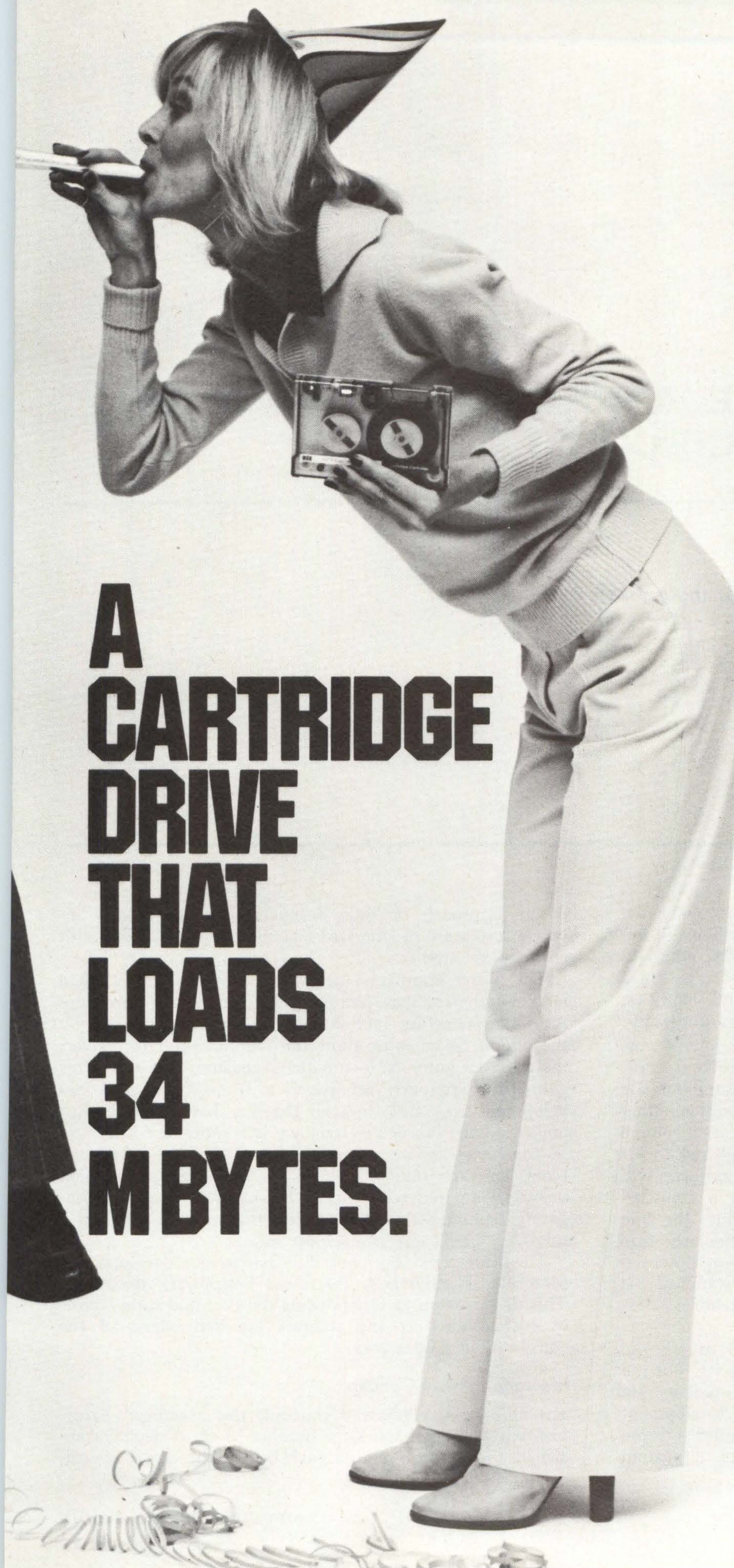
Circle 348 on Inquiry Card





See Us at NCC. Booth #368-369 New York Hilton.

HEY DISK JOCKEY, WE'RE CELEBRATING SOMETHING NEW TO BACKUP YOUR WINCHESTER DISKS.



A CARTRIDGE DRIVE THAT LOADS 34 MBYTES.

If you've been trying to backup Winchester disks with floppies and your file is beginning to look like this week's top 40, lend us your ears.

DEI's new 34 M Byte High Density Microtape™* Cartridge Drive is the latest development in the Funnel Series. It has as much capacity as 34 double density, double sided floppy disks, and 48% more capacity than an 800 bpi ½-inch reel-to-reel drive with 2,400 ft. of tape.

The 7,200 bpi, ¼-inch cartridge tape drive accomplishes this remarkable technical breakthrough by recording 7-tracks in GCR or MFM code at up to 10,000 FRPI and can transfer at the rate of 216 Kilobits/second.

Put Microtape Drive performance together with small size (it's just 7-inches wide, 5¾-inches deep, 4¼-inches high and weights 4 lbs.) and you'll have another reason to specify.

To top it all, there's DEI's experience with over 6,000 High Density cartridge tape drives in the field. In fact, our 17.28 MB Microtape drive has become an industry standard for Winchester disk save and restore.

So join the celebration and try our new High Density Microtape drive with your minicomputer system. Your customers will be tooting a tune that's music to your ears.

Write Data Electronics, Inc.
370 N. Halstead St., Pasadena
California 91107
Or call (213) 351-8991, Telex 67-5327.

DEI MICROTAPE CARTRIDGE DRIVE

CIRCLE 147 ON INQUIRY CARD

*Microtape is the DEI name for its ¼-inch cartridge tape drives.

A COST-EFFECTIVE APPROACH TO BIPOLAR VLSI COMPUTER CIRCUITS

Jerry Prioste

Integrated Circuits Division, Motorola, Incorporated,
Mesa, Arizona

Three basic approaches to logic design have been developed by the semiconductor industry to satisfy the demand for large scale digital integrated circuits: standard off-the-shelf circuits, custom circuits, and gate arrays. Since each of these has characteristic advantages and liabilities, the approaches are frequently mixed in system designs.

The off-the-shelf approach represents the lowest cost option for the MSI/LSI user because such circuits are normally sold in relatively large quantities throughout the industry as part of a circuit family for use in implementing logic, thereby supplying cost advantages of large volume semiconductor manufacture. However, the high risk factor that is involved in the probability that the industry will adopt a particular LSI circuit or family as a standard (thereby permitting large volume sales), limits the line of standard LSI circuit families. This is particularly true in high technology fields, such as ECL, where potential volume (even if a circuit is adopted as a standard) is much smaller than that of the more generalized, less critical applications.

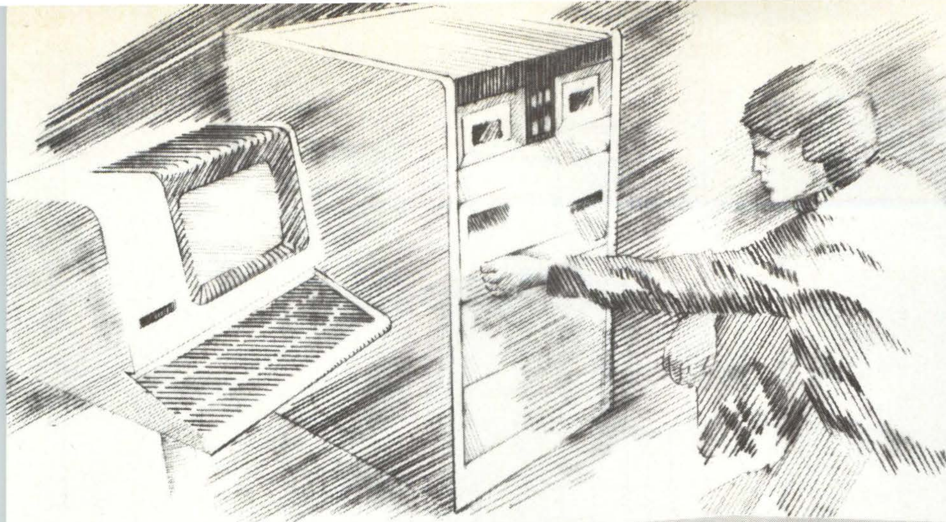
Custom design provides each customer with exactly the circuits he needs (usually on a proprietary basis), but the cost per circuit is high unless volume requirements are large enough to amortize the relatively high development costs. Moreover, development time of complex custom circuits can be on the order of 1 to 2 years. A custom design approach to logic design of systems usually involves a mixture of standard MSI/LSI circuits coupled with custom LSI circuits.

The third approach involves a standard array of a large number of gate circuits diffused into a silicon chip. An interconnecting metallization pattern is provided by the circuit designer to allow the manufacturer to convert these basic gates into functional custom circuits. This gate-array approach represents a tradeoff between development cost and time on the one hand, and performance on the other. Performance is compromised because of the necessity for using a gate as the basic building block for LSI circuits. This results in longer propagation delays, compared with similar functions using ECL series-gating techniques (for example), and usually involves a relatively inefficient use of chip area.

The Macrocell approach to custom LSI, developed at Motorola, supplements the three techniques described. This design strategy circumvents the cost and time factors of custom circuits, and reduces the deficiencies of the conventional gate arrays.

Macrocell Array Concept

Extending the gate-array concept, the Macrocell Array, instead of gates, contains a number of unconnected transistors and resistors within each cell in the array. Specifi-



TI Silent 700® or ANSI Compatible

Emulates paper tape with DEC software at up to 9600 baud

The Raycorder Cassette Terminal Model 6801

The Model 6801 Raycorder Cassette Terminal is a dual-cassette operating system capable of reading, writing, and copying data at switch selectable rates from 110 to 9,600 baud through a full duplex, asynchronous RS232C interface.

Operating under the control of a microprocessor with up to 4K of firmware, the Model 6801 has designed-in versatility never before available in a system of this type.

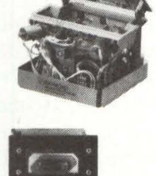
Connected to a serial port of a DEC PDP8 or PDP11 and given the proper address, it will emulate the typical paper tape reader/punch and perform the functions of program load, data logging, assembly, edit or duplication. Select one of two Texas Instruments Silent 700® modes, and tapes can be written, read, or copied that are completely compatible with the 733ASR but at much higher data rates.

With its extension connector, the Model 6801 can be connected to any RS232C port without disturbing the device formerly connected there. With this feature, for example, tape storage can be added where only hard copy print out or CRT display had previously existed.

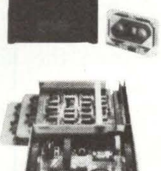
Utilizing two of Raymond's time-proven 6406 Raycorder cassette drives, the Model 6801 provides the ultimate in a reliable, flexible data storage and handling device for a multitude of applications. Detailed specifications will be provided on request.

For the OEM

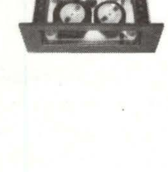
Raymond's small tape drives, long the standard of the industry, are now available with all new electronics that make interfacing a cinch.



Model 6406 for Philips Cassettes, redesigned with many new features at a lower cost.



Model 6409 for Mini-Data Cassettes, now has a parallel interface and other changes you'll appreciate.



Model 6413 for ¼-inch Data Cartridges, the newest member of the team is catching on fast.

Raycorder Products Division
Raymond Engineering Inc.
217 Smith Street
Middletown, Connecticut 06457
(203) 632-1000

a subsidiary of Raymond Industries

CIRCLE 148 ON INQUIRY CARD

Macrocell Array Characteristics

Cells		
	Major	48
	Interface	32
	Output	26
Equivalent Gates		
	1192	if full adders and latches used in all cells
	904	if flipflops and latches used in all cells
Die Size		221 x 249 mils
Power Dissipation		
	4 W typical for 904 gates	
	4.4 mW/equivalent gate	
Cell Delays		
	Interface	0.9 ns typ (1.3 ns max)
	Major	0.9 to 1.3 ns typ (1.3 to 1.8 ns max)
	Output	1.5 ns typ (2.2 ns max)
Drive		
	25-Ω load on any output cell (to total of 8)	
	50-Ω loads on all output cells	
Edge Speed		
	1.5 ns typ 20 to 80% (1 ns min)	
Macros		
	Major cells	54
	Interface cells	14
	Output cells	17
Ambient Temperature Range		
	0 to 70 °C with heat sink and 1000 lfpm (linear feet/min) air flow	
Thermal Resistance		
	15 °C/W with heat sink and 1000 lfpm air flow	
Absolute Maximum Junction Temperature		
	T_J = 165 °C	
Voltage Compensated		
	$V_{EE} = -5.2$ V ±10%	
MECL 10K Compatible		

cations for creating interconnecting patterns that can transform the unconnected transistors and resistors within each cell into SSI/MSI logic functions, called macros, are stored within a computer. These macros take the form of standard logic elements such as dual type D flipflops, dual full adders, quad latches, and many other predefined functions. All macros incorporate series-gated ECL structures for optimized performance. Presently 85 different logic functions make up the library.

To generate an LSI design, the designer need only select the appropriate macros from the library, assigning these to the desired cell locations, and creating the necessary cell interconnecting pattern. The computer itself generates the proper intraconnecting pattern within each cell.

This computer aided design approach, operated via standard timesharing terminals, greatly speeds up the circuit development while simplifying the designer/manufacturer interface. It serves to design the interconnects, to check out the performance of the designs, and to generate the custom metal patterns that complete the IC processing sequence.

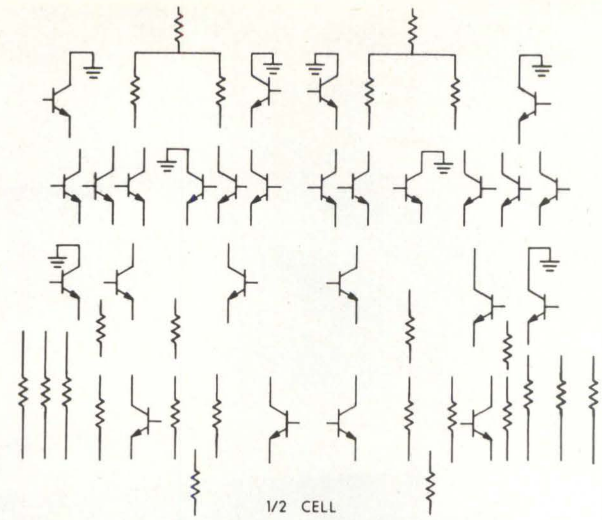


Fig 1 Half cell schematic (one-half of major cell). Major cells in array comprise internal area on the chip and are used for majority of logic capability. Each major cell contains 52 transistors and 48 resistors. Components are connected together on first layer metal to form logic functions with 4 series-gated structures operating on MECL 10K logic levels

Compared with the conventional approach to custom LSI circuits, the concept offers a considerable reduction in delivery time. With a stockpile of fully diffused and tested wafers, turnaround time (from the time the customer gives the go-ahead signal for generating the metal mask until finished parts are delivered) is an anticipated 12 weeks. In comparison with gate arrays, the use of higher component density and more efficiently designed subcircuits (macros) yields a substantial improvement in performance (circuit speed), while a greater utilization of onchip components reduces potential system costs. Compared with equivalent systems developed with discrete logic (separately packaged SSI/MSI logic functions), the high packing density of the array chip offers up to a 50 to 1 reduction in system component count, with a power dissipation reduction of as much as 5 to 1.

Important features of a Macrocell array are listed in the Table. The basic chip consists of 106 individual cells: there are 48 major cells, 32 interface cells, and 26 output cells. A half-cell schematic of a major cell shows the unconnected transistors and resistors (Fig 1). Cells within each of these three basic classifications contain identical fixed arrays of resistors and transistors, and all chips are built from a standard diffusion set; ie, all chips are identical and can be prefabricated, up to the metallization step.

Applications

One of the most important features of the design is the logic flexibility provided by the function library. The system value of the array can be shown by examining possible circuit options.

Fig 2 shows a block diagram of an 8-bit binary/BCD ALU that was designed using more than 96% of all cells in the array. The ALU operations include binary and BCD addition and subtraction, shift left, shift right, increment, transfer, invert, and various logic operations.

We heard you and...

HERE IT IS! A SMART APL *TELERAY* with...

...High-Resolution APL overstrikes

Five years of listening to thousands of APL users told us to give you the new Teleray Model 11. Its true overstrike, programmable wide-character display and "instant character replay" give you the most versatile APL/ASCII terminal yet available . . . and

And... 32 Programmable Functions

Call up forms and function sequences, answerbacks, in any combination, plus more programmable features than ever before . . . and

And... Mail-in Super Service

Direct-mail servicing, from your operating station to our Service Dept. with no middleman. No-tools, snap-in modules replace in 60 seconds, and reusable mailers get your modules back and forth to you without expensive service calls. Call us toll-free for any service help you need . . . and, so . . .

SEE MODEL 11 AT INTERFACE '79

Call for immediate info!

TELERAY Sales Offices:

(201) 652-7055	(301) 589-2802	(412) 243-8421	(613) 225-0411
(201) 944-1600	(303) 279-7796	(416) 622-6752	(617) 459-2578
(203) 623-5352	(305) 421-4989	(503) 292-3505	(713) 780-2511
(205) 881-9298	(305) 645-3444	(512) 451-5174	(714) 273-4771
(206) 641-6444	(312) 655-0040	(512) 828-0937	(714) 552-7850
(212) 947-0379	(313) 354-6421	(513) 223-8421	(716) 381-4120
(213) 328-9770	(404) 955-0293	(518) 587-2313	(801) 969-4034
(214) 661-0300	(405) 528-6071	(602) 968-5962	(808) 523-1326
(216) 585-8421	(408) 744-1930	(612) 535-5330	(919) 883-9125

TELERAY
DIVISION OF
RESEARCH INC
BOX 24064 MINNEAPOLIS, MINNESOTA USA 55424
PHONE (612) 941-3300

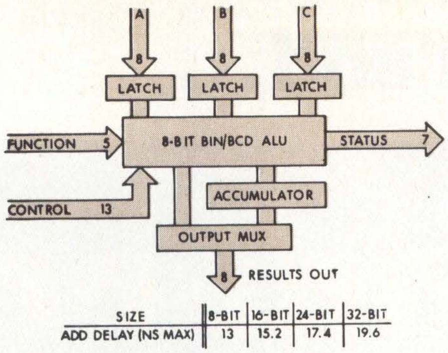


Fig 2 Eight-bit binary/BCD ALU utilizing Macrocell Array. Five function select inputs select 32 ALU operations on three 8-bit input ports, with result sent to output bus either directly or through accumulator for pipelining

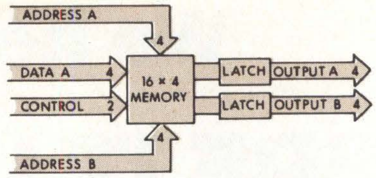


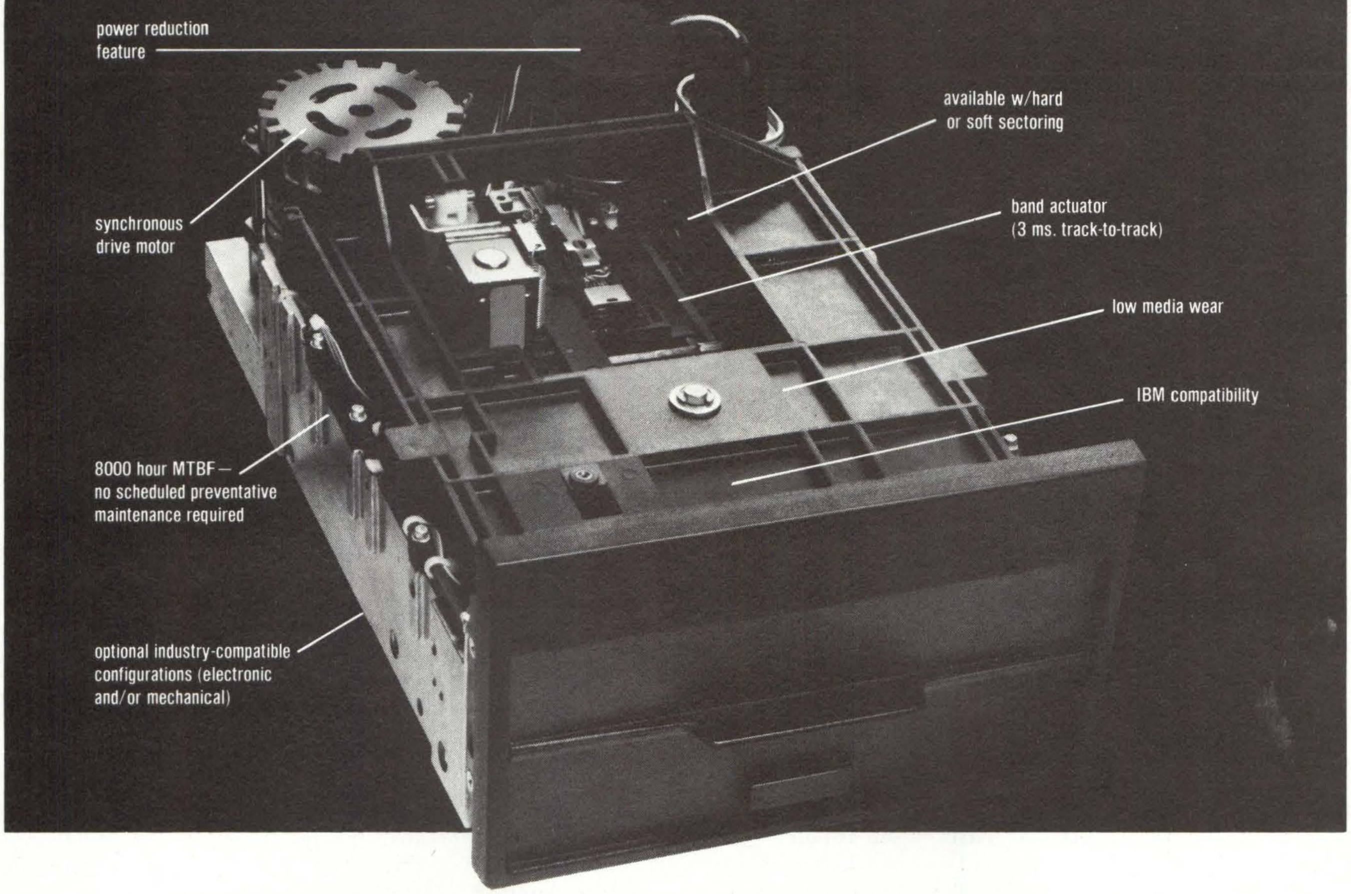
Fig 3 Multiport register (16 x 4) has independent address and output ports. During write cycle, data at input port are written into memory location designated by address A. Max times are 6.5 ns for address access and 7.0 ns for write cycle

MSB sign protection results on arithmetic shift right, and the overflow output checks for a sign bit change on arithmetic shift left. Three 8-bit independently controlled latches can be used to hold data on any input. The propagation delay for any function from input to output is only 13 ns (max). A 32-bit ALU can be built from four of these arrays, using ripple carry, with a propagation delay from input to output of less than 20 ns.

For larger word lengths, lookahead carry circuits such as the MC10179 can be used to minimize propagation delays. Typical power of the chip is 4.1 W total, which includes the power of the output transistors driving a 50-Ω load. The total number of equivalent gates using the gate equivalent in the library is 528, for a power dissipation of 7.8 mW/gate (avg).

A 16 x 4 multiport register file is diagrammed in Fig 3. The circuit has two independent address and output ports for reading the contents of the memory. Address access time is only 6.5 ns (max).

CDC knows what OEM's want most in a two-headed floppy. Confidence.



Experience plus feedback. The success formula that earned us our reputation in rigid disk technology can work for you in flexible disk technology. Our 9406 incorporates all that we've learned from building more than 100,000 single-sided floppies. All that we've learned from talking to our OEM customers about a wide variety of two-headed floppy applications.

Our 9406 has two read/write heads for two-sided media. But depending upon your application, the 9406 can be operated in either one- or two-sided mode as well as single- or double-density formats.

You have requested IBM media interchangeability and we have it. Optional mechanical and electronic configurations that are industry-compatible are available. Or you can match the dimensions, mechanical mounting and interface protocol used by our single-sided drives.

Besides confidence in the product, our 9406 customers can enjoy confidence in the company that makes it. Control Data is one of the world's largest suppliers of OEM equipment. And we've built a service and support organization that you can depend on. For financing, maintenance or spare parts. For assistance in building quality and confidence into your product line.

Put quality behind your nameplate. For more information, call 405/946-5421 or contact your Control Data representative. Or return coupon to:

Chet Baffa, Product Sales Manager
Control Data Corporation
4000 N.W. 39th St., Expwy.
P.O. Box 12313
Oklahoma City, Oklahoma 73112

Please tell me more about your 9406 flexible disk drive.

Name__________ Title__________

Firm__________ Phone__________

Address__________

City__________ State______ Zip______

CONTROL DATA CORPORATION

More than a computer company

CIRCLE 152 ON INQUIRY CARD

Four ICs Execute Data Encryption Algorithm to Safeguard Information

A 4-circuit set of data encryption circuits, based on I³L™ technology, execute the National Bureau of Standards encryption algorithm, meeting functional requirements specified in the Federal Informatic.. Processing Standard publication 46. The devices protect information (links or files) in data transmission systems and high performance peripherals through a virtually unbreakable encryption system.

A pair of data registers, four 8-bit shift registers, control logic, and two 64 x 4-bit ROMs comprise each 9414-1, -2, -3, and -4 circuit. The circuits are available as a set of components or as board level components. Pricing for the 4-piece set of circuits is $100 in 100 to 999 quantities.

A 56-bit key word enciphers or deciphers a 64-bit data word stored in eight 8-bit bytes. Two bits of each byte are distributed to each of the four chips. The 56-bit key word, combined with eight parity bits is also broken down into eight 8-bit bytes. Bits 1 through 4 of each byte go to both chips 1 and 2; and bits 4 through 7 go to chips 3 and 4, with the parity bit fed to one of four chips. Thus, the set stores a 64-bit plain text or cipher text word, as well as the key word.

During data loading, the chip set performs an initial permutation of the input word. The loaded data are split into two b'ocks, and each byte encounters further permutations through a series of 16 iterations/block of cipher data. There are 72 x 10^{15} key variations possible between the permutations of the 64-bit data word and 56-bit key. Deciphering uses the same key word. Access to a file is useless without the key.

Separate data I/Os allow simultaneous input of the data block to be processed with the previous block's output. The system can be implemented within existing data link protocols without modifying word size, since I/O blocks are both 64 bits. Processing of a 64-bit data block in 24 clock pulses makes the chip set potentially the fastest of its kind available, according to the FIRE Microcomputer Group of Fairchild Camera and Instrument Corp, 464 Ellis St, Mountain View, CA 94042. Throughput rates range up to 13.3 MHz (75 ns)/bit or 200 kHz (4.8 μs)/64-bit word.

Circle 360 on Inquiry Card

High Performance CMOS Amplifiers Employ Unique Circuit Design

A commutating autozeroing technique (CAZ) is utilized in the design of an operational amplifier, which provides a near zero initial offset voltage of 5 μV, 0.1 μV/°C offset drift with temperature, input leakage current of 5 pA, and open loop gain >100 dB. These parameters also characterize an instrumentation amplifier that is based on the same design technique.

Each device consists of two op amps, a set of analog switches, and a digital timing section, all included on a single CMOS chip. Autozeroing capacitors are required to complete the functions—two capacitors in the case of the 14-pin ICL7600 op amp, and four in the case of the 18-pin ICL7605 instrumentation amplifier. These two devices, produced by Intersil, Inc, 10710 N Tantau Ave, Cupertino, CA 95014, are priced respectively at $6.50 and $15.00 each in 100-unit quantities.

The analog switches in one of these CAZ amplifiers are used to connect each internal op amp alternately into either a signal processing mode or into an autozero mode. If one amplifier is in the autozero mode, the other is automatically in the signal processing mode. In autozero, the amplifier stores on a capacitor a voltage value that is equivalent to its noise voltage. Some time later, the amplifier's output and its noninverting and inverting inputs are reconnected through the analog switches, so that the error voltage stored on the capacitor is added to the noninverting (plus) input, canceling the internal input error voltage of the op amp. The result is that the input signal is continuously processed, while low frequency noise and offset errors of both op amps are monitored, updated, and corrected at the commutation frequency. Offset voltage drift with respect to time and temperature is considerably less than similar effects observed in conventional chopper-stabilized op amps.

According to the manufacturer, the CAZ technique gives the user a

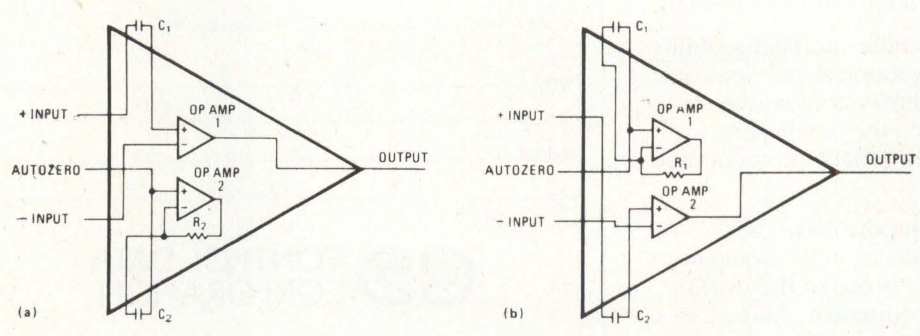
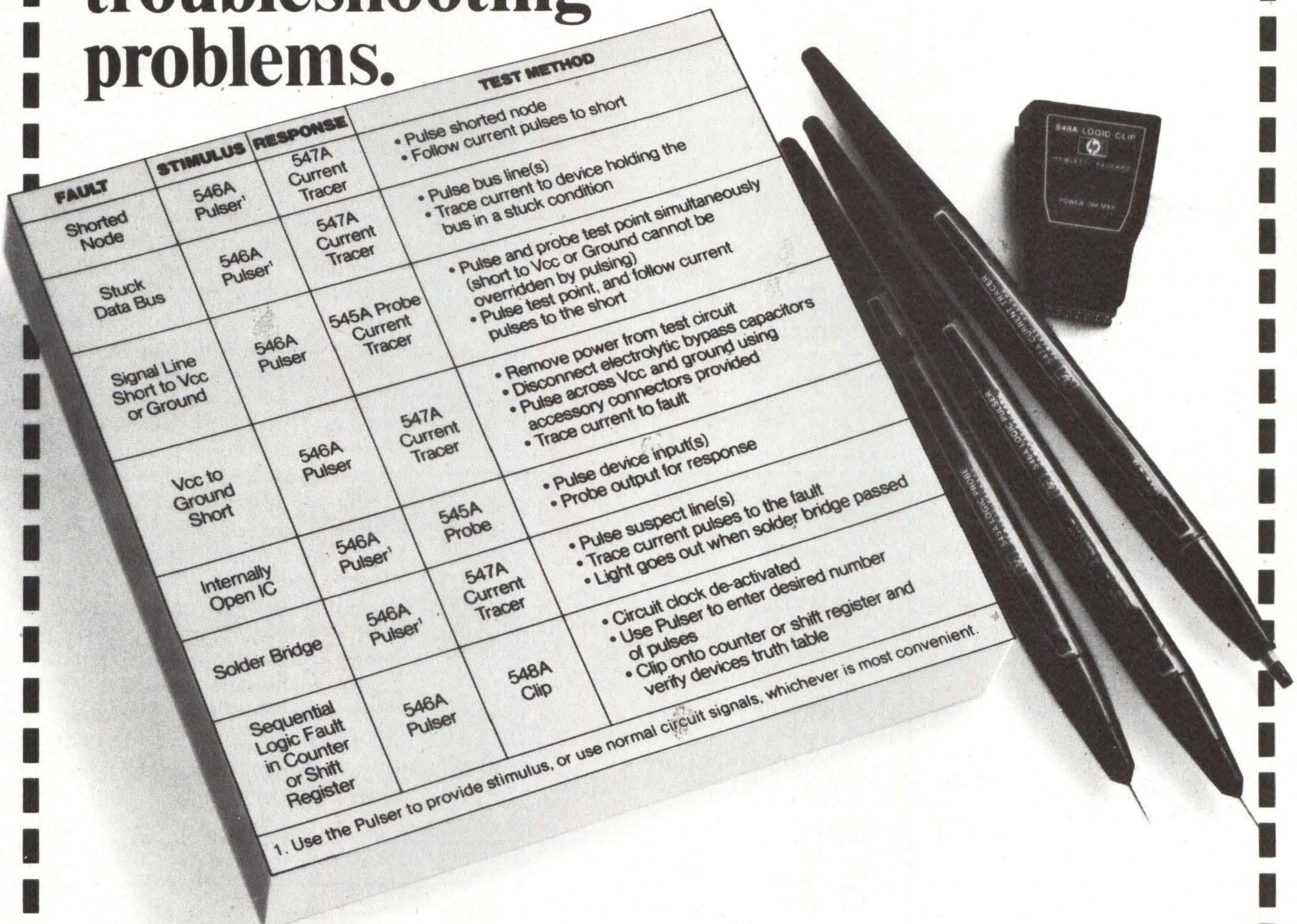


Fig 1 Commutating autozero op amp, ICL7600, from Intersil. Device includes two conventional op amps, one of which (a) processes input signal while second (b) stores offset errors on external capacitor. When op amps reverse roles, error on C_2 is in series with input of second op amp, canceling offset errors

Mail us this ad

and we'll help you discover simple, effective solutions to difficult troubleshooting problems.



HP's IC Troubleshooters make troubleshooting digital circuits fast and less frustrating. Take a look at the chart and see why more than 50,000 people use these simple, rugged, low-cost Hewlett-Packard instruments.

LOGIC PULSER stimulates IC's in-circuit for testing. Automatically drives the circuit to its opposite state. No unsoldering components or trace cutting. $115-$175*

LOGIC PROBE shows pulse activity: high, low or bad level, single pulse or pulse trains. High input impedance. Overload protected. Automatic. More convenient than a scope. $90-$150*

LOGIC CLIP with 16 LED's displays state of up to 16 IC pins at once. High input impedance. Overload protected. Automatic. $90-$125*

CURRENT TRACER inductively senses and displays logic current pulses. Finds shorts and stuck nodes with no unsoldering or trace cutting. Uses in-circuit current or pulses from Logic Pulser. $350*

*Domestic US prices only.

Order now or call your nearby HP field sales office for complete information.

I want to discover easy solutions to difficult troubleshooting problems. Please rush me a free copy of HP's 20-page Troubleshooting Catalog.

NAME________________________

COMPANY______________________

ADDRESS______________________

CITY__________________________

STATE__________ ZIP__________

HEWLETT hp PACKARD

1507 Page Mill Road, Palo Alto, California 94304

For assistance call: Washington (301) 258-2000, Chicago (312) 255-9800, Atlanta (404) 955-1500, Los Angeles (213) 877-1282

02904

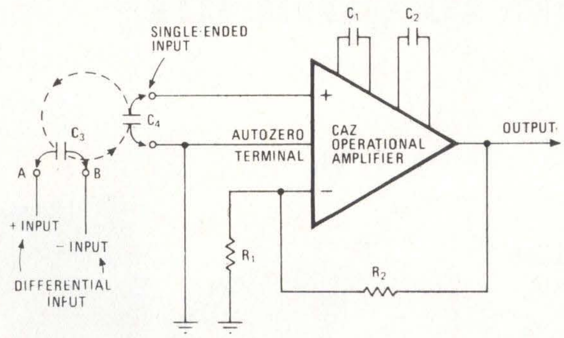


Fig 2 Capacitors C_3 and C_4 are switched between differential input and input of ICL7605 instrumentation CAZ amp to convert differential input into single-ended type

"virtually ideal" amplifier. There are no requirements for trimming or selection during manufacture, as compared to currently available devices, which require either special processing and/or careful selection to achieve comparable performance.

Other characteristics include a low noise voltage (3 μV pk-pk over a 0.1- to 10-Hz frequency range) and low noise current (1 pA pk-pk over the same frequency range). Low frequency temperature effects are correctable by the commutation circuitry. Long-term drift is fully compensated and, at ~0.1 μV/yr, is negligible.

The instrumentation amplifier is intended to replace the classic 3- or 2-op amp instrumentation amplifier designs. Those conventional designs require a fairly complex gain network of external resistors, which must match and track one another for good common-mode rejection. The CAZ instrumentation amp requires only two external resistors to set gain (as is also true of the CAZ op amp), and the common mode rejection ratio (CMRR) of 110 dB is independent of the resistor values. No adjustments other than full scale are necessary to achieve high performance.

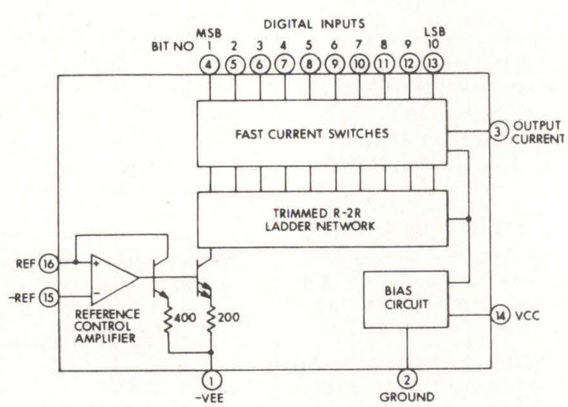
Control of device operation is accomplished via the digital section of the chip, which contains an RC oscillator, a frequency divider, a level translator, and an output buffer. The level translator allows use of an RC oscillator, which operates from a low, stabilized supply voltage. Power consumption is low and only minimal supply current transients are present for potential feedback into the analog section. The oscillator provides an output of about 10 kHz, and through addition of external capacitance, can be programmed to operate at any lower frequency. A ratio terminal permits the user to change the divider ratio to produce several options, from freerunning at any reasonable commutation frequency (10 to 500 Hz) to full lock to an external clock such as the master clock of an integrating ADC.

Circle 361 on Inquiry Card

Fast Monolithic 10-Bit D-A Converter Features ±½ LSB Linearity

Bipolar monolithic technology and TTL/CMOS compatibility are features of a D-A converter that is characterized by a 10-bit resolution and ±½ LSB worst case linearity error. DAC-IC10B, produced by Datel Systems, Inc, 11 Cabot Blvd, Mansfield, MA 02048, requires only an external reference and operational amplifier for voltage output operation. A full-scale change in output current settles in 250 ns, and with a fast IC op amp (such as AM-452 by the same manufacturer), a 10-V output change can settle within 1 μs. Digital input coding is straight binary for unipolar operation and offset binary for bipolar operation.

This circuit incorporates 10 fast switching current sources which drive a diffused resistor R-2R network.



DAC-IC10B (BM) from Datel is 10-bit monolithic DAC. Featuring ½ LSB linearity, device settles in 250 ns. Fast current switches drive diffused resistor R-2R ladder network, which is laser trimmed through cutting aluminum links

The ladder network is laser trimmed by cutting aluminum links. A reference control amplifier and a bias circuit are also included in the converter. An external reference current of 2 mA is required at the positive reference input terminal; this is accomplished by an external voltage reference and a metal film resistor.

Additional characteristics include ±1-bit linearity with monotonicity guaranteed at room temperature (25 °C). The gain tempco is 20 ppm/°C. Output current is 0 to 4 mA and output voltage compliance is −2.5 to 0.2 V, permitting direct driving of a 625-Ω resistor for a voltage output. The reference input current can be varied from 0.5 to 2 mA to give monotonic operation as a one or two quadrant multiplier. Other applications include digitally controlled attenuators, display systems, computational circuits, and automatic test circuits.

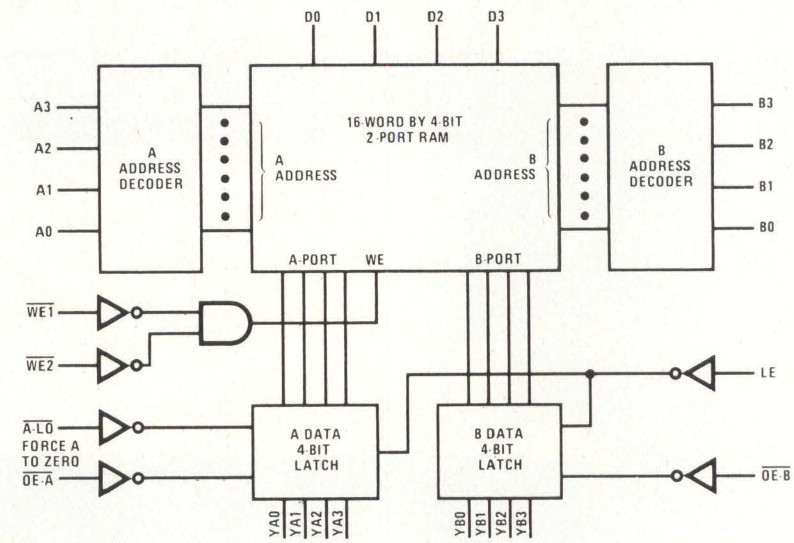
These converters combine operating flexibility and speed with low cost. They are available in both a commercial version (operating over 0 to 70 °C and priced at $14.50 in 1 to 24 quantities) and a military version (operating over −55 to 125 °C and priced at $27.50 in 1 to 24 quantities). Both are monotonic over the operating temperature range. Power supply requirement is 5 V at 18 mA and −15 V at 20 mA.

Maximum ratings limit V_{CC} to 7.0 V, V_{EE} to −18 V, and digital input voltage to 15 V. The output voltage (pin 3) must lie between 0.7 and −5.0 V. Reference current must not exceed 2.5 mA nor reference differential input exceed 0.7 V.

Circle 362 on Inquiry Card

Schottky ECL RAM/Register File Has Dual Output Ports

A 16-word by 4-bit monolithic random access memory/register file utilizing Schottky emitter coupled logic features two separate output ports, enabling any two 4-bit words to be read simultaneously from the outputs. Each output port contains a 4-bit latch, and a common latch enable (LE) input is used to control all eight latches. This device, which has two write enable ($\overline{\text{WE}}$) inputs, is designed so that LE and either $\overline{\text{WE}}$ can be wired together to make the operation of the RAM appear edge triggered.



RAM/register file, IDM29705A from National Semiconductor, is organized as 16 words by 4 bits. Device features Tri-State™ outputs and two separate output ports

IDM29705A is a selected high speed device having an access time of 25 ns, in contrast to a 53-ns access time for the standard 29705. National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95051, which provides the standard device on a second-source basis, is the sole source for the A version.

Having fully decoded A address and B address fields, the device can address any of the 16 memory words for the A output port and simultaneously select any of the 16 words for presentation at the B output port, with incoming data written into the 4-bit RAM word selected by the B address. Data accessed at the A address port appear at the A output port, and data accessed at the B address port appear at the B output port. The D inputs are used to load the new data into the device (see Diagram).

Several of these devices can be cascaded to increase the total number of memory words in the system. Tri-State™ outputs are provided, and when $\overline{\text{OE-A}}$ is high, the A output port is in the high impedance mode. $\overline{\text{OE-B}}$, when high, forces the B output port to the high impedance state.

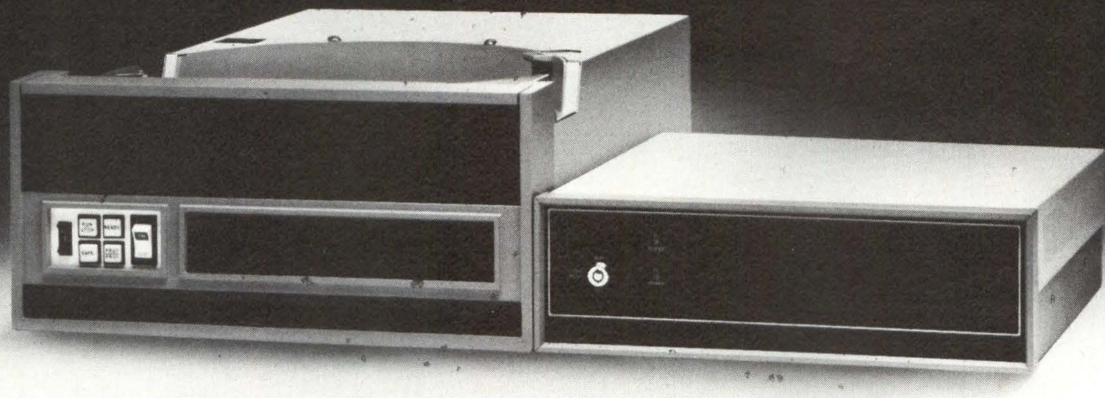
Writing of new data into the RAM is controlled by the $\overline{\text{WE}}$ inputs. With both of these inputs low, data are written into the word selected by the B address field. The memory outputs follow the data inputs during writing, if LE is high. With either $\overline{\text{WE}}$ high, no data are written into the RAM.

Absolute maximum ratings require that supply voltage (relative to ground) lie between −0.5 and 6.3 V, that dc voltage applied to outputs for high output state lie between −0.5 V and V_{CC} max, and that dc input voltage fall no lower than −0.5 V and no higher than 5.5 V. The dc output current (into outputs) is limited to 30 mA or less, while dc input current must remain between −30 and 5.0 mA. Storage temperature is constrained to the −65 to 150 °C range, and ambient temperature under bias must stay between −55 and 125 °C.

Hybrid V-F Converters Are Guaranteed Over Wide Temperature Range

An output pulse train having a repetition rate that is a precision linear function of input voltage is provided by low drift voltage to frequency converters. These 10-kHz/100-kHz

Now, a 10 megabyte hard disk subsystem designed for micros.



And iCOM® has it.

It's here. The new iCOM 4511R.

Slide these S-100 components into a standard 19-inch rack and you've got big computer storage capacity for your microsystem: 10 megabytes of useable storage.

The 4511R disk drive incorporates two 5 MB platters. The bottom one's fixed. The top one is removable, for efficient data backup and operating flexibility.

You can change cartridges easily, so the effective storage capacity of the system is limited only by the space on your shelf.

It can handle three more drives, too... boosting total, on-line, random-access memory to 40 megabytes.

And the 4511R is fast. Disks spin at 2400 rpm, and the average access time is only 40 milliseconds.

The bipolar disk controller provides integral power supply and key lock security.

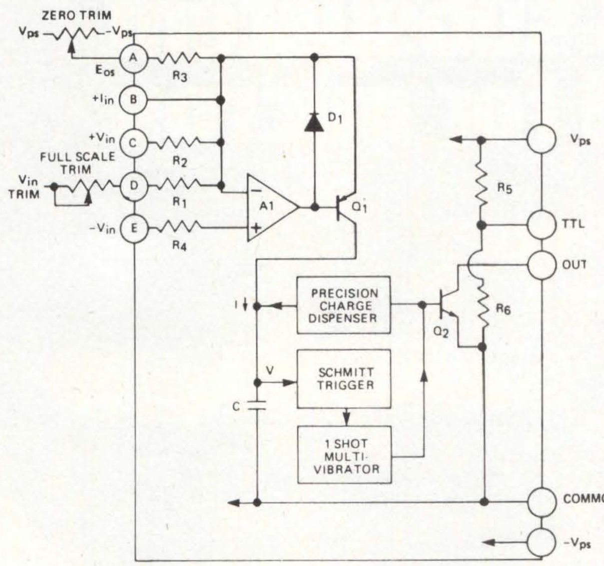
But hardware is only part of the story. The 4511R is available with CP/M,™ a sophisticated operating system which supports Microsoft's FORTRAN, BASIC, and COBOL.

PCC's iCOM Family.

The new 4511R hard disk subsystem rounds out iCOM's line of Microperipherals.® From our compact little 2411 Microfloppy™ to our new dual-density, dual flexible disk drive 3812 system, iCOM is the first name to look for in microperipherals.®

PCC SYSTEMS
PERTEC COMPUTER CORPORATION

For further information, call this toll-free number: 800-331-1000. (In Oklahoma, call 918-664-8300 Collect.)



Models 4731/4733 V-F converters from Teledyne Philbrick are freerunning (astable) voltage controlled multivibrators. Effective currents from inputs (A, B, C, and D) are summed at op amp A1. A1 and Q1 form precision current pump, producing current I from collector of Q1 to charge capacitor C at rate which is precise linear function of input signal. When voltage on C reaches fixed precision threshold, Schmitt-trigger output changes state and triggers one-shot (monostable) multivibrator, which produces constant width output pulse. Amplified by Q2, pulse functionally activates precision charge dispenser (PCD), which discharges C to same zero level every time output pulse is produced

full-scale V-F converters have the ability to handle positive, negative, and differential input signals over a wide range of power supply voltages (±9 to ±18 V). The 4731 and 4733 from Teledyne Philbrick, Allied Dr at Rt 128, Dedham, MA 02026, are said to be the only high performance V-F converters operating at these frequencies that have performance guaranteed over a −55 to 125 °C temperature range. Applications include use in no-drift integrate/hold, high common mode voltage isolation, 2-wire digital transmission, 20-bit ADCs, and optical data links.

With 126 dB of dynamic range, 70-dB CMRR, and 100% overrange, the devices provide linear operation with input voltages from ±10 μV to 20 V. Its current pin (the summing point of an op amp) resolves currents as low as 1000 pA, which makes operation possible with full-scale input voltages from less than 250 mV to greater than 100 V. Nonlinearity is 0.005%, equivalent to 16-bit end-point linearity, while differential nonlinearity and dynamic range approach 20 bits.

Guaranteed tempcos for the devices in ppm/°C are 15 (hot) and 25 (cold) for the 4731 and 20 (hot) and 30 (cold) for the 4733. Both are offered with 100% screening similar to MIL-STD-883, Method 5008. This screening includes internal visual, stabilization bake, constant acceleration, seal, fine and gross leak, external visual, and, for -83 versions of both models, burn-in and temperature cycling are also included.

Circle 363 on Inquiry Card

Quad Op Amp Operates From Single Supply Voltage

Quad operational amplifier LM3900 features current-mirror inputs with noninverting operation. It provides a large output-voltage swing and operates over a supply voltage range of from 4 to 36 V; with a balanced supply, it operates with voltages from ±2 to ±18 V. Specs include a low bias current of 30 nA, open loop gain of 70 dB, 2.5-MHz bandwidth, and output voltage swing of V+ - 1 V. Internal frequency compensation and output short circuit protection are included.

Texas Instruments Inc, PO Box 225012, Dallas, TX 75265, intends it as a second-source part for the National Semiconductor device with the same designation. Suitable applications for the 14-pin plastic or ceramic DIPS include ac amplifiers, RC active filters, and low speed, high voltage logic gates.

Circle 364 on Inquiry Card

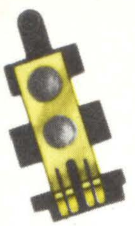
LSI Optical Transceiver Utilizes IIL Technology In Detection Devices

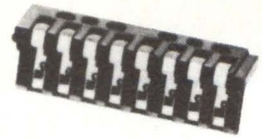
Utilizing linear IIL technology, an LSI optical transceiver is designed for use as a proximity detector or small particle sensor in security, industrial, or environmental applications. Produced by Cherry Electrical Products Corp, 3600 Sunset Ave, Waukegan, IL 60085, the CS-258 has the capability of strobed detection for high ambient light operation plus combined analog and digital noise filtering to eliminate false triggering. Onchip features include a 0.5-A LED driver, 140-μV receiver, and an output driver. The unit is provided in a standard 16-pin DIP.

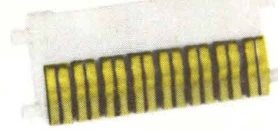
With addition of an IR LED, photodiode, and several noncritical resistors and capacitors, the device becomes a complete optical transceiver system. It includes a 3-pole filtering network on the receiver amplifier, which reduces the response to 120-Hz ambient light. This filtering, combined with strobed detection of incoming pulses and multiple pulse integration requiring consecutive pulses for triggering, allows the system to be relatively open to ambient conditions without false alerts.

Circle 365 on Inquiry Card

CIRCLE 156 ON INQUIRY CARD →

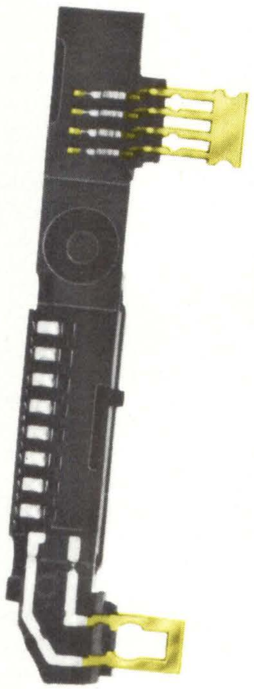






SPRING ASSEMBLIES

Instrument Specialties assumes all the headaches and guarantees quality!



Until recently, Instrument Specialties was known only for the superb quality and performance of our beryllium copper springs and spring contacts. Customers bought the springs, and frequently assembled them into molded blocks in their own plants—with varying degrees of success.

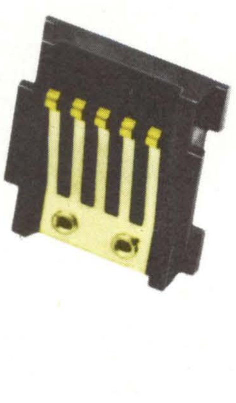
Now, Instrument Specialties can eliminate this divided responsibility. We can supply your contact springs attached to molded bases, and *guarantee to meet the specifications of the entire assembly*! We'll take complete responsibility for producing the plastic block, manufacturing the springs to exact specifications, and then assembling the parts through heat staking, press fitting, or ultrasonic welding. We can also weld or solder springs to other metal components.

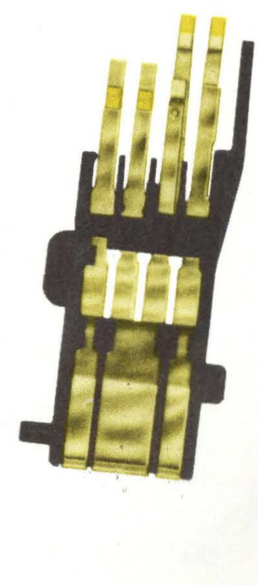
Of course, this eliminates a lot of your procurement and assembly headaches. But most important, your assemblies fit and work the way you specified—Instrument Specialties guarantees it!

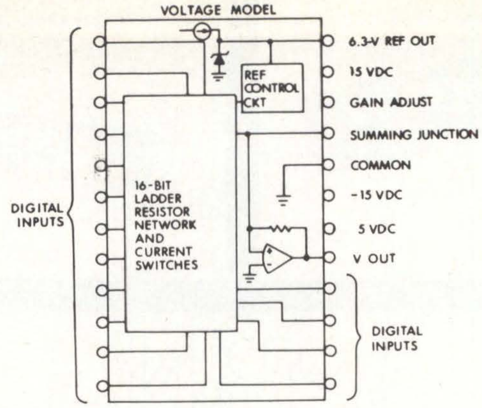
We'll be happy to discuss your specific needs—just phone. Or, for a free catalog, write today to Dept. CD-84.

INSTRUMENT SPECIALTIES CO., INC.
Little Falls, New Jersey 07424
telephone: 201-256-3500   twx: 710-988-5732

Specialists in beryllium copper since 1938







Voltage model of 16-bit DAC71 from Burr-Brown. Hybrid converter features ±0.003% nonlinearity (typ), gain drift of ±15 ppm/°C, and settles in 10 μs (max)

16-Bit DAC Provides Short Settling Time

Offering 16-bit, 4-digit resolution, ±0.003% nonlinearity (max), and a gain drift of ±15 ppm/°C or less over a temperature range of 0 to 70 °C, a hybrid D-A converter incorporates fast settling switches, low drift voltage reference, and stable, laser trimmed, thin film resistors. Settling time is 10 μs to ±0.003% FSR. Six models provide a choice of three codes (unipolar, bipolar, BCD), and voltage or current output.

DAC71 from Burr-Brown, PO Box 11400, Tucson, AZ 85734, provides output voltages of 0 to 10 V (CSB and CCD) or ±10 V (COB) as well as output currents of ±1 mA or 0 to −2 mA. Input power is ±15 Vdc (no load) and 5 Vdc (logic supply).

As a current output device, it will drive the summing junction of an op amp to produce an output voltage. The op amp output voltage is the product of the DAC's output current and the feedback resistance. Use of an internal feedback resistor is required to obtain specified gain accuracy and low gain drift.

All models are supplied with an internal 6.3-V reference voltage supply. This reference voltage has a tolerance of ±5% and is connected internally for specified operation. The zener is selected for a gain drift of ±3 ppm/°C and is burned in for a total of 168 h for guaranteed reliability. This reference may also be used externally but the current drain is limited to 200 μA. An external buffer amplifier is recommended if the DAC's internal reference is used externally in order to provide a constant load to the reference supply output.

Digital input specifications for TTL compatible levels call for 2.4 V (min) and 5.5 V (max) for logic 1 at 40 μA. Corresponding values for logic 0 at −1.0 mA are 0 and 0.4 V. The 24-pin ceramic package measures 1.375 x 0.75 x 0.25" (35 x 19 x 6 mm). It is priced from $39 in 100s. □

Circle 366 on Inquiry Card

MDS 2021/2022 CARTRIDGE TAPE DRIVE -a miniperipheral with big capabilities

We've shed light upon a 3M-compatible* cartridge tape drive that is in use by more OEM's than any other cartridge drive. It's simple to see why.

You'll find the flexibility you need for virtually any digital data handling requirement. Features like 30 ips read/write, 90 ips search and rewind, read-after-write checking, 800/1600 bpi recording density, and phase or biphase encoding on 1, 2, or 4 tracks. Storage capacity per cartridge is up to 23 million bits. But there's more to this drive's wide acceptance than meets the eye. Features like interchangeable printed circuit boards, long-life motor, and initiai low cost have made this unit particularly suitable for small system integration where cost/performance, reliability and serviceability are of utmost concern.

Applications like remote data collection, data communications, word processing, POS, and data entry are just a few ways that these drives are handling data in thousands of systems today.

To get all the facts on the MDS 2021/2022 Cartridge Tape Drive, mail the attached coupon, or call us collect today.

*3M DC300A Data Cartridge

Mohawk Data Sciences
OEM Division
Palisade Street,
Herkimer, N.Y. 13350
East Coast-Contact: H. Johnson (315) 866-5300
West Coast-Contact: J. Engstrom (714) 772-0803

Please send me information on the MDS 2021/22 Cartridge Tape Drive.

Name ______

Title ______

Company ______

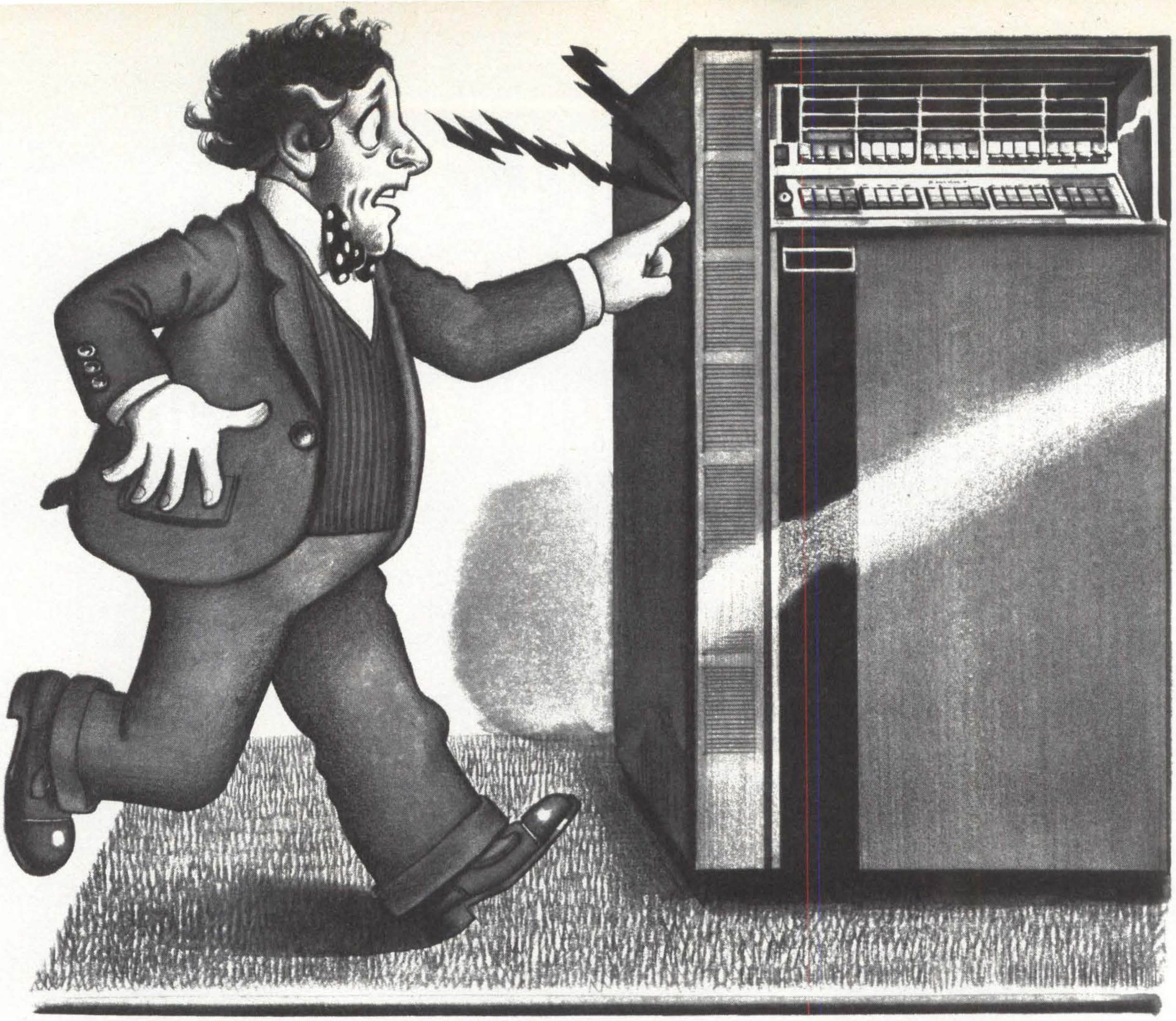
Street ______

City ______ State ______ Zip ______

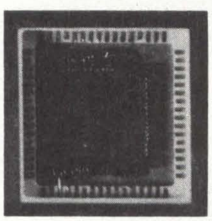
☐ I'm in a hurry. Have a representative call me at: (____) ______

CD579

CIRCLE 161 ON INQUIRY CARD



DESTROYING A CIRCUIT IS AS EASY AS WALKING ACROSS A CARPET



Acrylics, wools, silks and moving nylons in a computer room increase susceptibility to static charges. A few steps and a spark from body to computer cabinet is all it takes to produce a charge as high as 30,000 volts. And, if the cabinet and/or components are poorly grounded, the charge can be transmitted to components causing overloading and circuit malfunction.

Metex Shielding Provides Ideal Protection from Low Signal IC Overload

Metex shielding products such as Combo Strip® Gasketing, Xecote® Conductive Coating and Xecon® Conductive Elastomer protect your equipment by shielding it from this predatory energy...keeping it away from digital IC's and other vulnerable components.

Metex Products Protect Against Unwanted EMI/RFI Too

Viewing screens, air vents, cabinet slots and any other enclosure openings are access points for EMI/RFI energy. Easily picked up by sensitive components by induction, EMI/RFI radiation can cause distortion of low power signals and overloading of subsequent circuits. This may lead to IC degradation, or catastrophic failure.

Metex provides Shield-Vu® Shielded Windows of any size or shape, constructed of finely knitted wire fused between panes of acrylic or glass, that offer effective attenuation with over 90% visibility. We also make air intake and exhaust vents that permit free airflow but are almost totally opaque to EMI/RFI.

Available in configurations to meet your needs, Metex shielding products are produced to the most exacting demands, including France's CISPR, the German VDE and U.S. IEEE.

Protect your digital IC circuitry. Our staff of applications engineers will assist you now in finding solutions to your present and potential shielding problems. In the East call 201-287-0800, west of the Rockies call 213-320-8910. To write: 970 New Durham Road, Edison, N.J. 08817 or 20437 S. Western Avenue, Torrance, CA 90501

METEX
ELECTRONIC SHIELDING GROUP

CIRCLE 221 ON INQUIRY CARD

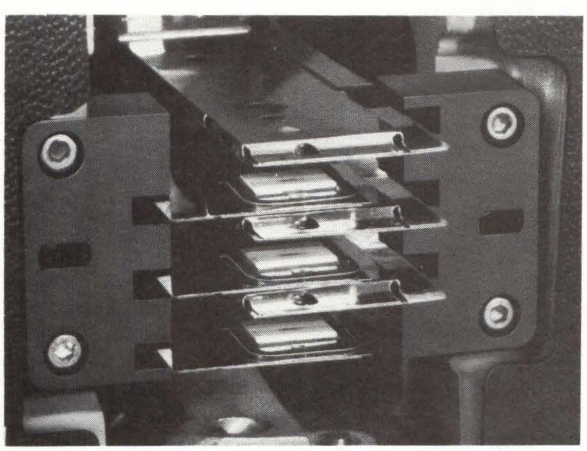
AMPEX DELIVERS

Ampex disk storage modules are both interface and *media* compatible with CDC's 9760 and 9762. And Ampex 40 and 80 megabyte SMDs offer a unique advantage over the CDC equivalents—they both can grow to a capacity of 160 megabytes with a simple field modification.

You'll find a lot more than CDC-compatibility when you look into the Ampex storage module family. Ampex can package your drive in rack, console or "Tempest" configuration, and can deliver such desirable features as variable sector format, address mark capability and on-track head servoing. The transfer rate is 1.209 megabytes per second, and access time average is 28 milliseconds.

CDC-COMPATIBLE SMDs WITH BUILT-IN GROWTH.

Other Ampex disk storage modules provide capacities of 100, 200 and 300 megabytes, and within a given family, you can begin with the minimum storage and upgrade to a higher capacity right in your own facility. For those with super special data needs, Ampex even has a 300 megabyte module with a parallel transfer rate of 10.88 megabytes per second.



Larry Russell has the information. Call him at 213/640-0150, and he'll prove that now there are twice as many ways to get the SMD capacity you need when you need it. Technical information and performance data is complete, and free. Write to Ampex Memory Products Division, 200 North Nash Street, El Segundo, California 90245. Immediate delivery is only a P.O. away.

AMPEX MAKES IT EASY.

See the complete line of Ampex Products for Data Processing in Booth 2208 at NCC

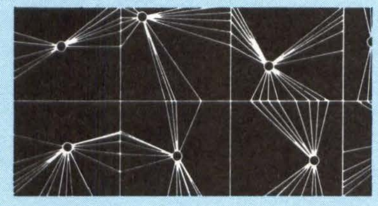
CIRCLE 159 ON INQUIRY CARD

EDUCATION

INTEGRATED COMPUTER SYSTEMS, INC.

Course 350 — Four days

Distributed Processing and Computer Networks



TORONTO
June 5-8

HARTFORD
June 12-15

WASHINGTON D.C.
June 19-22

SAN DIEGO
July 10-13

OTTAWA
July 17-20

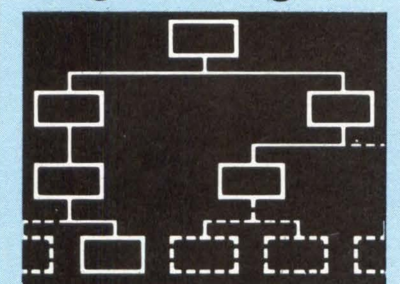
MINNEAPOLIS
July 24-27

This course provides a comprehensive introduction to distributed processing and computer network design techniques. It covers the individual elements of a distributed processing system and how these elements are synthesized to form a system which best meets application specific objectives. Throughout the course, application examples provide concrete examples of the concepts presented, with emphasis on the factors affecting key planning, design and implementation decisions.

- What is to be Distributed?
- Data Communication Concepts
- The Computation Continuum
- Computer Networks
- Network Protocols
- Database Structures
- Database Requirements
- Security Considerations
- Evaluation and Selection
- Management and Control

Course 320 — Four days

Structured Programming



CHICAGO
June 5-8

TORONTO
June 12-15

HARTFORD
June 19-22

SAN FRANCISCO
July 10-13

MINNEAPOLIS
July 17-20

OTTAWA
July 24-27

This course is designed for programmers, software engineers, systems analysts and their managers who are charged with the responsibility of creating and maintaining reliable, complex program structures. Participants will develop a clear understanding of the concepts and applications of structured methodology, and will learn to evaluate various types of structured programming techniques. The course will provide in depth exposure to structured design and structured programming tools and procedures. The underlying theme of the course is the development of skills which will enable the production of structured programs at minimum cost, while planning for program changes, modifications and reducing maintenance costs.

- Analyzing the Programming Function
- Principles of Structured Program Design
- Tools and Aids for Structured Program Design
- Case Study Workshop
- Implementing Structured Coding
- Verification Using Structured Walk-Through
- Developing Structured Systems
- Productivity Management and Project Control
- Organizing the Programming Team

Course 160 – Four days

Microprocessor Hands-On Workshop

WASHINGTON D.C.
June 4-7

BOSTON
June 11-14

SAN FRANCISCO
June 19-22

HONOLULU
June 26-29

SAN DIEGO
July 16-19

MINNEAPOLIS
July 24-27

OTTAWA
July 30-August 2

This course is intended for engineers, programmers, systems analysts and their managers. It has been found extremely useful by attendees both with or without prior experience in either computers or electronics. In fact, managers who have attended report the course provides a level of familiarity, awareness, and confidence which enables them to better manage their staff in applying microprocessors.

EACH STUDENT RECEIVES A COMPLETE 8080 MICROCOMPUTER AND INTERFACING SYSTEM FOR HIS PERSONAL USE THROUGHOUT THE COURSE.

- Microprocessor Concepts and Terminology
- Analysis of Potential Applications
- Microcomputer Hardware Design
- Hands-On Programming Exercises
- Hands-On Interfacing Exercises
- Development Equipment and Software
- Selecting the Correct Microprocessor
- Managing a Microcomputer Project
- How to Get Started
- Future HW and SW Developments

☐ PLEASE ENROLL ME IN **COURSE:**______

CITY______________

DATE(s)______________

MAIL TO:
Integrated Computer Systems, Inc.
3304 Pico Blvd., P.O. Box 5339
Santa Monica, CA 90405
OR:
Integrated Computer Systems, Inc.
300 N. Washington St., Suite 103
Alexandria, VA 22314

OR CALL:
(213) 450-2060
LOS ANGELES
OR
(703) 548-1333
WASHINGTON, D.C.

A confirmation letter with complete details will be forwarded to you.

Name______________ Job Title______________

Company______________ Mail Stop______________

Address______________

City______________ State/Province______________

Country______________ Postal Code/Zip______________ Telephone______________

☐ Please send FREE BROCHURES describing these courses.
☐ Please put me on your mail list to receive future course schedules.

FOR OFFICES THAT WANT TO KEEP IT QUIET, THE NEW TALLY HUSH-TONE KEEPS THE LID ON NOISE.

If printer noise disturbs your office serenity, you'll appreciate the mel-low decibels of the whisper-quiet Tally Hush-Tone. Our special acoustically designed enclosure attenuates printing noise level down to an unheard of quiet level. When not printing, the Hush-Tone is totally quiescent.

Available at 125 and 200 lines per minute, the Tally Hush-Tone is easy to live with, easy to operate. And easy on the pocketbook. It's the newest member of the Tally T-2000 series—the most reliable (and lowest cost of ownership) line printers you can buy. Remember, Tally line printers never need adjustments, lubrication nor preventive maintenance. And you can always count on consistent print quality.

The Tally Hush-Tone. You get more than quiet performance. You get up-time performance.

Call or write today. Tally Corporation, 8301 South 180th Street, Kent, Washington 98031. Phone (206) 251-5500.

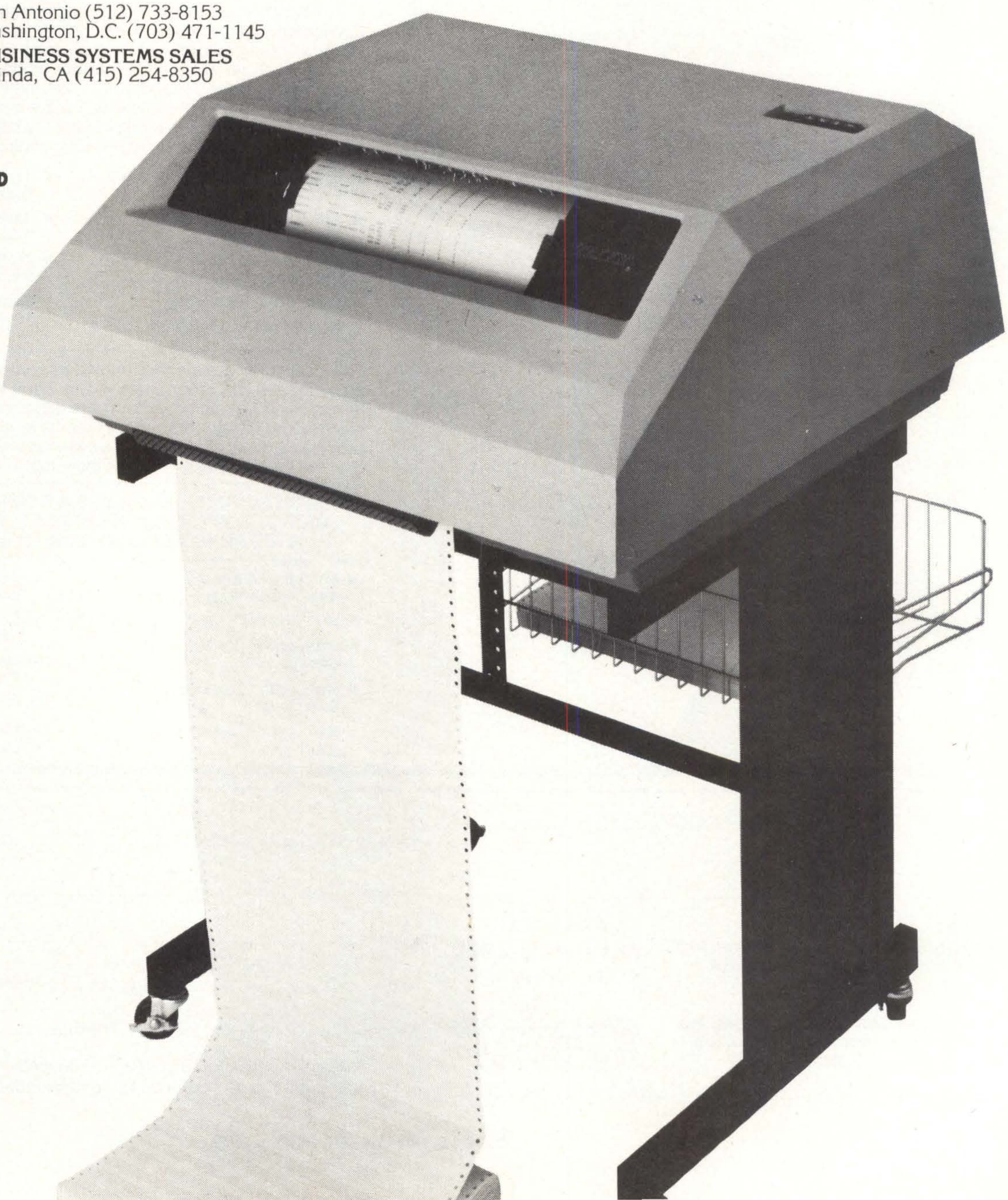
TALLY®
PRINTERS
WORLDWIDE

OEM SALES OFFICES
Boston (617) 272-8070
New York (516) 694-8444
Chicago (312) 885-3678
Los Angeles (213) 378-0805
Miami (305) 665-5751
Philadelphia (215) 628-9998
San Jose (408) 247-0897
Seattle (206) 251-6730
San Antonio (512) 733-8153
Washington, D.C. (703) 471-1145

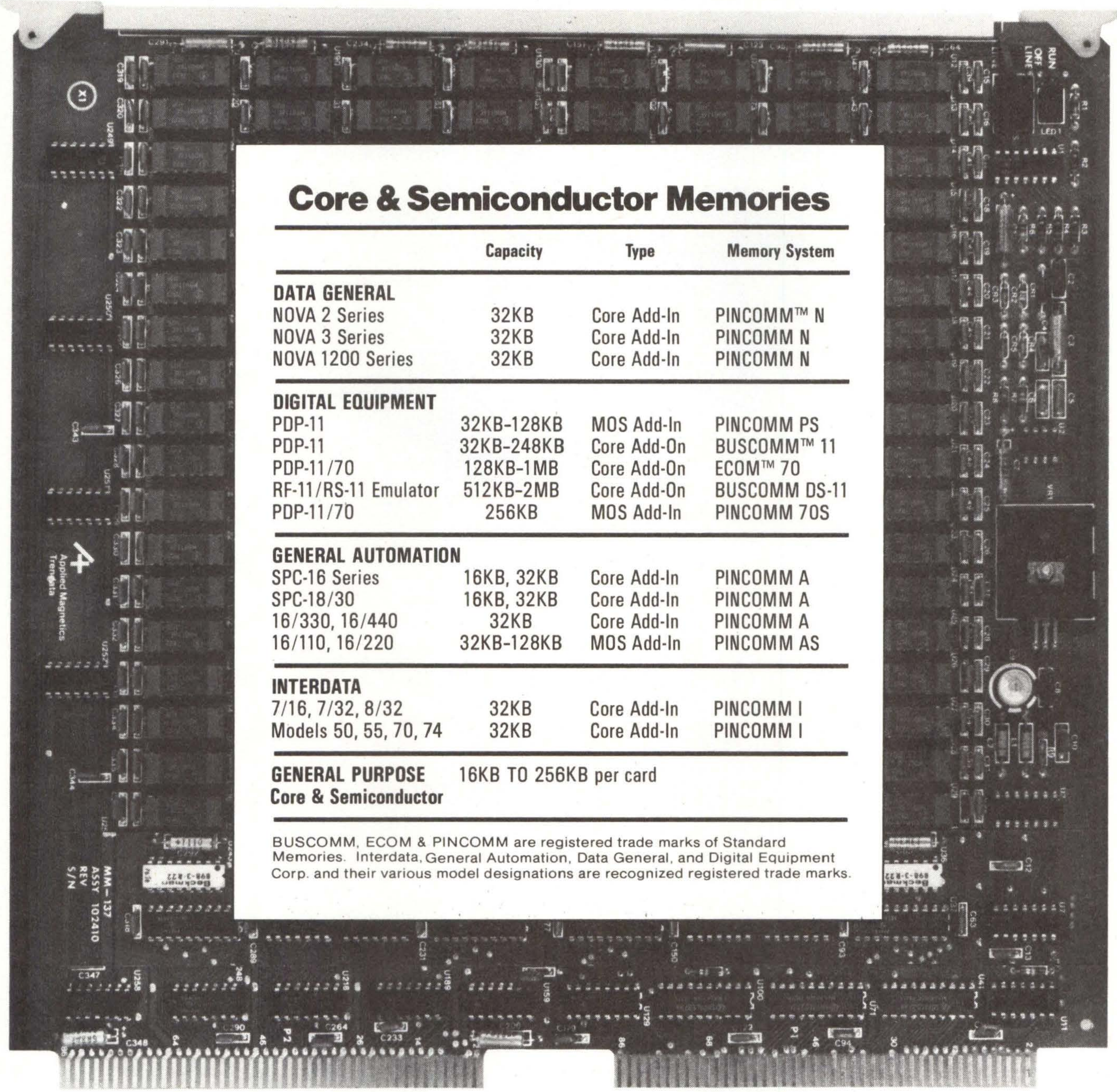
BUSINESS SYSTEMS SALES
Orinda, CA (415) 254-8350

CIRCLE 222 ON INQUIRY CARD

See us at NCC, Booth #2021.



LOOK WHAT WE'VE GOT ON BOARD



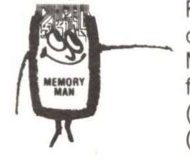
Core & Semiconductor Memories

	Capacity	Type	Memory System
DATA GENERAL			
NOVA 2 Series	32KB	Core Add-In	PINCOMM™ N
NOVA 3 Series	32KB	Core Add-In	PINCOMM N
NOVA 1200 Series	32KB	Core Add-In	PINCOMM N
DIGITAL EQUIPMENT			
PDP-11	32KB-128KB	MOS Add-In	PINCOMM PS
PDP-11	32KB-248KB	Core Add-On	BUSCOMM™ 11
PDP-11/70	128KB-1MB	Core Add-On	ECOM™ 70
RF-11/RS-11 Emulator	512KB-2MB	Core Add-On	BUSCOMM DS-11
PDP-11/70	256KB	MOS Add-In	PINCOMM 70S
GENERAL AUTOMATION			
SPC-16 Series	16KB, 32KB	Core Add-In	PINCOMM A
SPC-18/30	16KB, 32KB	Core Add-In	PINCOMM A
16/330, 16/440	32KB	Core Add-In	PINCOMM A
16/110, 16/220	32KB-128KB	MOS Add-In	PINCOMM AS
INTERDATA			
7/16, 7/32, 8/32	32KB	Core Add-In	PINCOMM I
Models 50, 55, 70, 74	32KB	Core Add-In	PINCOMM I
GENERAL PURPOSE Core & Semiconductor	16KB TO 256KB per card		

BUSCOMM, ECOM & PINCOMM are registered trade marks of Standard Memories. Interdata, General Automation, Data General, and Digital Equipment Corp. and their various model designations are recognized registered trade marks.

with immediate delivery and 1-year warranty

See us at NCC, Booth 1312.



For an instant quotation call The Memory Man toll free: (800) 854-3792, (in California) (800) 432-7271.

STANDARD MEMORIES

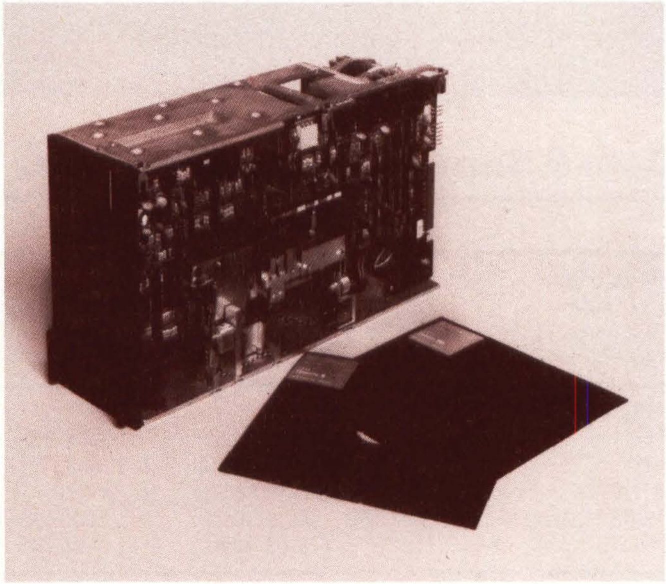
has grown into a new name

Applied Magnetics Trendata

3400 West Segerstrom Ave.,
Santa Ana, CA 92704. (714) 540-3605

CIRCLE 158 ON INQUIRY CARD

PRODUCT FEATURE



See at NCC Booth 4030

Improved Dual-Head Mechanism and Microprocessor Controller Ease Problems of Double-Density, Dual-Diskette Drive

Use of a precision ball bearing carriage such as that on large discs provides the model 288 double-density, dual-diskette drive with excellent stability in head positioning on both sides of the diskettes. Claimed by PerSci, Inc to be the industry's first microprocessor controlled diskette drive as well as the first with a dual-head design that lends itself to high yield volume production, this drive has seek speeds 2.5 to 10 times faster that that of standard drives plus twice the data capacity in the same space, but at a per diskette cost competitive with ordinary drives.

Both the two diskettes and the four read/write/erase heads are housed in a casting designed as a direct replacement for the Shugart 850/851. Except for voice coil, the units are pin for pin identical and physically, electrically, and data interchangeable.

Design Features

The head of the 288 differs from that of the company's other drives both electronically and mechanically. Although fully IBM compatible, the head uses straddle erase rather than tunnel erase. However, primary changes in the read/write head are mechanical.

To improve head compliance greatly and to effect high yield production, the company used a combination button/flexure head, an approach that minimized complexity and improved overall design. First, the gimbal was improved to allow greater freedom of movement in both axes. Then a different material and physical configuration was used for the head's flex cable. This more flexible cable eliminates interference with proper gimbal action. In addition, the precision head assembly maintains an exact relationship between flexure and media, assuring data reliability. Finally, a mechanism has been implemented within the drive body for holding each diskette in a precise plane, maintaining proper contact between the fixed button head and the media. This mechanism also reduces media and head wear by reducing penetration of the button head into the media.

(Continued on p 294)

FAMILY PLANNING

Beehive's Product Line Offers You a Choice!

Beehive International offers you a product line of flexible capabilities,
Plus two new choices:

Detachable Keyboard As a Micro Bee Standard
and
Our New Multi-Page / Editing Terminal, Model DM30

Family Planning At Its Best

Low Cost/Feature Enhancements
MICRO BEE/MODEL DM10 $995

The DM10 is an 8085A microprocessor controlled terminal offering numerous user oriented features, including a line drawing capability to allow creation of graphic displays. The 25th status line is used extensively by the DM10 system firmware to display modes of operation, error messages, communication protocol data and a time-of-day clock as well as a status message showing optional switch configurations.

Flexible Applications Oriented
MICRO BEE/MODEL DM1S $1345

The DM1S is a completely programmable terminal featuring a new design concept of socketed flexibility. The needs of virtually any application can be met with custom generated software or software purchased from Beehive. Emulation packages include DEC VT52*, Microdata Prism*, Data General Dasher*, ADDS Regent 100* and Beehive's DM1A™.

**These names may be subject to trademark claims*

Expanded Function Capabilities
MICRO BEE/MODEL DM1A $1395

The DM1A expands Beehive's product line conversation capability by allowing bidirectional, fully buffered communications to an auxiliary device. Communications between the CPU and the auxiliary peripheral device can be transparent to the terminal. Features include non-displayable character attributes enabling selection of seven video levels, a line drawing capability and the ability to enter or receive data in the unlocked portion of the display.

Mr. Duke DeForest, Vice President of Sales for Beehive, invites you to see the entire Micro Bee product line with new detachable keyboard styling at the
NCC . . . Booth 2135

Editing
MICRO BEE/MODEL DM20 $1695

Beehive's DM20 is a buffered terminal designed to address both interactive and batch mode markets. Standard features include bidirectional serial auxiliary port, fixed tabs, clear entry function, descenders on lower case characters, invisible cursor, CPU message deposit, line monitor mode, CPU line lock and transparent printing. An invisible memory address pointer, sixteen function keys and system mode/control keys are very positive enhancements.

BEEHIVE'S NEWEST!

Multi-Page/Editing
MICRO BEE/MODEL DM30 $1995

In addition to incorporating all DM20 features, Beehive's new DM30 provides two pages of display memory, an auxiliary serial interface, and an optional parallel interface. Next page and previous page key lets the user select page boundaries while Scroll Up and Scroll Down permits the user to go across page boundaries in scanning text and editing.

The answer is BEEHIVE
The choice is yours!

BEEHIVE INTERNATIONAL

TOLL FREE USA **(800) 453-9454**

or contact our sales office nearest you.

USA: California (714) 540-8404, (408) 738-1560; **Colorado** (303) 343-7093; **Florida** (305) 830-4666; **Illinois** (312) 593-1565; **Massachusetts** (617) 933-0202; **New York** (212) 682-2760; **Ohio** (513) 435-7073; **Pennsylvania** (215) 825-0243; **Utah** (801) 355-6000; **Virginia** (703) 356-5133; **Washington** (206) 838-4881

EUROPE: Amsterdam, The Netherlands Phone 020-451522

Through use of large scale integration (LSI), it has been possible to place all electronic elements on a single printed circuit board. Both the positioning system and most major drive functions are controlled through an 8048 microprocessor chip; read/write functions are controlled by a company designed LSI chip.

A "slimming filter," used with large discs but not previously on a diskette drive, effects read compensation in double-density. This eliminates the need to implement write precompensation in the controller to achieve high data reliability. That design feature makes the drive more tolerant of diskette imperfections, dirt, dirty heads, and noise, and results in more reliable data transfer. In addition, a pulse width discrimination technique prevents noise pulses from appearing as flux reversals and provides excellent noise immunity.

Specifications

Double-density unformatted capacities are 3.2M bytes/drive, 1.6M bytes/diskette, 10.4k bytes/track, with MFM or M^2FM encoding. Bit density is 6536 bits/in (2573/cm) and transfer rate is 500k bits/s. (Single-density figures are one-half those of double-density, but with FM encoding.) Operating times are 10-ms track to track access, 0 settle, 100-ms 76-track seek, and 35-ms head load.

Physical dimensions are 8.72″ H, 4.38″ W, 15.4″ D (22.15 x 11.13 x 39.12 cm). Weight is 22 lb (10 kg). Operating environment is 40 to 115 °F (5 to 45 °C).

Ac power requirements are 50/60 ±0.5 Hz, 90 to 127 V at 0.4 A typical (in 110/115-V installations) and 180 to 253 V at 0.2 A typical (in 200/230-V installations). Dc requirements are 24 V ±5%, 5.0 A average, 8.5 A peak; 5 V ±5%, 2.0 A max; and −5 V ±5%, 0.25 A typical.

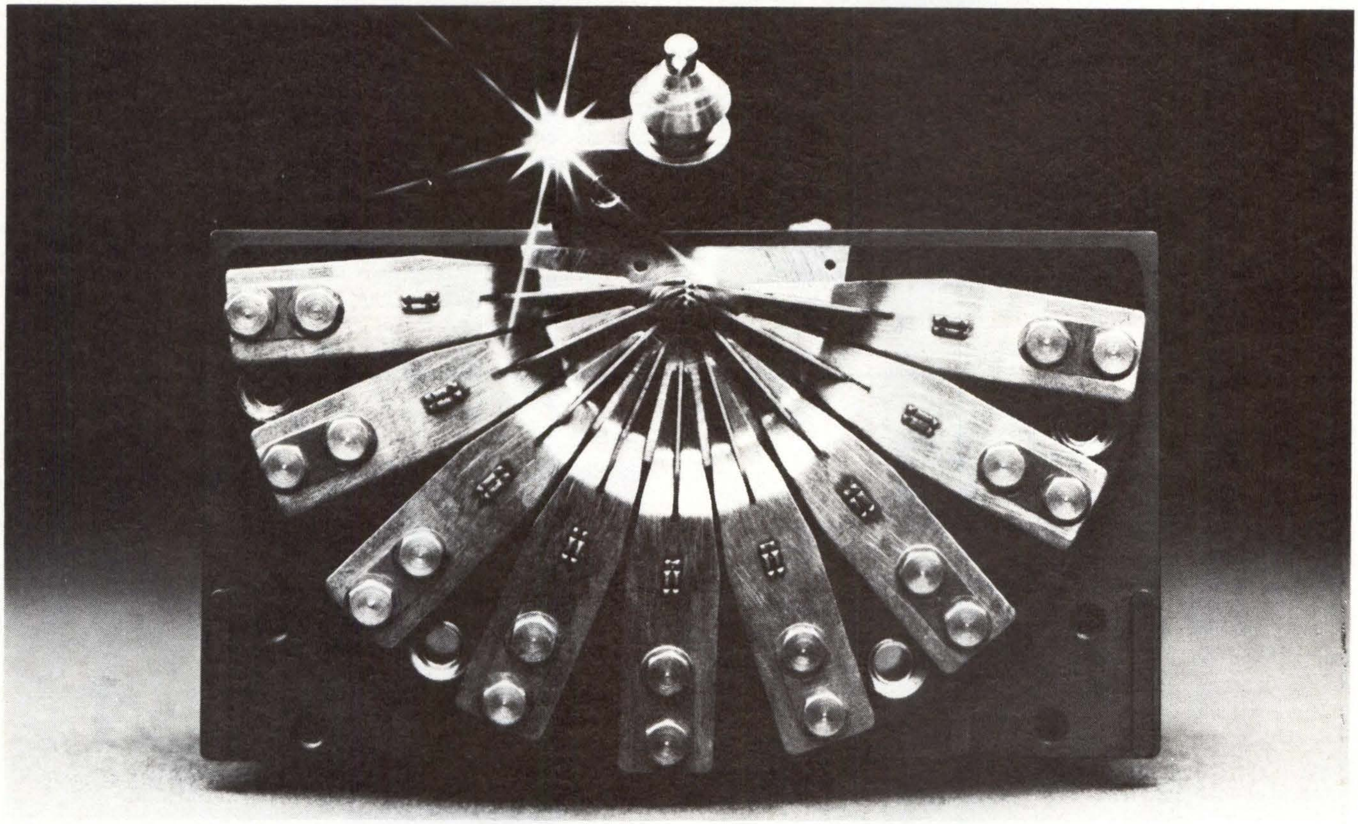
Reliability ratings are <1 soft read error in 10^9 bits, <1 hard read error in 10^{12} bits, and <1 seek error in 10^6 accesses. MBTF is >6000 h.

Price and Delivery

OEM quantity price for the model 288 diskette drive is $925. First deliveries will begin in June. PerSci, Inc, 12210 Nebraska Ave, West Los Angeles, CA 90025. Tel: 213/820-3764

For additional information circle 225 on inquiry card.

LET'S PUT OUR HEADS TOGETHER.



The Facit 4540 Serial Matrix Printer has already made a name for itself with its standard 250 characters a second - all crisp, fullbodied and perfect throughout the 500 million character service life of the printhead. Versatility comes from the rare 9×9 dot matrix, and the Facit 4540 offers a genuine 100% duty cycle and entire elimination of adjustment and lubrication.

The whole secret is in the unique printhead and its microprocessor controlled impact printing mechanism.

Integration of mechanics and electronics has made Facit peripheral data products world famous.

Facit 4540 extends this tradition.

So let's put our heads together. To make your systems more efficient, more competitive and more in demand.

Facit 4540 Serial Matrix Printer with the unique printhead.

FACIT DATA PRODUCTS

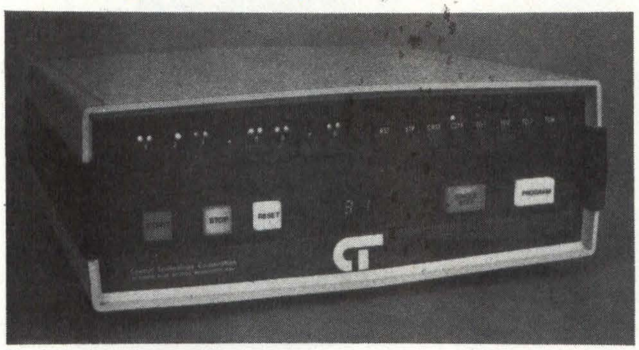
FACIT-ADDO INC., 66 FIELD POINT RD, GREENWICH, CONN. 06830. (203) 622-9150. TELEX 96-5998.

Visit the Facit Exhibit at NCC Booth # 1316.

CIRCLE 164 ON INQUIRY CARD

PRODUCTS

Easy to Program Electronic Controller Has 32 Programmable Steps



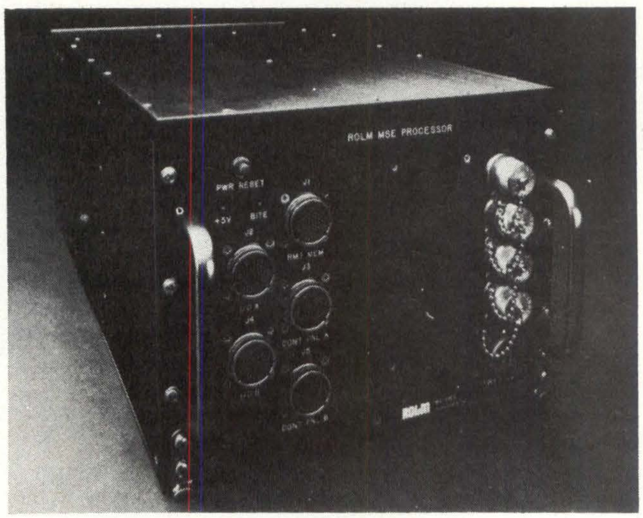
Circle 226 on Inquiry Card

For use in developing products or converting existing products to solid state electronic control systems that can perform jobs such as sequencing, timing, level sensing, flow rate, control valve operation, or automated assembly, standard unit has 32 programmable steps, 11 input functions, and 8 outputs, and is expandable to 40 outputs. All units are protected against switch bounce and emi, and have logic circuitry necessary to establish sequence of operation, and device drivers to interface with equipment under control. Timing range of clock and time delays is from 0.2 to 120 s/step. Outputs are rated 2 Adc at up to 50 V each. Dimensions are 5 x 12.5 x 11.5" (12.7 x 31.75 x 29.2 cm). Power requirements are 120 Vac, 50/60 Hz, 50 W. European models are also available. **Control Technology Corp,** 82 Turnpike Rd, Westboro, MA 01581

Fully Militarized Eclipse Minicomputer Meets Severe Environment Applications

The MSE/30, a military specification version of the Data General Eclipse[R] commercial minicomputer, supports Data General's multiprogrammed advanced operating system (AOS), as well as the INFOS[R] database oriented file management system, ANSI standard COBOL, FORTRAN, and PL/1. Capabilities include word, byte, and bit addressing, string handling, and field editing. For floating point operations, a separate extended arithmetic processor operates in parallel with the central processor. High speed cache memory boosts system throughput. Main memory can be expanded from a minimum of 256k to 1024k bytes. A minimum system includes at least a 67M-byte storage module, and up to 545M bytes of online disc storage are available with large systems. Multiprocessor systems and faster character I/O processing can be accommodated and the manufacturer's Mil-spec peripherals can be added. **Rolm Corp,** 4900 Old Ironsides Dr, Santa Clara, CA 95050.

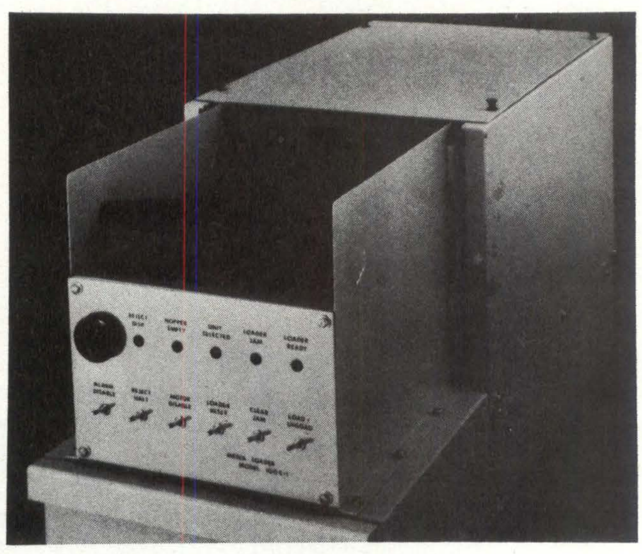
Circle 227 on Inquiry Card



Subsystem Automatically Loads Floppy Disc Media for Data Processing Operations

A self-contained automatic floppy disc loader for systems using either open or closed flap 8" (20-cm) discs in either single- or double-density format, the model 1005-1 allows the operator to process a number of discs sequentially without intervention. Input hopper capacity is 50 discs but as the stack decreases, the operator can add more discs to the hopper without stopping the loader. In automatic mode, the input hopper automatically feeds individual discs to a Shugart model SA801 disc drive. After completion of a read or write operation, an eject mechanism automatically places each disc in the output hopper. In manual mode, the operator may elect to sequence individual discs through load and unload cycles. A halt upon reject feature stops the automatic sequencing of discs and sounds an audible alarm to alert the operator that the last disc in the drive was rejected. **Media Systems Technology, Inc,** 1616 S Lyon St, Santa Ana, CA 92705

Circle 228 on Inquiry Card



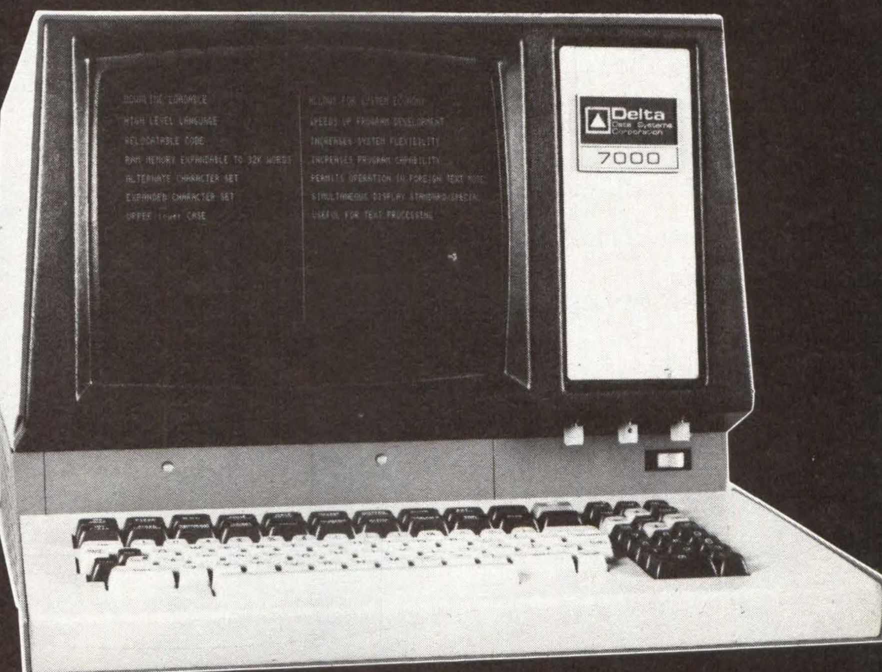
DELTA DATA introduces a new era in video display terminals

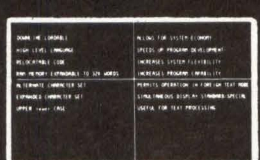
A *programmable terminal* for OEM's and large system users...

A *multifunctional terminal* for applications in distributed data processing and office environments of the future...

A *powerful, high performance terminal* that offers an intelligent choice for your special terminal requirements.

Introducing the new DELTA 7000 Series. A family of intelligent terminals which combines the latest 16-bit microprocessor technology with our own proven video display technology. We designed the DELTA 7000 with your interests in mind—from data communications (TTY/IBM 3270 emulation) to specific applications (Text Processing). Then we built in many special features, and loaded the DELTA 7000 with memory to handle your unique applications programs—at a most attractive price.

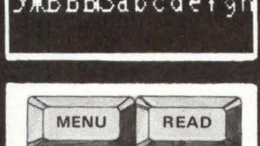




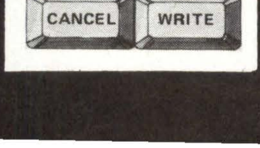
MULTIPLE SPLIT SCREEN allows you to divide the screen into independent display areas

PARITY	PRINT SPEED
BAUD RATE	ASCII/EBCDIC
BLOCK/TTY	SCREEN SPLITS
+ MANY OTHERS	

ELECTRONICALLY ALTERABLE ROM allows status to be set from keyboard or remotely, and retained during power off



EXTENDED CHARACTER SET generates special fonts and displays up to 672 different characters



MULTI-CHARACTER FUNCTION KEYS permit one key to display or send a string of multiple characters or codes

Enter your new era in video displays with the new DELTA 7000. Write or call for more information today.

Delta Data Systems Corporation

Woodhaven Industrial Park
Cornwells Heights, PA 19020
(215) 639-9400

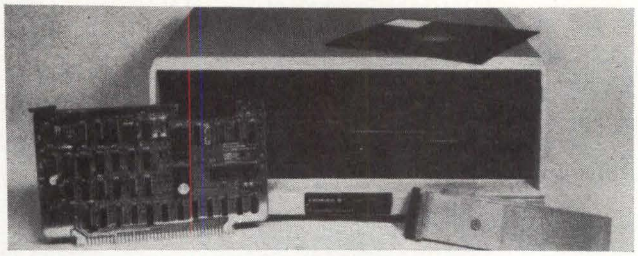
U.K. Subsidiary:
DELTA DATA SYSTEMS LTD.
Welwyn Garden 33833

Service in over 150 locations in the U.S. and 14 European countries and Canada.

CIRCLE 165 ON INQUIRY CARD

PRODUCTS

DOUBLE-SIDED, SINGLE-DENSITY FLOPPY DISC SYSTEM



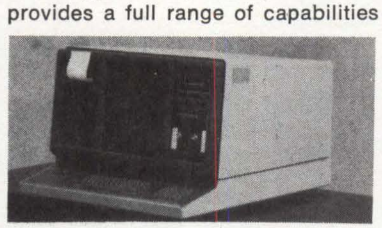
EXORdisk™ III provides a removable media storage capability for EXORciser™, EXORterm™, and Micromodule™ products. M68SFD1102 and M68SFDU1102E (expansion unit) systems offer storage for more than 1M bytes with the basic unit and over 2M bytes with the addition of an optional dual-drive expansion unit. Each system consists of 2 double-sided, single-density drives in a compact tabletop cabinet, a controller board, and an interconnecting cable assembly from the controller to the disc drive unit. Circuitry is included for head unload timeout, and a write protect feature protects master diskette programs. **Motorola Microsystems,** PO Box 20912, Phoenix, AZ 85036.
Circle 229 on Inquiry Card

COMMUNICATIONS PROTOCOL DEVELOPMENT SOFTWARE PACKAGE

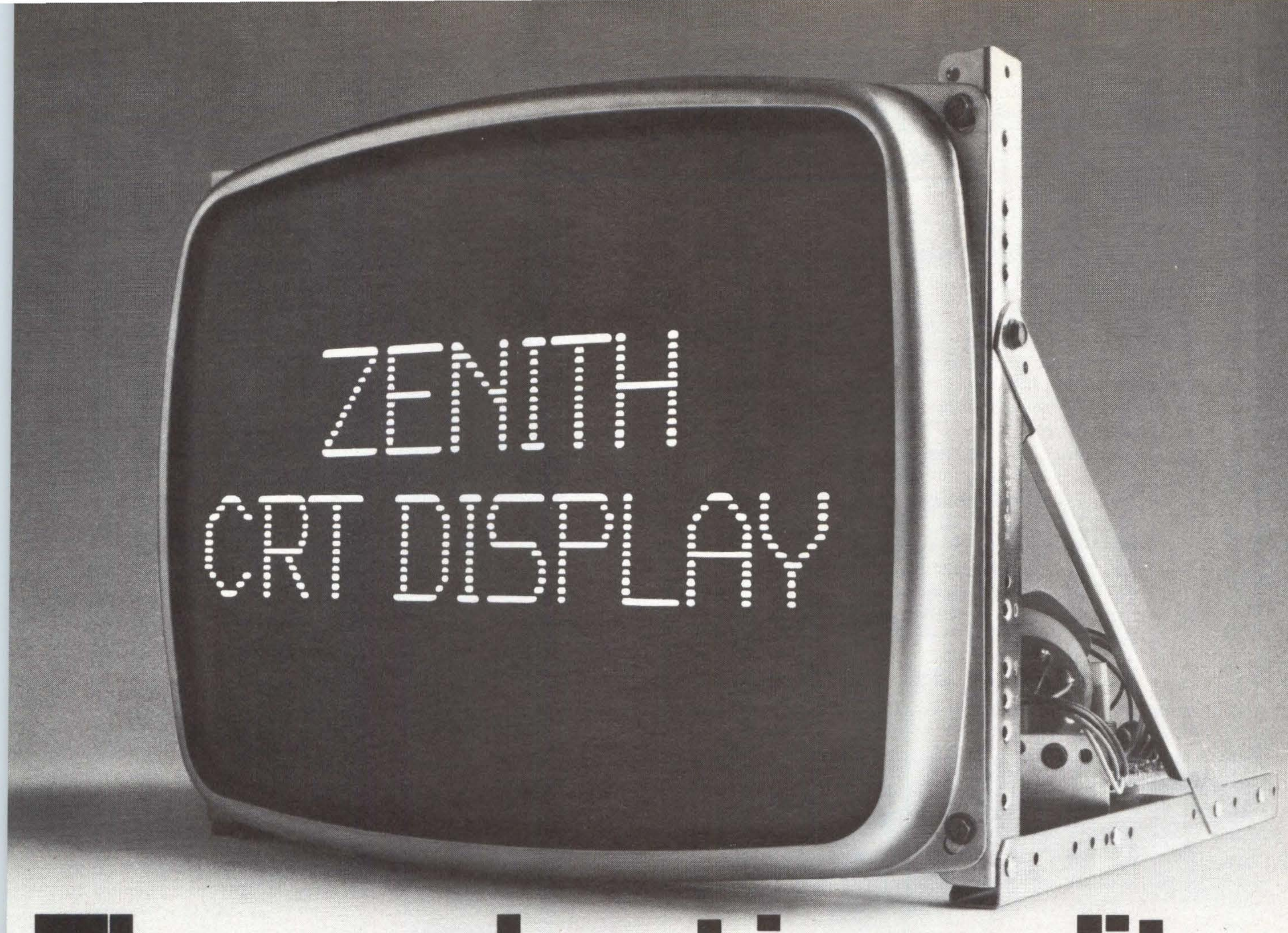
The GPD (general protocol driver) software package was developed for the Data General minicomputer product line using AOS, RDOS, and RTOS. It operates in the minicomputer or in the data communications unit (a programmable front end). The systems programmer writes a protocol description program in which logic is coded in a macro language that supports the control features of the asynchronous and synchronous line multiplexer interfaces. Macro language allows coding of IBM 2780 BiSync protocol in only 200 instructions. A single processor can support 7000 char/s, and asynchronous and synchronous protocols can be mixed in a variety of combinations. Protocol programs are automatically re-entrant. **Systems Strategies, Inc,** 1250 Broadway, New York, NY 10001.
Circle 230 on Inquiry Card

MINICOMPUTER BASED LABORATORY SYSTEM

A more powerful TP-50 lab computer system, based on a DEC PDP-11/34 minicomputer with 124k words of memory and supported by the RSX11-M software operating system, provides a full range of capabilities in pulse height analysis, instrument control, and general computation. Multiple users can be supported simultaneously, each performing a different task, and can interact with the system via several industry standard programming languages such as FORTRAN and BASIC. A bus translator allows any standard LSI-11 or PDP-11 compatible peripheral to be added to an existing system. **Tennecomp Systems, Inc,** 785 Oak Ridge Tpk, Oak Ridge, TN 37830.



Circle 231 on Inquiry Card



The read-out is quality.

Quality is what has made Zenith famous for over sixty years and number one in the television industry. It's that quality, that commitment to excellence—that insures the reliability of every product we make.

Our manufacturing facilities, laboratories, equipment, procedures, experience and know-how give you the quality and reliability that you look for in a CRT Display. A CRT Display that will hold up under really tough operating conditions.

And to all this, our people add the personal service and special attention you want from your CRT Display source.

Exhaustive testing

Our testing insures that every component operates to exacting Zenith standards. Exhaustive computer analysis, electron microscope and thermograph scan tests are only a sample of what we do.

Our environmental lab tests Zenith CRT Displays for thousands of hours under extreme humidity, vibration, altitude and temperature conditions.

Zenith CRT Displays are designed not only to meet our exhaustive testing requirements, but your demanding specifications as well.

Application engineering

Every CRT Display we design has our customers in mind. Before our engineers even begin new circuit layouts, we'll meet with you and find out what your exact needs and specifications are.

Advanced componentry

Components in the CRT Display are designed with reserve capacity for low maintenance and continued reliability.

The Zenith CRT Display is equipped with a Zenith designed and built deflection transformer. It not only gives a consistent scan, but it is also embedded in epoxy for long-term reliability and the elimination of high frequency squeal.

Important Zenith Features

The Zenith CRT Display is precision engineered. No linearity controls are required and the CRT Display's vertical and horizontal synchronization is automatic.

The Zenith CRT Display frame can be adjusted to virtually any angle you want. This will satisfy many customer requirements without having a frame custom designed.

But we do welcome the opportunity to meet all your special requirements.

Zenith tradition

At Zenith we'll make sure you get the same service, quality and reliability in your CRT Display that we've been giving our customers for over sixty years.

For further information and specifications, write CRT Display Engineering Division, Zenith Radio Corporation, 1000 Milwaukee Avenue, Glenview, Illinois 60025, or call 312-773-0074.

ZENITH ®

The quality goes in before the name goes on.®

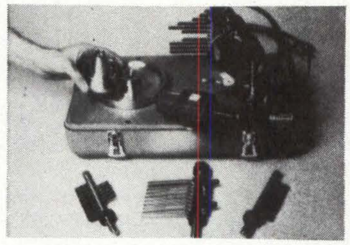
National Computer Conference, June 4-7, Booth 314.

CIRCLE 168 ON INQUIRY CARD

PRODUCTS

DISC PACK MAINTENANCE UNIT

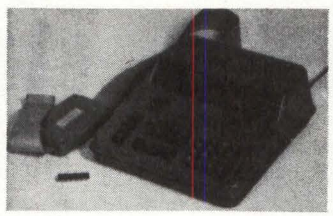
Designed for visual and mechanical inspection of magnetic discs, the system 340 tester/cleaner/inspector accommodates 6-high IBM 1316, 11-high 2316, and 12-high 3336 disc packs, or their equivalents, through use of interchangeable spindles. Features include instrumentation for the measurement of axial and radial runout, as well as for the mechanical rejection of deflected discs. An adustable disc surface mirror assembly provides a clear view of both sides of the disc. Visual inspection functions include the detection of dirt, scratches, edge damage, burned oxide, head crash damage, loading marks, and other unacceptable imperfections. **The Texwipe Co,** PO Box 278, Hillsdale, NJ 07642.



Circle 232 on Inquiry Card

STANDALONE Z80 EMULATOR

Model EZ-80 plugs into the CPU socket of Z80 based products to test and troubleshoot both software and hardware, with no restrictions on memory addressing or programming technique. Basic features include easy access to I/O or memory, realtime run, single-step, and dual breakpoints. A 255-word by 32-bit trace memory captures all target program activity for forward or backward review. Contents of 19 CPU registers are available for examination and may be changed to new values at any time. All memory locations and I/O ports are available for examination or modification. True hexadecimal readout of address, data, and register contents use dot matrix type displays for fast, accurate recognition. General purpose built-in system diagnostics include RAM test and ROM-P/ROM verification tests. **Applied Microsystems,** 11064 118th Place NW, Kirkland, WA 98033.



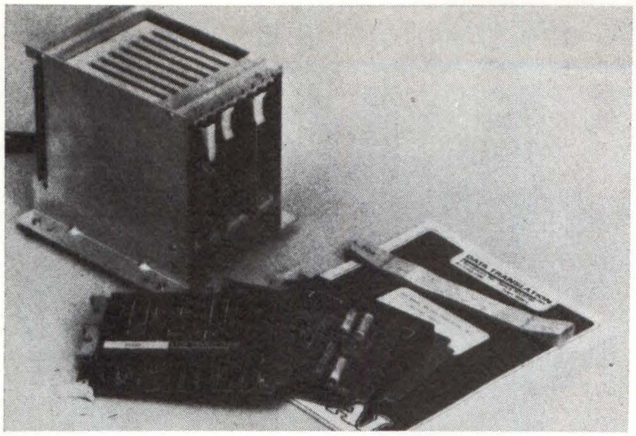
Circle 233 on Inquiry Card

MULTICOLOR VIDEO GRAPHICS TERMINAL

Available as a computer peripheral under direct memory access control or for use as a telecommunications terminal through an RS-232 interface, the AED 512 multicolor terminal has up to 8 memory planes that allow 256 simultaneous colors from a pallette of 2^{24} colors to be displayed on a TV monitor. Byte serial hardware interface is RS-232-C or 20-mA current loop, full- or half-duplex, at up to 19.2k baud (selectable at a backpanel thumbwheel switch or the keyboard). Direct video memory access is 8 or 16 bits parallel, on bidirectional 3-state data lines, at data rates up to 500k baud. Complete image transfer to or from terminal requires 0.5 s. Video memory is 16k x 1 MOS organized in 512 x 512 planes. **Advanced Electronics Design, Inc,** PO Box 61779, Sunnyvale, CA 94088.

Circle 234 on Inquiry Card

ANALOG INPUT SYSTEM CARDS FOR MD AND 7000 SERIES BUSES

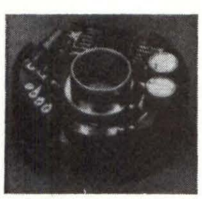


A family of 12-bit data acquisition systems that are backplane and protocol compatible with Mostek MD and Pro-Log 7000 series microcomputer building blocks consists of isolated and nonisolated single-board analog input systems mounted on a 4.5 x 6.5" (11.4 x 16.5-cm) card and operates from the ±12-Vdc present on the bus. Systems are designed for software effective operation with MK3880 or Z80 microprocessors; oncard interface logic provides all needed circuitry for vectored, daisy chained interrupt operation, and includes provisions for accommodating I/O port expansion. Interrupt prioritization, address selection, and expansion enabling of the I/O ports is achieved by jumpering appropriate points on the card for maximum ease of programming. **Data Translation Inc,** 4 Strathmore Rd, Natick, MA 01760.
Circle 235 on Inquiry Card

NOISE IMMUNE STEPPER CONTROLLER

Designed for direct connection to a range of microprocessor systems, MPSD-10 operates on the basis of input channel state transitions instead of the traditional pulse train. This eliminates the possibility of positioning inaccuracies caused by electrical noise. The controller permits full-step operation using only 2 logic signals and half-step operation using only 4 logic signals. Power supply overloads are prevented by a circuit that stops adjacent channels from being energized simultaneously. Each channel of the module, which snap mounts conveniently on standard 3" (7.6-cm) track, can be driven from a single, ordinary gate of any common logic family. **Duane Elms Associates, Inc,** 341 Alpha Pk, Highland Heights, OH 44143.
Circle 236 on Inquiry Card

MODULAR OPTICAL ENCODER



Because R-1500 and R-2000 encoders use a die-cast black anodized solid aluminum base, optical components cannot change position with time. Light source is a single LED, and sensors are on a monolithic IC, with uniform characteristics to eliminate sensor to sensor tempco differences. Models are available for mounting on shafts preloaded in either direction, thus preventing problems with pattern rub-off during axial shaft loading. Input voltages for both range from 4.75 to 5.25 Vdc at 125 mA. Quadrature is 90° ±9° at 5 Vdc and 75 kHz. Output format is a differential sinewave suitable for input to a comparator. **Electro-Craft Corp,** 1600 Second St S, Hopkins, MN 55343.
Circle 237 on Inquiry Card

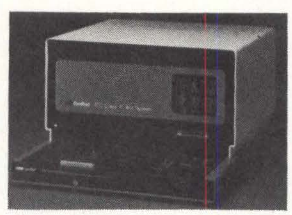
PRODUCTS

MULTIPLE-OUTPUT AUTO-TRACKING LABORATORY POWER SUPPLY

Model 1650 offers a 5-Vdc, 5-A output and two separate 25-Vdc outputs at 0.5 A, all completely isolated. An automatic tracking circuit allows one output to track voltage changes of another supply, and allows proportional control of one supply when the other's output is varied. Tracking is controlled by a pulse width modulated control signal that is coupled through an opto-isolator. This feature allows the supply to be used as a substitute power source for breadboard and prototype circuits and other equipment. The supply also can provide single or simultaneously varying voltages to observe operating effects on a circuit under test. **B&K-Precision Dynascan Corp,** 6460 W Cortland St, Chicago, IL 60635.

Circle 238 on Inquiry Card

MICROPROCESSOR CONTROLLED LINEAR IC TEST SYSTEM



Multiprocessor architecture enables the model 1731 to perform 20 tests on op amps; 14 to 20 tests on voltage comparators, regulators, and followers; and 16 tests on current mirror op amps—but with simplified programming and lower costs than for large systems. A Z80 microprocessor controls test, calculation, display, and keyboard functions, while a 6502 microprocessor controls tape drive functions. Operating software, stored on magnetic data cartridges, can be modified to accommodate new tests and new families of linear devices. Software simplifies program generation, program entry, and system setup. Program generation is interactive, with high level, user oriented prompting displays. **GenRad, Inc,** 300 Baker Ave, Concord, MA 01742.

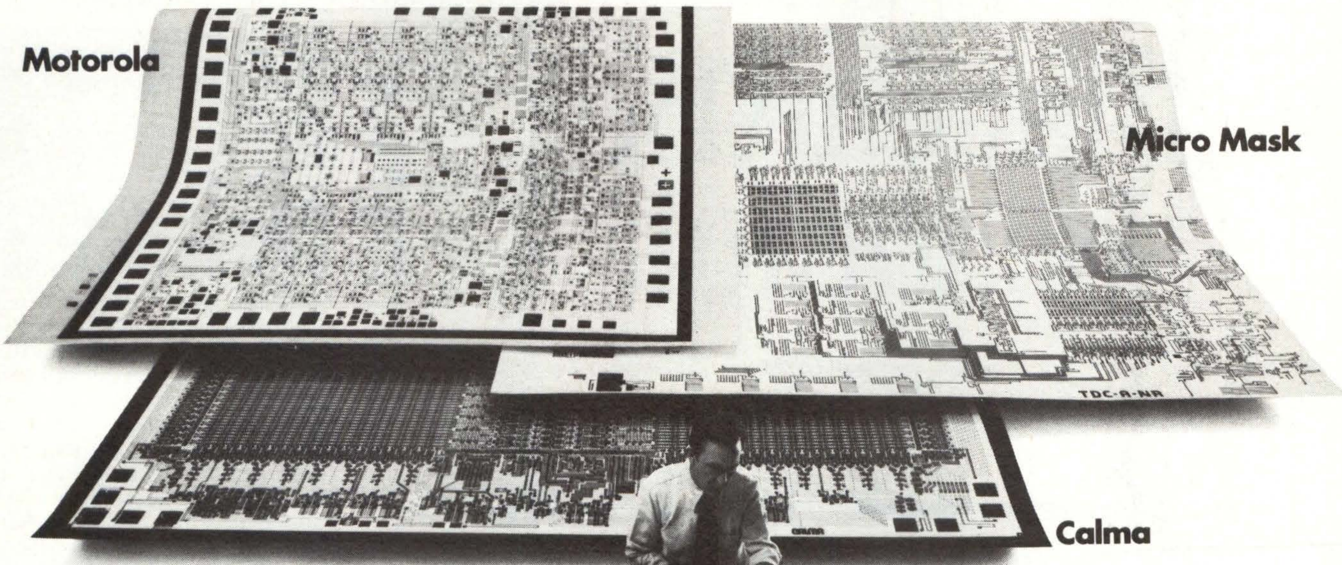
Circle 239 on Inquiry Card

LSI-11 COMPATIBLE I/O CARDS

Seven dual-width I/O cards that are compatible with DEC LSI-11 series microcomputers include the 1601 general purpose timer, which can be software programmed to operate at 7 clock frequencies and in 5 modes; the 1604 optical pulse input card, which can count input pulses from up to 4 separate sources, and the 1604 pulse output controller card, which handles up to 4 output channels; the 1616 multiple interrupt card, which allows expansion of interrupt capability; and the 1602 TTL digital card which has a 16-bit latched input data and output registers as well as a 16-bit control and status register. Other cards are a 1750 dual port asynchronous serial line I/O card and a 1014 high resolution ADC. **Adac Corp,** 70 Tower Office Pk, Woburn, MA 01801.

Circle 240 on Inquiry Card

Break the IC plotting bottleneck. With Versatec.

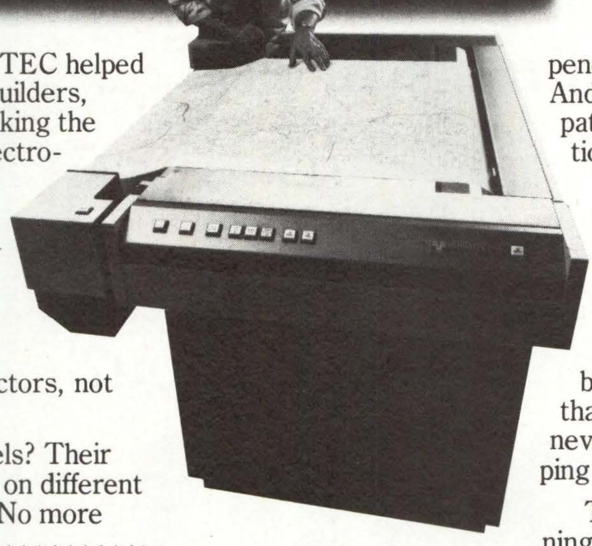


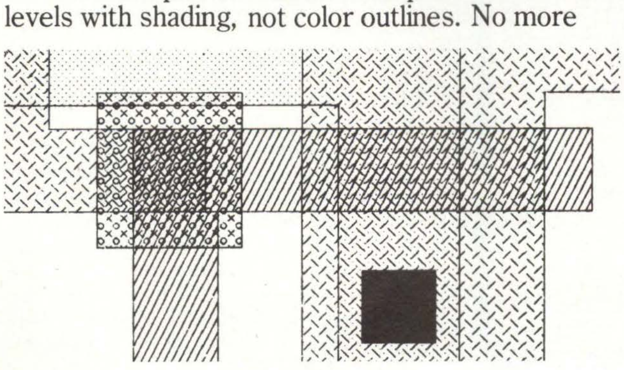
Calma does it. Motorola does it. ETEC helped Micro Mask do it. Leading IC system builders, semi houses and mask makers are breaking the IC plotting bottleneck with Versatec electrostatic plotters.

While your pen plotter is struggling to make one circuit drawing, they get two, three or more.

They produce plots more complex than anything you've ever attempted with a pen plotter. Up to four million vectors, not counting fill-in patterns.

Need clearer discrimination of levels? Their electrostatic plotters label circuit paths on different levels with shading, not color outlines. No more penciled fill-ins by hand! And see how well shading patterns identify intersections.





They plot in widths up to six feet. On translucent paper for fast, accurate overlays.

Their electrostatic plotters cost less to buy, less to operate than pen plotters. They never lose plots to a skipping pen or a balky solenoid.

They were up and running fast. Versatec hardware/software interfaces link to their computers and application programs.

They did it. So can you. Circle our number for literature, plot samples and the application report—"Plotting IC and PCB drawings." Versatec can end your CAD plotting bottleneck.

VERSATEC
A XEROX COMPANY

2805 Bowers Avenue, Santa Clara, California 95051 (408) 988-2800

XEROX® is a trademark of XEROX CORPORATION ®™ Versaplot is a Versatec trademark Sample plots courtesy of Calma, Motorola and Micro Mask. Shading patterns courtesy of Calma.

See Versatec at NCC

CIRCLE 175 ON INQUIRY CARD

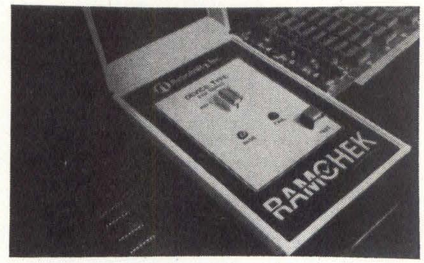
DIGITAL TEST SYSTEM

Inspector 100, a fully programmable digital IC test system, performs both functional and dc parametric tests on devices having from 14 to 24 pins and operating from 4.5 to 5.5 V. Controlled by a 8085 microcomputer system, tester has 32k bytes of memory, dual floppy discs, and built-in 9" CRT and keyboard. Test head accepts personality modules from 14 to 24 pins to automatically configure it to test corner power pin devices. All pin electronics are actively driven. **Pragmatic Designs, Inc**, 711 Stierlin Rd, Mountain View, CA 94043.
Circle 241 on Inquiry Card

FLOPPY DISC CONTROLLER

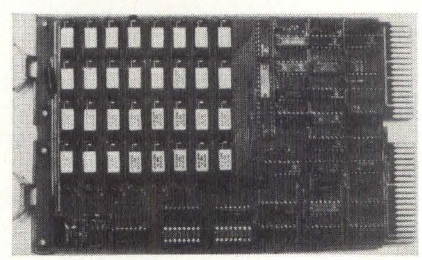
FD-100-STD, physically and electrically compatible with the Pro-Log/Mostek Std Bus concept, supports up to 4 IBM std format soft sectored 8 or 5.25" (20.3- or 13.3-cm) floppy discs. Software control allows intermixing of both types of drives. A motor on/off control circuit for minifloppies is provided as a std feature. All disc drive status lines are available to the host processor. I/O port selection is miniswitch selectable. **Applied Micro Technology, Inc**, PO Box 3042, Tucson, AZ 85702.
Circle 242 on Inquiry Card

STATIC MEMORY TESTERS



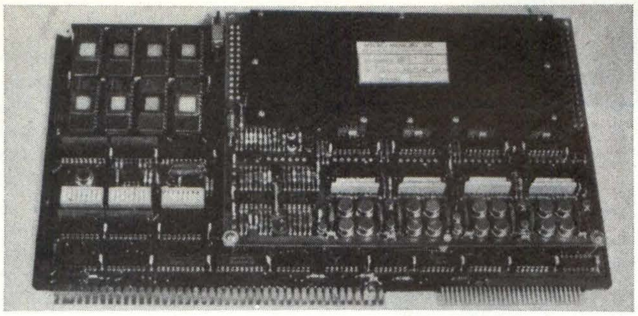
RAM CHEK testers administer pass/fail tests to all locations of device under test in <0.2 s. The 2102 tests 2102 type 1k static memories. Test procedure consists of plugging device into socket on instrument and pushing button. If green LED on the panel lights, all storage locations have passed test; if any location is inoperative, the test cycle stops and a red LED lights. Soft failures may be detected by continuously recycling test procedure. **Reliability, Inc**, PO Box 37409, Houston, TX 77036.
Circle 243 on Inquiry Card

64k MEMORY FOR H11 MICROCOMPUTER



Designed specifically for Heathkit/Digital Equipment H11 and DEC LSI-11/2 and PDP-11/03 microcomputers, CI-1103 is available as an 8k x 16 dual-width board using 200-ns 4027 4k x 1 dynamic devices, or 32k x 16 dual-width board using 200-ns 4116 16k dynamic devices. Unit plugs directly into computer and offers either onboard distributed refresh or external refresh control logic. Data access time is 300 ns and cycle time is 525 ns. **Chrislin Industries, Inc, Computer Products Div**, 31312 Via Colinas, #102, Westlake Village, CA 91361.
Circle 244 on Inquiry Card

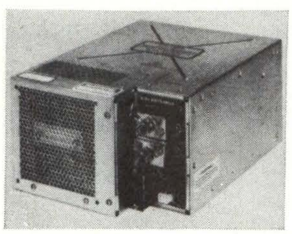
CORE MEMORY SYSTEM AND ROM MODULE FOR MDS AND SBC 80



Model MM-8080B, with 8k bytes of core memory and 8k or 16k bytes of ROM on the same module, is designed for nonvolatile storage with Intel's Intellec MDS and SBC 80/05, /10, /20, and /30 microcomputers. It is plug compatible with Intel's Multibus™ and is a direct replacement for the SBC 406, 416, and 016. It also can be used with computers from other manufacturers that offer SBC 80 compatible products. Internal power monitoring circuits protect data in core from power failure or during on/off conditions. No battery backup or special circuits are required for power supply sequencing. Portions of the core memory may be write protected in 1k increments up to 8k and are switch selectable. **Micro Memory, Inc,** 9438 Irondale Ave, Chatsworth, CA 91311.

Circle 245 on Inquiry Card

840-W HIGH EFFICIENCY SWITCHING POWER SUPPLY



JF750P series fan cooled switchers for either 208-Vac or 115/230-Vac nom operation at 47 to 63 Hz are available in 2-, 5-, 12-, 15-, and 24-V output (±10% adjustable) in current ranges from 180 to 35 A. Output power is rated up to 840 W, depending upon output voltage and current. Features include overvoltage protection, remote sensing, thermal shutdown, reverse voltage protection, paralleling capability, and an efficiency up to 80%. Options such as SCR crowbar protection, power fail, remote programming, and margin switch are available. Regulation is specified at 0.1% for any combination of line and load conditions, and ripple is 10 mV rms max, 50 mV pk-pk max. Holdover storage is >60 ms after input is removed. **ACDC Electronics, Div of Emerson Electric Co,** 401 Jones Rd, Oceanside, CA 92054.

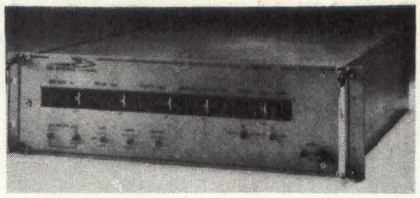
Circle 246 on Inquiry Card

ALPHANUMERIC AND GRAPHICS CRT CONTROLLERS

EXO-2480, a single-board video interface between EXORciser bus microcomputers and a standard TV monitor, provides 96 ASCII characters with descenders plus 32 graphic symbols in one 24 x 80 page or two 24 x 40 pages. Features include normal or inverse video, with or without blink, synchronized internally or from an external source. EXO-512, a complete graphics controller, provides a 256 x 512 horizontal display or 2 independent 256 x 256 images; 4-level gray scale is obtained by combining images. Both boards can be used as master or slaves in an alphanumerics/graphics application; by adding a second EXO-512, an image containing 4-bit pixels is produced. **Matrox Electronic Systems Ltd,** 2795 Bates Rd, Montreal, Quebec H3S 1B5, Canada.

Circle 247 on Inquiry Card

PROGRAMMABLE PULSE GENERATOR

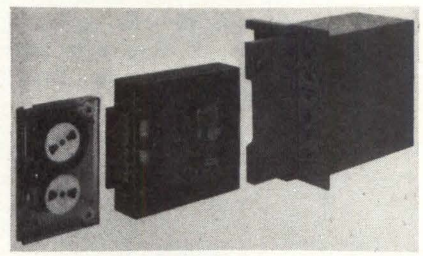


PX32 is a fully programmable pulse generator featuring repetition rates to 20 MHz and amplitudes to 25 V (with option G). Rise time at min settings is <5 ns. Repetition rate, delay, width, rise and fall times, offset and amplitude are all programmable using an IEEE-488 bus. Trigger mode, gating, pulse pair, and polarities of both output pulse and offset are programmable with the bus. Each function has a unique address allowing the pulse output to be modified without reprogramming all functions. **Tri-Phenix Electronics,** 15823 S San Pedro St, Gardena, CA 90248.
Circle 248 on Inquiry Card

PASCAL COMPILER FOR ECLIPSE MINICOMPUTERS

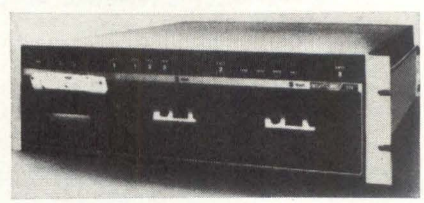
A PASCAL compiler for Data General's multiuser, multitasking advanced operating system (AOS) running on the Eclipse line of computers, AOS PASCAL can shorten program development time in production and research facilities, and open possibilities for online programming instruction. Developed from the University of Lancaster's RDOS implementation of the P4 standard of PASCAL, package includes source code and binaries on 9-track, 800-bit/in (314/cm) magnetic tape. **Gamma Technology, Inc,** 2452 Embarcadero Way, Palo Alto, CA 94303.
Circle 249 on Inquiry Card

HOSTILE ENVIRONMENT CARTRIDGE RECORDERS



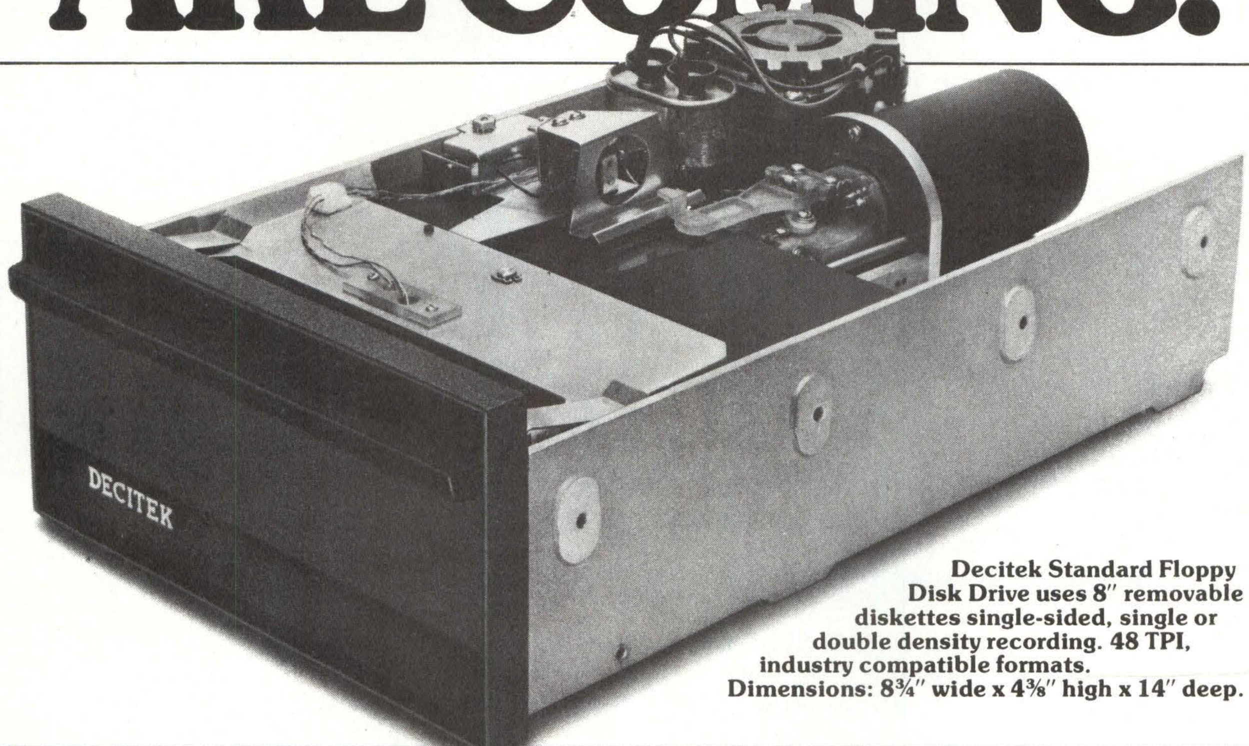
CR300 is designed to meet requirements of MIL-E-16400/-5400/-4158. The recorder features a sealed environmentally secure Super-Pak cartridge that houses a std completely interchangeable DC-300A cartridge. The unit offers 30-in (76-cm)/s read/write, and 90-in (228-cm)/s search/rewind. Capacity is 23M bits/cartridge. ANSI/ECMA compatibility; 1-, 2-, or 4-track serial or parallel recording; and transfer rates up to 192k bits/s are std. **Miltope Corp,** 9 Fairchild Ave, Plainview, NY 11803.
Circle 250 on Inquiry Card

HIGH PERFORMANCE CASSETTE TAPE SYSTEM



Model 374 includes an Intel 8085A microprocessor controller and std RS-232-C communications interface with switch selectable rates from 110 to 19.2k baud. Optional I/O ports allow inclusion of low speed peripherals. Using std Philips digital cassettes, the unit reads and writes digital data in both Diphase and ANSI formats. Rugged transport design incorporates 4 separate dc motors that accomplish all tape loading, positioning, and movements. **Dicom Industries, Inc,** 715 N Pastoria Ave, Sunnyvale, CA 94086.
Circle 251 on Inquiry Card

THE DECITEKS ARE COMING.



Decitek Standard Floppy Disk Drive uses 8″ removable diskettes single-sided, single or double density recording. 48 TPI, industry compatible formats. Dimensions: 8¾″ wide x 4⅜″ high x 14″ deep.

BRINGING PERFORMANCE NOT PROMISES TO FLOPPY DISK DRIVES!

You can be sure Decitek knows computer peripherals. Decitek Punched Tape Readers are the "recommended reading" of the industry.

Now, Decitek announces "The Sure Ones" in Floppy Disk Drives. That means whether you're looking for a sophisticated 2-sided floppy disk drive or the popular 1-sided... the sure ones will be Decitek.

Decitek knows how important minimum maintenance, long life and fail-safe dependability are to Floppy Disk Drives. Here are some of the features that make Decitek Floppy Disk Drives the sure ones.

- ☐ Direct linear head positioning
- ☐ Microprocessor controlled drive elements
- ☐ Industry compatible formats
- ☐ Sealed front panel

The Deciteks are coming, bringing performance instead of promises to floppy disk drives. Write today for complete information and delivery dates. Decitek, 129 Flanders Road, Westboro, Massachusetts 01581.

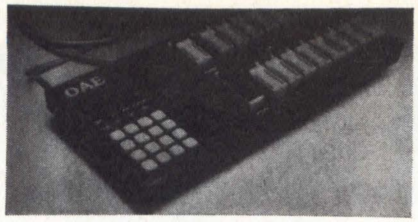
DECITEK

A Division of Jamesbury Corp.

Special Preview at Booth 4004

PRODUCTS

EPROM PRODUCTION TESTER AND DUPLICATOR



Designed to detect poorly erased or static damaged EPROMs, UPP-2700 evaluates all EPROMs both before and after programming. By pressing a single key, the 8048 processor tests and duplicates 16 2708s in <200 s. Solid state audio beeper informs operator of incorrectly inserted devices or test failures. A 40-pin personality module contains programming and test algorithms for generic EPROM families, including 2704, 2708, 27L08, TMS 2716, I2758, I2716, TMS 2516, TMS 2532. **Oliver Advanced Engineering, Inc**, 676 W Wilson Ave, Glendale, CA 91203.

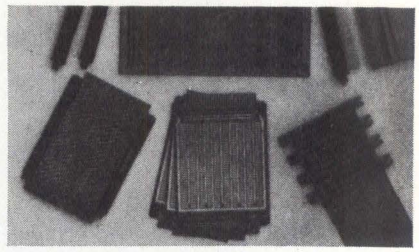
Circle 252 on Inquiry Card

SELF-CONTAINED SUBREGULATOR MODULE

Providing a −5-V at 600-mA regulated output from any −7 to −30-V source, AR5-.06/OVP connects to negative output of multiple output power supply to provide additional −5-V output required by microprocessors. Unit mounts within the original outline dimensions of any of the company's open frame supplies; all mounting and interconnecting hardware are provided. Output specs yield regulation characteristics of 1% for line and load, and output ripple of 5 mW. **Power-One, Inc**, Power-One Dr, Camarillo, CA 93010.

Circle 253 on Inquiry Card

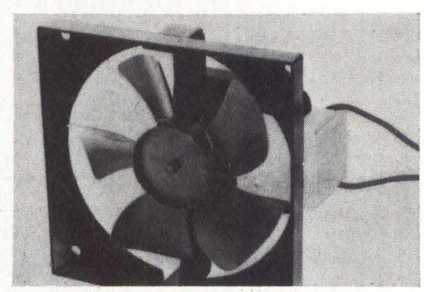
MICROCOMPUTER PROTOTYPING SYSTEM



A Eurocard width (100-mm) universal prototyping card for microcomputer and other bus oriented designs, LP-12U accommodates a dense mix of DIP ICs of all sizes. Holding 20 16-pin DIPs, the 4 x 6″ (10 x 15-cm) board has 60 gold-plated edgeboard connector fingers at each end for up to 120 offboard connections. Cards can be interconnected without chassis wiring using a generalized motherboard. Motherboards are available for openframe mounting or for use with card cages. **Cybertek, Inc**, PO Box 3467, Seminole, FL 33542.

Circle 254 on Inquiry Card

100-ft³/min AXIAL FLOW FAN



Model 320, measuring 4.6″ sq x 2.3″ deep (11.7 x 5.8 cm), delivers 100-ft³ (2.83-m³)/min free air at zero static pressure. Rugged 1-piece metal frame eliminates warpage and breakage; a Celcon plastic fan adapts the unit to high temperature environments. Powered by quiet, impedance protected, UL listed motor, fan weighs 1.25 lb (0.56 kg). **Hi-Tech Inc**, 3600 16th St, Zion, IL 60099.

Circle 255 on Inquiry Card

MICROPROGRAMMING? STEP UP TO STEP-2

THE FIRST REAL TIME IN-CIRCUIT DEVELOPMENT SYSTEM FOR ALL BIPOLAR PROCESSORS.

STEP ENGINEERING'S STEP-2 is a compact, affordable instrument containing all the features necessary for rapid system debug. Our customers find it so easy to use that they have it up and running the day it arrives. And, STEP-2 is so powerful, they have experienced a 50% savings in their development cycle. Join our other satisfied customers – find out how simple microprogramming can be –

STEP UP TO STEP-2!

For more information contact:

STEVE DRUCKER, V.P. MARKETING
STEP ENGINEERING
714 PALOMAR AVENUE
SUNNYVALE, CA 94086
(408) 733-7837

STEP-2 LOOKS INTERESTING!

I have
- ☐ an immediate need (0-3 mo.).
- ☐ a potential need (3-6 mo.).
- ☐ a lot of curiosity.

I need
- ☐ data sheets on STEP-2.
- ☐ an obligation-free demo.
- ☐ to talk to someone knowledgeable.

Name____________________

Company____________________

Address____________________

City__________ State________ Zip________

Phone____________________

I am using____________ chip set with

____________________ PROM type

STEP ENGINEERING
P.O. Box 61166, Sunnyvale, CA 94088

STEP-2'S REAL TIME (45 ns) RAM MEMORY simulates the system control store for fast trial of object code. Word widths from 8 to 96 bits can be efficiently achieved and memory reconfiguration can be accomplished in seconds. You can emulate two independent memories simultaneously for multiprocessor or unique architecture systems.

STEP-2'S ROM SIMULATION PLUG-INS make interconnection to your system a one-step operation. Seventeen field-upgradeable models emulate over 200 ROMs and PROMs.

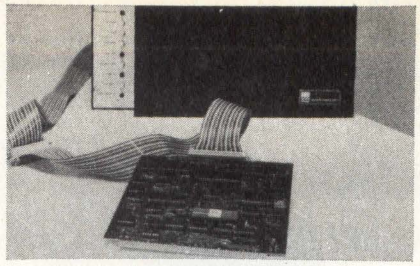
STEP-2'S WORD ORIENTED EDITOR simplifies locating and patching problems in your code. Features include octal or hex representation, binary readout and easy word/bit modification. Blocks of code can be moved in memory to insert additional lines or save a routine before editing. And our search command can locate all instructions containing a specified field or bit pattern.

STEP-2'S DIAGNOSTIC FACILITY speeds debug. Direct control of processor HALT, RUN, STEP, CYCLE, and RESET is accomplished through the keyboard. Real time break points/triggers can be set without disturbing processor activity. Breakpoint state and processor activity is displayed on the CRT, allowing you to quickly verify processor operation.

STEP-2 IS COMPATIBLE WITH YOUR EXISTING SOFTWARE. A full range of serial communications options makes it simple to connect to any computer system from a large computer, timesharing service or an Intel® Development System. Downloading your existing object code takes only minutes using either STEP-2's generalized PROM I/O routine (GENPROM)™ or word-oriented I/O routine (MICROWORD)™.

STEP-2 HAS COMPLETE SOFTWARE SUPPORT. Our Transportable Meta Assembler, (TMA), is completely compatible with AMDASM and can be installed on an Intel® Development System or 16 bit (or larger) computer with Fortran. The TMA is easy to understand and use – powerful conditional assembly statements and cross reference tables simplify code generation. The assembled code can be downloaded directly into STEP-2 for testing and verification.

MICROPROCESSOR COMPATIBLE TAPE DRIVES



DS11 controller utilizes Z80 technology and is directly compatible with Z80-MCB series bus, ZDS-1, and MCZ-1 microcomputer systems. It handles up to 4 tape drives, operating on single voltage, 5-Vdc power from the microcomputer bus, and is capable of controlling most formatted 9-track tape decks. The system uses 25-in (63.5-cm)/s tape deck, 800-bit/in (314/cm) NRZI recording, and incorporates DMA transfers. **Sonotek Ltd,** 2410-5 Dunwin Dr, Mississauga, Ontario L5L 1J9, Canada.

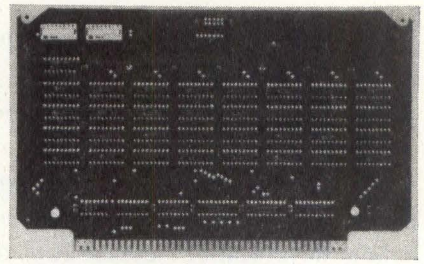
Circle 256 on Inquiry Card

CAMAC-GPIB INTERFACE

Model 8901 allows CAMAC instruments to operate as standard listeners and talkers on any IEEE Std 488-1975 bus. Program instructions from any GPIB controller to the interface select an individual instrument module within a CAMAC crate, select any subaddress within that module, and establish the read, write, or control function. A crate of up to 23 individual modules is handled in the same manner as an ordinary single device connected to the bus. **LeCroy Research Systems of California,** 1806 Embarcadero Rd, Palo Alto, CA 94303.

Circle 257 on Inquiry Card

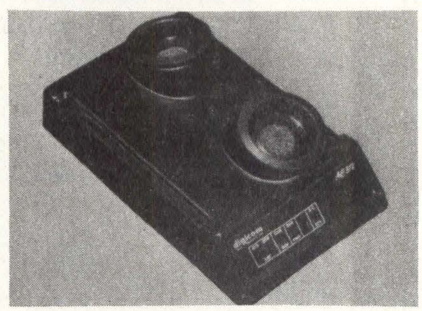
EXORCISER COMPATIBLE 16k STATIC RAM MODULE



A 16k-byte static random access memory module, the 9627 is configured as 2 independent 8k blocks which can be individually placed at any 8k boundary in the memory map. Std configuration has 480-ns access time; 9627A, a 300-ns version, and 9726B, a partially populated version, are available on special order. **Creative Micro Systems,** 11642-8 Knott Ave, Garden Grove, CA 92641.

Circle 258 on Inquiry Card

ANSWER/ORIGINATE ACOUSTIC COUPLER

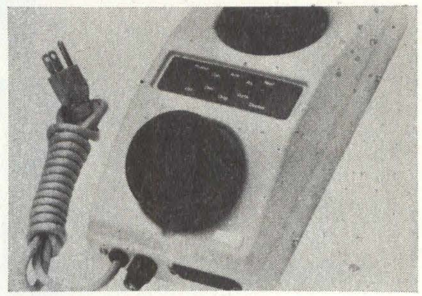


Operating at 300 bits/s, AC-312 coupler is Western Electric 103 compatible and is switch selectable between originate and answer modes. When in answer mode, unit generates answer tone necessary to communicate with 300-baud originate-only couplers and modems. Modulation is phase coherent frequency shift keying. Transmit output level is −18 dBm ±2 dB and receive sensitivity is −45 dBm ±2 dB. Carrier detect delay is 150 ms (on), 50 ms (off). **Digicom Data Products, Inc,** 1440 Koll Cir, Suite 108, San Jose, CA 95112.

Circle 259 on Inquiry Card

PRODUCTS

PORTABLE ACOUSTIC MODEM



An acoustically coupled modem, the 30-32 plugs into a page printer data terminal or CRT and accepts a std telephone handset in rubber caps mounted on its top. A remote computer can then be linked by std telephone lines to the terminal. Data are transmitted between computer and temporary telephone hookup via voice frequency tones acoustically coupled to the telephone microphone and earpiece. Units provide Bell System 103/113 compatible, full- or half-duplex, 300-bit/s data communication over conventional dial telephones. **Datec, Inc**, PO Box 839, Chapel Hill, NC 27514.
Circle 260 on Inquiry Card

COMPONENT LEVEL VOLTAGE TO CURRENT CONVERTERS

Designed to provide 4- to 20-mA outputs with 0- to 1000-Ω grounded or floating loads, model 2B20, a nonisolated version, accepts a std 0- to 10-V input, and features nonlinearity as low as $\pm 0.005\%$ max (B grade) and $\pm 0.025\%$ max (A grade), span drift of $\pm 0.005\%/^\circ C$ max, and op temp range of -25 to 85 °C. Model 2B22, an isolated version, accepts input ranges of 0 to 1 and 0 to 10 V and is available in J, K, and L grades, featuring a high CMV input to output isolation of 2500 Vdc continuous. **Analog Devices, Inc**, Rt 1 Industrial Pk, Norwood, MA 02062.
Circle 261 on Inquiry Card

HIGH AMPERAGE SUBMINIATURE FUSES

Rated at 20, 25, and 30 A, and for operation at 32 V or less, picofuses measure 0.13" (0.33 cm) in diameter and are 0.31" (0.79 cm) long. They are available with radial or axial leads 1.5" (3.8 cm) long and 0.04" (0.10 cm) in diameter. Devices will withstand vibrations of 10 to 2000 Hz at 20 G per method 204A, test condition D, of MIL-STD-202. Operating ambient temp range is from -55 to 125 °C. At -55 °C current carrying capacity is 110% of rating. **Littlefuse, Inc**, 800 E Northwest Hwy, Des Plaines, IL 60016.
Circle 262 on Inquiry Card

PRODUCTS

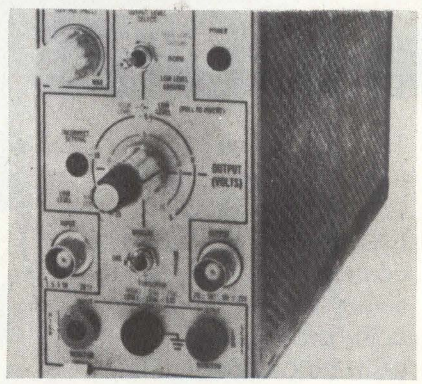
CARD READER FOR LSI-11 MICROCOMPUTER

A 300-card/min, 80-col card reader for the DEC LSI-11 and PDP-11/03, CR 300/21 is compatible with Digital Equipment's CR 11 hardware and software which operates on medium and large PDP-11 systems. The reader includes a vacuum feed reader mechanism, case work, electronics, interface cable, and a dual size module that mounts in one-half quad slot. **Cardamation Co,** 9A, Frazer Mall, Frazer, PA 19355.
Circle 263 on Inquiry Card

LED RETROREFLECTIVE SCANNER

Designed to sense a retroreflective target and ignore other reflective objects passing between the scanner and target, the S22004 Retro-Skan scanner and retroreflector provide positive detection for objects as reflective as polished metal at distances up to 20" (50.8 cm). Unit consists of invisible-IR LED, silicon photosensor, special lens, and ambient light filter sealed in 1-piece, machined aluminum body. It operates with steady state dc power or with modulated and pulsed controls. **Skan-A-Matic Corp,** Rt 5 West, Elbridge, NY 13060.
Circle 264 on Inquiry Card

PROGRAMMABLE 30-MHz MOS/CCD DRIVER



PI-454, compatible with Tektronix TM-500 series power modules, converts a TTL input signal into a ±15-V, 50-Ω output signal for driving MOS type devices at clock rates of >30 MHz. Output high and low levels are independently manually adjustable or voltage programmable from 15 to −5 V and from −15 to 5 V, respectively. A digital programming option is available, and output high or low level may be manually set to ground. **Pulse Instruments,** 1536 W 25th St, San Pedro, CA 90732.
Circle 265 on Inquiry Card

"WITH THE MODCOMP CLASSIC, WE DON'T HAVE TO TRADE PERFORMANCE TO GET RELIABILITY."

Bill Greene, Staff Engineer
Process Computer Systems Group
Chemicals & Plastics Division Engineering
Union Carbide Corporation

Bill Greene is a staff engineer for the Process Computer Systems Group which is responsible for designing, building, testing and installing process control computer systems in the company's manufacturing plants.

Because of their experience, we gave them our new Classic 7860 super mini to test. Their experience with it was summed up in three words. "We love it."

"It's a reliable machine. And reliability is the name of the game."

"We'll trade performance for reliability anytime," said Bill. "But with the Classic, we don't have to.

"The Classic hardware is very solid. Especially for a new product. "The performance characteristics of the Classic are impressive, too. With its extremely fast floating point processor, the Classic can run through a program more than 3.7 times as fast as a MODCOMP II."

"A working computer with software that doesn't work is useless."

"We've been running the MAX III operating system for five years and the MAXNET III network extension for the past two years. They've performed well under very demanding conditions. In fact, over the past year, we've had more than 99.5% uptime on more than 30 installed MAX III systems.

"However, we're installing larger process computer networks now with more and more satellites. So we need increased host computer hardware and software capabilities.

"Our tests with MODCOMP's enhanced MAX IV operating system in the Classic have been very encouraging.

"MAX IV and the new MAXNET IV will help us relieve bottlenecks so that we can add more links and do more work with the computer. We also expect that File Manager, which can create a new file anywhere on a disc, will be a useful tool."

"We install 15-20 systems a year, so ease of implementation is important."

"Even though the Classic is a powerful and sophisticated machine, it should be an easy system for our project teams to implement. MODCOMP provides plenty of documentation and they've always been very helpful in working with us to get our systems up and running.

"In fact, we think so highly of MODCOMP and the Classic, we've already ordered two MODCOMP Classic 7860's to be used as host computers in large process control distributed networks."

It takes a tough computer to satisfy a tough customer.

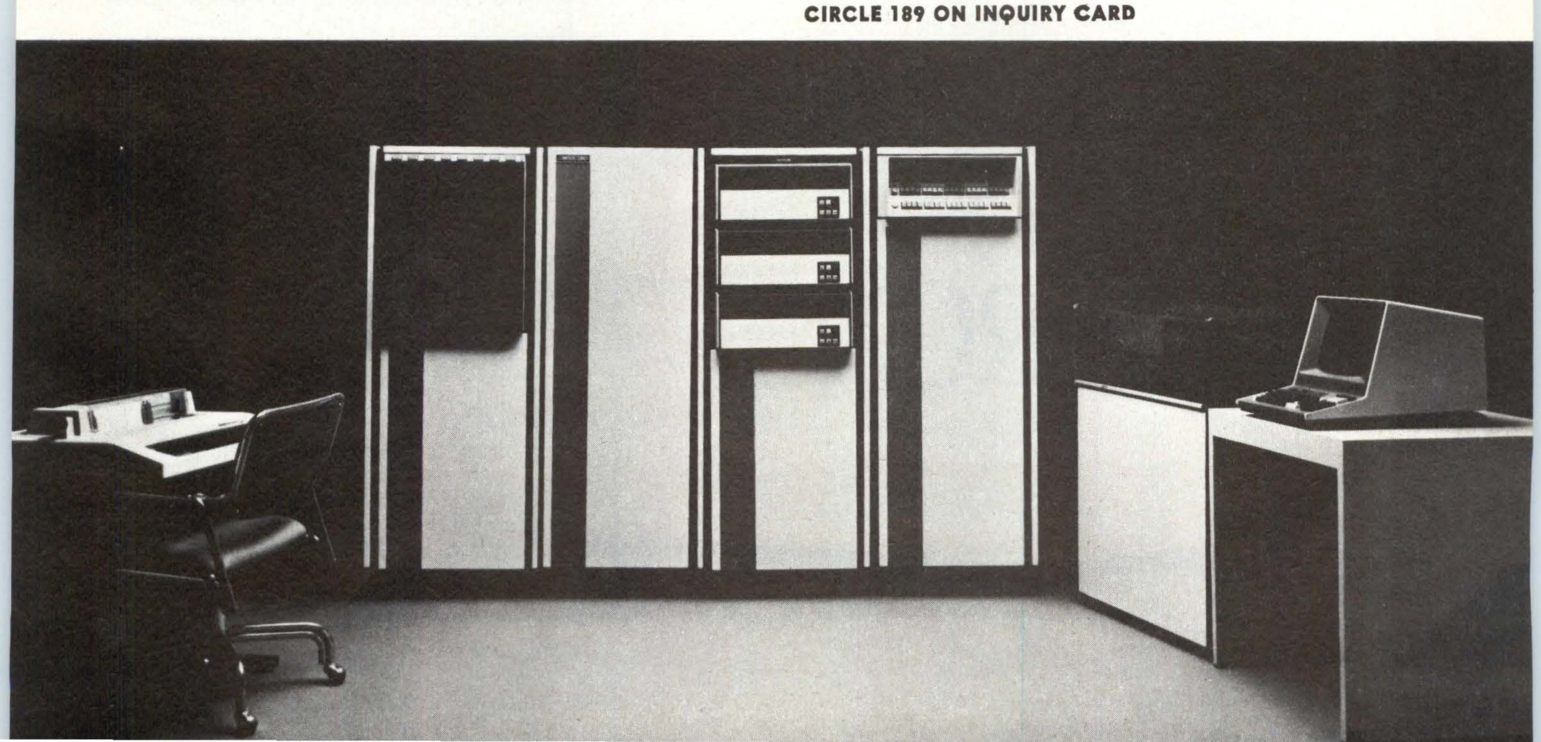
At MODCOMP, we specialize in building real-time computers. They work in chemical plants. In petroleum refineries. In steel foundries. In jet propulsion labs. In electric power plants. In some of the harshest industrial environments you can imagine. Nevertheless, independent surveys have rated MODCOMP computers the most reliable systems on the market.

If you want reliability, but you don't want to trade performance to get it, do what Union Carbide did. Buy a MODCOMP Classic.

MODCOMP®
Dedicated to your success

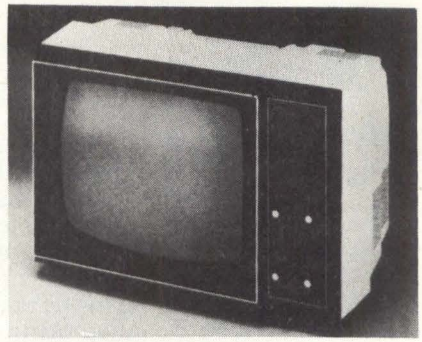
Modular Computer Systems, Inc.
1650 W. McNab Road Ft. Lauderdale, FL 33309
(305) 974-1380

CIRCLE 189 ON INQUIRY CARD



PRODUCTS

LOW COST 12" VIDEO TERMINAL



Black/white monitor is 14.3-lb (6.5-kg) unit featuring solid state circuitry for a sharp stable picture. Compatible with many computer systems, the unit provides composite video input, video bandwidth of 12 MHz ±3 dB, 75-Ω input impedance, resolution of 650 lines min in central 80% of CRT, 550 lines min beyond central 80%, ref EIA RS-375. Dimensions are 11.375 x 16.250 x 11.250" deep (28.892 x 41.275 x 28.575 cm), excluding input connector. **Micro Products Unlimited,** PO Box 1525, Arlington, TX 76010.
Circle 266 on Inquiry Card

MICROPROCESSOR COMPATIBLE 16-SEGMENT LCDS

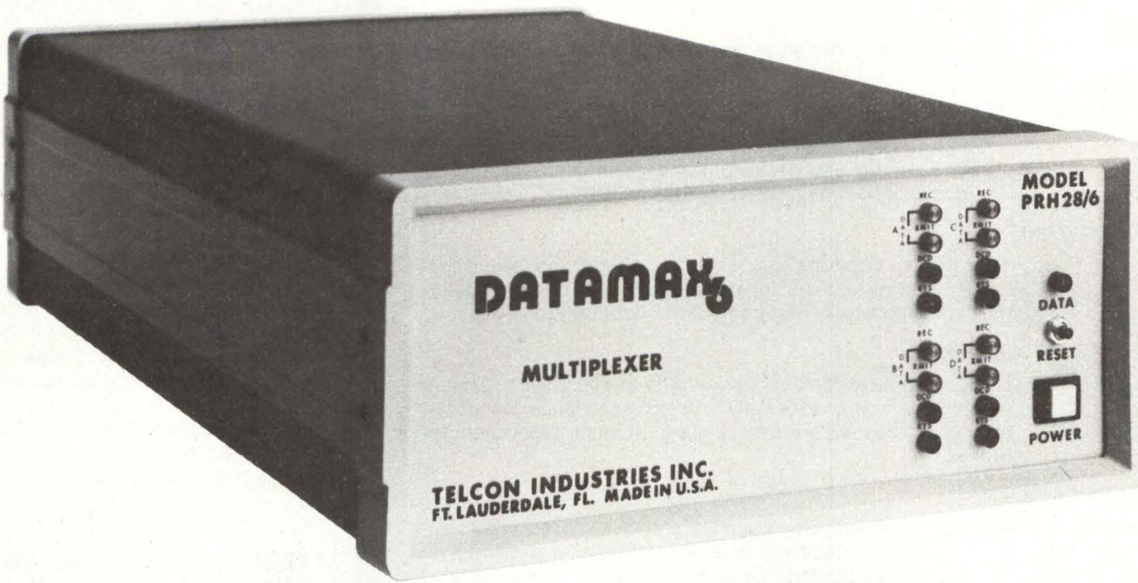
Compatible with driver and language capabilities of a microprocessor, 16-segment LCD displays do not limit stored and generated information from the processor to normal 7-segment format. 16-segment format includes full alphanumeric, plus signs, and limited graphics in English alphabet, plus several nonEnglish formats. Building block for the system is 1.3" (3.3-cm) high x 3" (7.62-cm) long 5634 which includes four 0.5" (1.27-cm) high char in a single substrate. **UCE Inc,** 20 N Main, Norwalk, CT 06854.
Circle 267 on Inquiry Card

20M-BIT/s FIBER OPTICS SYSTEM

Family III, a TTL compatible data link system that operates from dc to 20M bits/s RTZ or 40M bits/s NRZ, includes transmitter, receiver, instruction manual, and custom cable up to 100-m long. Incorporating electronic and optical components into a single package, transmitter requires 5-V power supply with no external components; receiver uses a 200-Ω potentiometer, supplied with the system, and requires ±12-V power supplies. Optical element in the cable is single fiber with attenuation under 10 dB/km. **Augat Inc,** 33 Perry Ave, Attleboro, MA 02703.
Circle 268 on Inquiry Card

The Squeezable One

DATAMAX PRH-28/6



FULLY EXPANDABLE MULTIPLEXER UP TO 32 INPUT DATA CHANNELS

YOU CAN SQUEEZE MORE INTO THE DATAMAX PRH-28/6

• Accepts SYNC, ASYNC, BISYNC, HDLC, SDLC protocols • Interfaces TTL, RS232, Current Loop, Telex, TWX • Modules field replaceable for low MTTR • Port Intelligence; code/speed conversion, protocol translation available on all I/O channels • System Status Reporting available by front panel indicators or external printer • Built-in Diagnostics • Built-in Modems available up to 2400 BPS • Lowest cost per port in the industry • Terminal Cluster Concentrators

More Than 1,400 Systems Installed

PLUS TELCON'S 36 MONTH LIMITED WARRANTY

Telcon
INDUSTRIES, INC.

5701 N.W. 31st Ave. • Ft. Lauderdale, FL U.S.A. 33309
Telephone (305) 971-2250 • TWX (510) 956-9412

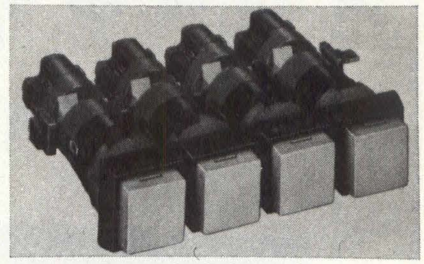
London, England
76 Shoe Lane, Suite 307
London EC4A3JB
01/353-4133

Leaders in Data Communications Since 1968

CIRCLE 190 ON INQUIRY CARD

PRODUCTS

INTERLOCK LIGHTED PUSHBUTTON ASSEMBLIES



Identical in appearance to other TH series switches, interlock assemblies are available in lighted pushbutton combinations; mushroom caps, key operated, Hall-effect, or oil-tight switches can be obtained on special order. Providing T-1¾ lamp compatibility, devices have double terminals and use metal mounting nuts. Wipe and roll gold-plated-silver self-cleaning contacts enable them to handle loads from low level to full range with min of contact bounce. All types are available 1 to 4 pole, and rated at 5 A, 250 Vac. **Unimax Switch Corp,** Ives Rd, Wallingford, CT 06492.

Circle 269 on Inquiry Card

TERMINAL CONTROLLER AND DATA CONCENTRATOR

VISTA/80 units use multiple microprocessor architecture and function either as intelligent clustered CRT/keyboard controller or hold and forward data concentrator. Modular design enables changes in network function protocol and terminal devices to be accommodated and expansion to handle network growth. Controller supports up to 18 CRT/keyboards or combination of CRTs and printers. Data concentrator attaches to host computers through 1 or 2 9600-baud lines, and supports 8 9600-baud circuits on downline side. **Microform Data Systems,** 830 Maude Ave, Mountain View, CA 94043.

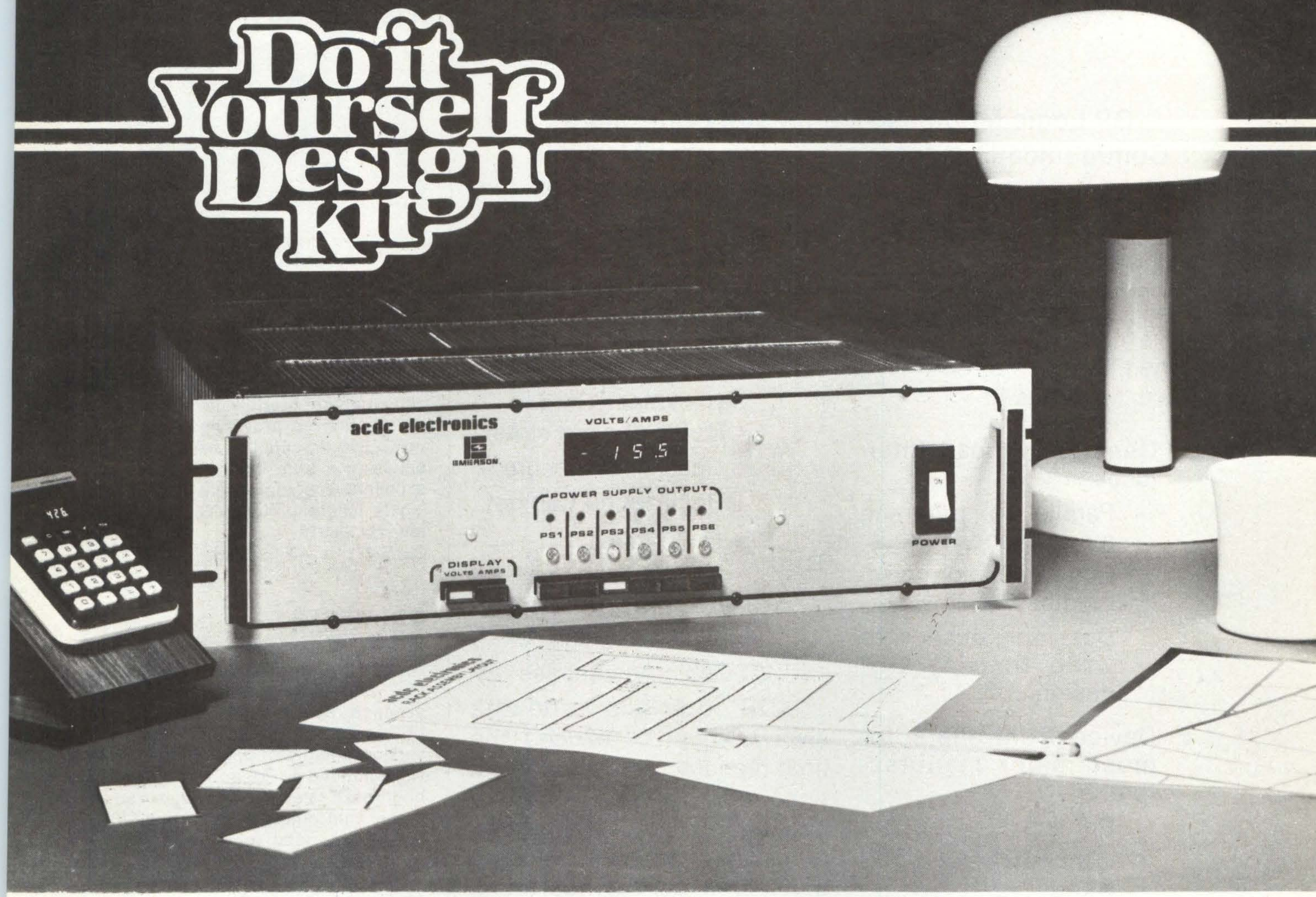
Circle 270 on Inquiry Card

HIGH PERFORMANCE BIFET OP AMPS

Internally compensated HA-5100 and uncompensated -5110 op amps have laser trimmed thin film resistors to reduce input offset voltage to <1.5 mV. Proprietary design and dielectric isolation process techniques produce wide-gain-bandwidth product to 80 MHz and settling time of <2 μs (0.1%, 10-V output step) at 25 °C. Drift is minimal over the temp range. Military (−55 to 125 °C) and commercial (0 to 75 °C) temp ranges are available. **Harris Semiconductor Products Div,** PO Box 883, Melbourne, FL 32901.

Circle 271 on Inquiry Card

Power Supply Rack System



It's simple. At your request, we send you a design kit that allows you to lay out up to six off-the-shelf-power supplies in our new standard 19" rack. The power supplies you select can be linear or switching supplies of various sizes to give you up to six outputs. And, the racks come in three different RETMA sizes, four front panel configurations and a wide range of features and options for maximum flexibility of design.The kit includes stick-on die cut outlines of all our standard power supply case sizes and a simple method for determining the system's cost . . . all in just a few minutes. An easy-to-complete order form is also included for your convenience.

Here's what we do . . .We assemble the power supplies into the rack, completely wired. Using specialized testing equipment, your entire system is checked for every function. And we provide you with the wiring diagram and an outline drawing for each rack assembly we deliver.

Selectable Rack Features

1. Push-button selector switches
2. Lighted circuit breaker
3. Front panel voltage adjustments
4. Digital volt/amp meter
5. LED output indicator
6. Individually fused modules
7. Perforated rack cover
8. Rugged slides
9. AC input barrier strip or optional line cord.

Send for your free design kit on your company stationery now.

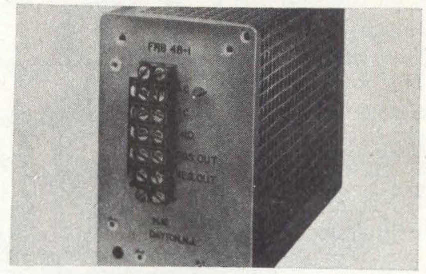
acdc electronics

401 Jones Road, Oceanside, California 92054 Telephone: (714) 757-1880

211 West Clay Avenue, Roselle Park, New Jersey 07204 Telephone: (201) 241-6077

PRODUCTS

50/60-Hz INPUT FERRORESONANT SUPPLIES

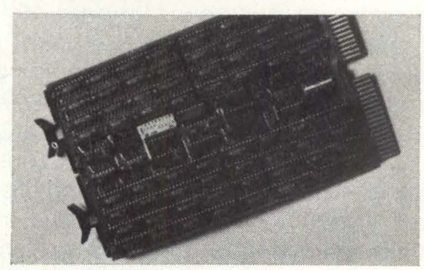


Changeover from U.S. std 60-Hz, 115-V to 50-Hz, 220-V sources is accomplished by simple internal strap changes in ac to dc power supplies, reducing inventory requirements for OEMs who furnish their equipment to worldwide markets. In 4 std case sizes providing output power up to 650 W, supplies have high MTBF, efficiencies from 65 to 85%, and offer excellent line regulation. Current limiting is inherent. **NJE,** PO Box 50, Dayton, NJ 08810.
Circle 272 on Inquiry Card

3-STATE LED

XC-5491 provides red and green lighted color from the same T-1¾ package. LED is a 0.200" (0.508-cm), 2-leaded package containing a red and green LED chip in inverse parallel. By reversing polarity of applied current, LED will emit red or green light. Chips are brightness matched so that red and green light output is uniform at 10 mA, eliminating need for special drive circuits. **Xciton Corp,** Shaker Pk, 5 Hemlock St, Latham, NY 12110.
Circle 273 on Inquiry Card

LSI-11 COMPATIBLE STATIC SEMICONDUCTOR MEMORY



VML 1116 is hardware and software compatible with DEC LSI-11, -11/2, and -11/03 microcomputers. Memory packs 16k x 16 on a single dual-width PC board. Onboard DIP switch allows memory operation to 124k. The 4096 x 1 NMOS static RAM design eliminates need for refresh. A single 5 V at 2.5 A derived from the bus option slot powers 16k. Access time is 250 ns and cycle time is 350 ns with no refresh. **Computer Extension Systems, Inc,** 17511 El Camino Real, Houston, TX 77058.
Circle 274 on Inquiry Card

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 an 8-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.

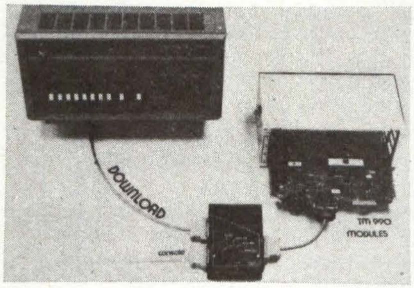
5301 Beethoven Street, Los Angeles, CA 90066
Call: (213) 390-7778 • Telex: WU 65-2451
East Coast
280 Park Avenue, New York, NY 10017
Call: (212) 682-0420 • Telex: WU 12-5059

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

CIRCLE 192 ON INQUIRY CARD

PRODUCTS

MDS 800 TO TM 990 CODE DOWNLOADER



Pivot MDS adapter unit, a hardware attachment for the Intel Intellec 800 microprocessor development system in conjunction with Pivot 9900 software, allows the MDS user to download 9900 code into TI's TM 990 modules. Attaching between console and the MDS console port, the adapter provides Local MDS, Local 990, Download, and Upload modes. It also allows the MDS console to be used to set breakpoints, examine memory, monitor I/O, and execute code in the 990. **Processor Innovations,** 118 Oakland St, Red Bank, NJ 07701.

Circle 275 on Inquiry Card

EXORCISER COMPATIBLE DEVICE PACKAGING BOARDS

Designed for high density packaging of DIPs and for bus compatibility with the Motorola 6800 EXORciser, 316 family panels have rows of socket terminals in 17 repetitive sections of 0.300" (0.762 cm) with 0.100" (0.254 cm) between sections to permit packaging of devices with 0.300" (0.762-cm) spacing. Rows of socket terminals in 3 repetitive sections of 0.300"/0.300" (0.762/0.762 cm) with 0.100" (0.254 cm) between sections permit packaging of devices that require 0.600" (1.524-cm) spacing. **Mupac Corp,** 646 Summer St, Brockton, MA 02402.

Circle 276 on Inquiry Card

100-W SWITCHING POWER SUPPLIES

S series 100-W switches offer efficiencies of 75% nom and densities of >1 W/in^3 (0.06 W/cm^3), an extra wide dual ac input, 20-ms min loss of line holdup, and overvoltage protection. Differential and common mode emi suppression, input surge current limiting, and input voltage transient protection are provided. All models are convection cooled and fully rated to 50 °C. Line and load regulation is 0.1%; ripple and noise is 50 mV pk-pk or 0.5% (whichever is higher). **Deltron, Inc,** Wissahickon Ave, North Wales, PA 19454.

Circle 277 on Inquiry Card

Brawn for your brainchild.

Computer Grade Aluminum Electrolytics. No one needs to tell you how vital capacitors are to the operating competence of a computer. A single surge or cut-back in power can potentially cause an entire system to malfunction. That's why Nichicon makes Computer Grade Capacitors under the strictest quality control procedures. We supply the brawny reliability to make sure that your brainchild works properly.

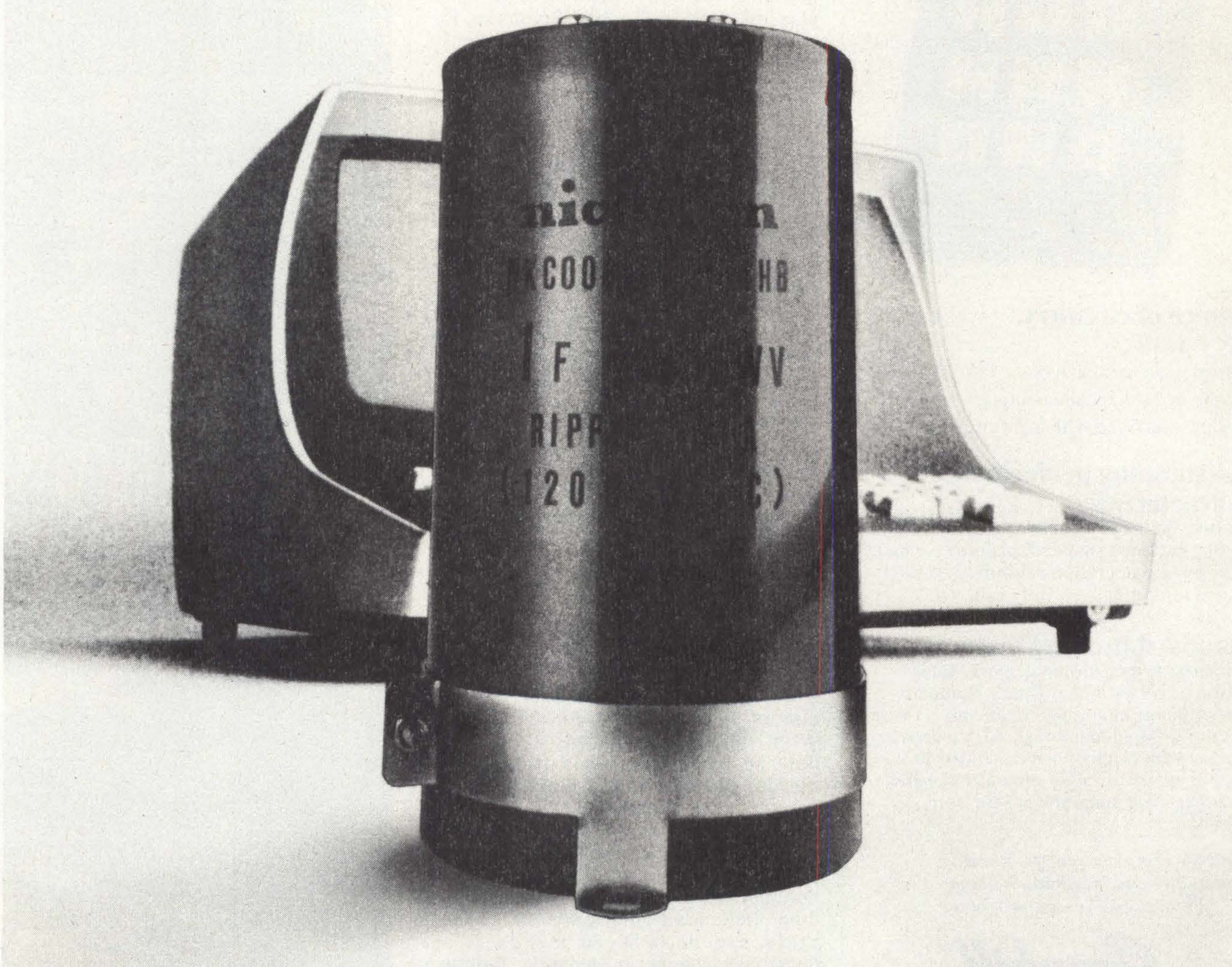
Nichicon has the right capacitor for every computer design need. These include our NKB Compact Series, NSB Standard Series and NHB High-Ripple Series. Nichicon computer grade capacitors feature top quality pressure sensitive safety vent construction with PVC insulating sleeves.

Long life reliability is built into every unit. In an operating temperature range of −25°C through +85°C, these aluminum electrolytics offer a dependable low-leakage current, high-ripple capabilities and low ESR.

Computer Grade Capacitors are excellent examples of Nichicon's continuing emphasis on reliability as the dominant design criterion. We also manufacture every other type of capacitor including all types of aluminum electrolytics, ceramic discs, film, oil filled—without PCB's, metallized paper and wax paper capacitors for standard or specialized applications.

Send for your free catalog and engineering samples today. Simply write to us on your company letterhead. You'll hear from us soon.

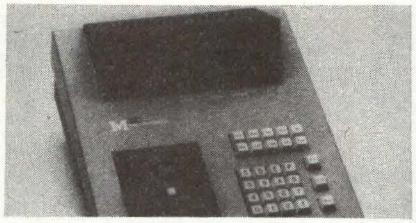
nichicon **The pulse of the industry.**



NICHICON (AMERICA) CORPORATION • 6435 N. Proesel Ave. • Chicago, IL 60645 • (312) 679-6530
Division of NICHICON CAPACITOR, LTD., Kyoto, Japan

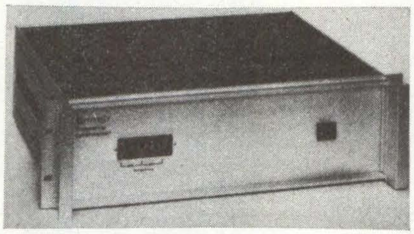
PRODUCTS

P/ROM PROGRAMMER



1M1010 programs bipolar P/ROMs, single-chip microcomputers, FPLAs, PGAs, PALs, and PMUXs to manufacturers' specs, provides full editing capability, and has 14-digit alphanumeric gas discharge display and full size keyboard. Capabilities include check sum, insert, delete, and move words or blocks of RAM. The entire P/ROM set may be programmed from RAM; 4k x 8 RAM is standard and 16k x 8 is optional. Two serial I/O ports are included. **International Microsystems, Inc,** 11554 C Ave, Auburn, CA 95603.
Circle 278 on Inquiry Card

VHF SYNTHESIZER



With an output frequency variable from 80 to 120 MHz, SI-103C offers 6½-digit resolution with the stability and accuracy of the internal crystal clock. Frequency stability is $\pm 1 \times 10^{-8}$ from -10 to 50 °C. BCD programming is available, if thumbwheel frequency control is not desired. Output is 13 dBm with nonharmonic spurious responses down to 70 dB below the carrier. Harmonic outputs are down to <25 dB below the carrier. Power requirements are 115/230 Vac at 50-60 Hz, 20 W max. **Syntest,** 169 Millham St, Marlboro, MA 01752.
Circle 279 on Inquiry Card

CARD PUNCH CONTROLLER

DP2029 allows card punching from any std asynchronous RS-232-C communications line equipped with hardware hold-off capability (on lines without this capability, user can delay or transmit nulls for card release, character, or feed delays). Baud rate is selectable from 110 to 9600. Unit buffers up to 2 characters with carriage return configured as std card release (other char may be used as triggers). **Digital Products,** PO Box 79438, Houston, TX 77079.
Circle 280 on Inquiry Card

When it comes to computers, SAMS PUBLISHES THE BOOKS

Introducing... THE BLACKSBURG CONTINUING EDUCATION SERIES™

It has long been the objective of the "Blacksburg Group" to develop timely and effective educational materials and aids that will permit students, engineers, scientists and others to quickly learn how to apply new technologies to their particular needs. The members of the group have long been involved in digital electronics, minicomputers, and microcomputers.

The Blacksburg Continuing Education Series™ is an easy to read format consisting of 16 titles. Subjects range from basic electronics through microcomputers, operational amplifiers and active filters. Each title in the series includes detailed experiments, "hands-on" learning experiences, and examples to reinforce basic concepts. Book Size 5½" x 8½", softbound.

Howard W. Sams & Co., Inc.

4300 West 62nd Street
P.O. Box 558
Indianapolis, Indiana 46206

The 8080A Bugbook®: Microcomputer Interfacing and Programming
by Peter R. Rony, David G. Larsen, and Jonathan A. Titus.
Provides a thorough description of 8080A-based microcomputer systems, including the hardware required for a typical 8080A microcomputer, the operation of the status latch, and the interface circuitry required for external input, output, and interrupting digital devices. Over 150 pages are devoted to a detailed description of the 8080A instruction set. More than 30 programming examples, which cover topics such as timing loops, stack operations, clearing memory, input and output, and interrupt servicing, are provided. 416 pages. BUGBOOK® is a registered trademark of E & L Instruments, Inc., Derby, Connecticut 06418.
No. 21447 $10.50

Introductory Experiments in Digital Electronics and 8080A Microcomputer Programming and Interfacing. Book 1.
by Peter R. Rony, David G. Larsen, and Jonathan A. Titus.
A novel introductory approach to the field of digital electronics that starts with the programming if an 8080A-based microcomputer and then proceeds to a treatment of the key concepts required to interface a microcomputer to external digital devices. Gates, flip-flops, latches, decoders, counters, monostable multivibrators, and gating are all described in detail as a prelude to the microcomputer interfacing experiments provided in Book 2. Seventeen programming experiments and forty-four digital electronics experiments are provided. 496 pages.
No. 21550 $12.95

Introductory Experiments in Digital Electronics and 8080A Microcomputer Programming and Interfacing. Book 2.
by David G. Larsen, Peter R. Rony, and Jonathan A. Titus
Book 1 provides the background necessary for this laboratory-based approach to the important principles of microcomputer interfacing: device select and address select pulse generation, accumulator I/O, memory-mapped I/O, and interrupting device servicing. The principles are discussed in the context of a small laboratory 8080A-based microcomputer, which is described in the Appendix. The entire 8080A instruction set is described in detail. Three programming experiments and forty-one interfacing experiments are provided. 416 pages.
No. 21551 $10.95

PLUS . . . there's 13 more timely computer titles. Order Today! See the complete selection on the order form below.

ORDER FORM

Quantity Ordered

_____ DBUG: An 8080 Interpretive Debugger No. 21536 $4.95
_____ Design of Active Filters, with Experiments No. 21539 $7.95
_____ Design of Op-Amp Circuits, with Experiments No. 21537 $7.95
_____ Design of Phase-Locked Loop Circuits, with Experiments No. 21545 $8.95
_____ Interfacing and Scientific Data Communications Experiments No. 21546 $5.95
Introductory Experiments in Digital Electronics and 8080A Microcomputer Programming and Interfacing
_____ Book 1 No. 21550 $12.95
_____ Book 2 No. 21551 $10.95
_____ Two Volumes No. 21552 $20.95
Logic and Memory Experiments Using TTL Integrated Circuits
_____ Book 1 No. 21542 $9.95
_____ Book 2 No. 21543 $9.95
_____ Two Volumes No. 21544 $17.95
_____ Microcomputer—Analog Converter Software and Hardware Interfacing No. 21540 $9.50
_____ 8080/8085 Software Design No. 21541 $9.50
_____ NCR Basic Electronics Course, with Experiments No. 21549 $9.50
_____ NCR Data Communications Concepts No. 21548 $6.95
_____ NCR Data Processing Concepts Course No. 21547 $7.95

Quantity Ordered

_____ 555 Timer Applications Sourcebook, with Experiments No. 21538 $5.95
_____ The 8080A Bugbook® Microcomputer Interfacing and Programming. Bugbook® is a registered trademark of E & L Instruments, Inc., Derby, Connecticut 06418. No. 21447 $10.50

_____ Sub Total
_____ Add local sales tax where applicable.
_____ Total Amount

Name_____________________
Address___________________
City_____________ State_________ Zip_________
(please print)

Save handling charges by enclosing payment with order.
☐ Payment Enclosed (No Shipping and Handling Charge)
☐ Bill Me (Shipping and Handling Charge will be added)
☐ Send me Free Sams Book Catalog

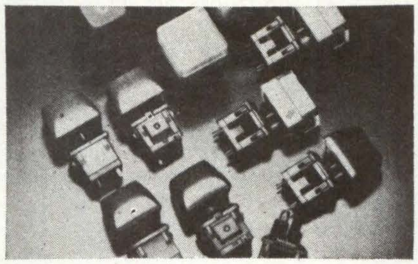
Prices subject to change without notice. 440

Return To:
Attention: Sales Department
Howard W. Sams & Co., Inc.
4300 West 62nd Street • P.O. Box 558 • Indianapolis, IN 46206

CIRCLE 199 ON INQUIRY CARD

PRODUCTS

PUSHBUTTON KEY SWITCHES



JM-0400 series includes mechanical switches with cycle life to 10M operations, reed type with life of 20M operations, pushlock switches, illuminated switches, and sealed membrane type units. All have the same body size, allowing interchangeability among models, and snap in place through the front panel with no mounting hardware required. Rated 12 Vdc at 100 mA, devices have a contact resistance of 1 Ω or less and bounce time of 3 ms max. **SMK Electronics Corp of America,** 118 E Savarona Way, Carson, CA 90746.
Circle 281 on Inquiry Card

SERIES/1 COMPUTER SOFTWARE PACKAGES

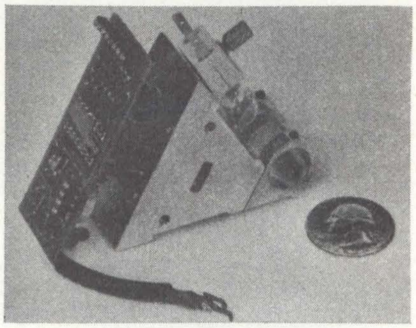
Using all IBM or a vendor-mix of hardware, software operates under IBM RPS operating system to control all laboratory processing. System requirements are processor with 64k bytes of main storage, disc storage for master files and temporary files, and 8-line controller and 4-line adapter. Online application programs perform order entry, billing, accounts receivable, and other processing for clinical laboratories. CRT terminals are used for data entry. Offline processing produces customer statements and other documentation. **Applied Computer Services, Inc,** 12200 Sylvan St, North Hollywood, CA 91606.
Circle 282 on Inquiry Card

DUAL-INLINE CONNECTOR FOR LCDS

Mounting 0.936 x 0.540" (2.377 x 1.372-cm) LCDs on PC boards without solder, connector assembly is made of clear plastic and consists of connector frame, bezel, and two Zebras that make contact with the DIL LCD. Two locating studs at base of the frame align the connector frame and LCD with the contact pads of the PCB. When the clear plastic bezel is installed and secured, the Zebra creates a gas tight electrical contact between LCD and PCB. **Technical Wire Products, Inc,** 129 Dermody St, Cranford, NJ 07016.
Circle 283 on Inquiry Card

PRODUCTS

OCR SCAN HEAD ASSEMBLY



Model 410 can optically scan printing of OCR-A, OCR-B, 1403, 1428, 7B, E13B, or 12F type styles, including the degraded quality typically produced by high speed printers and imprinters. Scanning a single line at a time, the unit reads at speeds from <100 to >1k char/s, with character reject rates of <1 in 20k, and substitution rates of <1 in 200k. Unit consists of scan head assembly, video processor, font recognition, control and interface logic, and dc power supply. **Scan-Data Corp,** 800 E Main St, Norristown, PA 19401.
Circle 284 on Inquiry Card

MICROMINIATURE PUSHBUTTON SWITCHES

TL-360 switches include integral buttons of varying heights, from flushtop to 0.125" (0.3175 cm) high, as std options. Flushtop models are 0.156" (0.396 cm) thick x 0.36" (0.914 cm) diameter. Life ratings are up to 250,000 cycles each. Switches are completely sealed in a silicone rubber boot, ultrasonically welded to seal them permanently from dust, dirt, and cleaning processes. Consisting of integral button and actuator, the devices have a tactile feel. **Standard Grigsby, Inc,** 920 Rathbone Ave, Aurora, IL 60507.
Circle 285 on Inquiry Card

LSI-11 PRINTER/PLOTTER CONTROLLER

VIF 1200, interfacing a Versatec electrostatic printer/plotter to an LSI-11, is contained on a dual-width PC board for LSI-11/2 compatibility and plugs directly into the computer's Q-bus. RT-11 software compatible, the controller has programmed device control in both print and plot modes. FORTRAN callable print and plot routines as well as diagnostic routines are provided on a floppy disc. Connection to printer/plotter is through a 20' (6-m) cable. **Image Automation, Inc,** 3350 Scott Blvd, Bldg 22, Santa Clara, CA 95051.
Circle 286 on Inquiry Card

MULTIFUNCTION PORTABLE EPROM PROGRAMMER

Using an 8-bit Z80 microprocessor and 16k bytes of RAM, PKW-5000 contains all circuitry, boards, and power supply to program NMOS EPROMS including 2704, 2708, 2758, 2516, 2716, 2732, and 2532. Weighing 1.8 kg and measuring 282 x 187 x 48 mm, the programmer provides editing functions through the RAM buffer and execution commands, in addition to simple programming functions, allowing its use as a simulator and debugger. **Intertek, Inc,** 7-2-8, Nishi-Shinjuku, Tokyo 160, Japan.
Circle 287 on Inquiry Card

ENCAPSULATED ±12-V POWER SUPPLIES

Outputs of ±12 Vdc at ±120, ±240, and ±360 mA are offered by 2.12.120, 2.12.240, and 2.12.360, respectively. Pinouts are identical. Line and load regulation is ±0.02%, op temp is from −25 to 71 °C, and line voltages are either 100, 115, or 230 Vac at 50 to 400 Hz. Modules are totally short circuit protected by foldback current limiting. Measurements are 2.50" long x 3.50" wide (6.35 x 8.89 cm) x 0.875, 1.25, and 1.56" (2.222, 3.175, and 3.96 cm) high, respectively. **Calex Mfg Co,** 3355 Vincent Rd, Pleasant Hill, CA 94523.
Circle 288 on Inquiry Card

LITERATURE

Thermal Printer Mechanisms

Sample outputs, specs, outline drawings, and descriptions of 7-segment numeric, 5 x 7 matrix alphanumeric, and graphics/alphanumeric/analog fixed head, nonimpact thermal printers are featured in brochure. **Gulton Industries, Inc,** East Greenwich, RI.
Circle 300 on Inquiry Card

Displays and Connectors

Application note supplements short-form catalog with drawings, metric and English dimensions, segment designations, and pin locations for series SP-100, -200 -300, and -400 displays. **Beckman Instruments, Inc, Display Systems Div,** Scottsdale, Ariz.
Circle 301 on Inquiry Card

MOS Semicustom IC Design

Schmitt triggers and multivibrators, and logic design for CMOS and NMOS monochips are subjects discussed in two application notes intended to aid in custom MOS IC design. **Interdesign, Inc,** Sunnyvale, Calif.
Circle 302 on Inquiry Card

Microcomputer Systems

Descriptions, photos, and conceptual diagrams for board level computers, rack mounted and prototyping systems, supporting products, plus STARPLEX™ information are included in databook that is available by letterhead request, attn: Series/80 Databook, to **National Semiconductor Corp,** CPG Marketing Services, MS/10A190, 2900 Semiconductor Dr, Santa Clara, CA 95051.

Multiplexer

Micro 700 Band Splitter, presented in brochure, allows up to four synchronous data terminals to share a single telephone or DDS link. **Micom Systems, Inc,** Chatsworth, Calif.
Circle 303 on Inquiry Card

Image Analysis System

Digital noise reduction, interactive image editing, image storage, and shading correction for Polyprocessor® C1285, plus applications and examples of output, are detailed in brochure. **Hamamatsu Systems, Inc,** Waltham, Mass.
Circle 304 on Inquiry Card

Flat Cable

Guide provides specs and dimensional drawings for bonded, laminated, and color coded flat cable; bulk and prestripped flat jumper cable; and custom assemblies. **Belden Corp, Electronic Div,** Richmond, Ind.
Circle 305 on Inquiry Card

Communications Line Test Systems

Brochure provides descriptive information and application data for basic, private line, and toll test board versions of 9800 series test board systems. **Wiltron Co,** Mountain View, Calif.
Circle 306 on Inquiry Card

Replacement Printers

Booklet cites operating features and characteristics of printers that interface to IBM, DEC, Data General, Hewlett-Packard, Univac, and Interdata systems. **Decision Data Computer Corp,** Horsham, Pa.
Circle 307 on Inquiry Card

Discrete Testing System

60-p brochure contains all information needed to define and configure test system, including photos, illustrations, and descriptions of IMPACT line, software, and accessories. **Lorin Industries, Inc,** Danbury, Conn.
Circle 308 on Inquiry Card

Low Profile Relays

Catalog supplies specs, dimensional drawings, PCB layouts, and photos for class 63, 64, and 65 relays. **Magnecraft Electric Co,** Chicago, Ill.
Circle 309 on Inquiry Card

Programmable Intelligent Terminal Systems

Brochure outlines extensive system software support that includes high level languages, forms generation, and utilities and diagnostics. **Ontel Corp,** Woodbury, NY.
Circle 310 on Inquiry Card

Extruded Aluminum Heatsinks

High power semiconductor coolers and medium power heat dissipators are profiled with technical details, performance curves, and dimensional drawings in catalog. **Vemaline Products, Div of Ostby & Barton Co,** Warwick, RI.
Circle 311 on Inquiry Card

Programmable Controllers

Primer on programmable controller for those not acquainted with them, and brochure on MaxiMiser programmable controller are available by letterhead request to **Cincinnati Milacron, Electronic Systems Div,** Mason Rd and Rte #48, Lebanon, OH 45036.

CIRCLE 203 ON INQUIRY CARD

LITERATURE

Industrial Grade Potentiometers

Specs, dimensional drawings, photos, and features of series 300 16-mm single- and multiple-construction, pushbutton or rotary switch potentiometers are presented in brochure. **Centralab Electronics Div, Globe-Union Inc,** Milwaukee, Wis.
Circle 312 on Inquiry Card

Modem Eliminator

Data sheet lists specs and pinout for unit that serves as modem for two terminals located within 100 ft (30 m) of host front-end equipment. **Compre Comm, Inc,** Champaign, Ill.
Circle 313 on Inquiry Card

Video Display Terminals, Printers, and Data Systems

Brochure highlights range of video display terminals from dumb to smart, Ballistic™ matrix printers, and combination systems. **Lear Siegler, Inc, Data Products Div,** Anaheim, Calif.
Circle 314 on Inquiry Card

Flat Cable System

Short-form catalog furnishes specs, dimensional drawings, and part numbers for line of socket connectors, headers, cable plugs, and transition connectors. **Robinson-Nugent, Inc,** New Albany, Ind.
Circle 315 on Inquiry Card

Precision Switch Assemblies

Hermetically sealed switches, operational up to 427 °C or down to −195 °C, are detailed with specs, photos, and dimensional drawings in brochure. **Haydon Switch & Instrument, Inc,** Waterbury, Conn.
Circle 316 on Inquiry Card

Data Acquisition and Control System

FIDAC system, comprised of I/O cards controlled by common 8-bit I/O bus, is featured in brochure. **F I Electronics,** Santa Rosa, Calif.
Circle 317 on Inquiry Card

Winchester Backup Drive

17.28M-byte cartridge drive that provides removable media backup for Winchester disc drives is featured in brochure. **Data Electronics, Inc,** Pasadena, Calif.
Circle 318 on Inquiry Card

Laminated Cables and IDC Connectors

Illustrated booklet gives specs for Spectra-Strip planar cable, IDC socket connectors, DIP plugs, PCB transition connectors, and other connection hardware. **Omega Wire & Cable,** Harleysville, Pa.
Circle 319 on Inquiry Card

Power Supplies

Listing pertinent specs, 4-p catalog covers dc-dc regulated and unregulated power converters and ac-dc switching power supplies. **Bikor Corp,** Torrance, Calif.
Circle 320 on Inquiry Card

92k Magnetic Bubble Memory

Specs on TIB0203 plus discussion on the fundamentals and advantages of bubble memories, and spec sheets for the interfacing ICs designed for use with the memories are contained in book. **Texas Instruments Inc,** Dallas, Tex.
Circle 321 on Inquiry Card

Digital Multimeters

Brochure details features, specs, and applications for three 3½-digit multimeters accurate to 0.5%. **B & K Precision/Dynascan Corp,** Chicago, Ill.
Circle 322 on Inquiry Card

Brushless Synchros And Resolvers

Size 8 to 18 single- or multispeed synchros and resolvers using rotary transformers to couple power into the rotor are detailed in brochure. **Kearfott Div of The Singer Co,** Little Falls, NJ.
Circle 323 on Inquiry Card

Linear Test System

Photos, schematics, sample outputs, and text describe J273B system comprised of test deck, dc measurement system, sync pulse panel, functional laser trimming, and software and applications packages. **Teradyne Inc,** Boston, Mass.
Circle 324 on Inquiry Card

Electrostatic Graphics Products

Short-form catalog mentions series of high speed printers, plotters/printers, and CRT hardcopiers; and lists electrostatic supplies plus additional technical bulletins. **Houston Instrument, Div of Bausch & Lomb,** Austin, Tex.
Circle 325 on Inquiry Card

International Switch Standards

Procedures for application, specs, markings, creepage and clearance distances, and electrical life required by European CEE CB, Canadian CSA, American UL, and German VDE are listed in handbook. **Cherry Electrical Products Corp,** Waukegan, Ill.
Circle 326 on Inquiry Card

Protocol and Diagnostic Testing

Intershake® test system permits operator of IBM 3270 or Teletype 40/4 terminals to verify operation; brochure details interconnection, test sequence, tests performed, and applications. **Atlantic Research Corp,** Alexandria, Va.
Circle 327 on Inquiry Card

Isolation and Instrumentation Amplifiers

Soft cover guide contains tutorial sections on theory, specs, and selection, plus applications sections covering industrial control and instrumentation. **Analog Devices,** Norwood, Mass.
Circle 328 on Inquiry Card

Touch Screen Digitizer

Permitting untrained personnel to access a data base, touch screen digitizer eliminates fixed function keyboards and lightpens. Brochure includes specs and basic operational theory. **TSD Display Products, Inc,** Bohemia, NY.
Circle 329 on Inquiry Card

See page 109

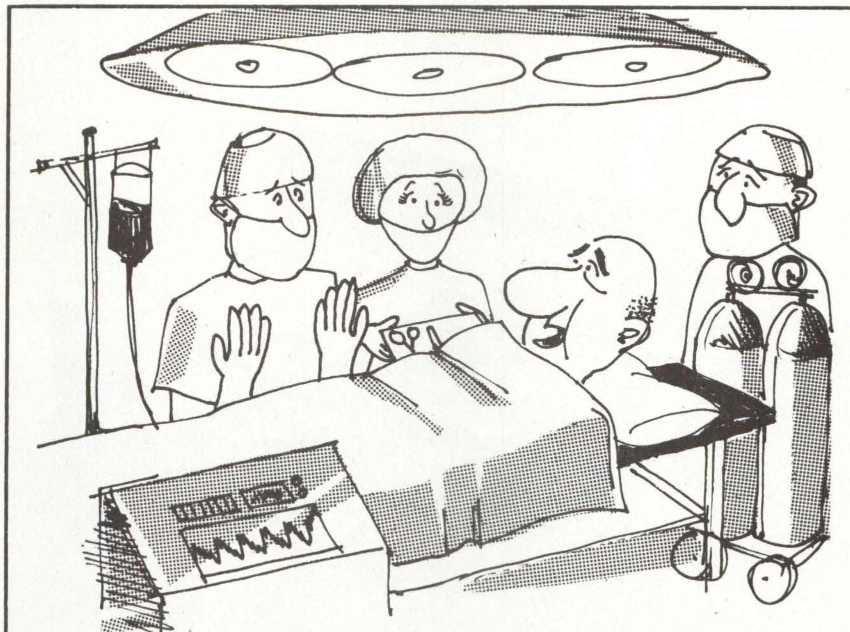
GUIDE TO PRODUCT INFORMATION

NOTE: The number associated with each item in this guide indicates the **page** on which the item appears—**not** the reader service number. Please do **not** circle the page number on the reader service card.

GUIDE TO PRODUCT INFORMATION

MEMORY/STORAGE EQUIPMENT

INPUT/OUTPUT AND RELATED EQUIPMENT



Test it.
EAGLE PICHER
Carefree magnum
RECHARGEABLE BATTERY

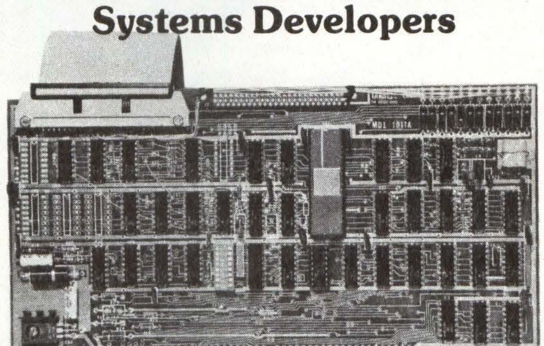
COMPUTERS AND COMPUTER SYSTEMS

ECLIPSE
NOVA
THE COMMUNICATOR™
8-Channel Multiplexer
Plug The Communicator into your Data General mini-computer for reliable, versatile communications. • Up to eight channels asynchronous communications on one 15" × 15" board • Jumper-selectable formats and baud rates, 110 to 19,200 • RS-232 or current loop • Modem control with automatic answering • Full Data General software compatibility • One year warranty • 30 day delivery • Service and support.
We've built our reputation on quality and service. See us for all your Data General controller needs.
NOVA and ECLIPSE are Registered Trademarks of Data General Corp.
NCC, Booth #4033
CUSTOM SYSTEMS INC
2415 ANNAPOLIS LANE
MINNEAPOLIS, MINNESOTA 55441
Tel: (612) 553-1112, Telex: 29-0975

GUIDE TO PRODUCT INFORMATION

ADVERTISERS' INDEX

(Continued on p 338)



SALES OFFICES

NEW ENGLAND AND UPSTATE NEW YORK

CALDWELL ENTERPRISES, INC.
Lindsay H. Caldwell
129 Cedar Hill Rd.
East Dennis, MA 02641
(617) 385-2533

LONG ISLAND AND MIDDLE ATLANTIC STATES

CALDWELL ENTERPRISES, INC.
Richard V. Busch
6 Douglass Dr.,
P.D. #4
Princeton, N.J. 08540
(201) 329-2424

SOUTHEASTERN STATES

COLLINSON & CO., INC.
Newton B. Collinson, III
Anthony C. Marmon
4419 Cowan Rd., Suite 302
Tucker, GA 30084
(404) 939-8391

MIDWESTERN STATES

Berry Conner, Jr.
88 West Schiller St.
Suite 2208
Chicago, IL 60610
(312) 266-0008

WESTERN STATES

BUCKLEY/BORIS ASSOC., INC.
Terry Buckley
Tom Boris
John Sabo
912 South Barrington Ave.
Suite 202
Los Angeles, CA 90049
(213) 826-4621

Plotting System CPS-11

Digital plotter and microprocessor based controller

combine to provide high performance plotting

The CØMPLØT® CPS-11 is a plotter and plotter controller designed to meet your plotting applications... whether on line or remote.

The field proven plotter incorporated in the CPS-11 gives you the highest resolution of any 11" digital plotter on the market today—4 switch selectable step sizes (in English or Metric) ranging from 200 to 1000 increments/inch. The pen moves at a remarkable rate of 4000 steps per second (240,000 steps per minute). The flat plotting surface and Z fold paper let you see what you're plotting while it's being plotted.

The plotter controller utilizes a microprocessor to provide automatic detection and correction of transmission errors, local generation of alphanumeric characters, circular buffer memory, and greatly simplified host computer software. The controller can either operate the plotter remotely from a host computer or serve as a sophisticated computer interface - whichever fits your specific application.

For complete information on how the CPS-11 can upgrade your plotting capabilities for only $5,390,*call or write Houston Instrument, One Houston Square, Austin, Texas 78753. **(512) 837-2620.** For rush literature requests or sales office information, persons outside Texas call toll free 1-800-531-5205. In Europe contact Houston Instrument, Rochesterlaan 6 8240 Gistel Belgium, phone (059) 27 74 45.
Visit us at the NCC, Booth 2232.

houston instrument | DIVISION OF **BAUSCH & LOMB**

"the graphics - recorder company"

* U.S. Domestic Price Only

® Registered Trademark of Houston Instrument

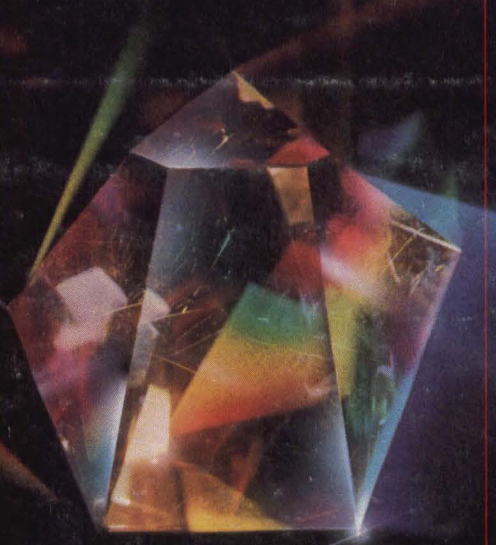
CIRCLE 216 ON INQUIRY CARD

Ramtek Colorgraphics cover the spectrum.

When you need a color graphics terminal that's exactly right for the job you're doing, call Ramtek. Only Ramtek covers the spectrum in price, performance, options and resolution.

Used singly or in combination, every model in Ramtek's Colorgraphics Terminal family delivers all the "extras" that only color makes possible. Extra information. Extra clarity. Extra operator efficiency. They work harder for you in every application.

Going from monochrome or black and white to colorgraphics? With Ramtek, interfacing is simple. Your terminal will be on line in no time. And Colorgraphics terminals are stand-alone units that let you develop your color software without costly CPU overhead.



The programming language is so uncomplicated with Ramtek's unique instruction set that you can be displaying your first colorgraphics within half-an-hour. Optional RAM memory, programmable in BASIC or PASCAL, joysticks, and graphic tablets give you added flexibility.

Like to know more? Just call your nearest Ramtek office. Or, write: Ramtek, 585 N. Mary Ave., Sunnyvale, CA 94086.

The complete terminal family is ready to plug in. The 6110, our lowest-priced true colorgraphics terminal. **The 6200A,** more capabilities per dollar than any comparable terminal. **The 6310,** the highest resolution raster color terminal made.

Ramtek
Our Experience Shows.

REGIONAL OFFICES: Sunnyvale, California (408) 735-8400 • Newport Beach, California (714) 979-5351
Dallas, Texas (214) 422-2200 • Maitland, Florida (305) 645-0780 • Huntsville, Alabama (205) 837-7000
Chicago, Illinois (312) 956-8265 • Cleveland, Ohio (216) 464-4053 • Washington, D.C. (301) 656-0350
Metropolitan N.Y. (201) 238-2090 • Boston, Massachusetts (617) 862-7720 • West Germany (0611) 771070

CIRCLE 217 ON INQUIRY CARD