COMPUTER DESIGN

THE MAGAZINE OF DIGITAL ELECTRONICS

OCTOBER 1979

BIT SLICE TECHNIQUE MINIMIZES MICROCONTROLLER COST/COMPLEXITY

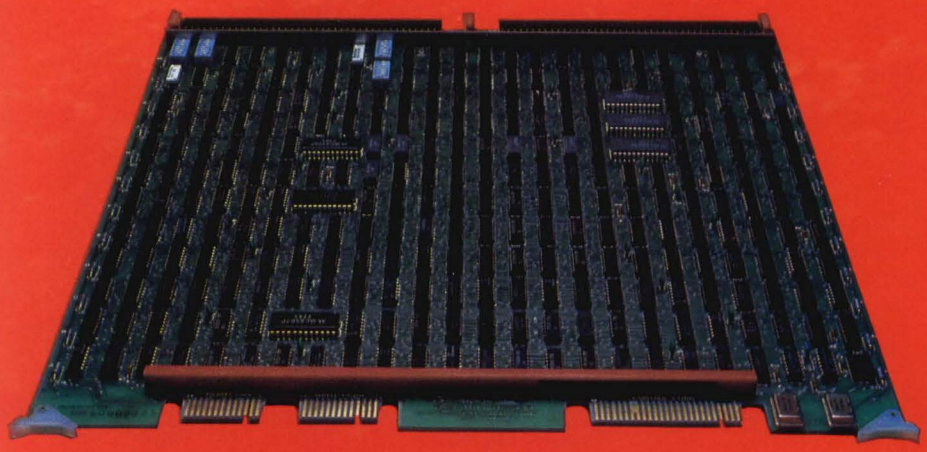
ADD-IN CACHE MEMORY DOUBLES MINICOMPUTER PROCESSING SPEED

LSI CHIPS EASE IEEE BUS INTERFACING

FA SAUNDERS
SR SCI
INST OF VISUAL SCIENCE
141 LANSDALE
FAIRFAX
CA 94930
4155634321A
536812
7801
CC001

two of the world's finest crafted products

one of them, controllers from western peripherals



Universal Tape Controllers

- Software compatible for PDP-11*, NOVA** & Interdata.
- Embedded design.
- 9 Trk 800/1600 bpi, 7 Trk 200/556/800 bpi intermixed.
- 12.5 to 125 ips, any two speeds.
- NRZ and PE formats.

Universal Disc Controllers

- Software compatible for PDP-11 & NOVA.
- Embedded design.
- Top Load (5440) & Front Load (2315).
- Up to 20 mb per drive.
- Media compatibility.

*trade name of Digital Equipment Corp.
**trade name of Data General Corp.

SEND FOR COMPLETE INFORMATION

western peripherals T.M.
Division of WESPERCORP

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

CIRCLE 1 ON INQUIRY CARD

Series 7000.
Hottest disk in Town.

Kennedy announces the second generation of it's fixed disk drives. Series 7000 is an 8″, random access Winchester Technology drive designed for mini and micro computer users.

Series 7000 is available in one, two or three platter versions, with the data capacities of 4, 12 and 20 megabytes. Track density is 300 TPI; maximum seek time is 100 msec.

Series 7000 features NRZ-MFM data encode/decode circuits and daisy chaining of up to four drives.

Because of it's small size (8.5″ x 16.5″ x 5.25″) it is possible to mount 2 drives horizontally or three drives vertically in a standard 19″ rack.

Series 7000 is the red hot, low cost answer to reliable, high performance data storage and collection. It's mini in size, micro in cost and mighty in performance.

KENNEDY
Subsidiary, Magnetics & Electronics Inc.
1600 Shamrock Ave., Monrovia, CA. 91016
(213) 357-8831 TWX 910-585-3249

Magnetics & Electronics, Inc.

KENNEDY • QUALITY • COUNT ON IT

CIRCLE 2 ON INQUIRY CARD

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.

TALLY®
PRINTERS
WORLDWIDE

Tally Corporation is a member of the Mannesmann Group.

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) 251-5524.

CIRCLE 3 ON INQUIRY CARD

COMPUTER DESIGN

THE MAGAZINE OF DIGITAL ELECTRONICS

OCTOBER 1979

VOLUME 18, NUMBER 10

DEPARTMENTS

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

Copyright 1979, Computer Design Publishing Corp. (USPS 127-340)

FEATURES

CONFERENCE

The Microline 80 —

Business or Pleasure?

Both! The Microline 80 is all business when it comes to performance. It will run all day at 80 characters per second. There are no duty cycle limitations! With a tiny seven pin head that weighs less than three ounces, it coolly and quietly produces letter perfect upper and lower case characters on standard paper in both 80 and 132 column formats.

It's all pleasure when you get to reliability and price. The Microline 80 carries a one year head warranty and a price tag that matches its unbelievably small size. You can change from friction to pin to tractor feed multi-part forms almost as fast as your program can change character spacing, line spacing and printing style—via your choice of microprocessor-controlled Microline 80 interfaces.

Call or write today for the name of your local Okidata distributor! You'll find it's a pleasure to do business with Okidata.

OKIDATA

Okidata Corporation
111 Gaither Drive
Mount Laurel, New Jersey 08054
Telephone: 609-235-2600

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. Miiller
Harold H. Seward

Production Manager
Linda M. Wright

Advertising Coordinator
Lou Ann Sawyer

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

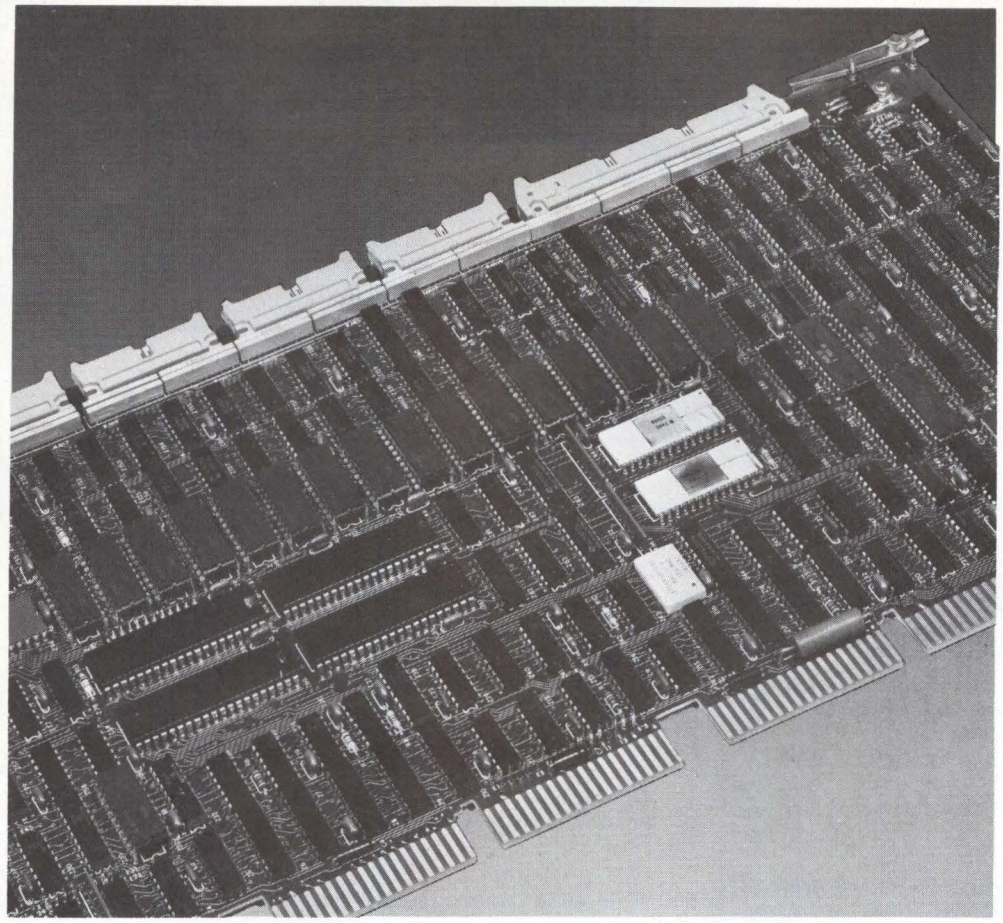
Business Manager
David C. Ciommo

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.



ONE-BOARD PDP-11 SMD CONTROLLER, SOFTWARE COMPATIBLE...A FIRST!

Dataram's S33 interfaces Digital Equipment Corporation's (DEC®'s) PDP-11 series to a wide selection of SMD (storage module drive) and Winchester type disk drives. The S33 emulates DEC's RM02 and is fully software compatible with RM02 diagnostics and RM02-supporting operating systems. Up to four drives per S33 controller, almost 300 MB of disk storage. The microprocessor-based S33 controller has 2 KB of data buffering, multiple sector transfers, and built-in self-test capability. And media compatibility with DEC's RM02 drive. All this and amazingly packaged on one DEC hex board...the only controller to make this claim!

One-board means you need only one hex SPC slot. One-board means easy insertion and optimum air flow.

One-board with its attendant features of minimized interconnections and low component count means lower power, complete accessibility, higher reliability...and best of all, lower cost.

If you're interested in one of our one-board S33 controllers, or a whole bunch of them, we'd like to hear from you. If you operate in the LSI-11® world, still contact us. Our LSI-11 cousin of the S33 is on the way.

DEC, LSI-11 and PDP are registered trademarks of Digital Equipment Corporation

DATARAM CORPORATION

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

CIRCLE 5 ON INQUIRY CARD

CALENDAR

CONFERENCES

OCT 30-NOV 1—CAD/CAM VII at Automated, Integrated, Factory of Tomorrow Conf, Cobo Hall, Detroit, Mich. INFORMATION: Jeff Spire, SME Technical Div, PO Box 930, Dearborn, MI 48128. Tel: 313/271-1500, X405

OCT 30-NOV 1—Interface West, Anaheim Convention Ctr, Anaheim, Calif. INFORMATION: Interface Group, 160 Speen St, Framingham, MA 01701. Tel: 617/879-4502

NOV 1 AND 15—Invitational Computer Conf, Cherry Hill, NJ; and Southfield, Mich. INFORMATION: B. J. Johnson & Assoc, 2503 Eastbluff Dr, Suite 203, Newport Beach, CA 92660. Tel: 714/644-6037

NOV 5-7—Asilomar Conf on Circuits, Systems and Computers, Asilomar Hotel and Conf Grounds, Pacific Grove, Calif. INFORMATION: Donald E. Kirk, Naval Postgraduate School, Monterey, CA 93940. Tel: 408/646-2081

NOV 5-8—Computer Software and Applications Conf (COMPSAC), The Palmer House, Chicago, Ill. INFORMATION: Dr William Smith, Bell Laboratories, Naperville, IL 60540. Tel: 312/690-2389

NOV 6-8—Federal Computer Conf, Sheraton-Park Hotel, Washington, DC. INFORMATION: Federal Computer Conf, PO Box 368, Wayland, MA 01778. Tel: 617/358-5181

NOV 6-8—MIDCON, O'Hare Convention Ctr and Hyatt Regency O'Hare, Chicago, Ill. INFORMATION: Dale Litherland, Electronic Conventions, Inc, 999 N Sepulveda Blvd, El Segundo, CA 90245. Tel: 213/772-2965

NOV 9-11—Midwest Small Business and Consumer Expo, O'Hare Exposition Ctr, Chicago, Ill. INFORMATION: Louise Garcia, 1453 Rio Rancho Dr SE, Rio Grande, NM 87124. Tel: 505/897-1971

NOV 14-16—Micro and Mini Computer Conf, Astro Village, Houston, Tex. INFORMATION: Dr Sam Lee, School of Electrical Engineering and Computer Science, U of Oklahoma, 202 W Boyd, Norman, OK 73019. Tel: 405/325-4721

NOV 18-21—Micro 12, Hershey, Pa. INFORMATION: Harry Hayman, Micro 12, PO Box 639, Silver Spring, MD 20901. Tel: 301/439-7007

NOV 26-29—Data Communications Sym and Tutorial, Asilomar Conf Grounds, Pacific Grove, Calif. INFORMATION: Kenneth J. Thurber, Sperry Univac, U2U19, PO Box 3525, St Paul, MN 55165. Tel: 612/456-3806

NOV 26-29—Internat'l Telecommunications Energy Conf (INTELEC), Sheraton Park Hotel, Washington, DC. INFORMATION: R. H. Jones, ITT North Electric, PO Box 688, Galion, OH 44833. Tel: 419/468-8525

NOV 27-29—Nat'l Telecommunications Conf, Shoreham-Americana Hotel, Washington, DC. INFORMATION: John N. Birch, Dept of Defense, 3311 Marlbough Way, College Pk, MD 20740. Tel: 301/935-0684

DEC 3-5—Internat'l Electron Devices Meeting (IEDM), Washington Hilton Hotel, Washington, DC. INFORMATION: Sarah M. Cooper, Courtesy Assoc, Inc, 1629 K St, NW, Suite 700, Washington, DC 20006

DEC 10-11—Internat'l Sym on Mini & Microcomputers in Control, Galt Ocean Mile Hotel, Ft Lauderdale, Fla. INFORMATION: The Secretary, Computers in Control Sym, PO Box 2481, Anaheim, CA 92804. Tel: 714/774-6144

DEC 10-14—IEEE Computer Society Tutorial Week, Hotel Del Coronado, San Diego, Calif. INFORMATION: Tutorial Week 79, PO Box 639, Silver Spring, MD 20901

DEC 12—Computer Networking Sym, Nat'l Bureau of Standards, Gaithersburg, Md. INFORMATION: Harry Hayman, PO Box 639, Silver Spring, MD 20901. Tel: 301/439-7007

JAN 7-10—ATE Seminar/Exhibit, Pasadena Convention Ctr, Pasadena, Calif. INFORMATION: Karen Knope, ATE Seminar/Exhibit, 1050 Commonwealth Ave, Boston, MA 02215. Tel: 617/232-5470

JAN 23-25—Internat'l Microcomputers, Minicomputers, Microprocessors (IMMM)—Japan '80, Harumi Exhibition Ctr, Tokyo, Japan. INFORMATION: Industrial & Scientific Conf Management, Inc, 222 W Adams St, Chicago, IL 60606. Tel: 312/263-4866

JAN 30-FEB 1—MIMI'80 Asilomar (Internat'l Sym on Mini & Microcomputers), Asilomar Conf Grounds, Pacific Grove, Calif. INFORMATION: The Secretary, MIMI'80 Asilomar, PO Box 2481, Anaheim, CA 92804. Tel: 714/774-6144

FEB 13-15—Internat'l Solid State Circuits Conf, Hilton Hotel, San Francisco, Calif. INFORMATION: Lewis Winner, 301 Almeria Ave, Coral Gables, FL 33134. Tel: 305/446-8193

FEB 19-22, 26-29, AND MAR 5-7—TechEx America, Europa, and Asia, Atlanta, Georgia, U.S.A.; Copenhagen, Denmark; and Singapore, Republic of Singapore. INFORMATION: Dr Dvorkovitz & Assoc, PO Box 1748, Ormond Beach, FL 32074. Tel: 904/677-7033

FEB 25-28—COMPCON Spring, Jack Tar Hotel, San Francisco, Calif. INFORMATION: Harry Hayman, PO Box 639, Silver Spring, MD 20901. Tel: 301/439-7007

MAR 4-6—Internat'l Zurich Sem on Digital Communications, Zurich, Switzerland. INFORMATION: Prof P. E. Leuthold, Eidgenossiche Technische Hochschule Zurich, Institut fur Hochfrequenztechnik, Sternwartstrasse 7, Zurich, Switzerland

MAR 24-28—Eurocon'80 (European Conf on Electrotechnics), Stuttgart, Germany. INFORMATION: Prof Dr W. E. Proebster, IBM Deutschland GmbH, Postfach 80 08 80, D-7000 Stuttgart 80, Germany

SEMINARS

NOV 1 AND 2—NC Machine Control Maintenance Sems, Holiday Inn/Airport North, Dallas, Tex, and Airport Marina Hotel, Los Angeles, Calif. INFORMATION: Elaine Skott, Numerical Control Soc, 1800 Pickwick Ave, Glenview, IL 60025. Tel: 312/724-7700

NOV 7-9, JAN 14-16, AND MAR 3-5—Minicomputers and Distributed Processing Sem, Miami, Fla; San Francisco, Calif; and Washington, DC. INFORMATION: Heidi E. Kaplan, Dept 20NR, The University of Chicago Conf Ctr, 360 Lexington Ave, New York, NY 10017. Tel: 212/953-7262

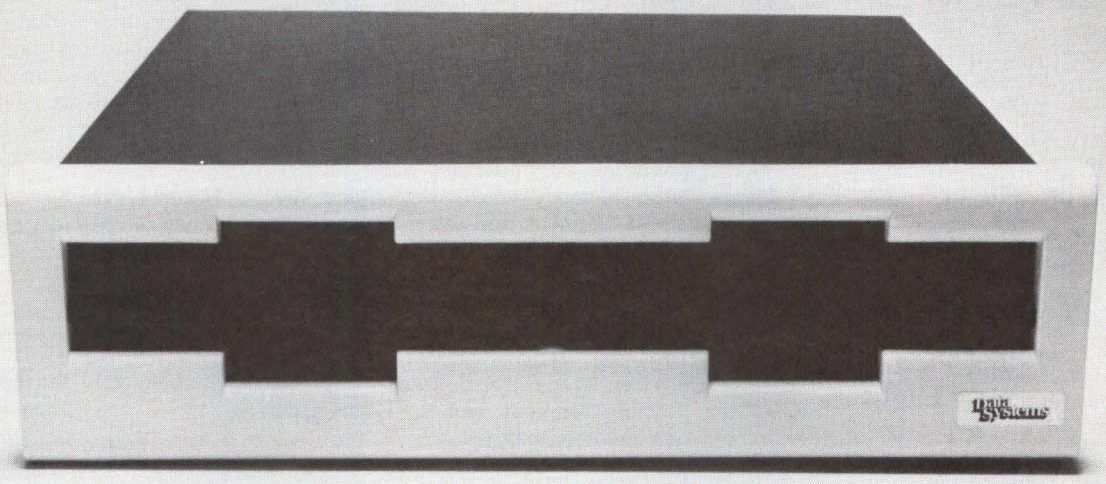
SHORT COURSES

3-Day Microprocessor Course, Assembly Language Program for Microprocessor, Microprocessor Seminar, Fiber Optics, and Computer Automated Measurement & Control. INFORMATION: Vincent J. Giardina, Mgr of Continuing Education, 445 Hoes Ln, Piscataway, NJ 08854. Tel: 201/981-0060, X174

DEC 10-12—Project Management for Computer Systems, Chicago, Ill. INFORMATION: University of Chicago, Center for Continuing Education, 1307 E 60th St, Chicago, IL 60637

Announcements intended for publication in this department of *Computer Design* must be received at least *three* 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 6 ON INQUIRY CARD

LETTERS TO THE EDITOR

To the Editor:

I must object to the technical errors contained in the article "Comparing Architectures of Three 16-Bit Microprocessors" (by Henry A. Davis, pp 91-100) in the July issue of *Computer Design*.

In particular, the first paragraph on page 97 of that issue makes this statement regarding the 8086: "The actual address—called the physical address—is formed by adding a 4-bit effective address to a 16-bit segment register, resulting in a 20-bit address." Where the author got this idea is not clear. Compare his statement with the correct statement from Intel's MCS-86 User's Manual: "Bytes or words within a segment are addressed using 16-bit offset addresses, or effective addresses (EA), within the 64k-byte segment. A 20-bit physical address is constructed by adding the 16-bit offset address to the 16-bit segment address with four low-order zero bits appended [to the segment]. That is, they are left-shifted four places." The author also makes another peculiar statement within that paragraph: ". . . the code segment usually begins at $FFFFF_{16}$ to handle the reset vector." Since FFFFFH is the end of maximum memory directly supported by the 8086, it appears that the author is suggesting that a code segment be placed in never-never land. The fact of the matter is as follows: after the RESET pin has been held high, the processor sets CS = FFFFH and IP = 0000H so execution will begin at FFFF0H.

Furthermore, this author failed to point out an important basic fact of 8086 memory addressing. Since the 16-bit segment address is shifted left 4 bits before being added to the offset, there are actually 2^{16} possible segments within 1M bytes of memory; ie, a segment boundary occurs every 16 bytes. This fact confuses 8086 novices who think there are only 16 possible segment values, 1 for each 64k memory page.

Edward Arnold
STC Communications Corp
Broomfield, Colo

The Author Replies:

The errors pointed out by Mr Arnold crept into the paper during the editing and revision of over 60 typed pages of original manuscript, and are entirely my responsibility as its author. Since the paper provided as fair a comparison of the three processors as possible within the space limitations and was not intended as an exhaustive treatment of each processor, the omission of the final details of 8086 memory addressing does not strike me as serious.

Henry Davis
American Microsystems, Inc
Santa Clara, Calif

Letters to the Editor should be addressed:

Editor, Computer Design
11 Goldsmith St
Littleton, MA 01460

ok WIRE FOR WIRE-WRAPPING ok

CUT TO LENGTH AND PRE-STRIPPED ON BOTH ENDS

"L"

LENGTH "L" INCH	AWG 30 (0.25MM) KYNAR* WIRE INSULATION DIAMETER .0195 INCH (0.50MM) STRIP-OFF LENGTH BOTH ENDS 1 INCH (25MM) 500 WIRES PER PACKAGE			
	BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500
1	30B-010	30W-010	30Y-010	$4.88
1.5	30B-015	30W-015	30Y-015	5.19
2	30B-020	30W-020	30Y-020	5.50
2.5	30B-025	30W-025	30Y-025	5.82
3	30B-030	30W-030	30Y-030	6.13
3.5	30B-035	30W-035	30Y-035	6.44
4	30B-040	30W-040	30Y-040	6.75
4.5	30B-045	30W-045	30Y-045	7.07
5	30B-050	30W-050	30Y-050	7.38
6	30B-060	30W-060	30Y-060	8.00
7	30B-070	30W-070	30Y-070	8.63
8	30B-080	30W-080	30Y-080	9.25
9	30B-090	30W-090	30Y-090	9.88
10	30B-100	30W-100	30Y-100	10.50

AWG 28 (0.32MM) KYNAR* WIRE INSULATION DIAMETER .023 INCH (0.59MM) STRIP-OFF LENGTH BOTH ENDS 1 INCH (25MM) 500 WIRES PER PACKAGE			
BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500
28B-010	28W-010	28Y-010	$5.25
28B-015	28W-015	28Y-015	5.63
28B-020	28W-020	28Y-020	6.00
28B-025	28W-025	28Y-025	6.38
28B-030	28W-030	28Y-030	6.75
28B-035	28W-035	28Y-035	7.13
28B-040	28W-040	28Y-040	7.50
28B-045	28W-045	28Y-045	7.87
28B-050	28W-050	28Y-050	8.25
28B-060	28W-060	28Y-060	9.00
28B-070	28W-070	28Y-070	9.75
28B-080	28W-080	28Y-080	10.50
28B-090	28W-090	28Y-090	11.25
28B-100	28W-100	28Y-100	12.00

AWG 26 (0.40MM) KYNAR* WIRE INSULATION DIAMETER .027 INCH (0.69MM) STRIP-OFF LENGTH BOTH ENDS 1 INCH (25MM) 500 WIRES PER PACKAGE			
BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500
26B-010	26W-010	26Y-010	$5.75
26B-015	26W-015	26Y-015	6.23
26B-020	26W-020	26Y-020	6.68
26B-025	26W-025	26Y-025	7.13
26B-030	26W-030	26Y-030	7.60
26B-035	26W-035	26Y-035	8.05
26B-040	26W-040	26Y-040	8.50
26B-045	26W-045	26Y-045	8.98
26B-050	26W-050	26Y-050	9.43
26B-060	26W-060	26Y-060	10.35
26B-070	26W-070	26Y-070	11.25
26B-080	26W-080	26Y-080	12.18
26B-090	26W-090	26Y-090	13.55
26B-100	26W-100	26Y-100	14.00

ROLLS OF WIRE

100 ft. roll	R30B-0100	R30W-0100	R30Y-0100	$3.65
500 ft. roll	R30B-0500	R30W-0500	R30Y-0500	10.40
1000 ft. roll	R30B-1000	R30W-1000	R30Y-1000	16.82

R28B-0100	R28W-0100	R28Y-0100	$4.05
R28B-0500	R28W-0500	R28Y-0500	12.85
R28B-1000	R28W-1000	R28Y-1000	21.10

R26B-0100	R26W-0100	R26Y-0100	$4.35
R26B-0500	R26W-0500	R26Y-0500	13.80
R26B-1000	R26W-1000	R26Y-1000	23.15

® KYNAR - PENNWALT

MINIMUM BILLING $25.00. ADD SHIPPING CHARGE $1.00. NEW YORK RESIDENTS ADD APPLICABLE TAX.

OK MACHINE & TOOL CORPORATION
3455 CONNER STREET, BRONX, N.Y. 10475 (212) 994-6600 Telex 125091

RAM Tamer

Intel's new 8202 RAM controller makes dynamic memory behave like static.

Good news for microprocessor system designers. Now you can take advantage of the density and economies of dynamic memory with all the convenience and design simplicity of static RAMs. You'll reduce component count fourfold, cut power dissipation per bit tenfold or better and save money, too.

Just design in Intel's new single chip 8202 dynamic RAM controller. It unburdens the CPU of all refresh and address clocking and provides all bus multiplexing required to interface with 4K and 16K RAMs and Intel's 5V only 16K 2118, too.

Another labor-saving device.

Intel's family of 28 microprocessor peripheral devices all help designers avoid the time, cost and complexity of custom interface and control logic.

That's just what the 8202 does. It's a total solution; it handles all the arbitration, refresh and clocking required by dynamic memory and does it regardless of reset or DMA transfers and without asking the CPU to relinquish the bus. And it does all this with one 40-pin bipolar component.

Designers have always been attracted to dynamic memory for the highest density and power sensitive applications.

Now our 8086 16-bit microprocessor, able to address a full megabyte of memory, has created a new class of microcomputer applications where the traditional advantages of dynamic RAM look even more attractive.

Performs all system control.

The 8202 provides all system support needed to control and refresh up to 16K bytes of 4K

dynamic RAM or 64K bytes of 16K dynamic RAM in your 8085A systems. For 8086 systems, the 8202 output drives up to 128K bytes—as many as sixty-four 16K RAMs.

Failsafe refresh is assured. Internal refresh is done at the correct refresh rate for the specific memory device involved. Regardless of processor state, refresh takes place on schedule. External refresh—a CPU command to perform a refresh—permits synchronized or "hidden" refresh, too.

Design flexibility.

The 8202 interfaces directly to the 8080A bus, to the demultiplexed 8085A bus and to the demultiplexed 8086 bus. Eight 8202's can be grouped in an 8086 maximum mode system to provide control and addressing for a full megabyte of dynamic RAM.

To order any of the 28 Intel® peripheral interface and control components, contact your distributor. Or for more information on them and the 8202 dynamic RAM controller, 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, Wyle/Elmar, Wyle/Liberty, L.A. Varah and Zentronics.

VIDEOTEX AND TELETEXT SYSTEMS

J. W. Hughes

Associate Editor

Some enthusiasts in the field, while admitting that "videotex" and "teletext" are not, presently, household words, anticipate that they or some trademarked derivatives may become as common as the terms "telephone," "radio," and "television." These system concepts are not exactly new, but technological advances, especially those that have made available the low cost large scale integration chip, and thereby an economically feasible decoding system, have brought their realization into the realm of practicality for broader applications. Videotex and teletext systems are undergoing increasing interest, scrutiny, and promotion. These systems are designed to display a wide variety of useful information on the screen of a television set located in the home or at a business office, using different transmission media as carriers.

Teletext is a 1-way broadcast system that transmits digitally coded information, inserted into the lines in the vertical flyback interval of the TV signal, that carry no picture information. Pages of text and rudimentary graphics, selected by the broadcaster, are sent in a cyclically repetitive manner. At the receiving end, a viewer operated decoder selects the pages of particular interest, using frame-grabber techniques.

Videotex, on the other hand, is an interactive, on-demand data retrieval service that uses the switched telephone network as a transmission medium to display on the receiver screen information requested by the user by means of an appropriate keypad.

British Systems

Probably the most advanced implementation of teletext and videotex systems is to be found in the United Kingdom. By way of historical interest, the teletext system arose from efforts by the British Broadcasting Company (BBC) and the Independent Broadcasting Authority (IBA) to accommodate digitally encoded alphanumeric data on field flyback television lines. Two teletext services resulted: CEEFAX ("see facts") from BBC, and ORACLE (optical reception of announcements by coded line electronics) from IBA.

Concurrently with these developments, work being carried out by the British Post Office (BPO) on Viewfone led to further investigations into using the narrow band dial-up telephone network for transmission of the same type of digital information, and using the home television (TV) receiver as the display. These investigations led to the development of the Viewdata system, now known as Prestel.*

CEEFAX, ORACLE, and Prestel are off and running in Britain. Standards have been adopted that allow user access to all services, since the memory, character generator, and display unit of the decoder are common to them all. The standards have established a 960-character display page of 40 char/line by 24 lines. Characters are in a 5 x 7 matrix, upper and lower case, with effectively identical character codes. There is a choice of seven colors. Table 1 highlights and compares the features offered by the three services.[1]

Three major organizations participate in the Prestel service: BPO, which manages the computer system and the communications network; information providers (IPS), independent organizations supplying the data base with information pertinent to various fields of

*Prestel is the registered trademark of the BPO videotex service.

ADVANTAGE: FLEXIBILITY

Another way the Model 730 aces the competition!

Centronics' Model 730 miniprinter shatters the rules of the game. Greater flexibility than any printer is one of the reasons why.

APPLICATIONS FLEXIBILITY Now you can meet a wide range of applications requirements with just a single printer: the Model 730. Payroll checks on preprinted continuous forms. Inventory listings on fanfold. Direct mail on company letterhead. General information on roll paper . . . and change from one to another quickly.

INVENTORY FLEXIBILITY Model 730's versatility means no more costly inventories of limited-use printers. Stock only one set of spares. One set of service tools. Train to service only one highly reliable machine.

INTERNATIONAL FLEXIBILITY To make your overseas marketing easier, international models of the 730 can print 96 character U.S., British, French, German, Italian, and Swedish/Finnish. Available in all standard international power requirements.

Here are more reasons why the Model 730 is the newest sensation on the circuit.

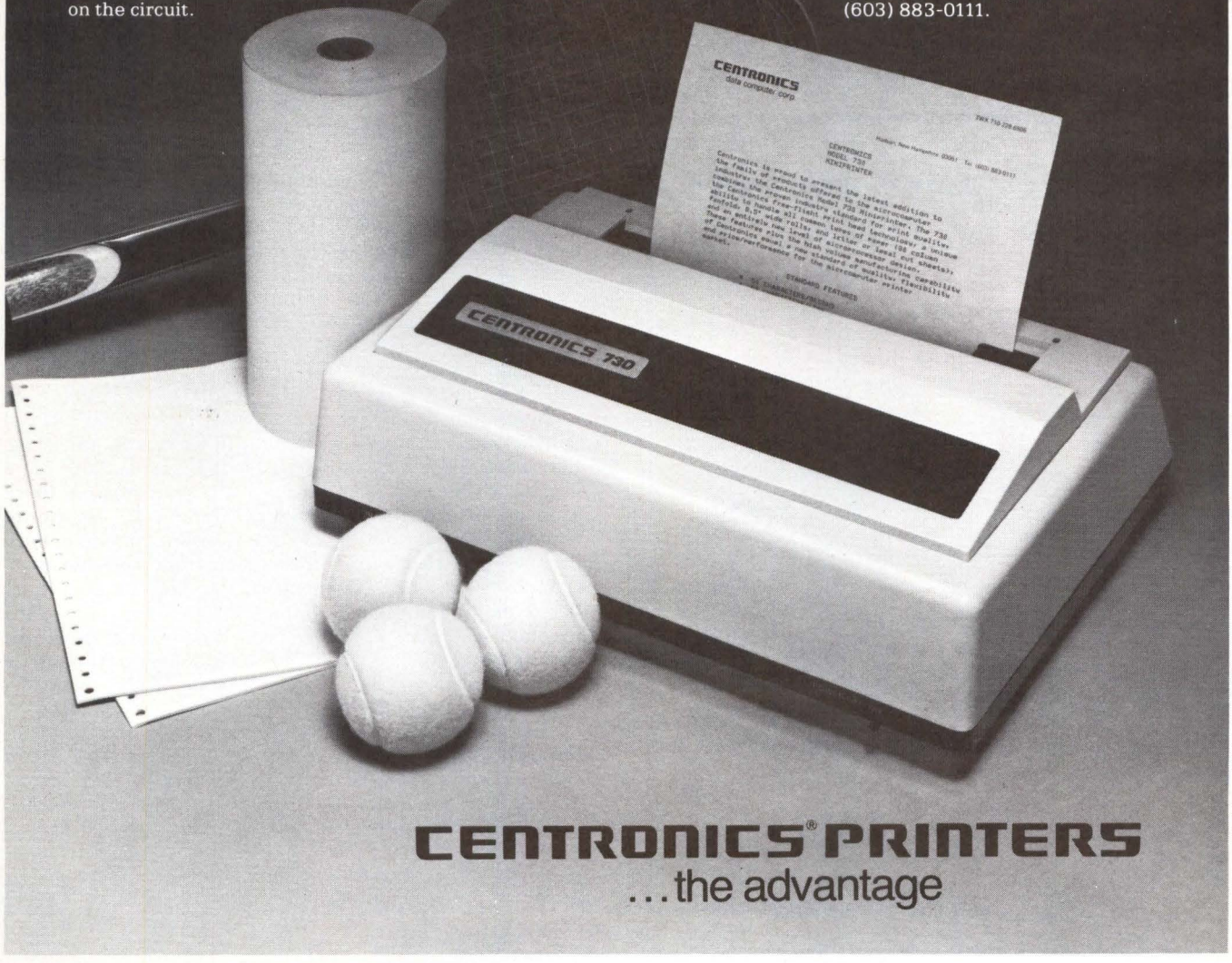
Its simple design ensures reliability. Combine that with an attractive purchase price and you have a very low cost of ownerlship.

Although it's surprisingly affordable, Model 730 sets new quality standards. Its 7x7 dot matrix produces crisp, clean characters, and its quiet, compact, and stylish design makes it welcome in any environment.

Best of all, because of Centronics' manufacturing capabilities, volume delivery is assured.

ADVANTAGE:MODEL 730 Model 730 leads the way to a whole new era. Naturally, it's from the leader: Centronics. No other company can match our strong serve in performance, selection, and value. And every Centronics printer is backed by one of the largest worldwide service organizations of any independent printer company.

On flexibility, features, price, and support, the Model 730 is a clear winner. For more information on products or employment opportunities, please write or call today: Centronics Data Computer Corporation, Hudson, New Hampshire 03051 (603) 883-0111.



CENTRONICS® PRINTERS
. . . the advantage

TABLE 1

Teletext and Videotex Services

Features	Teletext (Ceefax, Oracle)	Videotex (Prestel)
Transmission medium	Broadcast	Telephone network
Information retrieval	Yes (limited)	Yes (unlimited)
Information sources	Broadcast/program companies only	Open-ended; about 160 organizations[a]
Message service	No	Yes (store-and-forward)
Calculations	No	Yes
Programmed learning	No	Yes
Enquiry page	No	Yes
Reservation mode	No	Yes
Problem solving	No	Yes
Facilities for deaf	Yes	Yes
Usage charge	No (currently)	Yes (where applicable)
24-h service	No	Yes
Response time	12.5 s avg (for 100-p system)	2 s avg (for 60k-p system)

KYNAR® gives you another advantage.

CHEMICAL RESISTANCE.

KYNAR PVDF was born to handle solvents and corrosives in chemical plants. You get that protection in KYNAR wire insulation. Resists UV and nuclear radiation, too. Get full information. Write KYNAR, Pennwalt Corporation, Three Parkway, Philadelphia, PA 19102. Or call (215) 587-7514.

PENNWALT
CHEMICALS ■ EQUIPMENT
HEALTH PRODUCTS

®KYNAR is a registered trademark of Pennwalt Corporation for its polyvinylidene fluoride.

interest; and the TV manufacturers who supply videotex/teletext-compatible receivers.

Prestel operates over the 4-kHz bandwidth telephone network. Data are transmitted from computer to terminal at 1200 bits/s and on the return path at 75 bits/s. Standard 1200/75-bit/s limited distance modems are used, since operation is normally over short local network distances. This allows the modem to be integrated into the terminal and enables a simple plug and jack connection to the network. Where longer distances from the data bank are involved, separate standard modems may be needed.[2]

The system is accessed by a 12-digit keypad. Dial-up is programmed into the terminal, so no conventional "phone call" is necessary. With the TV set turned on, the local Prestel center is called by operation of a keypad button. Another button calls out a master index of main headings of available information. The viewer is guided by means of a "tree search" routine, which narrows the displayed information from the broad to the particular, by selecting via the keypad one numbered item from each frame on the tree until the required information is received. Where location of the desired page is known in advance, such as through a printed directory, direct access may be made, bypassing the tree search procedure.

Charges entailed by the user are on a per page information access basis, determined by the IP. This access may, in such cases as advertising or corporate image promotion, be free. There is a charge for normal local telephone usage. A page-handling charge covers system management costs. Charges are kept low compared to conventional timesharing and database access rates in order to insure the attractiveness of Prestel to a mass market, and to achieve the economies of scale that are essential to the success of the system.[3]

TABLE 2

Characteristics of ANTIOPE Teletext System

	525-line NTSC color	625-line PAL color	625-line SECAM color
Blanking lines	12	17	8
Useful bytes/line	20	32	32
Useful capacity—bits/s	9600	12800	12800
Pages/s for one line of data*	1.8	2	2
Max capacity on program channel (pp/s)	21	34	16
Max capacity on clear channel (pp/s)	450	610	610

*An average page includes 800 bytes

ANTIOPE

ANTIOPE, the French teletext system, is an acronym for "l'Acquisition Numérique et Télévisualisation d'Images Organisées en Pages d'Ecriture," or paraphrased as "digital signal processing conversion to printed page images on home TV sets." It was developed at the Television and Telecommunications Research Center (CCETT) and has undergone field trials on the TDF network. It is currently implemented on two kinds of networks, the data broadcasting network DIDON, and public switched telephone and data networks.[4,5] ANTIOPE is designed to give a broadcast, interactive, or mixed service, depending on the transmission medium.

The ANTIOPE system, while not nearly as advanced in implementation as Prestel, has such interesting features as an advanced communications protocol, a non-synchronous communications transmission scheme suited to all TV formats: PAL, SECAM, and NTSC (Table 2). The associated interactive system TITAN conforms to the same protocol.

Figure 1 shows a functional block diagram of the system. Composed and edited "magazines" (pages of related information) are converted into digital form, stored in a computer or floppy disc, and cyclically transmitted to a multiplex system (DIDON) where the data are separated into packets of 32 bytes and inserted into the free scan lines of the TV signal. Bit frequency is 397 times the line frequency, 6.203 MHz for France or 4.2 MHz for NTSC systems. Each packet is preceded by an 8-byte header: two for clock run in, one for framing synchronization, and five Hamming code protected bytes, as follows: three for source identification, one for packet continuity check, and one for the packet format.

KYNAR® gives you another advantage.

CUT-THROUGH PROTECTION.

KYNAR PVDF wire insulation gives you excellent abrasion and cut-through protection even though you may pay less for KYNAR than other fluorinated plastics. Get full information. Write KYNAR, Pennwalt Corporation, Three Parkway, Philadelphia, PA 19102. Or call (215) 587-7514.

PENNWALT
CHEMICALS ■ EQUIPMENT
HEALTH PRODUCTS

®KYNAR is a registered trademark of Pennwalt Corporation for its polyvinylidene fluoride.

CIRCLE 11 ON INQUIRY CARD

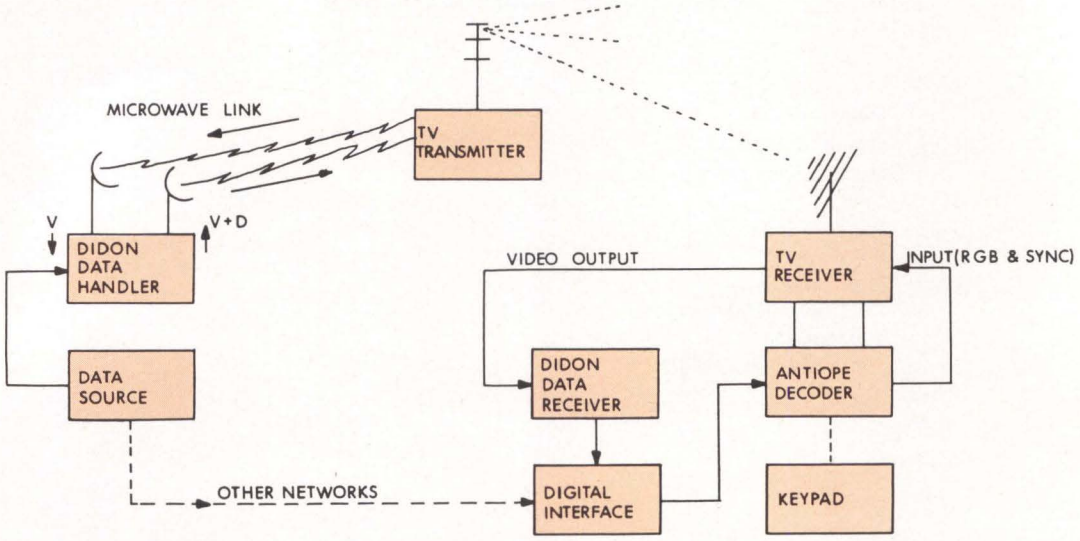


Fig 1 ANTIOPE system. Devices for editorial processing, layout, and updating of material are connected to data source, essentially minicomputers storing digital information. DIDON data handler inserts pulses from source into picture signal. At receiver, DIDON receiver strips data from video signal. When keyboard selects desired page, corresponding data are translated by processor in decoder into displayable characters, stored in decoder page memory, and displayed on screen. Interface unit permits data reception from other networks (interactive) or retrieval of data from DIDON receiver

The system can be expanded to use the full TV channel when the station is off the air in order to transmit large quantities of additional data which can be coded for proprietary access by special interest groups. By lowering the data rate to accommodate the transmission channel, ANTIOPE signals can be sent over telephone lines or FM radio stations.

Telidon

This is the Canadian videotex system developed at the Communications Research Centre (CRC) of the Department of Communications. Telidon is a public access information system, said to be a "second generation" approach to the design of videotex systems, that provides improved graphic images, and a method of describing images in the data base that is independent of terminal design and transmission media.[6,7]

Both Prestel and ANTIOPE are fixed format, character oriented systems that produce rudimentary graphic images in an "alphanumeric" pattern on the display. In the European 625-line systems this display comprises 24 rows of 40 characters, or 960 character spaces, while in North America the 525-line system accommodates 20 rows of 40 characters for a character space area of 800. Images are built up in these spaces from specially identified coded graphic characters, pieced together as individual sections of a complete image, as in a mosaic. This technique makes it impossible to send higher resolution images without knowing the display capabilities of the terminal; also, data bases might have to store many versions of each image in order to suit advances in terminal technologies and to satisfy a demand for improved graphics.

Telidon meets these problems by using a method of describing images at data banks that is independent of access arrangements at the central computer, of the communications medium, and of display terminal configuration and capability. The system incorporates a concept known as picture description instruction (PDI) codes.

PDI codes describe images in terms of commands to draw geometrical primitives such as line, arc, rectangle, and polygon at specific positions in the overall picture. The format enables sufficient resolution for monitors capable of displaying up to 960 x 1280 picture elements, or about four times that required for television screens. Practically all images can be described by seven basic instructions which are contained in 8-bit bytes. One bit is for parity to conform to current standards for data transmission. A shift-in (SI) com-

"Finally, a flat cable as tough as me."

"One visit from my Spectra-Strip rep convinced me that their Spectra-Guard™ extruded jacketed cable is my kind of flat cable.

All the benefits of planar. Plus the toughness of an extremely flexible extruded hide—er, jacket—that's perfect for all my cabinet-to-cabinet wiring.

Both the cable and jacket are flame-retardant and UL-listed to 105°C and 150V. The cable—flat, twisted pair or Twist 'N' Flat®—is available gray or color coded, with or without EMI/RFI shielding. And the outer jacket is easily removed for mass termination using any of the Spectra-Strip IDC connectors.

When things get hot around here, I even have Spectra-Strip or one of their value-added distributors provide terminated and tested jumpers and custom assemblies, and does that ever save time and money!

So if you've been trying to dig up a reliable source for your planar cable, IDC connectors and assemblies, I strongly recommend that you write Spectra-Strip, 7100 Lampson Avenue, Garden Grove, CA 92642, telephone (714) 892-3361. In the East, call (203) 281-3200.

Tell them you want to see how tough they are."

© Spectra-Strip 1979

When you're down to the wire

CIRCLE 12 ON INQUIRY CARD

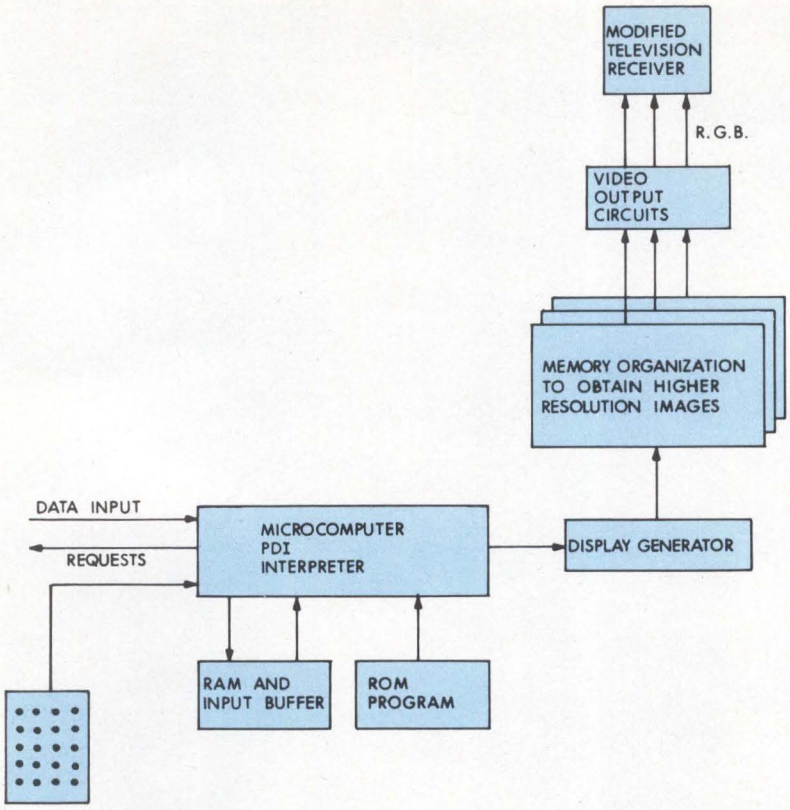


Fig 2 Telidon terminal with bit-map memory. Terminal can display photographic-like, as well as alphanumeric and graphic, images. Terminal independent PDI codes must be interpreted before contents of display memory are generated. Therefore, microprocessor is included to generate display memory code

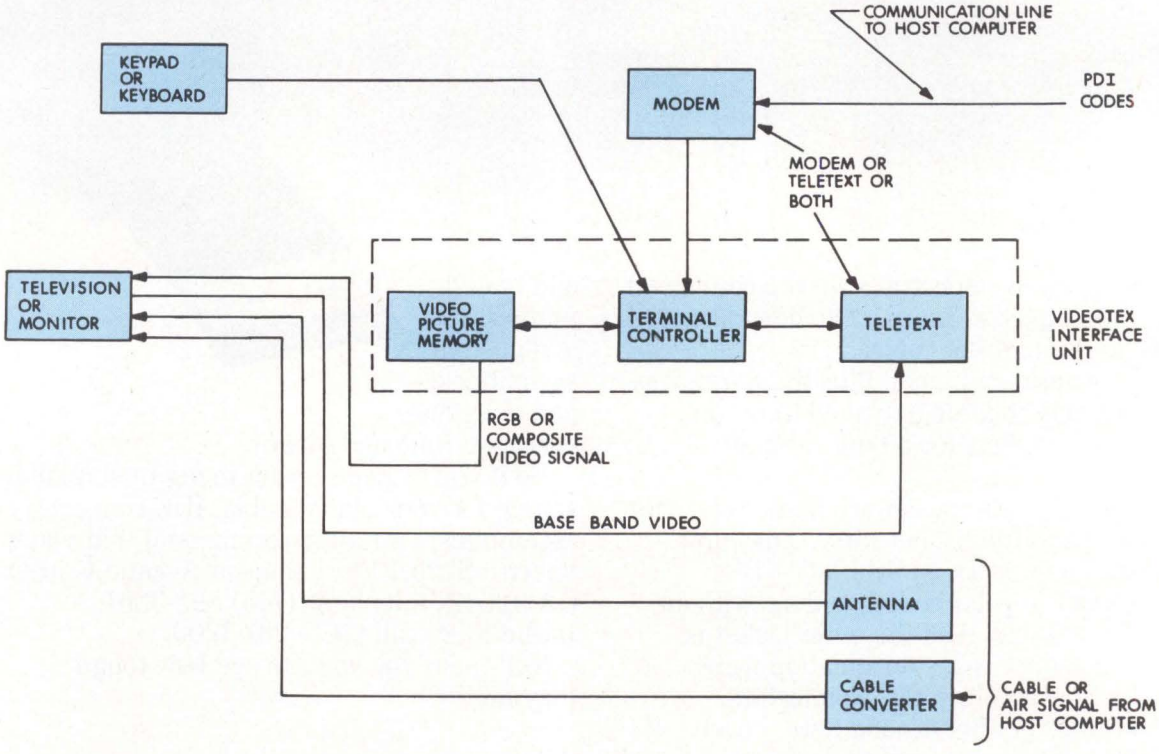


Fig 3 Block diagram of typical Telidon terminal (Norpak Ltd). PDI codes are in firmware. Facilities are provided to draw points, areas, polygons, arcs, text, and bit- or run-length encoded pictures. Data, text, and commands are embedded in 7-bit ASCII code

mand changes from graphic to text mode, and shift-out (SO) back to graphics. A subset of the PDI code may be used for simple terminals which may respond only to textual information.

The Telidon terminal design has a bit-map memory for high definition graphics (Fig 2). A less costly and less functional character oriented terminal based on display memory of 800 8-bit words is also possible. A variety of terminals based on the PDI concept can be produced. Fig 3 shows one of these from Norpak Ltd, Pakenham, Ontario, Canada.

The PDI concept is applicable to already installed older type systems, and it includes extensions for future developments in an evolving service. The concept is being considered as a possible standard by the International Organization for Standardization (ISO) and by the International Telegraph and Telephone Consultative Committee (CCITT).

Future Potential

Interest in teletext and videotex systems has been growing rapidly. Prestel has successfully marketed its technology in the U.S., Germany, the Netherlands, and Switzerland. ANTIOPE has come into the U.S. with a marketing subsidiary.[8] Systems tests have been implemented at KSL-TV, Salt Lake City[9] and the CBS television network is conducting field tests on a teletext system at KMOX-TV, St Louis.[10] In Japan, a system called "Captains," which can handle the full character set of the Japanese language, has been implemented by Nippon Telephone and Telegraph.

Full fruition of these systems depends ultimately on the growth of the marketplace for these services. Implementation of a "public" system in the U.S. is, at the moment, highly unlikely due to regulatory structures. More probable is the further development of teletext and videotex for proprietary needs within individual organizations.

References

1. R. Bright, "Telecommuting by Viewdata," *Proceedings Intelcom '77*, Vol 2, pp 595-599
2. M. L. Ford, "Prestel—The British Post Office Viewdata Service," *ICC '79 Conference Record*, Vol 4, pp 56.5.1-56.5.4
3. R. Bright, "Prestel—The World's First Public Viewdata Service," *IEEE Transactions on Consumer Electronics*, No 3, July 1979, pp 251-255
4. B. Marti, *et al*, "The ANTIOPE Videotex System," *ibid*, pp 327-333
5. P. Frandon and G. Chauvel, "ANTIOPE LSI," *ibid*, pp 334-338
6. H. G. Brown, *et al*, "Telidon: A New Approach to Videotex System Design," *ibid*, pp 256-266
7. Department of Communications/Communications Research Centre, "CRC Technical Note No 697-E," Ottawa, Canada, Dec 1978
8. Information Gatekeepers, Inc, *Intel-Trade Newsletter* Brookline, Mass, May 30, 1979, p 13
9. G. Robinson and W. Loveless, "Touch-Tone Teletext, A Combined Teletext-Viewdata System," *IEEE Transactions on Consumer Electronics*, No 3, July 1979, pp 298-303
10. R. A. O'Connor, "Teletext Field Tests," *ibid*, pp 304-310

THE PITTMAN® LINE OF D-C MOTORS

Better check it out!

LO-COG® Servo Motors
3 series: 1.2, 1.6 & 2.0" OD
Stall torques:
about 1 to 128 oz.-in.

PITMO® Gearmotors
2 series: 1.38 & 2.00" OD
gearboxes
Torque limits with
standard gearing:
100 & 175 oz.-in.

PITMO® Motor-Tachs
2 series: 1.2 & 1.6" OD
Standard tachometer gradient:
2 volts/1,000 rpm

Samarium Cobalt Field 4-Pole Motors
1 x 1¼" cross-section
Stall torques:
12 to 24 oz.-in.

PITMO®

THE PITTMAN CORPORATION

A Subsidiary of Penn Engineering & Manufacturing Corp.
Harleysville, PA 19438 · 215:256-6601

© 1979

21A

National Bureau of Standards Implements Local Packet Data Network

National Bureau of Standards (NBS) computer scientists have designed and developed a new system to link computer terminals, data acquisition equipment, laboratory minicomputers, and mainframe computers at the NBS Gaithersburg, MD facility.

A study of data communications needs at the complex identified about 700 user devices, consisting of two major and some 60 smaller computers, and 300 to 500 terminals, all dissimilar units operating at different data rates. The network linking them would require the following capabilities:

Full connectability for terminals, micro-, mini-, and major computers, and laboratory instruments

Speed conversion over a minimum range of 110 to 9600 baud, with required flow control

Addressing at least 2000 user nodes, a few hundred simultaneously

Coverage of a 1.5-km long site having about 20 buildings

Ease of user access

Provision of data encryption, if required

Tolerance of a large number of user interface node failures

The system developed to provide these capabilities is an adaptive time division multiple access cable system with fully-distributed control. Existing coaxial cables used as part of the NBS standard frequency distribution system form part of the network. The Table summarizes the network characteristics. Data are transmitted by packets; a typical packet is shown in Fig 1.

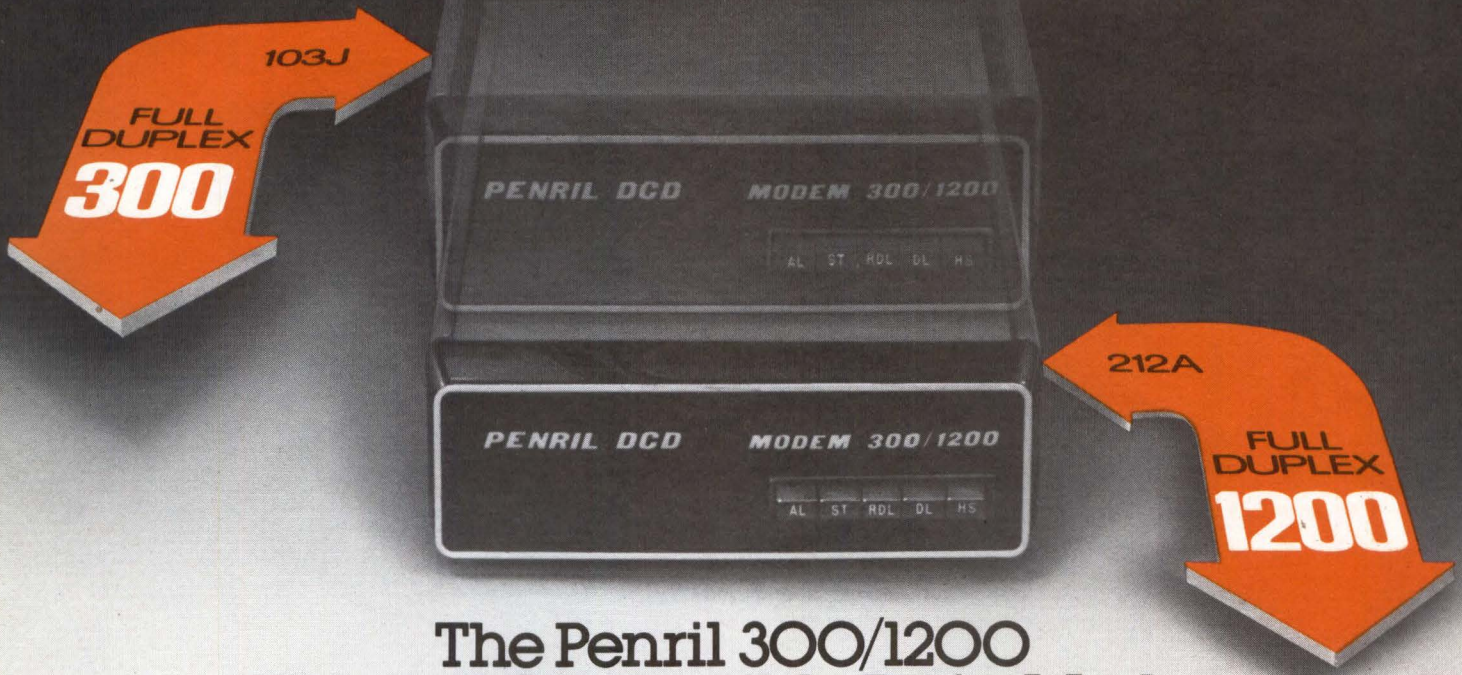
Heart of the system is a microprocessor based node called terminal interface equipment (TIE). These units interconnect user devices of differing signal speed requirements, and control flow of data on the network. Other features provided are error detection, automatic retransmission capability, certain line editing functions, and, with the addition of a data encryption chip, data en-

NBS Network

Coaxial cable bit rate	1M bits/s
Signaling method	On/off, Manchester
Max packet size	136 bytes
Max packet duration	1.088 ms
Data bytes per packet	0 to 128
Number of addresses in packet	2 (destination, source)
Size of address fields	16 bit (65k addresses) One address is reserved for broadcast messages which are accepted by all TIES
Error control	16-bit error control CRC
Basic contention protocol	Ethernet
Connection to user equipment	Serial asynchronous, RS-232-C or RS-449; parallel possible
Bit rate to user equipment	Common speeds up to 9600 baud
Flow control	End-to-end, in-band or out-of-band to suit user equipment

Fig 1 Typical packet structure. End to end flow control allows user stations operating with different bit rates to communicate with each other

TWO FOR THE PRICE OF ONE



The Penril 300/1200 212A Bell Compatible Data Modem

Save once by handling both 300 and 1200 bps rates with a single modem, a single phone line and a single computer port. Save again by mating with your existing low-speed system, then upgrading to higher speeds whenever you're ready.

Older terminals, new terminals, mixed data streams — you can handle them all, over switched or leased telephone networks with the Penril 300/1200, the full duplex 2-wire dial line modem manufactured under license from Western Electric for both synchronous and asynchronous operation.

FCC Registered; No. ABE976-67837-DM-R

Designed for use with an exclusion mode telephone set for manual calling or answering, this versatile FCC certified modem gives you an automatic answering option, too. Lift the telephone handset for dialing and voice conversation. Activate the exclusion key for the data mode, and answering is automatic with no operator intervention required. You can select either 300 or 1200 bps to originate a call; when answering, the incoming data mode is automatically recognized and accommodated.

Easy to Use; Easy to Service

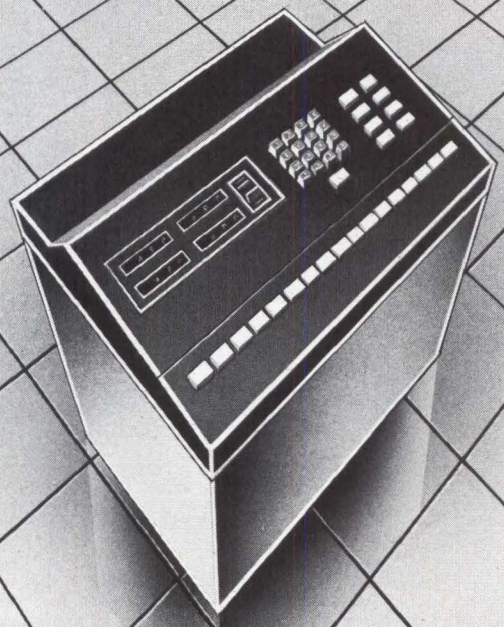
With 16 switch-selectable options on the modem printed circuit board, you're in control all the way. Use of high quality active filter networks keeps data transfer accurate, even over inferior telephone lines. Integral diagnostics keep servicing simple.

For details, contact;
Penril Corporation,
Data Communications Division,
5520 Randolph Rd.
Rockville, Maryland 20852.
Telephone (301) 881-8151.

Penril DATACOMM
...We Still Care.

CIRCLE 14 ON INQUIRY CARD

BIPOLAR LSI



Our Isoplanar-S™ helps you pack the mind of a mainframe into the body of a mini.

Imagine being able to pack all the complex memory and logic capabilities of a room-size mainframe into a desk-size minicomputer. Or increasing your mainframe's capability many times over without increasing its existing space and power requirements.

Now you can do either, and dramatically improve the performance of your computer at the same time. We've made it possible, thanks to Isoplanar-S, Fairchild's evolutionary new Bipolar process for scaling down Isoplanar geometries.

16 times the density. Four times the performance.

Our Isoplanar process has helped us give the computer industry and related fields superior-density/performance LSI RAMs, PROMs and logic for a long time. With Isoplanar-S, we'll be doing it for a long time to come. The next two years will be especially exciting as we reduce dimensions from our current 4-micron geometry all the way down to 1 micron.

As we shrink into the future, we'll offer you both ECL and TTL LSI with 16 times the density and four times the performance. That's an incredible increase in speed and density, along with a major decrease in system power and cooling requirements. Just look at what the potential of 1 micron can mean to you. This is the kind of progress that continues to make Fairchild a major force in the future of computer technology.

ISOPLANAR-S PRODUCT EVOLUTION

	4μ	1μ
RAM	4K x 1 35ns	1K x 4 10ns
PROM	1K x 8 50ns	8K x 8 45ns
LOGIC	200 GATE ARRAY 0.7ns	2000 GATE ARRAY 0.5ns

Isoplanar-S. It makes HMOS look like peat moss.

Once you've seen Isoplanar-S, you won't be interested in any other high-speed technology. That's because, along with superior performance, it offers high reliability and radiation tolerance. And most important, as we scale down, nothing is compromised.

Within the next few years, when we reach 1-micron geometry, there won't be another technology that can touch us. Or another computer that can touch yours when you design with Isoplanar-S.

HMOS? Use it on your asparagus.

Fairchild's dual commitment. To technology and volume.

To prove how totally committed we are to the future of computer technology, we've done what very few other companies in our business could afford to do. We've made major investments toward the advancement of Isoplanar-S and high-volume production. All because of our goal to meet your volume requirements with the fastest and densest LSI devices available. With them, you'll be able to make the best computers in the world.

Isoplanar-S-based devices are now in production. Watch for our announcements.

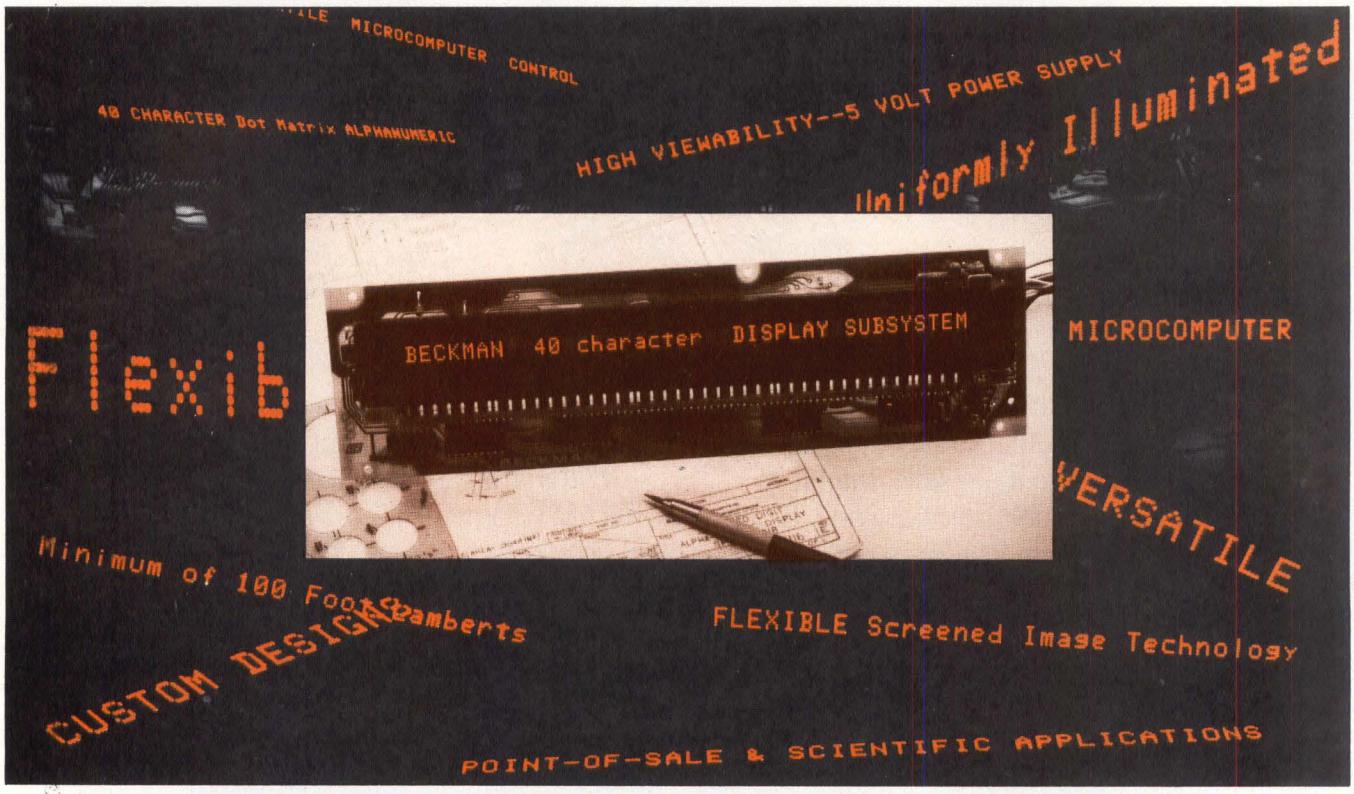
There's lots more to tell you about Isoplanar-S. Write or call Bipolar LSI at Fairchild Semiconductor Products Group, P.O. Box 880A, Mountain View, California 94042.
Tel: (415) 962-3951.
TWX: 910-379-6435.

FAIRCHILD

Shaping the future of LSI technology.

CIRCLE 15 ON INQUIRY CARD

WE CALL IT BECKMAN'S INTELLIGENT DISPLAY SYSTEM



BECAUSE IT'S SO BRIGHT!

That's visibly bright and microcomputer smart!

In fact, it's more than two times brighter than comparable gas discharge display systems. Beckman's SM-810-001 alphanumeric display system is the apex of the five-year development of the Screened Image technology. That's what makes it so bright. And, makes it flexible enough that you can do your own customizing. The microcomputer gives it the control and versatility that only a microcomputer can.

The SM-810-001 will give you 40 — count 'em 40 — high brightness characters in a 5 by 7 matrix of large, uniformly illuminated dots. *Each* of the quarter-inch characters provides a minimum of 100 footlamberts of brightness. Think what 40 of them will do for the overall illumination. In addition, the unit offers a remarkable viewing angle (for a subsystem) of 130°, plus a flicker-free 94 Hertz refresh rate. And, it's all in one compact, microcomputer-controlled assembly . . . smaller than a carton of cigarettes.

The SM-810-001 is currently being evaluated by several major users. Obvious applications include: medical/scientific instrumentation, process control and point-of-sale. More importantly, the almost limitless flexibility of the Screened Image concept makes it possible to adapt this display system to your system . . . without the usual, high engineering design and development charges.

Significant Features of the SM-810-001

- High Viewability.
  - — High Brightness & Wide Viewing Angle.
- Versatile, Microcomputer Control.
  - — Direct User Access.
  - — Right, Left & Random Entry.
  - — Character & Block Blinking.
  - — Data Write Time = 310 nS.
  - — Expanded ASCII — 98 Character Set.
- Compact, self-contained assembly.
  - — 10.75″ x 3.0″ x 2.0″
- Standard Interfaces.
  - — Single, 5 Volt Supply.
  - — 8 Bit Parallel Bidirectional Bus.

SM-810-001 JOINS THE SA-252.

If you prefer a larger character, 14-segment display, you may also wish to investigate Beckman's SA-252 Alphanumeric Display System. Its 16 characters are each 0.55″ high, and provide excellent viewability, even at long distances. The SA-252 is also microcomputer controlled, with direct user access. And, it's ideal for biomedical, process control and general electronics applications.

Beckman Displays. The Visible Edge.

For more information concerning your standard or custom requirements, write: Displays Systems Division, Beckman Instruments, Inc., 350 North Hayden Rd., Scottsdale, AZ. PHONE: (602) 947-8371. TWX: 910-950-1293.

BECKMAN

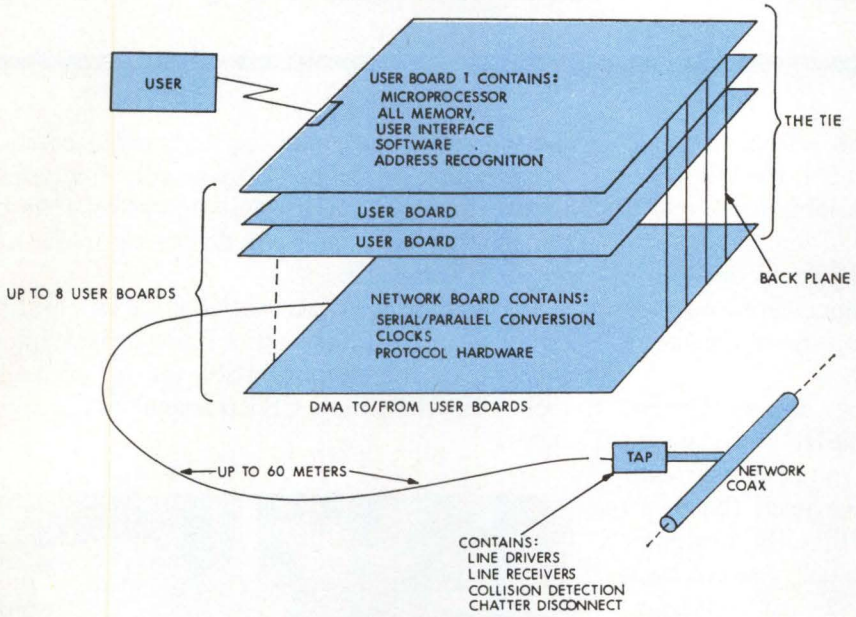


Fig 2 NBS network hardware. One UB is required for each connected user device, and NB/TAP combination can support eight UBs. Communication control, message buffering, assembly of data packets, and error control functions reside on each UB. UBs sharing the single NB are polled and do not contend with each other

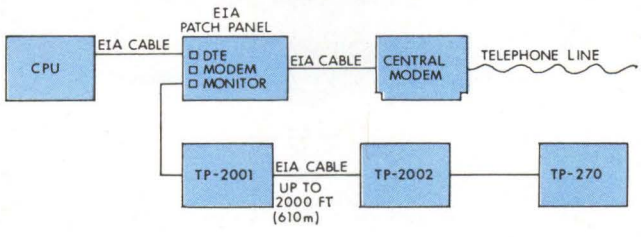
cryption and decryption. The TIE is shown in Fig 2. Major sections are the network board (NB) and user board(s) (UB), managed by a microprocessor and associated erasable programmable read only memory (EPROM). Output from NB is coupled to the coaxial distribution cable by a tap.

The TIE is designed to provide efficient control of data through the network. Before transmitting, the TIE checks to be sure that the cable is free. However, if two TIEs start to use the cable at the same time, each will immediately detect packet collisions. At this point, each party involved will truncate the packet being transmitted and impose a random waiting period before trying to regain control of the cable. This type of contention for the cable with detection and delay before retransmitting results in highly efficient use of the cable channel's data transmission capacity.

User-to-user protocol is built on the user-to-TIE, TIE-to-TIE, and TIE-to-user protocols. Implementation of user-to-TIE and TIE-to-user protocol takes into account differences in the requirements of different user terminals, processors, and mainframes. Differences are recognized and the software is personalized to the local user devices.

Analyzer Measures Online Network Performance

TP-270 remote network analyzer measures system response time in a 3270 network and provides specific measurements of the effects of hardware and software changes on the system. The microprocessor based unit, located at the central computer site, can detect and measure minimum and maximum response times for each terminal location. It will display actual measurements of the elements contributing to the response times, such as poll to poll, poll to



Remote monitor connection. In this configuration TP-2001 and TP-2002 line driver pair are used to extend EIA interface beyond customary 50-ft (15.24-m) limit

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.

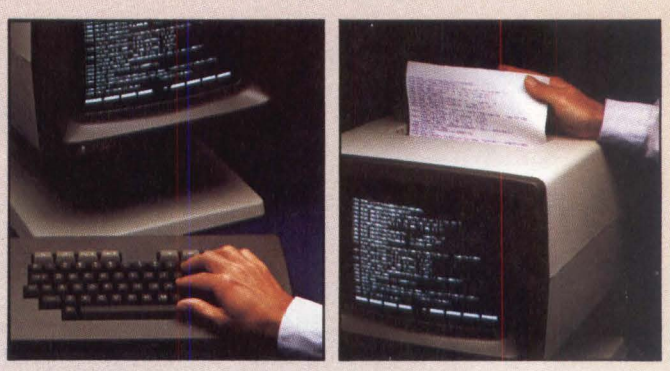
We designed the keyboard like the familiar typewriter, so you don't have to waste time relearning it. We built in eight function keys, too. These control the cursor, rolling and scrolling. And, to make life easier, they're labeled on the screen for self-test, configuration, display and editing.

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 _____

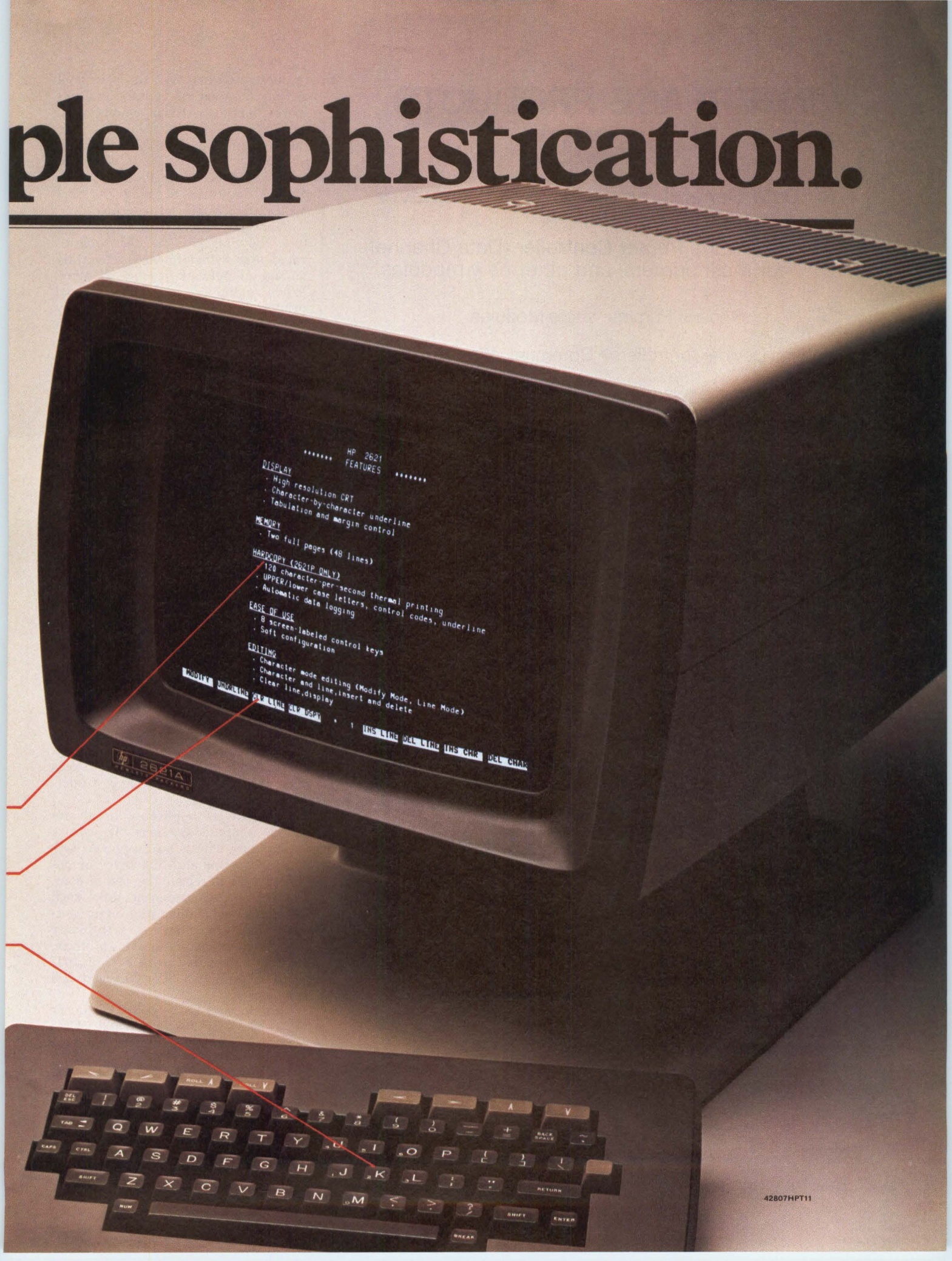
Mail to Hewlett-Packard, Attn: Ed Hayes,
Marketing Manager, Data Terminals Division, Dept. 1247,
19400 Homestead Road, Cupertino CA 95014.

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 17 ON INQUIRY CARD

ple sophistication.



INTERFACE PRODUCTS from MDB

for Data General** or similar type computers

NEW! DMA Line Printer Controller (Data Channel) for most printers; and other new modules.

General Purpose Logic Modules

Peripheral Device Controllers ▪ Communications Interfaces

Chassis Assemblies ▪ Power Supplies

☐ General Purpose Interfaces

GPIO features include interface logic with wirewrap portion for 105 devices of any DIP configuration, four 16-bit I/O registers and Data Channel Connection with sync and request logic

Wire Wrap Board for 215 sockets, provides for any DIP configuration; plus external I/O connectors

☐ Device Controllers for most major manufacturer's

Printers

Card equipment

☐ Communications/Terminal Modules

Multiple I/O board for two TTY and/or RS232 Controllers; other options include Real Time Clock and Modem Control

Multiplexor, four or eight channel with full modem control; 4060 compatible with additional program controlled features. Optional multiplexor or panel provides for 25-pin connectors for each channel

☐ Chassis Assemblies

Front loading expansion chassis, six slots with ¾" spacing

Terminator Modules

Extender Board

☐ Power Supplies

MDB interface products always equal or exceed the host manufacturer's specifications and performance for a similar interface. MDB interfaces are completely software transparent to the host computer. MDB products are competitively priced, delivery is 30 days ARO or sooner.

MDB places an unconditional one year warranty on its controllers and tested products.

MDB also supplies interface modules for PDP*-11, LSI-11, IBM Series/1 and Interdata computers. Product literature kits are complete with pricing.

* TM Digital Equipment Corp.

** Data General is a computer manufacturer unrelated to MDB.

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

Circle 168 for DG; 169 for PDP; 170 for LSI; 171 for IBM; 172 for Interdata

response, and CPU wait times, as well as the duration of inquiry and response messages. Event counts, such as ACKS, NAKS, WACKS, and messages are displayed to show direction of origin. The TP-270 is available from TeleProcessing Products, Inc, 4565 E Industrial St, Bldg 7K, Simi Valley, CA 93603.

While not intended as a diagnostic tool, the unit provides the sophisticated user with inferences which are an aid in network trouble shooting. When equipped with an optional printer interface card, a hardcopy printout of individual functions or a complete status report will be produced on a user-provided printer.

The TP-270 will handle synchronous data rates up to 9600 bits/s. Codes are switch-selectable, ASCII or EBCDIC. Size is 5.25 x 17 x 11.5" (13.3 x 43 x 29.2 cm), weight, 13 lbs (5.85 kg). Power requirement is 115 Vac, 60 Hz, 1 A.

Circle 400 on Inquiry Card

Intelligent Processor Improves Computer Communications

An intelligent network processor (INP) relieves CPU congestion, enables computer to computer communications at speeds to 56k bits/s, and improves distributed systems network (DSN) operations as well as remote job entry functions via 2780 links. The INP was recently introduced by Hewlett-Packard General Systems Div, 19447 Pruneridge Ave, Cupertino, CA 95014.

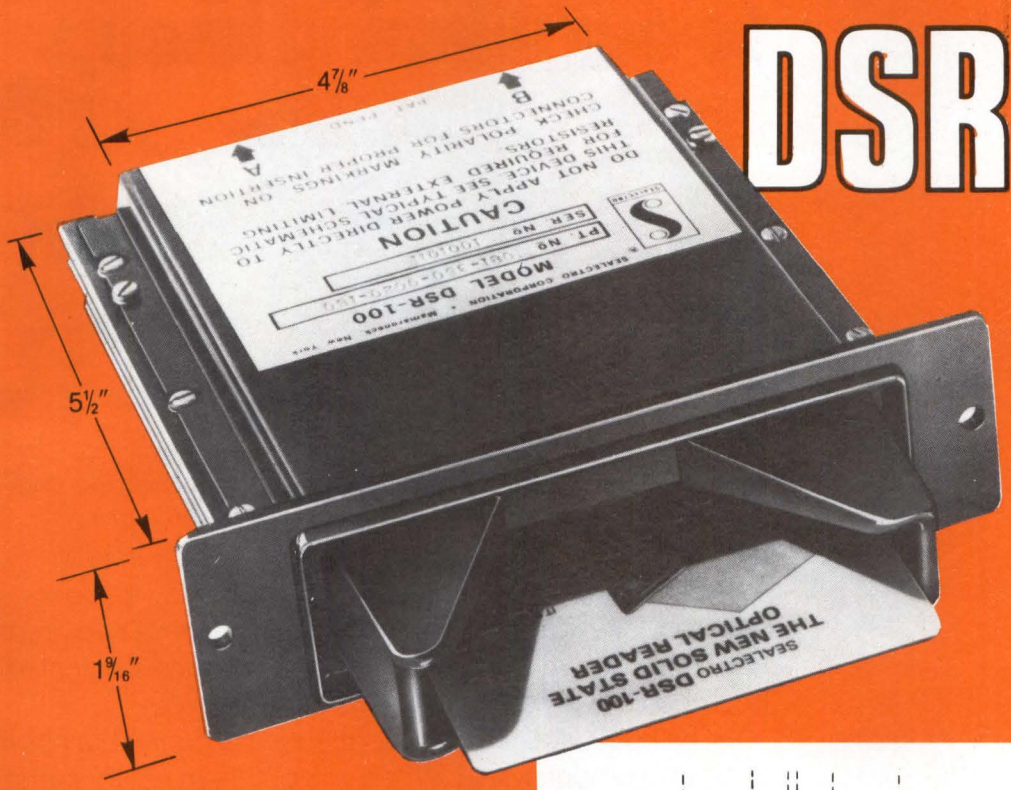
The INP is applicable to all HP 3000 computer systems. It uses a proprietary silicon on sapphire (SOS) microprocessor and 32k bytes of onboard RAM to relieve the CPU of communications management tasks such as character handling and buffer storage. The processor uses IBM binary synchronous communications protocol, and is compatible with HP 32210T, 37220T, and Bell 201, 208, and 209 modems.

Interface is EIA RS-232-C, CCITT V24/28, V.35, or hardwired. Data rates are 19.2k bits/s using modem, half or full duplex, or to 56k bits/s with V.35 or a hardwired link. Data buffer capacity is as much as 2k bytes/buffer; buffered data are protected in case of power failure. Self-test capability and a comprehensive diagnostic program for troubleshooting are included.

Circle 401 on Inquiry Card

FOR MAXIMUM PERFORMANCE... IN A MINIMUM PACKAGE... EVERYONE AGREES...IT'S THE

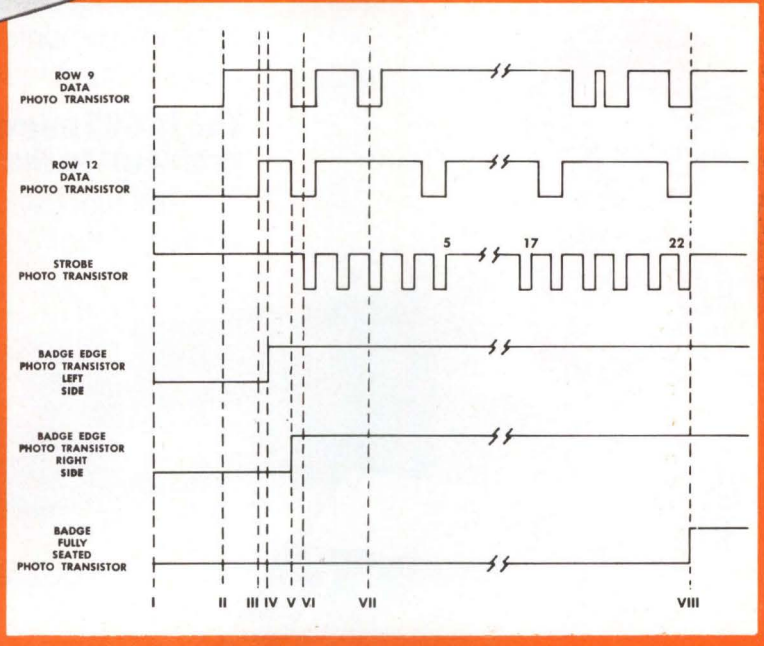
DSR-100 BADGE READER



- ★ 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

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

CIRCLE 19 ON INQUIRY CARD

F6800 SERIES

We've just added two hard-hitting rookies to our winning lineup.

Now that the new F6802 microprocessor and F6846 combo chip have joined Fairchild's F6800 team, you've got a minimum, microprocessor-based-system solution to your design problems. One that's low cost and easy to work with too. Like the rest of our F6800 family, these two great new NMOS products are made using Fairchild's patented Isoplanar™ process.

The F6802 and F6846 are already becoming big hits in the microcomputer field. When you put them on your team, they're bound to score some winning runs for you.

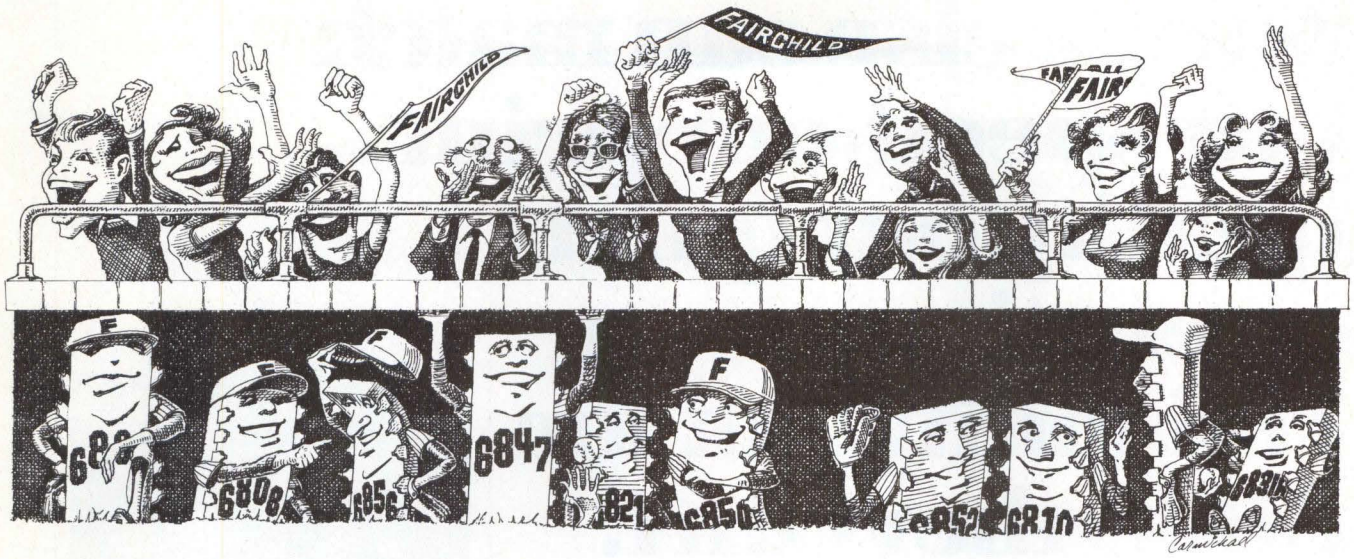
The F6802 microprocessor. It sends your design problems to the minors.

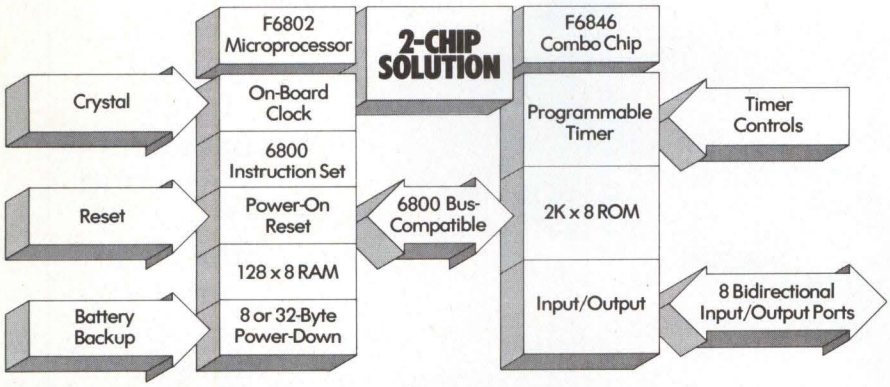
And that's where they'll stay, thanks to this enhanced version of the F6800 central processing unit. The F6802 offers an on-chip power-on reset function, on-board clock for easier use and on-board 128 x 8 RAM with options of 8-byte or 32-byte power-down. Now you no longer need an additional RAM with battery backup systems.

The F6802 features a memory-ready line for slow or fast memory. So you can use memories in synchronous or asynchronous mode. And the F6802 is bus-compatible for easy use with all of the other F6800 peripherals.

The F6846 combo chip. It's a memorable teammate.

The F6846 is a user-defined ROM-based peripheral element. It features 2K x 8 ROM, a powerful programmable binary timer, and eight bidirectional input/output ports on the same circuit. It's also F6800 series bus-compatible.





We're a major-league supplier.

Some of the biggest OEM customers come to us. Including names like General Motors, Ford, H.P. and Lear-Siegler, to mention a few. They know we're one of the biggest suppliers and one of the best sources for F6800 microcomputer products in the industry. We offer the entire F6800 family, including peripherals, memory and communication circuits. And we can get them to you when you need them because we're in high-volume production. We also have some great new circuits coming up soon from training camp — the F6856 SPCC, F6808 CPU, F6847 VDG controller and F6801 single chip.

We support your team.

No matter what your needs, from standard to hi-rel, we can supply you because our F6800s are in stock at our distributors now. In quantity too, so you can have on-time delivery.

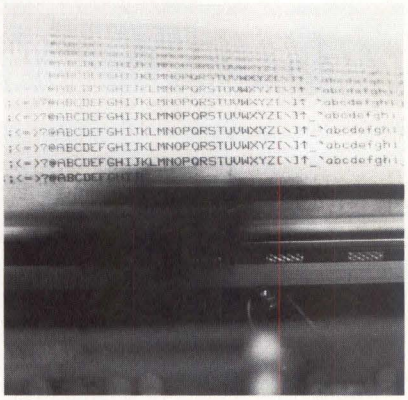
When you need some heavy-hitting microprocessor circuits for your team, give us a call and we'll hit you with our winning lineup. Just ask for our Microprocessor Group at (408) 224-7000. Or write Fairchild Camera and Instrument Corporation, P.O. Box 880A, Mountain View, California 94042. TWX: 910-379-1227.

FAIRCHILD

Call us on it.
(408) 224-7000

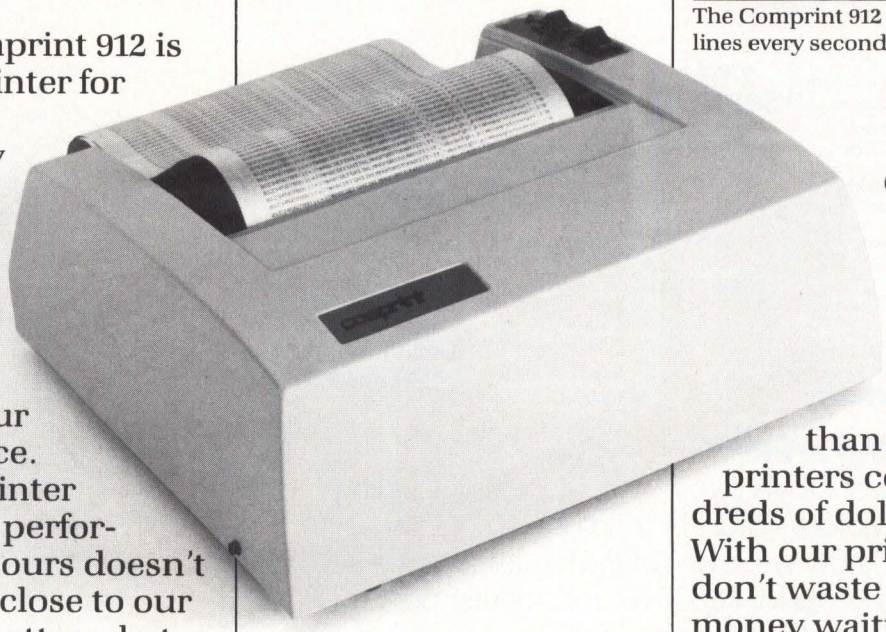
CIRCLE 20 ON INQUIRY CARD

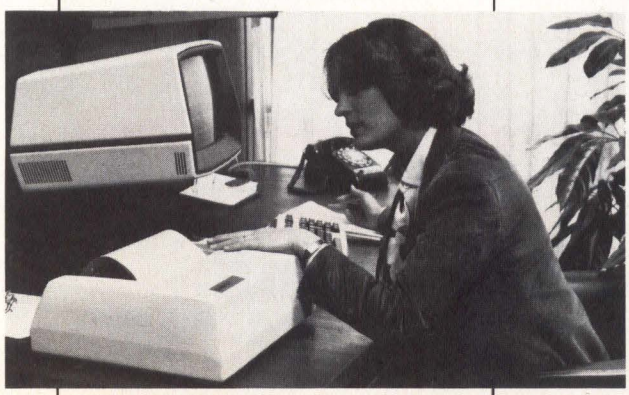
The Comprint 912 printer. No one else can match our speed, our print quality, our quiet operation, or our reliability. Not for $660 they can't.



The Comprint 912 prints nearly 3 lines every second.

Our Comprint 912 is the best printer for the money. Period. Any printer that can match our price can't even begin to match our performance. And any printer that boasts performance like ours doesn't even come close to our price. No matter what your application; computer reports, listings, CRT hard copy, message receiving, scientific/industrial data logging, or anything you can think of, the Comprint 912 is **the** performance leader in printers under $1000.





CRT hardcopy is an excellent application for the Comprint 912.

First consider our performance.

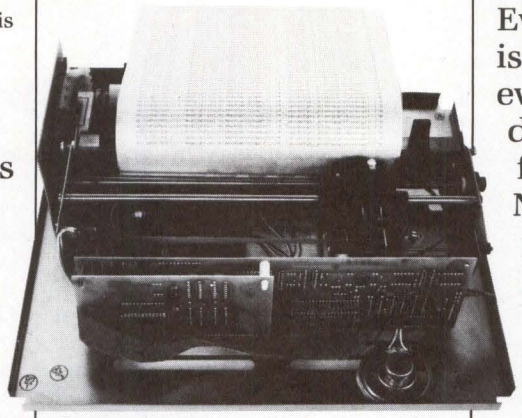
Speed.
At 225 characters per second (170 LPM) the Comprint 912 is up to 4 times faster than impact printers costing hundreds of dollars more. With our printer you don't waste time and money waiting for your print-out.

Print Quality.
Our 9x12 matrix provides sharp, crisp characters. Compare that with our competition. Their very best is a 9x7 matrix, which means no lower case descenders and cramped letters. With the Comprint 912 you don't have to put up with the irritation of fuzzy, hard to read computer printing. This

xceptional print quality in
ly by the Comprint 912 in 7
nless reliability, 6 month
rallel I/O and 8 1/2" wide
been shipped to happy custo

The superior print quality provided by the Comprint 912 is obvious in this actual size sample.

offer a 6 month warranty, twice the industry standard. The key to all this superior performance is our special paper. This aluminized "silver paper" works just like ordinary paper. It won't fade or discolor and actually costs less than plain paper and one time ribbons. For the vast majority of printing applications it's just plain better than plain paper. Especially when you consider the hidden costs of plain paper printers due to their inferior performance compared to the Comprint 912. And on those rare occasions when you really do need a plain bond paper copy, just run your Comprint 912 printout through your plain bond copy machine and you've got it. Even though our paper is special, it's available everywhere; from your dealer or distributor, or from us.



Fewer moving parts in the Comprint 912 mean greater reliability.

Now consider our price.

The Comprint 912.

$660 with parallel interface, $699 with serial interface.

We could talk about our other advantages, like our 80-character lines on 8-1/2" wide paper, or our compact, light-weight size, and the fact that the Comprint 912 has no ribbons to mess with, no chemicals, nothing to add but paper.

But you have to see for yourself. Before you buy any printer, insist on seeing the Comprint 912, **the** performance leader, at your local computer store or industrial distributor. Or contact us for a descriptive brochure, a sample print-out, and applications literature.

means increased productivity. And because the Comprint 912 makes better originals, our originals make better Xeroxes.

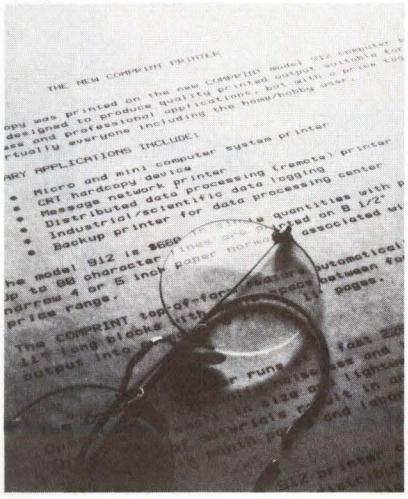
Quiet Operation.

Most computer printers are irritatingly noisy. They can disrupt concentration and reduce the efficiency of anyone working near them. They're noisy because they're impact. The Comprint 912 has no mechanical print head banging on the paper. It's electronic. It's quiet.

The Comprint 912 is quiet because it's electronic not mechanical.

Reliability.

Since the Comprint 912 prints electronically, rather than mechanically like ordinary impact printers, we have fewer moving parts and less vibration. The Comprint 912 has fewer things to go wrong and less wear. That's why we



comprint

The performance leader.

Computer Printers International, Inc.
340 E. Middlefield Rd.
Mountain View, California 94043
415 969-6161

Work Station Incorporates IATA Protocol

Basic software package of the 2001 work station now incorporates the 83B3 communications protocol, allowing operation in this communications medium because it takes into account special International Air Transport Association (IATA) format and specific communications restrictions. The work station combines an 83B3 communications terminal and a complete word processing system. The 2001 is manufactured by Megadata Corp, 35 Orville Dr, Bohemia, NY 11716.

Word processing and communications functions occur simultaneously. Total number of messages in line queue can amount to about 245k characters. The system comprises a 64k RAM, dual floppy discs, a letter quality printer for word processing, and a separate printer for incoming and outgoing messages.

A file of "canned" phrases allows 1-time entry of commonly used text, with a 6-char code used to call up the phrases. IATA forms control is included to perform complete check of outgoing messages and insure validity of header information. Communications are fully supported with all output messages queued up on a disc. Automatic header checking, message blocking, and reject message handling are included.

Circle 402 on Inquiry Card

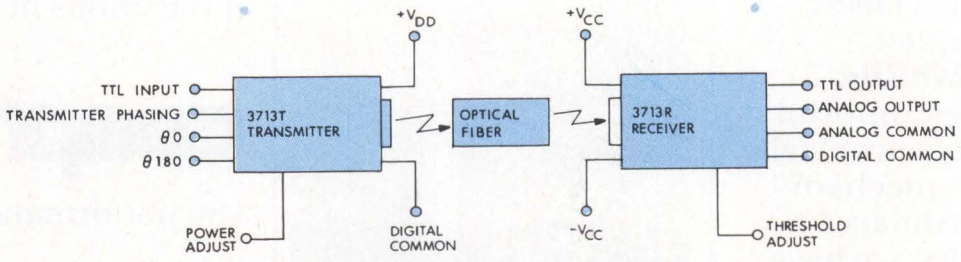
Fiber Optic Data Link Operates to 250k Bits/s

High sensitivity, medium speed 3713 data link is designed to provide signal isolation in electrically noisy environments, and is compatible with many process and control configurations. Made up of the 3713T transmitter and 3713R receiver connected by a suitable fiber optic cable, the 3713 provides a 250k-baud NRZ data link capable of operation to 1.7 km. An AMP Optimate single-fiber connector system simplifies interfacing modules and fiber and minimizes problems of source/fiber/detector alignment. Metal packages of both transmitter and receiver provide immunity to electromagnetic radiation, and direct PC board mounting without need of an additional heat sink.

The integral connector system also permits choice of a variety of cables to match specific needs, with maximum cable length depending on the type of fiber optic cable used. Units operate with 10^{-9} bit error rate (BER) and 20-dB aggregate cable and connector loss when used with a 200-μm fiber. When low loss silica fiber is used, the link can function over distances to 2.5 km. The 3713 link system is offered by Burr-Brown, International Airport Industrial Pk, PO Box 11400, Tucson, AZ 85374.

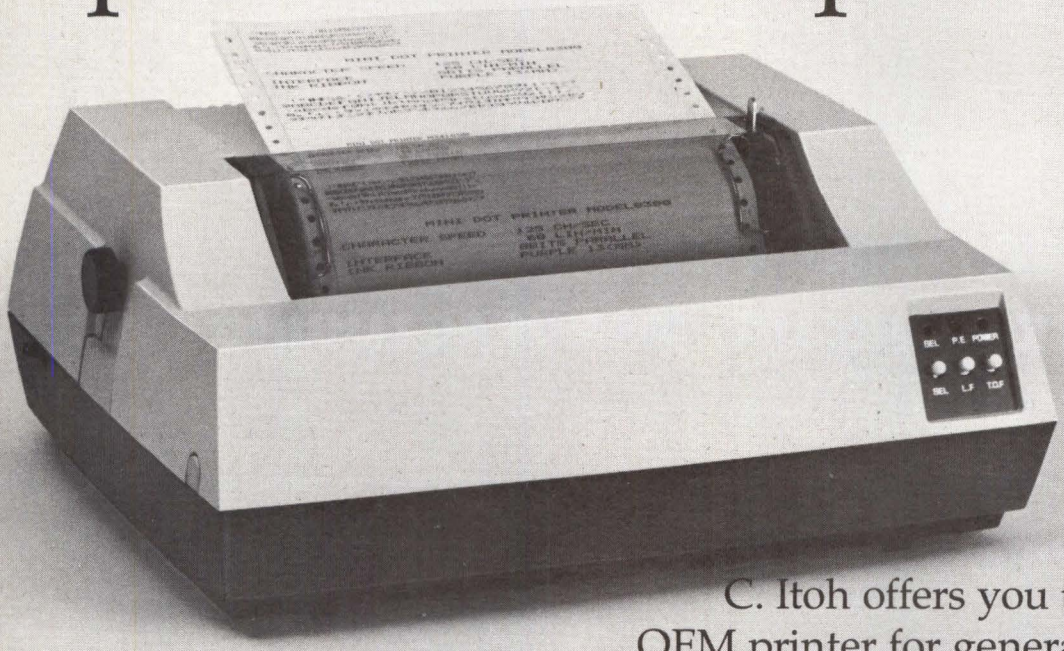
Power requirement for the transmitter is 5 V; optical power may be adjusted with a single resistor. The receiver takes a ± 15-V supply. An automatic threshold circuit is incorporated in the receiver for maximum noise immunity. Package size is 41 x 77 x 16 mm. Direct PC board mount is enabled by seven pins located on the bottom of each unit.

Circle 403 on Inquiry Card



3713 fiber optic data link. Transmitter converts TTL level inputs to optical pulses via LED light source at data rates from dc to 2M baud NRZ. Receiver converts light input via PIN photodiode to TTL output, with receiver sensitivity of 15 nW and data rates to 250k baud NRZ

C. Itoh's Model 8300 printer looks superb.



It works even better.

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

C. Itoh Electronics, Inc.

C. Itoh means excellence in printers.

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

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

CIRCLE 73 ON INQUIRY CARD

TECHNOLOGY AND ECONOMICS: INTEGRATED CIRCUIT MANUFACTURING COSTS

Montgomery Phister, Jr

Systems Consulting
Santa Monica, California

When engineers were designing the first commercial digital computers, a system flipflop occupied one-third of a cubic foot and cost over $100 (see Table 12, p 117 of *Computer Design*, Oct 1978). Designers therefore were interested in logic minimization, and devoted time and effort to finding structures which shared registers and eliminated superfluous gates.

Today a system flipflop costs 80¢ and occupies 2 in^3 (33 cm^3) of cabinet volume. The integrated circuit, unimagined by early computer engineers who struggled with vacuum tubes and dreamed of transistors, has turned the designer's world upside down. He is still interested in elegant structures, but his bricks are ALUs, decoders, P/ROMs, and microprocessors rather than gates and flipflops. Furthermore, because the lion's share of a system's cost is in its components, he has an abiding interest in IC prices and price trends.

Prices in a free market are of course complicated entities. They depend on the price of functionally equivalent, existing alternative parts. They depend on the demand from the marketplace, and on the supply of parts available. But ultimately they are limited by the manufacturing cost of the parts. Design engineers interested in prices and price trends therefore must have some understanding of the factors which influence IC manufacturing cost.

NEC Spinwriters. Tailored printers.

Printers for every job. Terminals for every line.

NEC Spinwriter™ character printers and terminals can be configured in as many varieties as there are jobs to do.

They start as basic 55-cps printer mechanisms for some OEM buyers who want to add their own value. Then they grow and change to fit your precise letter-quality output needs.

Each of our 10 models is surrounded with features and options that make customizing easy.

Eight industry-standard interfaces, serial and parallel, let you add Spinwriter printers quickly to your current system. Ten form-feed options—most operator changeable—provide unparalleled document handling flexibility. Dozens of 10 or 12 pitch and Proportional Space thimbles—with up to 128 characters—solve your technical and language output requirements.

That's not all. Spinwriter printers and terminals lead the industry in reliability, with a more than 2000-hour MTBF. And in serviceability, with a 30-minute MTTR.

When you want hard-working printers that are tailored to your individual needs, call the NEC Spinwriter regional representative nearest you. He'll assure a perfect fit.

NEC. Going after the perfect printer.

NEC

NEC Information Systems, Inc.

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

CIRCLE 23 ON INQUIRY CARD

The more you dema
the more you sh

Chances are, you'll find that the performance you need is already there.

At HP, our long experience in developing instruments for engineering and manufacturing has given us a real good idea of what's needed in computer systems for technical applications. That's why Hewlett-Packard's family of computer products can meet your needs so closely in the lab or on the factory floor.

Matching the computer to the job.

Take our 9800 Series Desktop computers. For single-station interactive computing, they're in a class by themselves. With up to 449K bytes of memory, enhanced BASIC, graphics capabilities, and a built-in keyboard and display, you get the power of a minicomputer in one complete, integrated package. And there's easy interfacing with HP instruments and peripherals for jobs like control and testing, statistical analysis, and even engineering design.

For more complex multi-processing tasks, the HP 1000 computer has the power and flexibility to meet your needs. You can choose from a broad range of computation power to process your data, from the low-cost M-Series to the high-speed floating point F-Series. All of the configurations use upward-compatible RTE operating systems, so you don't have to rewrite your programs when you change jobs or move up to another model. And if you need additional storage, you can expand the systems to two megabytes of main memory starting at only $18K/per megabyte.

The HP 1000 system also comes with a number of applications tools to minimize your programming costs. HP's new DATACAP/1000 software, for example, lets you design a real-time factory data collection system according to your shop floor needs. And to help you manage vast quantities of technical data, we developed our powerful IMAGE/1000 data base management system. Just a few simple keystrokes give you up-to-the-minute information on inventory levels or instrument check-out status. If you'd like a really clear picture of your information, HP's GRAPHICS/1000 will plot your data in a way you can understand.

nd from a computer, ould look at HP.

Communication made simple.

General purpose interface cards let you adapt the HP 1000 to a variety of tasks, including A/D conversion and multi-point communications. What's more, with the plug-in HP-IB (interface bus), you can process and control data from over 200 sophisticated measurement and testing instruments.

Talking to the computers is easy, too. The HP 1000 uses BASIC and FORTRAN as well as assembly and microcode languages. And our powerful communications software, DS/1000, lets you hook HP 1000 computers together in any network configuration you want—across your plant or around the world.

A continuous growth plan.

HP's family of computer products is constantly growing to meet your scientific, engineering, and manufacturing needs. Whether it's instrumentation front ends, CRT terminals, plotters or digitizers, HP's compatible products let you add to your system at any time without writing new software. And of course, you get HP's full support, service, training and documentation.

Go ahead and ask your own computer some tough questions. Then ask ours and see the difference. For a hands-on demonstration of the HP 1000, just call your nearest HP sales office listed in the White Pages. Or for more information write Hewlett-Packard, Attn: Roger Ueltzen, Dept. 1259, 11000 Wolfe Road, Cupertino, CA 95014.

Here are just a few of HP's range of products for manufacturers and engineers:

1. HP 9845 Desktop Computer.
2. HP 9825 Desktop Computer.
3. HP 1000 Model 45 Real-time System with HP 7906 Disc Drive and HP 2648A Graphics Terminal.

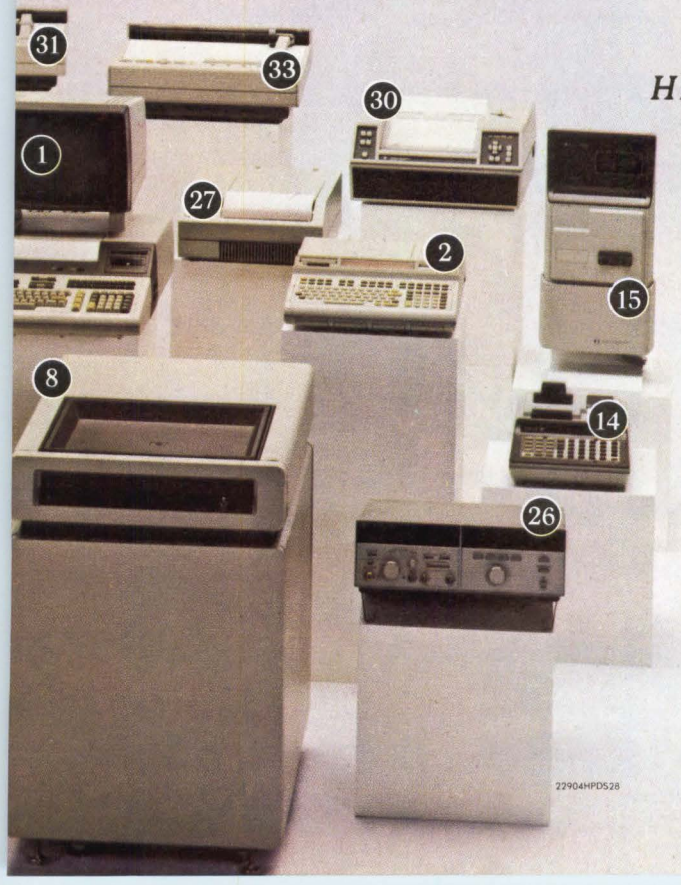
4-6. HP 1000 F-, E-, and M-Series Computers.

7. HP 2108 Board Computer.
8. HP 7925 Mass Storage Unit.
9. HP 2240 Measurement & Control Processor.
10. HP ATS Automatic Test System.
11. HP 12050 Fiber Optics.
12. HP-IB Link IEEE-488 Standard Interface.
13. HP 2621 CRT Terminal.
14. HP 3075 Data Capture Terminal.
15. HP 3077 Time Reporting Terminal.
16. HP 3455 Voltmeter.
17. HP 3495 Scanner.
18. HP 5328A Universal Counter.
19. HP 5342 Microwave Frequency Counter.
20. HP 436A Power Meter.
21. HP 4262 LCR Meter.
22. HP 8566A Spectrum Analyzer.
23. HP 8754A Network Analyzer.
24. HP 3325A Synthesizer/Function Generator.

25-6. HP 8660A & HP 8672A Synthesizer/Signal Generators.

27-8. HP 9876A & HP 2608A Printers.

29. HP 2635 Printer.
30. HP 7245A Thermal Plotter/Printer.
31. HP 7221A Plotter.
32. HP 7225A Graphics Plotter.
33. HP 9872A Programmable Graphics Plotter.
34. HP 9874A Digitizer.
35. HP keeps it coming.



HEWLETT hp PACKARD

CIRCLE 24 ON INQUIRY CARD

IC Manufacturing Process

Briefly, IC manufacture begins with a sequence of alternating optical and chemical steps carried out on a thin wafer of silicon.[1] The optical operation transfers circuit patterns from a set of masks to the wafer, and the chemical (or physical/chemical) processes create appropriate conducting, semiconducting, and insulating paths in the silicon locations specified by the masks. The masks typically contain patterns for tens or hundreds of identical circuit components, or chips (the actual number depends on wafer and chip dimensions). When the manufacturer finishes the processing steps on a batch of wafers, he tests the individual chips and marks the bad ones. The ratio of good chips to total chips on the wafer is called the *wafer yield,* and is a most important parameter.

Next, the manufacturer separates the chips, discarding the bad ones. He mounts each good chip on a package "header," and bonds it in place. Then he attaches the chip terminals to the package leads, and inspects the result. The ratio of good circuits to total circuits at this point is the *packaging yield.*

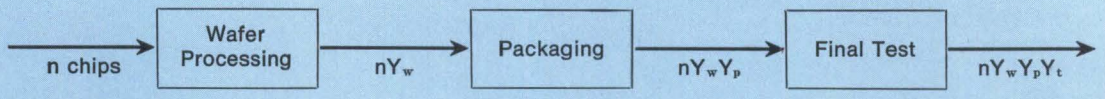
The last steps in the manufacturing process call for the mounted chips to be capped and marked, and to undergo a final test, which cycles the finished product through a sophisticated test appropriate to its complexity. The ratio of good units to total units here is the *final test yield.*

Cost Influencing Factors

"A Model for Integrated Circuit Manufacturing Costs" provides a simplified model[2,3,4,5] for this entire process. Total cost is the sum of processing, packaging, and testing costs. The latter two costs are assumed constant, and dominate manufacturing cost for small chips. As chip size increases, however, both wafer yield and the number of chips per wafer fall, and the first term, processing cost, becomes dominant. Fig 1 shows how wafer yield varies with chip area, and Fig 2 illustrates how the number of chips per wafer varies, for two common wafer sizes. [The 3-in (7.6-cm) wafer is the most widely used in the U.S. today, but it is being superceded by the larger wafer.]

The resulting chip manufacturing cost is shown in Fig 3. To put things in perspective, note that Intel's 16k dynamic RAM, the 2116, has an area of 0.034 in^2 (0.219 cm^2), and IBM has announced that their 64k RAM has an area of 0.0625 in^2 (0.403 cm^2). The model predicts that the former would have a manufacturing cost of about $1.50, and that the latter would cost about

A Model for Integrated Circuit Manufacturing Costs



$$\text{IC Manufacturing Cost/Chip} = \text{Processing Cost} + \text{Packaging Cost} + \text{Final Test Cost}$$

$$\text{Processing Cost} = \frac{\text{Cost of Processed Wafer}}{(\text{Chips/Wafer}) \times (\text{Wafer Yield}) \times (\text{Packaging Yield}) \times (\text{Test Yield})}$$

$$= \frac{C_w}{\left(\frac{\pi D^2}{4e^2} - \frac{1.77D}{e}\right) \times \left(\frac{0.8}{(1 + ke^2)^3}\right) \times Y_p Y_t}$$

where

D = Wafer Diameter (inches)

e = Edge of square chip (inches)

k = Silicon wafer defect density

$$\text{Packaging Cost} = \frac{(\text{Cost of IC Package}) + (\text{Cost of IC Connections})}{(\text{Packaging Yield}) \times (\text{Test Yield})}$$

$$= \frac{P + C}{Y_p Y_t}$$

$$\text{Final Test Cost} = \frac{\text{Cost of Testing Finished IC}}{\text{Test Yield}} = \frac{T}{Y_t}$$

$$\text{IC Manufacturing Cost/Chip} = \frac{A(1+kA)^3 C_w}{0.8\, Y_p Y_t (\pi D^2/4 - 1.77D\sqrt{A})} + \frac{1}{Y_t}\left[\frac{P + C}{Y_p} + T\right]$$

where

$A = e^2$ = Chip Area

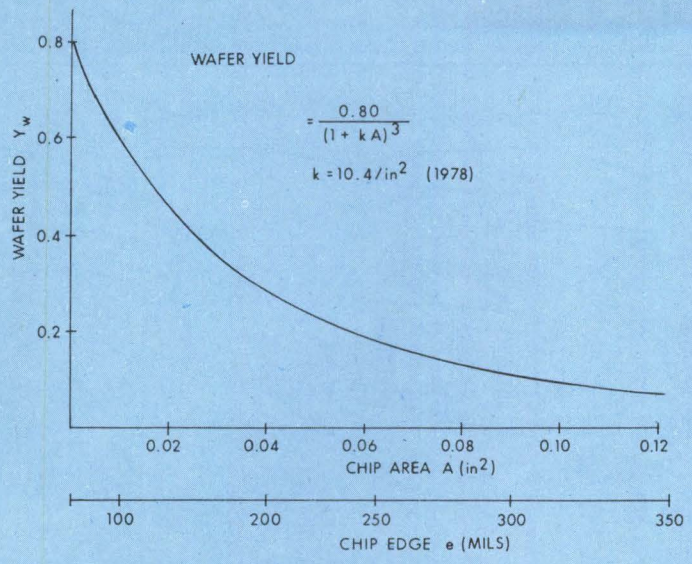


Fig 1 Wafer yield vs chip area. Wafer yield is ratio of good chips, at point where wafer processing is complete, to total number of chips on wafer. Bad parts typically result from defects in wafer or abberations in optical system. Yield falls off rapidly with increasing area

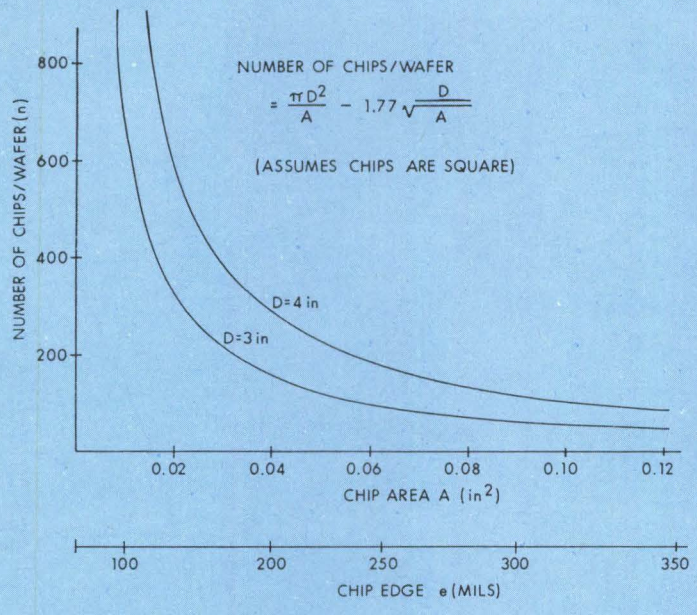


Fig 2 Chips/wafer vs chip area. Number of rectangular chips which can be laid out on circular wafer is function of wafer and chip dimensions. Formula shown is fairly accurate for square chips

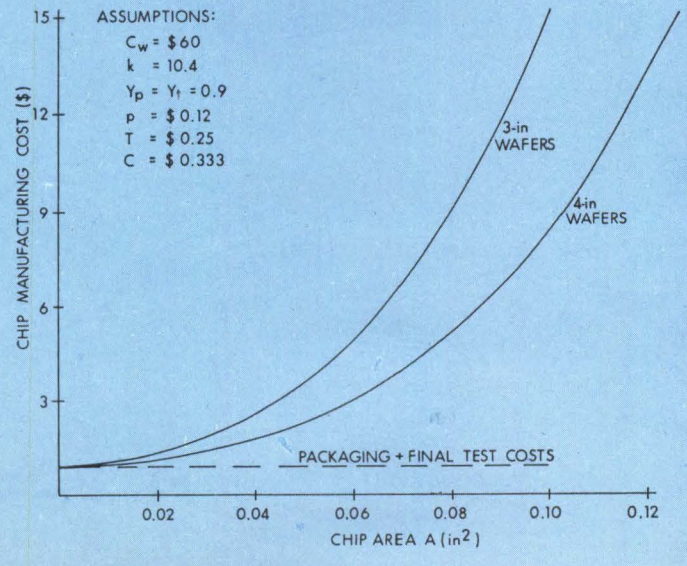
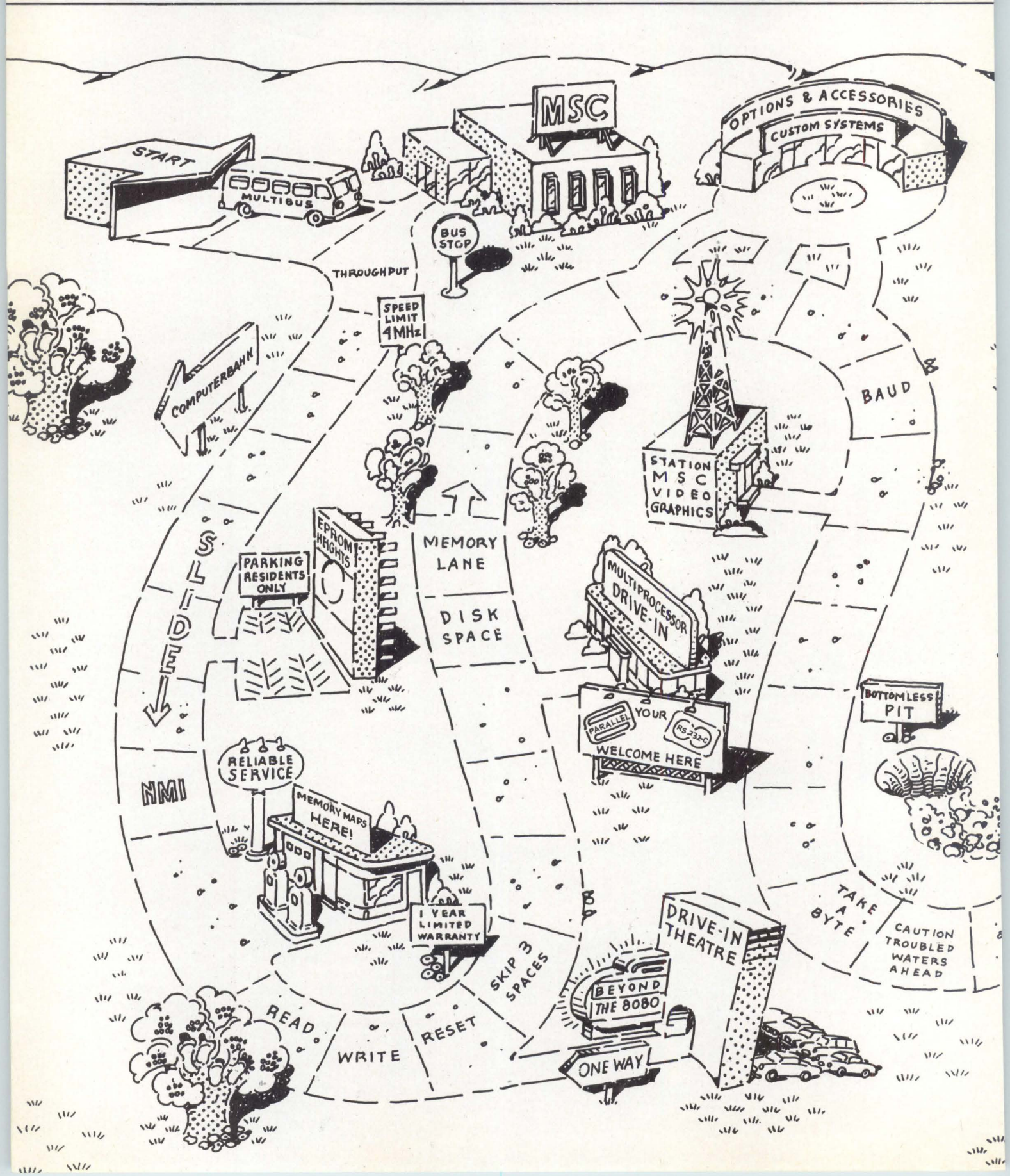
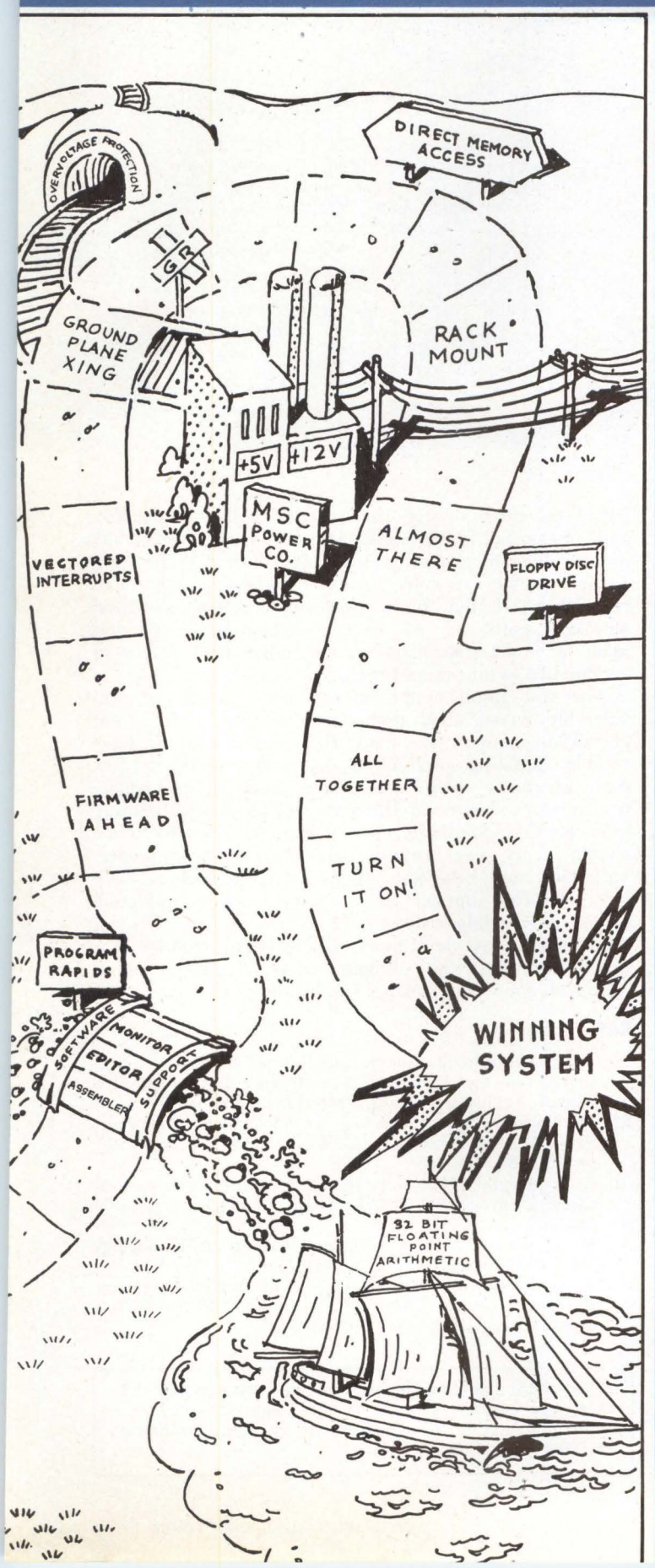


Fig 3 Chip manufacturing cost vs chip area. "Model for Integrated Circuit Manufacturing Costs" predicts that total manufacturing cost is sum of fixed packaging-plus-test cost and processing cost which increases sharply with area. IC prices are typically two to four times manufacturing costs

Your MULTIBUS® based system



starts here.



Take the MULTIBUS with us, Monolithic Systems Corporation. We've got a complete line of MULTIBUS compatible products on our route. Like our Z80A® based single board computers, I/O and memory expansion boards, floppy disk controllers, video graphics controllers and RAM/EPROM add-in memories.

And to complete your system there's our MULTIBUS computer chassis, power supply and extender and universal boards. Our path is easy to follow because we offer an EPROM resident uniform monitor, EPROM resident operating system and a floppy disk resident Z80 to 8080 macro file to guide you through.

Our MULTIBUS compatible products are the best route to a winning system. Check us out. We won't send you back to start.

Our brochures tell all about our MSC 8004 Z80A/Am9511 Single Board Computer and our complete line of MULTIBUS compatible products.

For your free copies call or write Monolithic Systems Corp., 14 Inverness Drive East, Englewood, CO 80112. Phone: 303/770-7400 Telex: 45-4498

The innovators in MULTIBUS compatible products.

Monolithic Systems corp.

14 Inverness Drive East
Englewood, Colorado 80112
303/770-7400

MULTIBUS is a trademark of Intel Corp.
Z80A is a trademark of Zilog, Inc.
©1979, Monolithic Systems Corp.

CIRCLE 25 FOR LITERATURE
CIRCLE 189 FOR QUOTATION

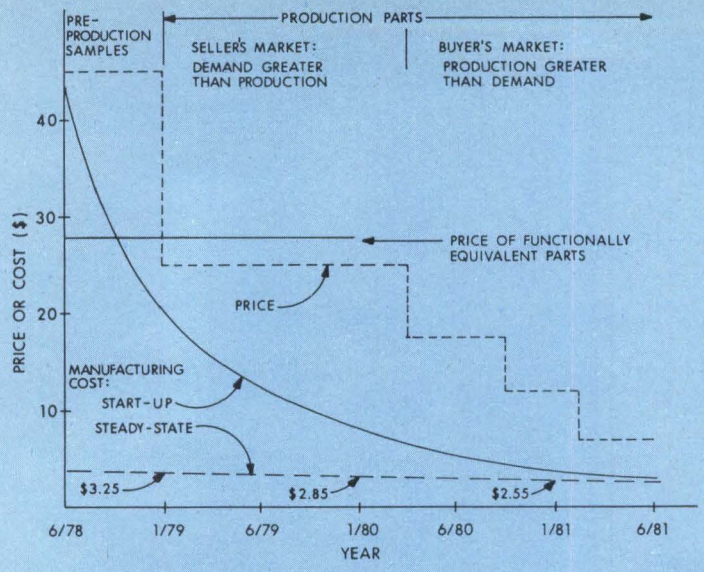


Fig 4 Cost/price history of 0.0625-in² chip on 4-in wafer. In idealized picture, manufacturing cost (solid line) starts much higher than that predicted by model (dashed line), and drops as manufacturing problems are identified and solved. Steady state, model predicted price falls slowly as defect density k drops. Selling price (dotted line) depends on market conditions

$3.25. The equation and graphs show very clearly that cost increases faster-than-linearly with area—for large enough areas, cost increases with the *cube* of area, other things being equal. If we were to modify the model to accommodate the fact that packaging and test costs also increase with chip area to some extent, the increase would be even greater.

The model predicts steady-state manufacturing cost in some given year. As time passes and technology improves, defect density k drops, wafer yield increases, and cost falls off somewhat. But more important, from the equipment designer's point of view, are the manufacturer's start-up problems. When an IC first enters manufacturing, its cost is far higher than that predicted by the model. Typically all yields are lower than their steady-state values, and wafer, connection, and test costs may be higher than standard while the plant learns how to make the part. Wafer yield in particular may be slow to reach its predicted value, and manufacturing may have to make changes in masks and/or in process chemistry and physics to solve the yield problems.

Actual manufacturing cost for a 0.0625-in² (0.403-cm²) chip may thus follow a curve like the solid line in Fig 4, and prices might change as shown by the dotted line. During the first six months, manufacturing costs are very high, yields are low (perhaps 2% or less), parts correspondingly scarce, and production samples are available at a premium price. After this six month period, wafer and other yields have improved somewhat, and there are enough wafers in process for the manufacturer to supply parts in quantity. He then lowers the price to the point where the part will be attractive in comparison to functionally equivalent parts. His yields, however, though improving, are still low, keeping parts in relatively short supply compared with the demand. During the next months there is thus a sellers' market and the price holds steady.

Ultimately yield increases further, alleviating the part shortage. In addition, the success of the IC attracts competitors, and their yields increase to the point that production capacity exceeds demand. Users can get parts from any of several vendors, and make a choice based on price. There thus ensues a buyers' market, and prices fall with increasing frequency. Meanwhile the steady-state manufacturing cost (dashed line in Fig 4) falls slowly as defect density improves, and actual costs approach that limit. However, to cover overhead and sales costs, and to recover development costs and make a profit, the manufacturer must hold prices at a value two to four times his costs.

The cost trend might be somewhat better, or considerably worse, than that shown in Fig 4. It is not at all uncommon to read that manufacturers have trouble initiating production on a new and complex part, especially when some new facet of technology is being introduced. In this case, yields may stubbornly hold at disappointingly low values for months while engineers try new circuits, new masks, new process variations, and new tests. The supply of parts is very low, and the supplier loses money even at premium prices. Meanwhile, users must scramble for parts, or must employ old and more expensive technology. For this reason the wise designer is very cautious about introducing new components into his designs.

References

1. Integrated Circuit Engineering Corp, "Status 1978—A Report on the Integrated Circuit Industry," Integrated Circuit Engineering Corp, Scottsdale, Ariz, 1978
2. M. Phister, *Data Processing Technology & Economics*, Santa Monica Publishing Co, Santa Monica, Calif, 1976, pp 180-187, 491-495
3. B. T. Murphy, "Cost-Size Optima of Monolithic Integrated Circuits," *Proceedings of the IEEE*, Dec 1964, pp 1537-1545
4. R. N. Noyce, "Making Integrated Electronics Technology Work," *Spectrum*, May 1968, pp 63-66
5. A. Gupta and J. W. Lathrop, "Yield Analysis of Large Integrated Circuit Chips," *IEEE Journal of Solid State Circuits*, Oct 1972, pp 389-395

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.**

TEKTRONIX thinks your logic analyzer should be as versatile as you are

So ours let you connect probes *fast.*

The Harmonica Connector: fast, convenient probe connection

Logic analyzer versatility can often mean the difference between spending time on a problem…or on its solution. With some logic analyzers, for example, probe connections can take up to *70% of your time.*

A variety of Tektronix probes give you that time back. The patented *Harmonica Connector* eliminates attaching individual connectors to each test point. Our *Quick Connect Probe* allows you to measure any number of test points, without constantly attaching and re-attaching connectors. Use the *Low Profile Dip Clip* for easy access to integrated circuit pins. There's even a *special probe for the GPIB.*

The result is convenience and efficiency that can encourage you to use your logic analyzer more frequently—*and make you more productive.*

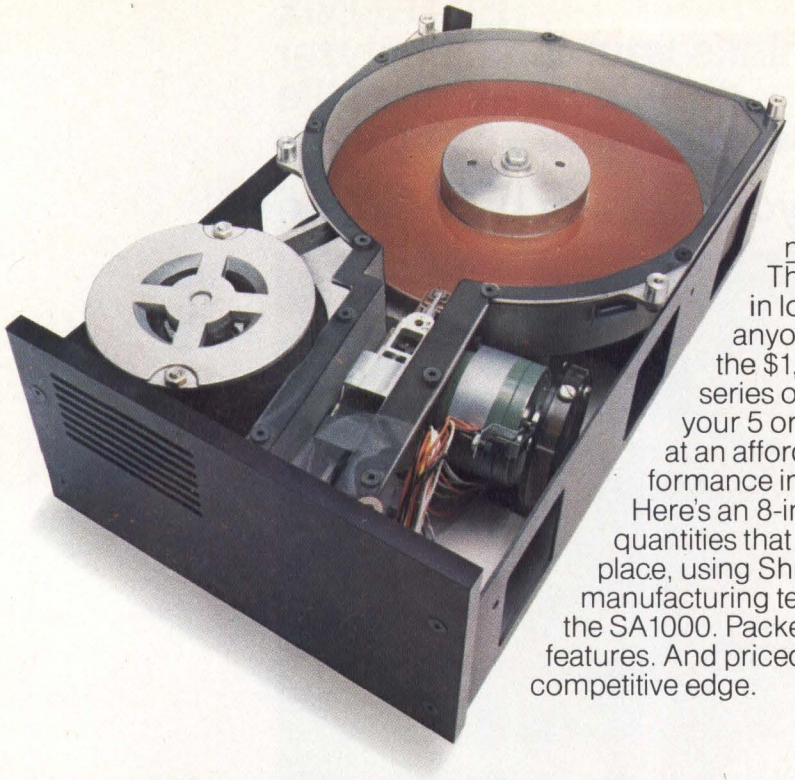
Fast probe connections: they help make our Logic Analyzers versatile. So you can do today's job and tomorrow's. So you can change applications without changing your logic analyzer.

Contact Tektronix Inc., P.O. Box 500, Beaverton, OR 97077. In Europe, Tektronix Ltd., P.O. Box 36, St. Peter Port, Guernsey, Channel Islands.

Tektronix®
COMMITTED TO EXCELLENCE

TEKTRONIX LOGIC ANALYZERS THE VERSATILE ONES

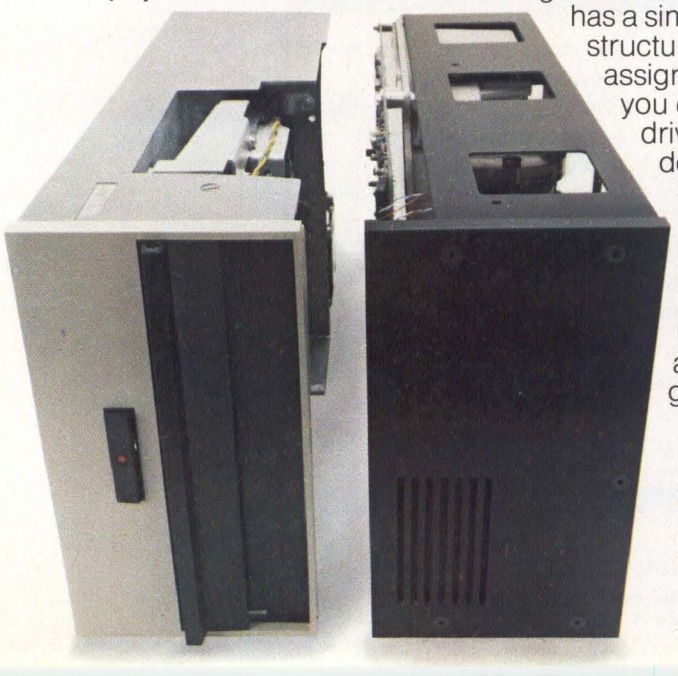
For immediate action dial our toll free automatic answering service 1-800-547-1512

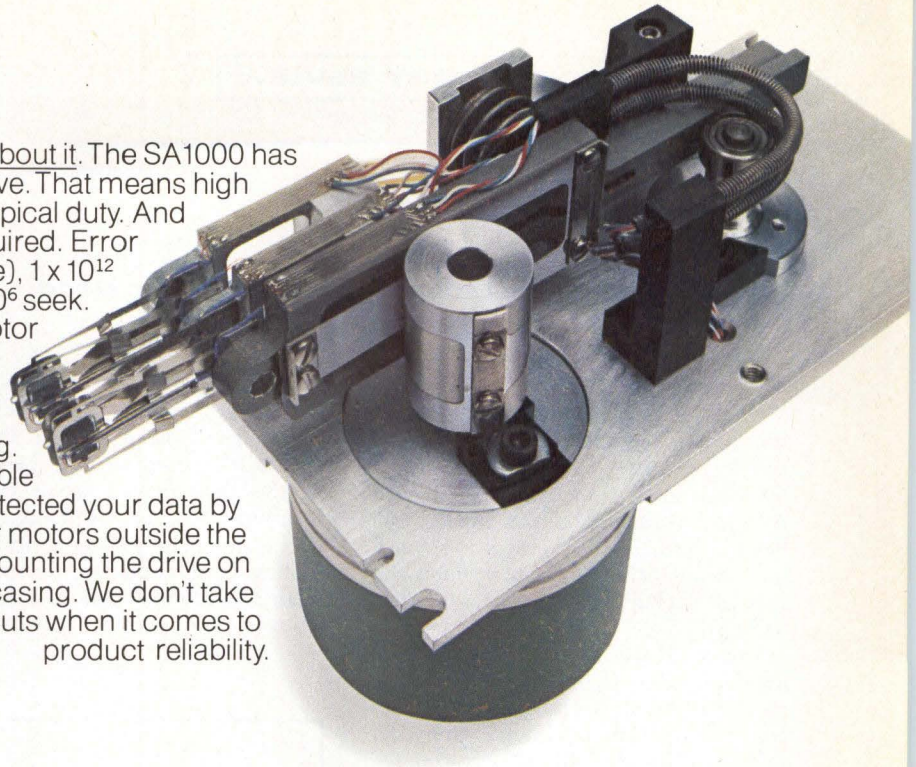


Shugart delivers the lowest cost per megabyte in an 8-inch Winchester drive. The company with more experience in low-cost Winchester technology than anyone else in the industry has broken the $1,000 price barrier with its SA1000 series of 8-inch fixed disk drives. Here's your 5 or 10 megabyte system upgrade at an affordable price. Here's Winchester performance in a compatible floppy-sized package. Here's an 8-inch drive that will be built in the quantities that you need for your marketplace, using Shugart's high volume manufacturing technology. Introducing the SA1000. Packed with valuable features. And priced to give you the competitive edge.

Introducing the 8" fixed disk drive

It's easy to upgrade your system. Our design objective for the SA1000 was to create an 8-inch Winchester drive as mechanically and electrically identical to our floppy disk drives as possible. The result is a drive that has the same physical dimensions and mounting holes as our 8-inch floppy drives. Also, the SA1000 has a simple "floppy-like" interface and command structure. And drive control signals use the same pin assignments as our SA850/851 floppy drives so you can daisy chain both fixed and floppy drives from the same controller. Software development is simple too, because the SA1000 has the same capacity per track as the double-density SA850. Even the power voltages are the same. All this means that we've made it easy and economical for you to increase data throughput to 4.3 Mb/sec., average access time to 70 msec., and capacity to 5 or 10 Mbytes. Shugart gives you value where it counts.

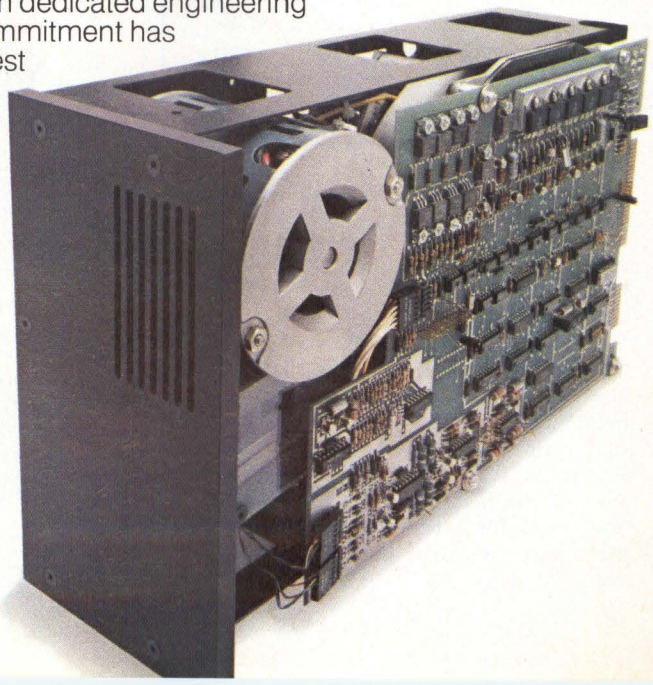




Product reliabilty—we're Headstrong about it. The SA1000 has 40% fewer parts than a floppy drive. That means high MTBF—8000 power-on hours of typical duty. And no preventive maintenance is required. Error rates equal 1 x 10^{10} soft (recoverable), 1 x 10^{12} hard (non-recoverable), and 1 x 10^{6} seek. The belt-driven AC spindle drive motor eliminates the need for a separate power supply. Our new Fasflex™ III ball bearing-supported actuator provides more precise head-to-track positioning. Data reliability? We've eliminated possible media contamination and further protected your data by locating the AC drive and stepper motors outside the media chamber and by shock-mounting the drive on three points within its casing. We don't take shortcuts when it comes to product reliability.

SA1000. The only under $1000.

Shugart's Headstrong about product availability. From initial product concept through manufacturing, Shugart has designed the SA1000 for high volume, highly mechanized production and backed it with it's own dedicated engineering and manufacturing organization. This kind of commitment has made it possible for us to bring you the lowest cost per function 8-inch fixed disk drive available today. We'll be delivering the SA1000 drives in the first quarter of 1980. Optional controller and data separator will also be available. The new SA1000 from The Headstrong Company. Contact your nearest sales office. Shugart headquarters: 435 Oakmead Parkway, Sunnyvale, CA 94086 (408) 733-0100; West Coast Sales/Service: (408) 737-9241; 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 26 ON INQUIRY CARD

Single-Channel, Positionable Magnetic Tape Head Records 16 Tracks with 12k-Bit/in Density

A positionable bidirectional read-after-write head can double the bit density and significantly increase track density of tape systems. Developed by Nortronics Co, Inc, 8101 Tenth Ave, N, Minneapolis, MN 55427, the head combines the best of disc and tape head technologies to reduce the cost of backup storage for rigid disc systems.

Increased use of rigid discs in various sizes for high speed access to data has created the need for low cost backup systems. Such systems do not require the high performance characteristics of large tape drives because they normally run in a streaming mode—you turn on the drive and let it run—continually recording data with no start or stop. To do this economically, however, both high track density and high bit density are necessary to provide the needed capacity. Current backup storage—floppy discs and 7-track 0.25" (0.635-cm) tape drives—are either too expensive or lack the necessary capacity.

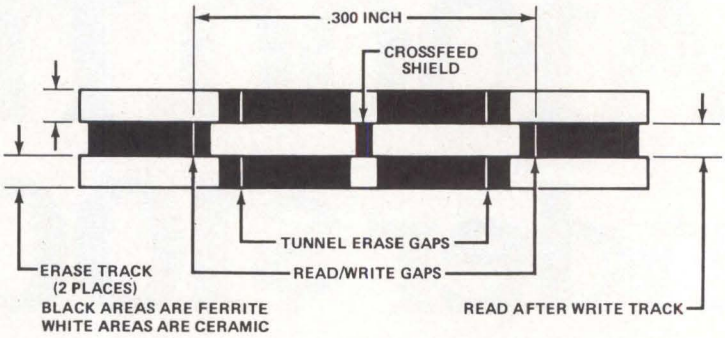
The single-channel positionable head permits high track and bit density recording, at a fraction of the cost of heads in existing backup systems. Capable of writing up to 16 data tracks (see Fig 1) on 0.25" magnetic tape and increasing bit density to 12,000 bits/in (4724/cm), approximately twice what is currently possible, the head is constructed of ferrite and ceramic to extend head and tape life, and to permit increased bit density.

In use (see Fig 2), the single-channel head is first positioned to record one track near the tape edge. When the tape has run its length, the head automatically reverses itself, moving and recording data in the opposite direction. This recording process continues in a serpentine manner.

Read-after-write capability (Fig 3), automatically reversed when the tape is reversed, is a key feature of the head, according to Matthias Grundtner, director of engineering for Nortronics. When tape is reversed the area of the head that was reading is now used for writing, and the area that was writing begins reading. "While the tape is written in one direction, the same track will have a symmetrical assembly on the other end that is used to read back. Thus, as the tape moves across the head, it is written, erase trimmed, and read back immediately after writing." This feature permits data to be transferred from disc to tape with minimum error. A second important feature of the head is the symmetrical tunnel erase system which permits close track spacing, and therefore more tracks with reduced noise.

Prototype units are currently being built; manufacture of the heads will begin early in 1980. In high production quantities, the 1-track positionable head will cost approximately $75.

Circle 175 on Inquiry Card



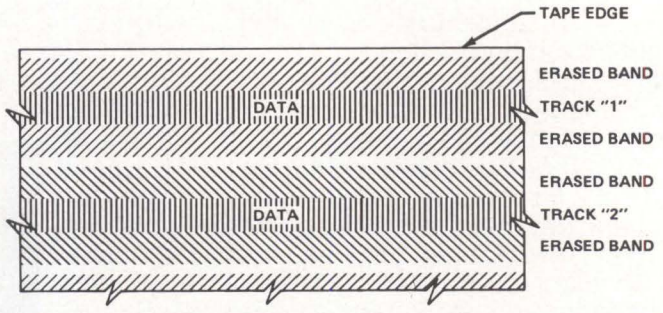


Fig 1 Bidirectional read-after-write tape head (a) is capable of recording up to 16 tracks on 0.25" tape with a density of 12,000 bits/in. Combination of ferrite and ceramic areas permits increased bit density. Symmetrical tunnel erase system permits close track spacing without increased noise, and results in multitrack tape format (b), with Track 1 written in one direction, Track 2 in the reverse

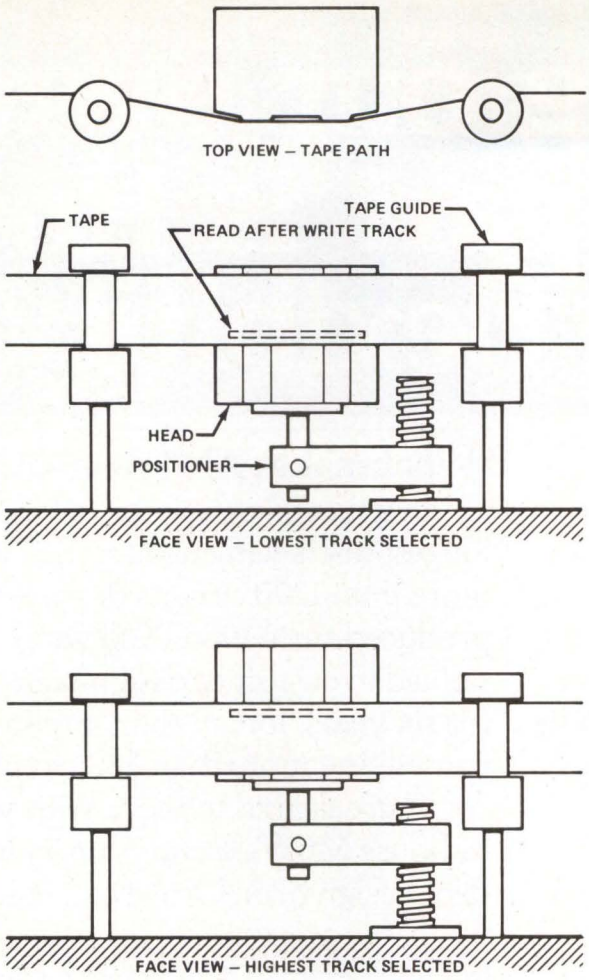


Fig 2 Positionable single-channel magnetic tape head assembly combines disc and tape head technologies to provide high track and bit density at low cost

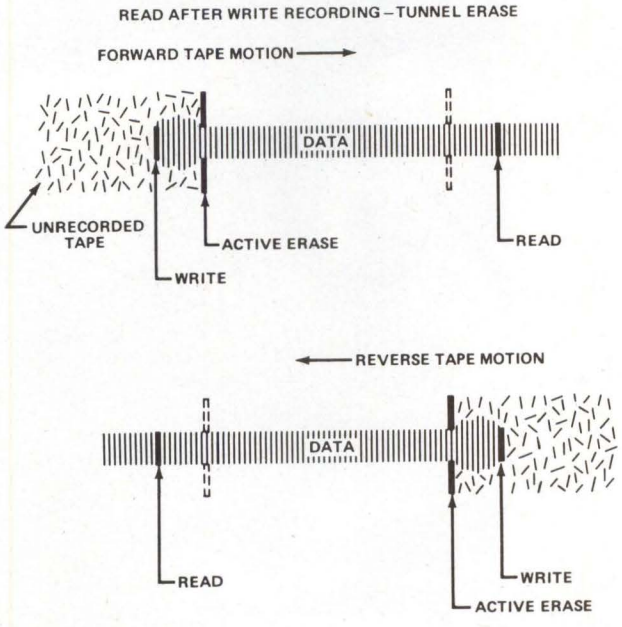
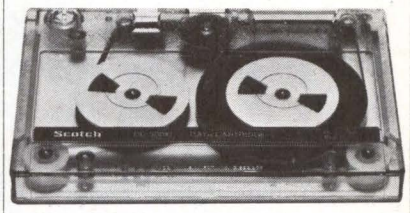


Fig 3 Read-after-write capability that is automatically reversed when tape is reversed results in serpentine recording on tape

THE FIRST DATA CARTRIDGE THAT ALWAYS FINISHES LAST.



3M's DC-300-XL Data Cartridge always finishes last because it records and stores at a field-tested rate of 6400 bpi on 450 feet of tape. And that's 150 feet more than standard data cartridges.

Which means you won't have to change it so often. And you'll have fewer cartridges to mess with. Or lose.

Like all 3M DC-300-A data cartridges, the DC-300-XL has the same metal baseplate. And the ANSI three-point positioning system.

What's more, it's the exact same size as other 300-foot cartridges. So you can use it in any drive that accepts standard cartridges. Yet the DC-300-XL stores 50% more data.

You see, sometimes finishing last has its advantages, too.

For information about where to get the DC-300-XL, call toll-free, 800-328-1300. In Minnesota, call collect: (612) 736-9625. Or write: Data Products/3M, 223-5E, 3M Center, St. Paul, MN 55101.

3M

CIRCLE 27 ON INQUIRY CARD

"Designing our own LSI The hard part is finding with some flexibility."

The inflexibility of most LSI manufacturers can be really frustrating. The fact is, they're just not set up to handle "customer designed" projects.

You'll find things a lot different at AMI. We're the *only* major LSI company with a group specially organized to handle these jobs. It's our sole responsibility. Last year, we ran more than a hundred circuits designed by a wide variety of customers. And the list is growing fast.

"We want to do it our way."

That's okay with us. No two customers bring us a job at the same stage of development anyway. So it would be a waste of our time and your effort to set up a lot of hard and fast requirements. Instead, we make it as simple as possible for you to interface with us at almost any design or production phase.

You can supply us working plates, pattern generator or data base tapes, complete test programs or test vectors. We'll take it from there. And we'll provide components at any of these stages: wafers, prototype circuits, or complete, fully tested assemblies.

We don't limit your choice of process, either. We work in 25 variations of four basic MOS disciplines. What's more, our manufacturing capability is large enough to set aside an entire fab line for fast turn-around circuit prototyping. And allocate other fab lines for production runs.

"What makes AMI so great?"

In a word: experience. We have the longest history in custom, with a record of more than 1200 circuits designed and produced since 1966. And we've been involved in customer designed projects for six years, longer than anyone else, completing more than 300 circuits.

We're geared to work with your in-house MOS designers or an independent design firm. Or we can handle your

We're flexible enough to work with you at almost any stage of your circuit development. After all, you're the customer.

circuit isn't the problem. a manufacturer

Comparison of MOS Processes

	P Chan Hi V_T Metal	P Chan 1^2 Metal	P Chan SiGate	N Chan SiGate	Complementary MOS	N Chan 1^2	N Chan 1^2 + dep Lds.	VMOS
Speed (per unit area)	6	4	5	3	2	3	1	0
Power Consumption (low speed)	6	2	4	5	1	5	3	3
Area (per logic function)	4	3	3	2	5	2	1	0
Noise Immunity	4	2	5	5	1	4	3	3
Logic Flexibility	3	1	3	3	1	2	1	1
On-Chip Clock Generation	4	2	5	4	1	3	2	2
Bipolar Compatibility	5	2	3	1	1	1	1	0
Power Supply Latitude	4	2	4	4	1	3	2	3
Process Simplicity	1	2	2	2	6	3	4	6

Rankings are relative among the processes, with the lowest number being most desirable.

AMI offers 25 variations of four basic MOS processes. So you can pick the one that fits your product and budget.

job from scratch, giving it the full custom treatment that has made us the leader in this field.

We're also in a unique position to advise you on the best way to tackle your application. As we also produce standard 4, 8 and 16-bit microprocessors (the S2000, S6800 and S9900), we may be able to show you a cost-effective way to mix standard MPUs and custom peripherals. Or customize a standard MPU specially for you.

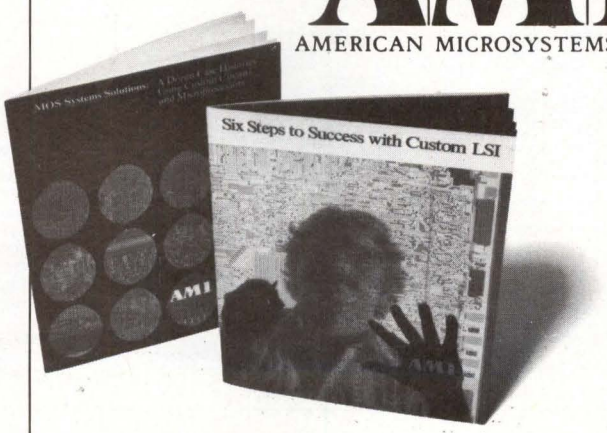
"Fine, but I need more details."

We have all the documentation you need, from design and test parameters to production schedules. And we've also just published two new brochures describing AMI's involvement in the custom LSI business. These are "Six Steps to Success with Custom LSI" and "MOS Systems Solutions: A Dozen Case Histories Using Custom Circuits and Microprocessors."

You can get hold of copies by writing to AMI Customer Designs Marketing II, 3800 Homestead Road, Santa Clara CA 95051. Phone (408) 246-0330. Or from one of these AMI sales offices: California, (213) 595-4768; Florida, (305) 830-8889; Illinois, (312) 437-6496; Indiana, (317) 773-6330; Massachusetts, (617) 762-0726; Michigan, (313) 478-9339; New York, (914) 352-5333; Pennsylvania, (215) 643-0217; Texas, (214) 231-5721, Washington, (206) 687-3101.

And, if you'd like a "live" show, we'll make a 30-minute presentation right in your office. That should be long enough to convince you how flexible an LSI company can be.

AMI®
AMERICAN MICROSYSTEMS, INC.



CIRCLE 28 ON INQUIRY CARD

MOS Memory Option For Mainframes Increases Execution Speeds

Doubling memory capacity of earlier MOS configurations and making semiconductor memory available on the DECsystem 1091-S, the MOS memory option, announced by Digital Equipment Corp, Large System Group, Maynard, MA 01754, provides a factor of 14 improvement in availability. Expansion of primary memory made possible with the option decreases the reliance on secondary memory devices and thus increases system execution speeds.

Because the MOS memory modules used for both the DECsystem 1091-S and DECsystem 2040 and 2060 incorporate error correction logic capable of correcting single-bit errors and detecting double-bit errors, an improvement in reliability can be seen over core memory systems. In addition, 64k-byte segments of memory can be mapped out dynamically to allow for deferred corrective maintenance.

Up to 12M bytes of MOS memory can be installed in the 1091-S configuration; the first 6M in the basic system cabinet, with a separate cabinet necessary for additional increments. The same type of cabinet is used to expand capacity of 2040 and 2060 configurations to the system maximums of 12M bytes.

Basic system configurations of 2040, 2060, and 1091-S, including 1M byte of memory, are priced from $324,600, $399,100, and $440,700, respectively. Deliveries of MOS memory and memory expanded versions are scheduled for early next year.

Circle 176 on Inquiry Card

Mid-Range Computer Meets Short Term Demands With Accelerator Option

A mid-range addition to the 470 series of high performance computers made by Amdahl Corp, 1250 E Arques Ave, Sunnyvale, CA 94086, the 470V/7A gives users high performance at lower cost with the option of increasing capacity through upgrades. 470/Accelerator hardware provides ability to meet short term increases in demand without having to support expensive idle capacity over the long term.

With performance rated between that of the V/6-11 and the V/7 and slightly higher than that of the IBM 3033, a minimum configuration V/7A consists of 4M bytes of memory, 12 I/O channels, 32k-byte high speed RAM buffer, console display, and independent console processor. Machine cycle time is 29 ns. This configuration expands to 16M bytes of memory and 16 I/O channels. Optional are 470/Accelerator, channel to channel adapter, and 2-byte interface.

The 12 I/O channels can be configured by the user into any combination of block multiplexer, byte multiplexer, or selector channel mode. 2048 subchannels are provided. Using high performance bipolar RAMS to speed access, the buffer is organized as a set associative cache memory with eight sets.

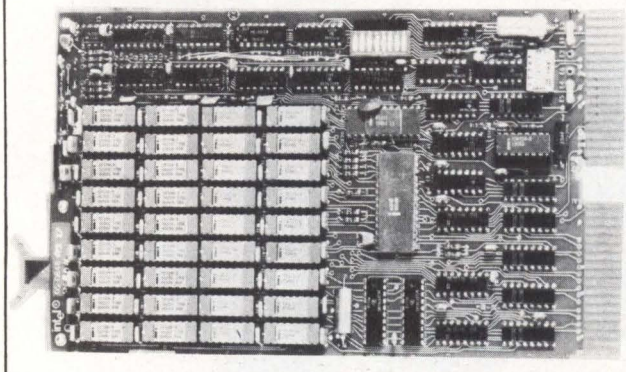
The independent console processor, an internal minicomputer, performs service diagnostics, monitors important CPU functions, and interfaces to the company's diagnostic assistance center to obtain remote maintenance support for the system.

Available on a time metered rental basis, the 470/Accelerator when activated by user command increases processor performance. It operates with V/5 and V/5-11, raising their performance to V/6 and V/6-11 levels, respectively; and increases performance of a V/7A to the V/7 level—approximately 20%.

Consisting of special console processor software command and LSI hardware, the option installs within the existing system. A single accelerator command brings the unit online; another turns the unit off. Software is not affected either in the transition or while the CPU is in accelerator mode. Similarly, jobs are not disrupted by either on or off command.

A hardware meter to measure CPU time spent in accelerator mode is included in the system as a usage meter, not an elapsed time meter. In minimum configuration the V/7A will sell for $2,450,000. The Accelerator option will rent for $1800/mo for 20-h usage, plus $90/h beyond the 20-h minimum.

Circle 177 on Inquiry Card



LOW PRICES ON INTEL'S LSI-11 & PDP-11 COMPATIBLE MEMORY

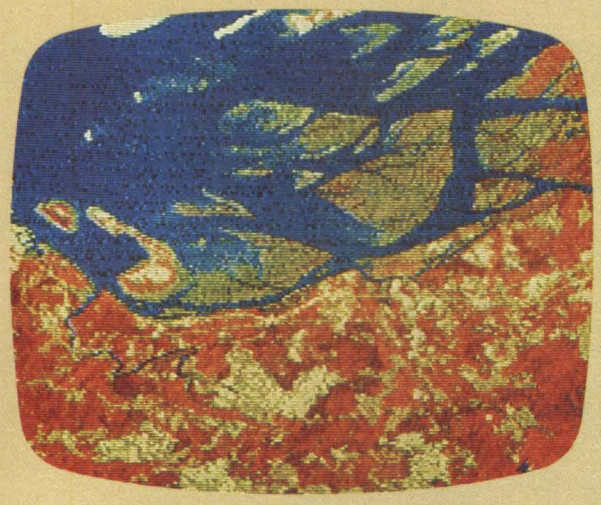
Model in 5004 Memory For LSI-11, LSI 11/2 & PDP 11/03
5004-624 48KBytes (24KX16) $732.00
5004-632 64KBytes (32KX16) $820.00

Model in 5034 Memory For PDP - 11/04 & PDP - 11/34
5034-832 64KBytes w/Parity (32KX18) $1062.00
5034-864 128KBytes w/Parity (64KX18) $1606.00

Model in 1670 Memory For PDP 11/70 (Price upon request)

ORDER FROM: SECO Sales, Inc., 111 S. Maitland Ave., Suite 202, P. O. Box 1475, Maitland, FL 32751 – Phone 305–645-3444

Image processing. Your way.



Now, with the Grinnell GMR-270 Image Processing System, you can have pipeline image processing tailored to fit your application.

The GMR-270 combines the best features of our proven GMR-27 line of high speed graphic display systems with a special package of sophisticated image processing features. The result is a modular image processing system that can be furnished with any or all of the following:

- Convolution
- Image multiplication and ratioing
- Zoom and pan
- 512 x 512 panning window on a 1024 x 1024 image
- Function memories
- Pseudo-color tables
- Video digitizers with frame averaging
- Split screen and image toggling
- Full graphics and alphanumerics
- Up to four overlay memory planes
- Independent cursors
- Trackballs and joysticks
- External synchronization
- Plug compatible interfaces for most minicomputers

In addition, the GMR-270 has a display resolution of 512 x 512 pixels and a video format that is RS-170 compatible. It is housed in a rack-mountable chassis and drives standard TV monitors.

Besides the GMR-270, Grinnell manufactures two complete lines of graphic television display systems: the GMR-27 Series and the GMR-37 Series. GMR-27 units are high speed, graphic and image display systems; GMR-37 units are low cost graphic display systems. Both are available with display resolutions from 256 x 512 to 1024 x 1024.

So, whether you want to analyze images from outer space or monitor a process in a plant, Grinnell has a system that can do it. For detailed specifications and/or a quotation, call or write today.

Photographs provided by Stanford University Department of Applied Earth Sciences, Palo Alto, California.

GRINNELL SYSTEMS

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

CIRCLE 30 ON INQUIRY CARD

WHAT SPERRY UNIVAC IS DOING IN THE MINICOMPUTER BUSINESS.

WE'RE BUILDING HARDWARE THAT HELPS CUT THE COST OF SOFTWARE.

The Sperry Univac V77-600 and V77-800 minicomputers with SUMMIT don't just speak Pascal, they were designed and assembled with it.

At Sperry Univac Mini-Computer Operations, we understood that Pascal was a giant advance in computer technology when other manufacturers still considered it a passing fancy.

And now that they are just beginning to recognize Pascal as the cost saving, time saving solution to the spiraling expense of software, we've already perfected our Pascal designed systems.

MAKES PROGRAMMERS 10 TIMES AS PRODUCTIVE.

Pascal is a high level, general purpose language, composed in orderly steps so it's easy and efficient to write. It provides for excellent documentation so that software errors can be reduced by as much as 90% over Cobol.

But most important, Pascal dramatically cuts the time necessary for programming — a major consideration when most programming staffs spend nearly 75% of their time just maintaining existing software.

COST CUTTING PORTABILITY.

Although Pascal is frequently used as a system development language, unlike an assembly language, it can be transported between computers that support Pascal with minimal reprogramming.

This advantage alone means that the existing software can be used on newer, state-of-the-art systems. It's not necessary to write a whole new program for the new computer.

ALL THE TOOLS FOR COMPLETE PASCAL SUPPORT.

The Sperry Univac Structured Programming System (SPS) running under our SUMMIT operating system, includes several powerful program development tools available for Pascal support.

Pascal Compiler conforms to recognized industry standards and provides concurrent compilation for from one to 32 terminals.

Pascal Debugger allows the terminal user to monitor execution of Pascal code on a program, procedure, or line-within-procedure basis.

Pascal Program Formatter accepts Pascal program source code in an unstructured form and produces indented source output, conforming with generally accepted practice for structured programs.

SPS Text Editor allows the terminal user to enter and edit Pascal source code in an efficient manner.

SPS Document Formatter provides for the efficient generation of documentation.

Pascal Concordance program sorts and outputs all symbols and symbol-references within a Pascal source file.

WE'RE COMMITTED TO SOLVING YOUR PROBLEMS.

That's why we're committed to Pascal. We know a major concern of our customers involves curbing and controlling the high cost of programming and maintaining software.

At Sperry Univac Mini-Computer Operations, we feel that with Pascal and our Pascal adapted systems we're helping our customers solve those problems.

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

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

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

SPERRY UNIVAC

SPERRY UNIVAC IS A DIVISION OF SPERRY RAND CORPORATION

CIRCLE 31 ON INQUIRY CARD

Sperry Univac Mini-Computer Operations, Marketing Communications, 2722 Michelson Dr., Irvine, California 92713.

Please send information on Sperry Univac minicomputers with Pascal to:

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY_____

STATE_____ ZIP_____

PHONE (_____)_____

CD

ICEMAN delivers the Never-Say-Die supply!

400 W, PSN1801, Single-Output ICEMAN Switching Power Supply

Now you have reliability that won't melt away.

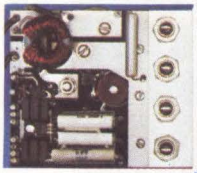
Just like our line of ICEMAN™ linear supplies, long-term reliability in a switcher begins with how it's made. Fewer components, fewer connections, less wiring, reduced failure points and modes.

That was our design goal.

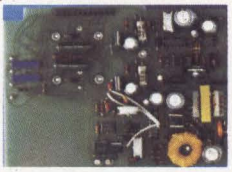
By actual count, this Motorola PSN1801 switcher contains only 143 electrical parts—about 25% less than the nearest comparable. It employs only 22 wires. Others have 200 or more. It uses just one connector. Some use as many as 20.

Two boards and MTBF.

There's more protective circuitry, in less space, in a Motorola ICEMAN switcher than anyone else offers. Just two circuit boards do it all.



The control board measures only 24 square inches and contains the latest multifunction ICs in place of dozens of discrete parts. The board



furnishes remote turn-on/turn-off, overcurrent and short-circuit protection, soft-start to limit overshoot voltage, automatic reset of OVP, primary current limit and capacitor bleed-off circuits.

The 18 square inch main output board combines OVP, soft-start for inrush current limiting and all output supply components.

ICEMAN keeps his cool.

All the way through. Longer. More efficiently.

Four paralleled, 60 A, high-temperature Switchmode™ Schottkys, with a maximum of 240 A capability, are used to achieve the 5 V, 80 A output. In other words, they're run at just 33% of total capability. And the Schottkys and the low-sat, high-speed Switchmode power transistors run at no more than 65% and 60%, respectively, of maximum rated junction temperatures, minimizing thermal stress.

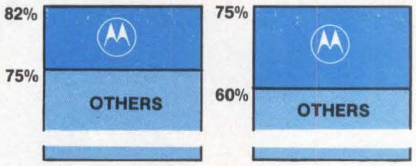
Specifications

PSN1801, 5 V/80 A
PSD1802, 5 V/60 A, 12 V/8 A
PST1803, 5 V/60 A, 12 V/4 A, 12 V/4 A

Input. 100-130 Vac/200-260 Vac (Selectable), 45-440 Hz Single Phase
Output. Floating, isolated from each other and from ground, 600 Vdc max
Regulation. Line: ±0.1% Output, for 100-130 or 200-260 Vac. Load: ±0.29% Output, no load to full load
Ripple and Noise. Less than 10 mV RMS, 50 mV p-p, as measured with 50 MHz scope
Temp. Coefficient. Less than 0.2%/°C
Switching Frequency. 25 kHz (Pulse width modulated)
Transient Response. 500 μs to within 1% after a 25% load change at 5 A/μs, main output

The standard warranty period for all Motorola linear and switching power supplies is 1 year.

The heat sinking is up to 100% thicker than others, ensuring even thermal gradients with all the heat quickly going where it's supposed to go . . . out. We've even special-wound the transformer to cut losses.



You also get minimum 30 ms hold-up time so the regulated 5 V supply is retained after interruption under full load.

Cost is cool, too.

Prices for the three models range from $530 to $675, 1 to 9 quantity.

Contact Motorola Subsystem Products, P.O. Box 20912, Phoenix, AZ 85036, (602) 244-3103 or your authorized Subsystem distributor or representative for more information.

ICEMAN.
Quality delivered.

MOTOROLA INC.

CIRCLE 32 ON INQUIRY CARD

ICEMAN'S Available

MOTOROLA MANUFACTURERS' REPRESENTATIVES

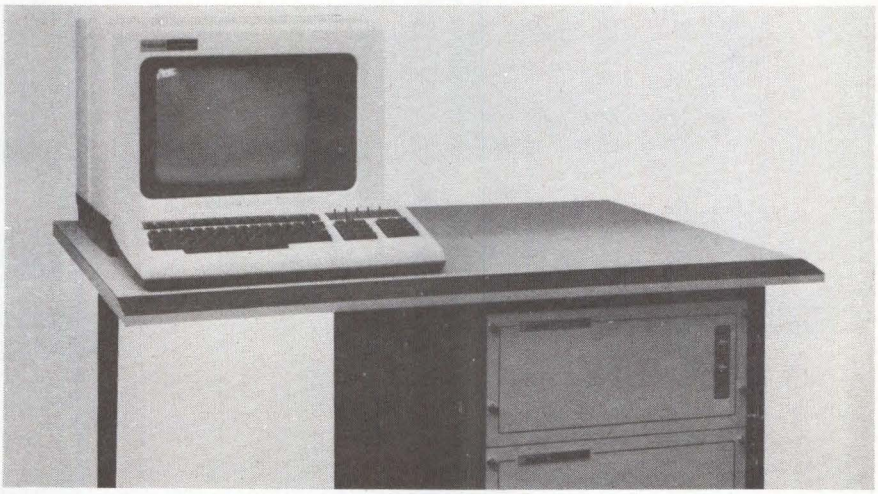
ARIZONA, Phoenix	Summit Sales	(602) 994-4587
CALIFORNIA, Los Angeles	Ed Landa Company	(213) 879-0770
CALIFORNIA, San Diego	Ed Landa Company	(714) 436-7498
CALIFORNIA, San Francisco	QuadRep Inc.	(408) 733-7300
COLORADO, Denver	Thorson Company	(303) 759-0890
INDIANA, Ft. Wayne	McFadden Sales	(219) 485-2526
INDIANA, Indianapolis	McFadden Sales	(317) 896-5070
MICHIGAN, Detroit	McFadden Sales	(313) 681-7540
MINNESOTA, Minneapolis	Comstrand, Inc.	(612) 788-9234
NEW JERSEY, Newark	HLM Associates	(201) 263-1535
NEW YORK, New York	HLM Associates	(516) 757-1606
NEW YORK, Rochester	S.F. Foster Co., Inc.	(716) 265-2072
NEW YORK, Syracuse	S.F. Foster Co., Inc.	(315) 637-5427
OHIO, Cleveland	McFadden Sales	(216) 381-8070
OHIO, Columbus	McFadden Sales	(614) 459-1280
OHIO, Dayton	McFadden Sales	(614) 877-9934
OREGON, Beaverton	E.S. Chase Co., Inc.	(503) 641-4111
PENNSYLVANIA, Philadelphia	TAI Corp	(215) 627-6615
TEXAS, Dallas	Mycrosystems Mktg., Inc.	(214) 238-7157
TEXAS, Houston	Mycrosystems Mktg., Inc.	(713) 783-2900
TEXAS, San Antonio	Mycrosystems Mktg., Inc.	(512) 735-5073
UTAH, Salt Lake	Anderson Associates	(801) 292-8991
WASHINGTON, Seattle	E.S. Chase Co., Inc.	(206) 762-4824

AUTHORIZED MOTOROLA SUBSYSTEM DISTRIBUTORS

ALABAMA, Huntsville	Hall-Mark Electronics	(205) 837-8700
ALABAMA, Huntsville	Hamilton/Avnet Electronics	(205) 837-7210
ARIZONA, Phoenix	Hamilton/Avnet Electronics	(602) 275-7851
ARIZONA, Phoenix	Wyle Distribution Group	(602) 249-2232
ARIZONA, Phoenix	Sterling Electronics	(602) 258-4531
CALIFORNIA, Costa Mesa	Avnet	(714) 754-6111
		(213) 558-2345
CALIFORNIA, Culver City	Hamilton Electro Sales/L.A.	(213) 558-2000
CALIFORNIA, Cupertino	Western Microtechnology Sales	(408) 725-1660
CALIFORNIA, El Segundo	Wyle Distribution Group	(213) 322-8100
CALIFORNIA, Irvine	Schweber Electronics	(213) 537-4321
		(714) 556-3880
CALIFORNIA, Sunnyvale	Hamilton/Avnet Electronics	(408) 743-3300
CALIFORNIA, Palo Alto	Kierulff Electronics, Inc.	(415) 968-6292
CALIFORNIA, San Diego	Hamilton/Avnet Electronics	(714) 279-2421
CALIFORNIA, San Diego	Wyle Distribution Group	(714) 565-9171
CALIFORNIA, Santa Clara	Wyle Distribution Group	(408) 727-2500
COLORADO, Commerce City	Wyle Distribution Group	(303) 287-9611
COLORADO, Denver	Hamilton/Avnet Electronics	(303) 534-1212
CONNECTICUT, Danbury	Schweber Electronics	(203) 792-3500
CONNECTICUT, Georgetown	Hamilton/Avnet Electronics	(203) 762-0361
CONNECTICUT, Wallingford	Cramer/Connecticut	(203) 265-7741
FLORIDA, Ft. Lauderdale	Hall-Mark Electronics	(305) 971-9280
FLORIDA, Ft. Lauderdale	Hamilton/Avnet Electronics	(305) 971-2900
FLORIDA, Hollywood	Schweber Electronics	(305) 927-0511
FLORIDA, Orlando	Hall-Mark Electronics	(305) 855-4020
FLORIDA, St. Petersburg	Hamilton/Avnet Electronics	(813) 576-3930
FLORIDA, St. Petersburg	Kierulff Electronics Inc.	(813) 576-1966
GEORGIA, Norcross	Hamilton/Avnet Electronics	(404) 448-0806
ILLINOIS, Chicago	Newark Electronics Corp.	(312) 638-4411
ILLINOIS, Elmhurst Industrial Park	Semiconductor Specialists, Inc./Chicago	(312) 279-1000
ILLINOIS, Bensenville	Hall-Mark Electronics	(312) 860-3800
ILLINOIS, Elk Grove Village	Pioneer/Chicago	(312) 437-9680
ILLINOIS, Elk Grove Village	Schweber Electronics	(312) 593-2740
ILLINOIS, Schiller Park	Hamilton/Avnet Electronics	(312) 678-6310
INDIANA, Indianapolis	Graham Electronics Supply, Inc.	(317) 634-8202
INDIANA, Indianapolis	Pioneer/Indianapolis	(317) 849-7300
KANSAS, Overland Park	Hamilton/Avnet Electronics	(913) 888-8900
KANSAS, Shawnee Mission	Hall-Mark Electronics	(913) 888-4747
MARYLAND, Gaithersburg	Cramer/Washington	(301) 948-0110
MARYLAND, Gaithersburg	Pioneer/Washington Electronics	(301) 948-0710
MARYLAND, Gaithersburg	Schweber Electronics	(301) 840-5900
MARYLAND, Hanover	Hamilton/Avnet Electronics	(301) 796-5684
MARYLAND, Savage	Pyttronic Industries, Inc.	(301) 953-9650
MASSACHUSETTS, Bedford	Schweber Electronics	(617) 275-5100
MASSACHUSETTS, Lexington	Harvey Electronics	(617) 861-9200
MASSACHUSETTS, Newton	Cramer Electronics, Inc.	(617) 969-7700
MASSACHUSETTS, Woburn	Hamilton/Avnet Electronics	(617) 935-9700
MICHIGAN, Livonia	Hamilton/Avnet Electronics	(313) 522-4700
MICHIGAN, Livonia	Pioneer-Standard Electronics	(313) 525-1800
MICHIGAN, Livonia	R S Electronics	(313) 525-1155
MINNESOTA, Bloomington	Hall-Mark Electronics	(612) 884-9056
MINNESOTA, Eden Prairie	Schweber Electronics	(612) 941-5280
MINNESOTA, Edina	Hamilton/Avnet Electronics	(612) 941-3801
MISSOURI, Earth City	Hall-Mark Electronics	(314) 291-5350
MISSOURI, Hazelwood	Hamilton/Avnet Electronics	(314) 731-1144
#MISSOURI, Kansas City	LCOMP/Kansas City, Inc.	(816) 241-2400
#MISSOURI, Maryland Heights	LCOMP/St. Louis, Inc.	(314) 291-6200
NEW JERSEY, Cherry Hill	Hamilton/Avnet Electronics	(609) 234-2133
NEW JERSEY, Fairfield	Hamilton/Avnet Electronics	(201) 575-3390
NEW JERSEY, Fairfield	Schweber Electronics	(201) 227-7880
NEW JERSEY, Pinebrook	Harvey Electronics	(201) 575-3510
NEW MEXICO, Albuquerque	Hamilton/Avnet Electronics	(505) 765-1500
NEW YORK, East Syracuse	Hamilton/Avnet Electronics	(315) 437-2642
#NEW YORK, Farmingdale	Harrison Radio Corporation	(516) 293-7979
NEW YORK, Hauppauge, LI	Cramer/Long Island	(516) 231-5600
NEW YORK, Liverpool	Cramer Electronics	(315) 652-1000
NEW YORK, Rochester	Cramer/Rochester	(716) 275-0300
NEW YORK, Rochester	Hamilton/Avnet Electronics	(716) 442-7820
NEW YORK, Rochester	Schweber Electronics	(716) 424-2222
NEW YORK, Vestal	Harvey Electronics	(607) 748-8211
NEW YORK, West Henrietta	Harvey Electronics	(716) 334-5920
NEW YORK, Westbury, LI	Hamilton/Avnet Electronics	(516) 333-5800
NEW YORK, Westbury, LI	Schweber Electronics	(516) 334-7474
NEW YORK, Woodbury, LI	Harvey Electronics	(516) 921-8700
NORTH CAROLINA, Greensboro	Pioneer/Washington	(919) 273-4441
NORTH CAROLINA, Raleigh	Hall-Mark Electronics	(919) 832-4465
NORTH CAROLINA, Raleigh	Hamilton/Avnet Electronics	(919) 829-8030
NORTH CAROLINA, Winston-Salem	Cramer/Winston-Salem	(919) 725-8711
OHIO, Centerville	Hamilton/Avnet Electronics	(513) 433-0610
OHIO, Cleveland	Pioneer/Washington Electronics	(216) 587-3600
OHIO, Dayton	Pioneer/Dayton	(513) 236-9900
OHIO, Warrensville Heights	Hamilton/Avnet Electronics	(216) 831-3500
OKLAHOMA, Tulsa	Hall-Mark Electronics	(918) 835-8458
PENNSYLVANIA, Horsham	Pioneer/Washington	(215) 674-4000
PENNSYLVANIA, Horsham	Schweber Electronics	(215) 441-0600
PENNSYLVANIA, Huntington	Hall-Mark Electronics	(215) 355-7300
PENNSYLVANIA, Montgomeryville	Pyttronic Industries, Inc.	(215) 643-2850
PENNSYLVANIA, Pittsburgh	Pioneer-Standard Electronics	(412) 782-2300
SOUTH CAROLINA, Columbia	Dixie Electronics	(803) 779-5332
TEXAS, Austin	Hall-Mark Electronics	(512) 837-2814
TEXAS, Austin	Hamilton/Avnet Electronics	(512) 837-8911
TEXAS, Dallas	Hall-Mark Electronics	(214) 234-7400
TEXAS, Dallas	Hamilton/Avnet Electronics	(214) 661-8661
TEXAS, Dallas	Schweber Electronics	(214) 661-5010
TEXAS, Dallas	Sterling Electronics	(214) 357-9131
TEXAS, Houston	Hall-Mark Electronics	(713) 781-6100
TEXAS, Houston	Hamilton/Avnet Electronics	(713) 780-1771
TEXAS, Houston	Sterling Electronics, Inc.	(713) 627-9800
UTAH, Salt Lake City	Bell Industries	(801) 972-6969
#UTAH, Salt Lake City	Hamilton/Avnet Electronics	(801) 972-2800
WASHINGTON, Bellevue	Hamilton-Avnet Electronics	(206) 746-8750
WASHINGTON, Bellevue	Wyle Distribution Group	(206) 453-8300
WASHINGTON, Seattle	Almac/Stroum Electronics	(206) 763-2300
WISCONSIN, New Berlin	Hamilton/Avnet Electronics	(414) 784-4510
	CANADA	
CALGARY, Alberta	L.A. Varah, Ltd.	(403) 276-8818
CALGARY, Alberta	Zentronics, Ltd.	(403) 230-1422
DOWNSVIEW, Ontario	Zentronics, Ltd.	(416) 661-2622
EDMONDTON, Alberta	Bowtek Electric Co., Ltd.	(403) 426-1072
HAMILTON, Ontario	L.A. Varah, Ltd.	(416) 561-9311
LONDON, Ontario	C.M. Peterson Co., Ltd.	(519) 434-3204
MISSISSAUGA, Ontario	Hamilton/Avnet Int'l Canada Ltd.	(416) 677-7432
MONTREAL, Quebec	Cesco Electronics Ltd.	(514) 735-5511
OTTAWA, Ontario	Zentronics, Ltd.	(613) 232-3591
OTTAWA, Ontario	Hamilton/Avnet Int'l Canada Ltd.	(613) 226-1700
QUEBEC CITY, Quebec	Cesco Electronics, Ltd.	(418) 524-4641
ST. LAURENT, Quebec	Hamilton/Avnet Int'l Canada Ltd.	(514) 331-6443
TOWN OF MOUNT ROYAL, Quebec	Zentronics, Ltd.	(514) 735-5361
VANCOUVER, B.C.	Intek Electronics, Ltd.	(604) 324-6831
VANCOUVER, B.C.	L.A. Varah, Ltd.	(604) 873-3211
VANCOUVER, B.C.	Zentronics, Ltd.	(604) 325-3292
WILLOWDALE, Ontario	Electro Sonic, Inc.	(416) 494-1555
WINNIPEG, Manitoba	Zentronics, Ltd.	(204) 775-8661

#Authorized for all Components, Plus Subsystem Products

Color Graphics Computer Programmable In Pascal/Assembly Language



Fully integrated RM-6114 color graphics computer system from Ramtek is programmable in Pascal or assembler language, can operate as either standalone system or with host computer, and provides color data presentation as well as data storage and manipulation

The 6114 Colorgraphic computer provides a means for graphic presentation, a programming language that allows users to manipulate data, and a standalone system for storage of data files. The fully integrated color graphics computer system from Ramtek Corp, 2211 Lawson Lane, Santa Clara, CA 95050 gives users a range of choices not previously available in a low cost, medium resolution display system. While previous systems have concentrated on data entry and manipulation problems, this system uses programmable graphics capabilities to accommodate instant interpretation by presenting data visually and in color.

In its Pascal configuration the system consists of Z80 central processor operating at 4 MHz with 64k programmable memory, floppy disc controller, 250k-byte single-density floppy disc drive, and pedestal display unit. Graphics refresh memory is 256 x 320 with 240 x 320 displayable pixels (picture elements). RGB output may be used with NTSC encoder to drive a video cassette recorder. The format also provides square pixels since the CRT screen itself is a 4:3 aspect ratio as is the displayable pixel array. The display features a full screen crosshair cursor and eight standard colors. Alphanumeric memory will display 96 characters in a format of 24 lines of 80 characters each.

The Pascal system is a licensed version of UCSD Pascal, permitting any Pascal source programs written on an UCSD system to be transferred to the 6114 and the reverse. This use of standard operating system software permits software to be transferred from one computer to another and enables the use of standardized computer graphics procedures.

The large amounts of memory and large number of peripheral devices sometimes necessary with a graphics system are handled with the hardware/software RAMOS (Ramtek operating system) package. RAMOS provides hardware memory management and protection up to 512k bytes, special user/system switching control, and I/O interrupt vectoring. Multitasking and virtual space features in the operating system allow users to add software in assembly language.

The system's CRT oriented editor creates and updates text files, which are edited on the console CRT using a file window concept. A file manager allows files to be created and controlled on the floppy discs. Access to assembly language programming is supplied by Z80 Assembler and linker.

Optional interfaces for the system include RS-232 communications, color printer/plotter, black/white printer, and graphics tablet. Price for the basic system is approximately $12,000. With a monochrome display (upgradable to color), the system is available for about $1000 less.

Circle 178 on Inquiry Card

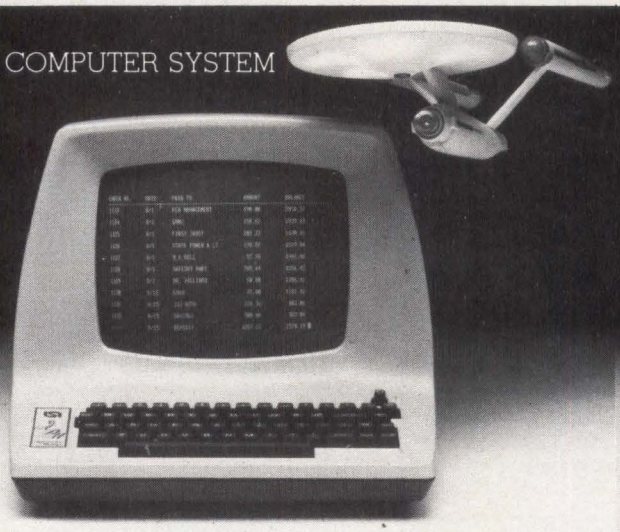
SOPHISTICATED GRAPHICS TERMINAL

SMALL BUSINESS SYSTEM

INVENTORY CONTROL

PORTABLE I/O DEVICE

HOME COMPUTER SYSTEM



VERSATILE DATA TERMINAL

What could anyone possibly do with 85,000 Dumb Terminals®?

That's how many ADM-3A's there are out in the field working right now. And more being shipped each day. Now just what accounts for such remarkable popularity?

Sure, it's the definitive dumb terminal, adaptable enough to fit a host of applications. It has a 12-inch diagonal screen. Full or half duplex operation at 11 selectable data rates. 1920 easy-to-read characters in 24 rows of 80 letters. 59 entry keys. An RS232C interface extension port. And direct cursor addressing.

But we wondered if all 85,000 Dumb Terminals were being used for just everyday data entry. So we checked around.

And found that people are using Dumb Terminals for things even we never thought of.

THE ADM-3A GOES INTO BUSINESS.

More and more OEM's are putting the Dumb Terminal into small business systems. They assemble a package that usually contains a disk, memory, a printer, and a video display terminal — the adaptable ADM-3A.

So the chances are that when you buy a small business system from someone, it'll contain, you guessed it, the amazing Dumb Terminal.

IT TAKES STOCK OF THE SITUATION.

Many businesses are using the Dumb Terminal, along with a light pen (Universal Product Code Decoder), to keep track of their inventory. The decoder is interfaced to the Dumb Terminal, and when a piece of merchandise imprinted with a Universal Product Code passes under it, the item is entered into a computer for tallying.

Simultaneously, the item is also displayed on the ADM-3A's screen — so it's instantly available for quick double-checking.

PROGRAMMERS LIKE IT, TOO.

Surprisingly enough, many computer programmers use the ADM-3A as an effective, portable I/O device. They can take it into a back room or, along with an acoustic coupler, to their homes if they wish, and compile programs nearly anywhere.

By using telephone lines, they can have direct access to a computer. Or, with the addition of an inexpensive cassette, the programmer can store the program on tape and enter it into the mainframe at a later date — with no loss of data.

THE DUMB TERMINAL PUTS ON A NEW FACE.

Some of our more ambitious customers have transformed their ADM-3A's into sophisticated graphics terminals. Simply by installing another PCB, they've enabled their terminals to perform complex plotting, graphics, and even draw charts.

And the Dumb Terminal is so adaptable that these industrious people had no trouble with installation — the graphics PCB required not the slightest cutting or soldering. It simply slipped right in and started working, all in a matter of minutes.

YOU CAN EVEN TAKE IT HOME TO MEET THE FAMILY.

We discovered that many computer buffs are using the Dumb Terminal as an inexpensive way to upgrade their systems. After all, the equipment found on most microcomputers leaves a lot to be desired. Such as the tiny five or six-inch screen, for instance.

By upgrading to the ADM-3A, they get a full 12-inch screen that's easy on the eyes. Not to mention a lot of capabilities they wanted, but just didn't get on their systems.

All for only $895.

THE DUMB TERMINAL. THE HALLMARK OF VERSATILITY.

When you get right down to it, the Dumb Terminal's applications are pretty amazing.

It can be interfaced with a staggering variety of RS232 devices. Such as cassettes, disks, floppy disk drives, printers, paper tapes, and readers, to mention just a few.

In fact, the ADM-3A is compatible with just about any RS232 device you can name. Even other video terminals, if you wish.

And people call this a "dumb" terminal?

WHAT WILL THEY THINK OF NEXT?

Who knows? But it seems that as long as there are Dumb Terminals, people will find new, unsuspected uses for them.

Of course, the ADM-3A will continue to be the same dependable data entry terminal that's made it an industry legend.

With good, reliable features and a minimum of frills. Nothing could change that. The fact is, we think that's probably the main reason that so many people have come up with so many uses for the ADM-3A.

Who said you can't teach a Dumb Terminal new tricks?

Lear Siegler, Inc./Data Products Division, 714 N. Brookhurst Street, Anaheim, CA 92803. (800) 854-3805. In California (714) 774-1010. TWX: 910-591-1157. Telex: 65-5444. Regional Sales Offices: San Francisco (408) 263-0506. Los Angeles (213) 454-9941. Chicago (312) 279-5250. Houston (713) 780-2585. Philadelphia (215) 968-0112. New York (212) 594-6762. Boston (617) 423-1510. Washington, D.C. (301) 459-1826. England (4867) 80666.

DUMB TERMINAL SMART BUY

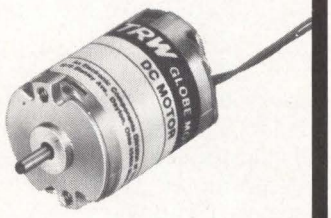
LEAR SIEGLER, INC.
DATA PRODUCTS DIVISION

Dumb Terminal® terminal is a registered trademark of Lear Siegler, Data Products Division.

CIRCLE 33 ON INQUIRY CARD

New 1½" DC motor-tach cuts noise in your system

With the new EM-15 motor-tach, you don't have to run AC power lines into noise-sensitive areas of your system. Rated voltage: 6 to 24 v.d.c. Tach frequency: 8 cycles/rev. AC tachometer is brushless. You get accurate speed at low cost.



Low-cost DC PM motor only 1¼" in diameter

Our economy EM-13 motors have many of the features of our quality military motors. Torque constant: 2.6 oz. in./amp for 12 v.d.c. version. Voltage constant: 1.92V/K rpm. Available in 6, 12, or 24 v.d.c. versions. Tooled for high-volume production.

In a hot spot? Cool it with our fans and blowers

Cool your critical components with our miniature DC fans and blowers. Power source 12 to 115 v.d.c. 10 to 315 cfm free air. Propeller, centrifugal, tubeaxial, vaneaxial, and propaxial types. Diameters 1.25" to 5.75".

TRW GLOBE MOTORS

Dayton, Ohio. (513) 228-3171.
Distributed by Arrow, Hall-Mark, Hamilton/Avnet, Jaco, Pioneer.

Compact Computer System Broadens Range Within Compatible Family

Reducing the entry level price of the 3000 family to $49,750, the HP 3000 series 30, introduced by Hewlett-Packard Co, 1507 Page Mill Rd, Palo Alto, CA 94304, is a full function machine capable of batch operation, program development, data entry, and data communications. In addition to a lower price, the unit provides a more compact package and an intelligent network processor (see p 26) that relieves CPU congestion and enables communication at speeds to 56k bits/s.

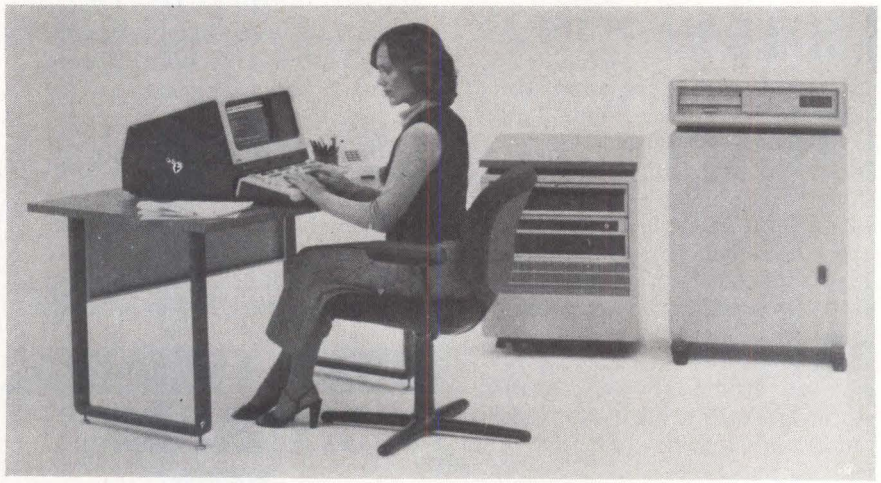
Compact design and low power requirements of the system stem from the application of proprietary silicon on sapphire technology. The CPU is based on three SOS chips (ICF-25A) that are integrated at the 15k gate level. Memory is composed of 16k RAMS. Packaged within a cabinet measuring 24 x 30 x 18" (61 x 76 x 46 cm) the unit is accompanied by a separate system/maintenance console and system disc. It runs on standard 120-V power, uses only 15 A, and needs no special air conditioning.

The system is a full function HP 3000 capable of batch operation, program development, data entry, and data communication. Differences between it and Series 33 and III lie in performance and expandability. Since it uses the MPE-III operating system, applications programs written for those machines will run without reprogramming, recompiling, or relinking. Among the application areas are as standalone business data processing systems and as stations within 3000 networks. Like the series 33, the series 30 incorporates a self-test feature and remote system verification program.

Series 30 systems can execute programs written in COBOL, BASIC, FORTRAN, RPG, or SPL, (the company's systems level programming language). Bundled in with the machine are IMAGE/3000 database management with QUERY, VIEW/3000 business forms generating software, and KSAM/3000 keyed sequential file access method.

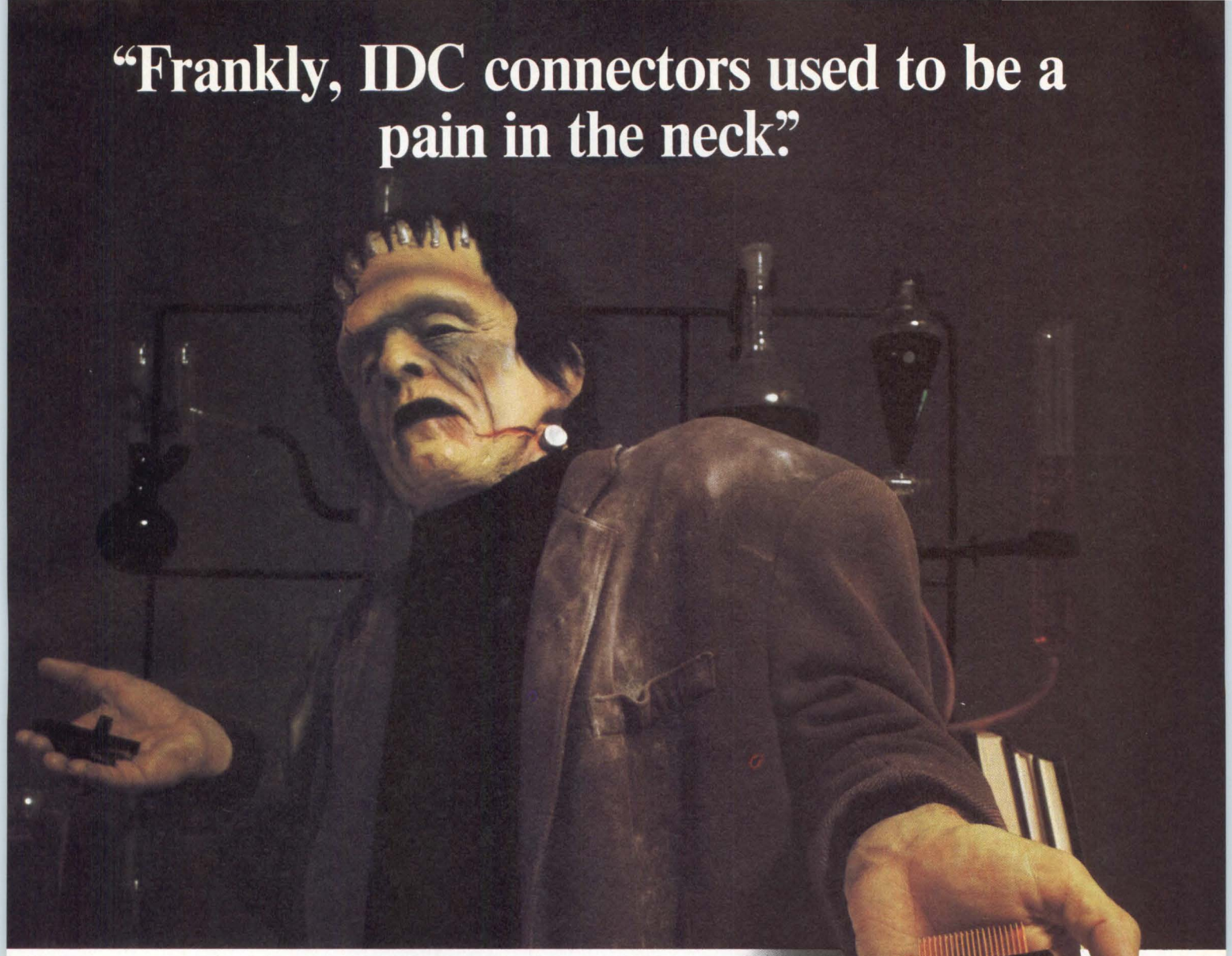
List prices for the systems begin at $49,750 for a base level unit that has 256k-bytes error correcting semiconductor memory, 1M-byte flexible disc, four asynchronous terminal ports, system/maintenance console, 20M-byte system disc, and eight powered I/O expansion slots. This configuration can be expanded to include 1024k-byte main memory, 960M-byte disc capacity, up to 32 terminal ports, 4 magnetic tape drives, and 2 line printers. Up to two communications lines can be added, each replacing four terminal ports.

Circle 179 on Inquiry Card



Hewlett-Packard's application of SOS technology in its 3000 family compatible series 30 reduces power and cooling requirements as well as package size

"Frankly, IDC connectors used to be a pain in the neck."



"My problems were monstrous.

When I could find the connectors I needed, I would have to go digging around for the cable. If the price was right, the products weren't. And on and on, eon after eon.

Until one day my doctor suggested Spectra-Strip.

Of course! They've been making flat cable longer than anybody, so they would have to know how to make ends meet!

They do, and now I get all my IDC receptacles, headers, DIP plugs and sockets, PCB transitions and card-edge connectors from a single, reliable source: Spectra-Strip.

When things get really busy at the lab, I even have them or one of their value-added distributors provide completely terminated and tested jumpers and custom assemblies.

Their products are just what the doctor ordered, their Q.C. has real teeth in it, and their prices never put the bite on my budget.

For the name and number of your nearest distributor or rep, write Spectra-Strip, 7100 Lampson Avenue, Garden Grove, CA 92642, telephone (714) 892-3361. In the East, call (203) 281-3200.

And tell them Frank sent you."

©Spectra-Strip Inc. 1979

SPECTRA-STRIP An Extra Company

When you're down to the wire.

Family of Systems Offers Distributed Processing Benefits to All Users

600/X5 series distributed data processing systems, announced by Nixdorf Computer Corp, 168 Middlesex Tpk, Burlington, MA 01803, offer increased processing power, configuration flexibility, and concurrency. Each system in the series—consisting of 600/15, /25, /35, /45, and /55—can perform batch and interactive communications, local file processing, data entry, word processing, and local data base inquiry and update using DBMS.

All models provide virtual memory multiterminal operations, synchronous batch and interactive communications, character and line printers, and extensive mass storage capabilities. Operating under the control of the Distributed Processing Executive (DPEX) operating system, the machines have a virtual architecture that allows performance of multiple concurrent tasks without real-memory constraints. Communications protocols include 3741, 2780, 3780, and HASP multileaving remote batch communications, as well as 3270 transaction processing emulation.

Intended to serve in remote applications where small volumes of data are entered and processed locally before transmission to another system within a network, the 600/15 is a diskette based distributed processing system with 1100-ns processor. It can perform any two of the following operations concurrently: batch or interactive communications, local file processing, data entry, local data base inquiry and update, or word processing. Support is provided for a 2-terminal, 2-diskette configuration with 300k bytes of virtual memory.

Designated as a remote terminal system for larger members of the family, the 600/25 has a 1100-ns processor and offers the same concurrency as larger models. It provides support for up to six terminals, two diskette units, 4.8M-bytes fixed disc capacity, and 1M-byte virtual memory.

Among the larger configurations, the 600/35 serves in small remote offices where concurrent operations are required but cost must be kept low. This unit has a 1100-ns processor and supports up to eight terminals, two diskettes, two fixed discs, magnetic tape unit, and 2M-byte virtual memory.

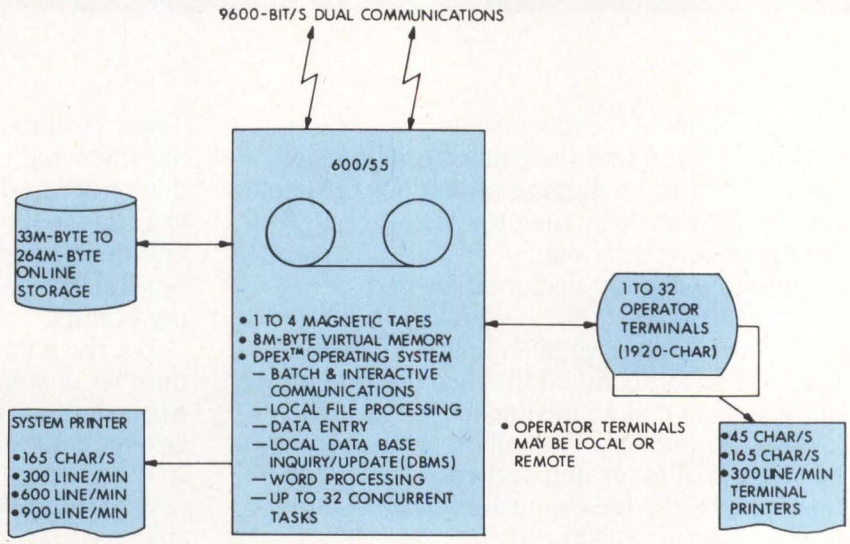
Providing a mix of processor power and configuration flexibility that meets demands for multiple concurrent operations, the /45 has a 700-ns processor. It supports up to 16 terminals, two diskettes, magnetic tape, virtual memory of 8M bytes, and up to 132M bytes of fixed disc storage.

The top of the line /55 is designed for operation where large volumes of information must be locally stored, interrogated, and maintained. Incorporating a 450-ns processor, this system handles up to 32 terminals, 2 diskettes, magnetic tape unit, 8M-byte virtual memory, and 264M bytes of online storage.

A terminal oriented, multitasking virtual memory operating system, DPEX provides a combination of high level data processing and communications capabilities. To provide operational simplicity for both operator and programmer, the system manages all aspects of virtual memory allocation, application program relocatability, and sharability, and simultaneous data base access. In addition to data processing capabilities, it provides a range of communications emulators. Features include file inquiry, retrieval and update capabilities, terminal and system security, sort/merge, batch and interactive communications, and data entry capability. Word processing is an optional software package that allows operators to enter, store, correct, manipulate, and output document style text. The word processing system operates concurrently with other functions and may be used by multiple operators simultaneously.

Prices for the systems in basic configurations start at $31,450 for the 600/15 and range upward to $69,670 for the 600/35. A top level 600/55 has a price of $159,050.

Circle 180 on Inquiry Card



Based on 450-ns processor, Nixdorf's 600/55 distributed processing system provides configuration flexibility while meeting demands for large online data storage and concurrent operations

Datacom Interfaces. 5 chips...1 socket.

Signetics' family of UARTs/USARTs lets you design up—not out.

Specify a socket for one of our five programmable datacom controllers . . . and you've specified it for all of them. Design your PC board for today's needs, then design up with the same board tomorrow.

Simply plug in the Signetics UART or USART that's right for the job. With all the same pinouts, your datacom options stay open.

If you want asynchronous *only* data transfer, insert our 2641 UART. It's fully programmable, with an on-chip baud-rate generator.

Need both synchronous and asynchronous flexibility? Choose our industry-standard 2651 USART. Same socket.

Baud-rate table changes? Pick one of our enhanced USARTs: 2661-1, 2661-2 or 2661-3. Same socket, again.

A quick plug-in replacement shifts you to the desired range—where you can program-select from 16 different baud rates.

Want to support bisync operation? Team any of our pin-compatible USARTs with the Signetics 2653 Data Integrity Controller for a fast firmware solution. Add our 2652 Multi-Protocol Communications Controller and extend your system to include SDLC, HDLC and ADCCP. Datacom controllers. Five pin-compatible UART/USARTs. Plus two unmatched LSI solutions for data integrity and protocol control. Start putting 7-chip convenience into your datacom design today. Contact us, your nearby Signetics sales office or authorized distributor.

signetics

a subsidiary of **U.S. Philips Corporation**

Signetics Corporation
811 East Arques Avenue
P.O. Box 409
Sunnyvale, California 94086
Telephone 408/739-7700

Learn more about LSI for Data Communications. Signetics and its Hamilton/Avnet distributor are co-sponsoring data communications seminars in 24 cities. Call us or Hamilton/Avnet for your admission ticket and program details.

To: Signetics Publication Services, 811 E. Arques Ave., P.O. Box 409, Sunnyvale, CA 94086

( ) Please send complete specifications on Signetics' socket-compatible family of datacom controllers.

( ) Send me the above plus data sheets on the 2652 and 2653. CD1079

Name _____ Title _____

Company _____ Division _____

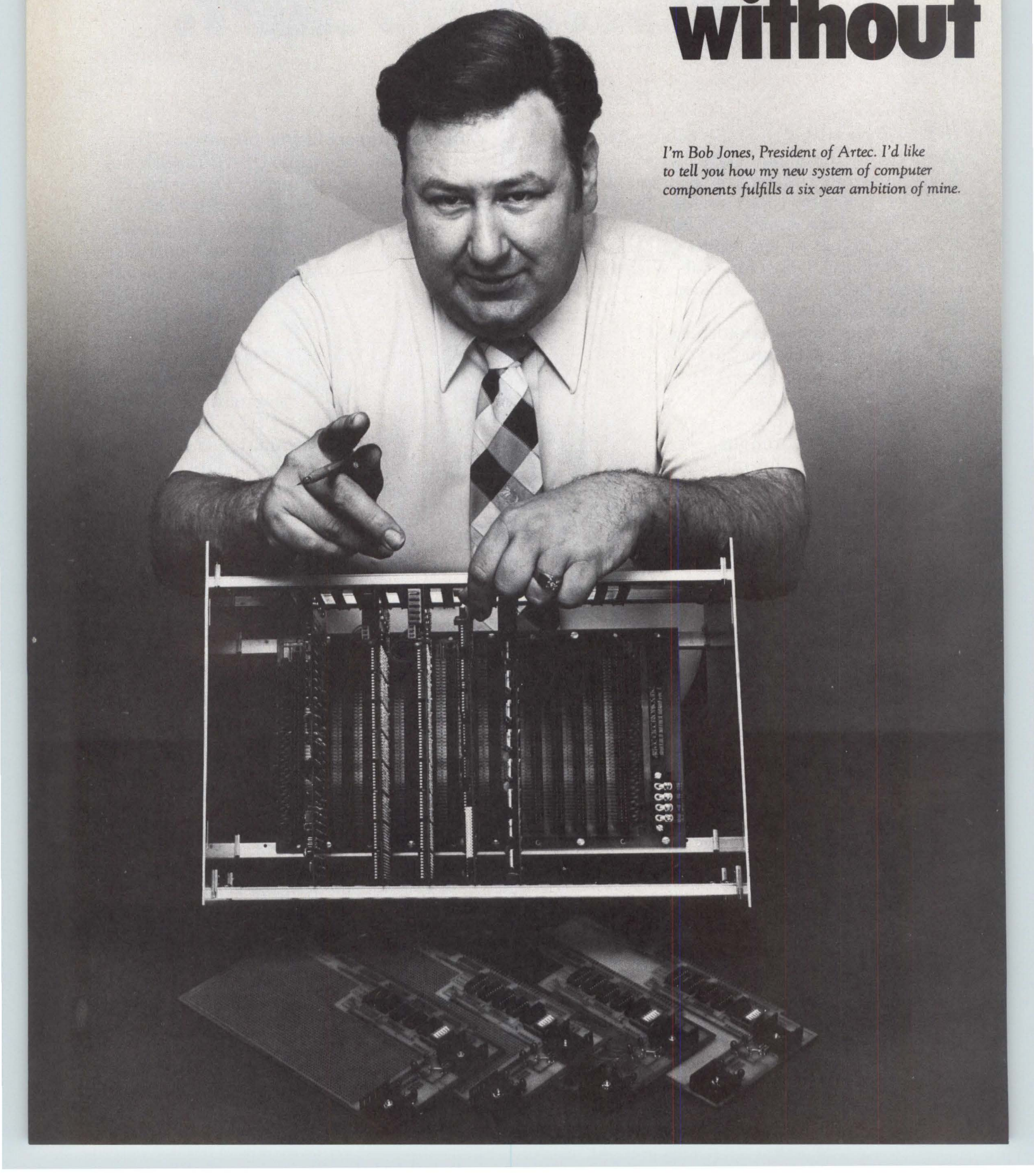
Address _____ MS _____

City _____ State _____ Zip _____

( ) My need is urgent. Please have a datacom specialist phone me at once: ( ) _____

"I can cut your control without

I'm Bob Jones, President of Artec. I'd like to tell you how my new system of computer components fulfills a six year ambition of mine.



system CPU costs 40% sacrificing quality"

You may think I'm crazy now. You won't after you find out more about this system.

Ever since I started Artec Electronics, I've wanted to build a computer system that was better than the ones built by the computer industry's giants. As you can see from the comparison chart, I've done it.

The Artec Centurion System not only offers more features than the popular 8-bit microcomputer board families built by Intel and Vector Graphic, but substantial savings too.

The key to lowering costs without lowering quality was choosing the S100 bus. This major innovation allows smaller PC boards, fewer chips and more compact cabinets. All features that reduce system costs. But the level of quality is superior to any board family anywhere.

A SIDE BY SIDE COMPARISON—INTEL, VECTOR GRAPHIC AND ARTEC

Feature	Intel SBC/8030	Vector Graphic MZ	Artec Centurion
Clock speed	2.7 MHz	4MHZ	5MHz
Onboard monitor	yes	no	yes
Hardware floating point	no	no	yes
Onboard memory	8K PROM 16K RAM	none	3K PROM 1K RAM
Onboard regulators	no	yes	yes
Board size	6.75″×12″	5.3″×10″	5.3″×10″
Onboard ports for keyboard and RS232	yes	no	yes
Price	$1298	$215	$850

Consider this 5 MHz CPU with monitor, math chip and on-board memory for $850.

Using the Intel 8085A2, this CPU card has been specially designed to do what you want it to. Hardware floating point lets you perform math four times faster than you can on the other CPUs. To get this kind of performance before, you probably had to buy a mini.

The board also comes with a powerful, but simple to use, monitor in PROM memory. This monitor lets you test memory, debug software and check the status of your program at any time.

For a scratch pad, the CPU uses 3K of PROM memory and 1K of RAM. For simple control applications you may not even need add-on memory.

If that isn't enough to convince you, how about this? This card also has four vectored interrupts, switch-selectable I/O ports, variable clock frequency (2 and 5MHz) and a phantom line.

16K PROM Memory Card for just $300.

Everything in this card is the best you can find. The PROMs are reliable, 2708-type designed by TI. The board is high-quality FR4 glass epoxy with fully-buffered address and data lines and plated-through holes. You can choose from 0–4 wait states (selectable by DIP switch). You can also address any 4K group of memory to any 4K boundary. This bank select feature allows you to control up to 8 banks of memory.

No question about it, this is a tremendous card for the money. The card without memory is just $125 with all the sockets in place. The EPROM chips alone are $11 each.

8K-32K Expandable RAM memory just $175–$620.

We've used a fine, Texas Instrument designed chip, the 4044. Start with the board and 8K of memory and then add on as your application grows. The board holds up to 32K of fully static memory. It has bank select and the same high-quality PC board construction techniques as the PROM card.

The 8K board costs just $175; 16K is $315; 24K is $475; and the 32K board is $620. 8K add-on kits are $135. Single TI 4044 chips are $7.

A rugged card cage built around Artec's Totally Silent Motherboard

Some people argue for passive termination, others for active termination. All I know is that we have the motherboard that is totally free from spurious noise at 2MHz, 4MHz, or 5MHz.

More than twice as thick as most motherboards you can find for the S100 bus, this is the best possible start for a reliable control system.

The card cage itself is made out of 12 gauge anodized aluminum for solid support and protection of your investment. Available in 6, 8, 10, 12, or 16 slots.

Breadboards for people who like to do it themselves— $20

For just $20 each these breadboards are incredible. You can find every board you need including copper clad boards with no holes, wire wraps, and two with plated-through holes that are set up for different pin arrangements.

Call me and let me tell you more about this system

If you still have questions about this system, call Artec Electronics, Inc. at (415) 592-2740. Ask for Bob Jones, and tell the person who answers you want to talk about his computer system. Or use the coupon if you don't have time to call. Our address is 605 Old County Rd., San Carlos, CA 94070.

Either way, don't sit there wondering if I'm crazy or not. Find out for yourself by calling or writing today.

ARTEC

O.K. Bob, convince me, get in touch with me and tell me more about your computer system.

Name/Title _____

Address _____

Company _____

City _____ State _____ Zip _____

Phone _____

Mail to: Artec Electronics, Inc.
605 Old County Rd., San Carlos, CA 94070

CIRCLE 36 ON INQUIRY CARD

THE MICROPROCESSOR INTRODUCED NEW KINDS OF BOARD TEST PROBLEMS.

Old ways of testing IC boards don't work very well on MPU-based products. So far, attempts to fill the testing gap have proved expensive or inadequate. Or both. And they usually need an engineer to run them.

The MicroSystem Analyzer, on the other hand, doesn't need an expert or a five-figure budget to troubleshoot fast and accurately to the node level.

To do this, Millennium pioneered the concept of testing from the inside out. Instead of making edge connections or using a bed of nails, you unplug your microprocessor and plug our system right into your MPU socket. To test any board or node with which the μP can communicate, just push a couple of buttons, and you're off and running at system speed up to 5 MHz—so you catch more faults. And in a true system environment.

Simple programming; exhaustive testing.

It doesn't take much preparation to run complete system testing. In a short time, using your system's microprocessor language, programs can be ready to do Go/No testing of your digital and hybrid boards, and with a Signature Analysis, trace a fault down to a defective node.

To make things even easier, you can easily modify your existing diagnostics to run on the MicroSystem Analyzer.

The low price of success.

This new approach to testing also breaks some cost barriers. With a starting price of $4000, you can afford to share your test, QA and maintenance loads. And, when you change to a different microprocessor, all you do is change the low-cost personality cards in the Analyzer.

For factory-field compatibility, your service force can also take it right to the customer, replace only defective boards on-site, spearhead repairs at your local office, using factory level diagnostics to reduce that board float problem. The MicroSystem Analyzer also has an optional RS232 capability, making it ideal as a test station or for remote field service.

Millennium's filling the gap.

The MicroSystem Analyzer is a significant first step in making the MPU-based product easier to test.

For μPs and μCs past, present and future.

Here Today	More Tomorrow
8080A	8048
8085A	8049
6800	8035
6802	8039
Z80A	8748
	8021
	and more

Our other two products, the MicroSystem Designer and MicroSystem Emulator, will help engineers get their jobs done better, faster and cheaper, too. So you can look to Millennium for the new ways to solve the new microprocessor problems—all the way from MPU evaluation and product development to system test and field service trouble-shooting.

Get your hands on.

It's easy to see whether the MicroSystem Analyzer is all it's cracked up to be. We'll arrange a hands-on demonstration for you. Just call or write to Barney Hordos, Millennium Systems, Inc., 19020 Pruneridge Avenue, Cupertino CA 95014. Phone (408) 996-9109. We'll send you complete information, including our new 24-page **"Guide to Testing Microprocessor-Based Systems and Boards."**

With all the new microprocessors around, the MicroSystem Analyzer is the only true test.

MILLENNIUM

a subsidiary of American Microsystems, Inc.

CIRCLE 38 ON INQUIRY CARD

MILLENNIUM INTRODUCED A NEW KIND OF BOARD TEST SOLUTION.

Multiprocessing Adds Flexibility to Business Computer Family

BC/7-900 uses a different processor to provide 1.5 times the speed of the /7-800, and offers 262,144 bytes of MOS memory, compared to 131,072 bytes for the /7-800. Adding power to the BC/7 family from Sperry Univac, PO Box 500, Blue Bell, PA 19424, the 900 model performs in a multiprocessing environment, handling four jobs concurrently to supply flexibility particularly at peak processing periods.

Secondary storage capacity of 40M bytes is available on two 20M-byte disc drives, a further 4M-bytes from diskettes. The 20M-byte capacity drive offers removable disc cartridge capability and requires only one cabinet for the 40M configuration, reducing floor space, electric power, and heat dissipation.

The unit is compatible with the -800, which can be upgraded in the field. All software presently in use on the -800 and all existing peripheral equipment can be used on the -900 model without modification. Additional benefits of the system include printer spooling transparent to application, a file sharing feature that extends to all users, and user program size up to 48,152 bytes.

A typical system consists of 262,144 bytes of main storage, 40M-bytes disc capacity, diskette unit, and four workstations. Purchase price is $76,587. First deliveries are planned for second quarter 1980.

Circle 183 on Inquiry Card

Packaged Systems Lower Cost of Dispersed Data Processing Operations

ARCPAC systems increase the attractiveness of dispersed data processing by offering complete computer systems at substantial savings. Available only as complete units, the attached resource computer system packages are composed of modular ARC system components (see *Computer Design*, Feb 1978, p 28) and differ only in the amount of disc storage provided. Datapoint Corp, 9725 Datapoint Dr, San Antonio, TX 78284 provides system and timesharing software, industry standard programming languages, and all necessary cabling with each unit.

Model 4724 includes 20M-bytes cartridge disc storage while the 4754 has 120M bytes. Both systems include five 3810 Dispersed Processors, one 6600 Advanced Business Processor, and the necessary interprocessor bus components—six 9483 Resource Interface Modules plus a 9484 Active Hub, and cabling.

The 3810s are the applications processors of the system and feature 60k-bytes user memory, 1920-char video display screens and typewriter style keyboards. The 6600, with 120k-bytes user memory, 960-char screen, and typewriter keyboard, acts as the system's file processor.

Software is comprised of ANSI Interactive and batch COBOL, BASICPLUS, and RPGPLUS, along with the DATABUS® businesss programming language, and DATASHARE® business timesharing language. Also part of the software package is the DOS disc operating system plus DOS utility programs including EDIT, LIST, SORT, and INDEX. Additional software telecommunications support is provided by DATAPOLL® for datapoint to datapoint networks.

Model 4724 has a purchase price of $58,950; price for the 4754 is $84,950. These prices include software license fees.

Circle 184 on Inquiry Card

Text Processor/Editor Packages Run On Portable Computer System

Software that simplifies the preparation, editing, and production of documents on the Miniterm® model 1206/DOS portable computer system includes text processor and editor packages. The system, introduced by Computer Devices, Inc, 25 North Ave, Burlington, MA 01803, combines text manipulation features with random access storage in a portable unit that provides transmission over dial-up telephone lines to final production system.

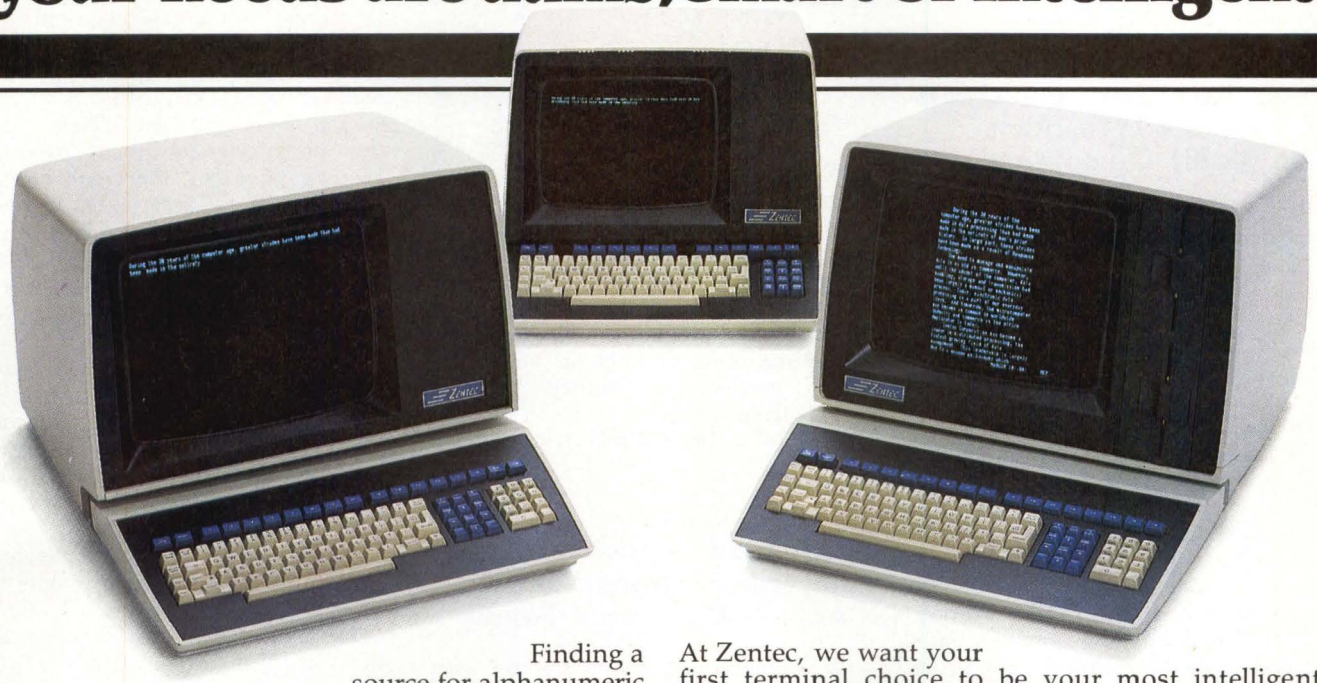
User prompting messages allow persons having no computing experience to perform various interactive tasks in addition to text processing. Text processor and editor software permit documents and blocks of text to be stored and retrieved using user specified labels. Stored material can be merged into a primary document automatically to generate personalized correspondence.

Dynamic margin adjustment, tabulation, text centering, and text justification routines accommodate requirements for multiple column widths. Page lengths can be specified and headers and numbers inserted automatically. A single keyboard command adjusts left margins and page header (number) locations to left and right of page. The system can also generate indexes and tables of contents under user command and can drive any RS-232-C compatible printers.

System hardware includes a 64k processor programmable in BASIC, 128-char ASCII keyboard, 80-/132-col 50-char/s thermal printer, disc controller, and communications interface. All are enclosed in a carrying case small enough to fit under an airplane seat. The disc controller supports up to four Minifile double-density minifloppy disc drives to provide up to 1.44M bytes of random access storage. The unit is priced at $7075.

Circle 185 on Inquiry Card

Considering alphanumeric terminals? Our I.Q. test can determine whether your needs are dumb, smart or intelligent.



Finding a source for alphanumeric terminals is relatively easy. Finding the right terminal isn't necessarily so easy.

That's where our I.Q. Test can help.

Numerous questions must be answered before you can specify the optimum terminal for your data or word processing system. Should it be dumb? Smart? Or intelligent? Clustered or stand alone? Do you need local processing capability? Expansion RAM, ROM or PROM? Should it be user programmable? Or can you pre-program it to satisfy your system's requirements? The handy I.Q. Test inside our new ZMS Family brochure can help us help you find the answers to these basic questions. And more. Here, you'll also find detailed information on our new ZMS Family of intelligent terminals: the ZMS-50, ZMS-70 and ZMS-90 . . . three intelligent solutions to your system design problems.

	Dumb	Smart	Intelligent	Your Requirements
Local CPU Processing	No	No	Some	
User Programmability	No	No	Some	
Expansion RAM	No	No	Some	
Expansion ROM/PROM	No	Some	Yes	
Displayable Characters	64	64–96	128–256	
Video Attributes	Limited	Some	Some	
Screen Character Matrix Resolution	5×7	7×8	7×9	
"Soft-Font"	No	No	Some	
Down Load Capability	No	No	Some	
Printer Capability	Some	Some	Yes	
Mass Storage Capability	No	No	Some	
Protected Data	No	Some	Yes	
Higher Level Languages	No	No	Some	

At Zentec, we want your first terminal choice to be your most intelligent choice. So we'd like to assist you in reviewing your basic requirements. And help you analyze your system needs. If intelligent terminals are the answer, we'll help you determine which ZMS terminal best fits your system requirements. Or how you can best modify our modular designs to satisfy your specific application. We'll also help you weigh other selection criteria than just hardware. Like custom configurations. Customized firmware and software. And specialized interfaces and protocols. All to insure that the terminals you specify offer you the best price/performance ratio money can buy.

Looking for an intelligent alternative?

If you'd like to find out more about how Zentec intelligent terminals can provide intelligent solutions to your data or word processing problems, send for our free ZMS Family brochure. Then take the I.Q. Test. Write: Zentec Corporation, 2400 Walsh Avenue, Santa Clara, CA 95050. Or call (408) 246-7662. It may be one of the smartest moves you've ever made.

CIRCLE 159 ON INQUIRY CARD

ZENTEC

. . . the last word in intelligent terminals.

Sales Offices—Santa Clara, CA, (408) 246-7662; Los Angeles, CA, (714) 975-1285; Richardson, TX, (214) 690-9265; Palatine, IL, (312) 991-0105; White Plains, NY, (914) 428-2801; Boston, MA, (617) 935-4511; Washington, DC, (703) 941-9270; Austria: Tonko, 425-451; England: Zygal Dynamics, 02405-75681; Finland: Videodata, 90-578-877; France: Tekelec, (1)027-7535; Switzerland: Atek, 041-831043.

SOFTWARE

FORTRAN Compiler Meets ANSI X3.9-1978, Runs On 32-Bit Computers

Part of a FORTRAN product family introduced by Systems Engineering Laboratories, Inc, 6901 W Sunrise Blvd, Fort Lauderdale, FL 33313, FORTRAN 77+ meets ANSI X3.9-1978 standards, supports MIL-STD-1753, and provides comprehensive structured FORTRAN. Developed to run on the company's series 32 line of 32-bit computers, the FORTRAN family is supported by RTM and MPX-32 realtime operating systems, and is designed to exploit 32 series hardware capabilities to improve total system performance.

Primary features of the FORTRAN 77+ compiler include FORTRAN based, Pascal based, realtime based, and industry based extensions that improve program efficiency while reducing development costs. Extensions are highlighted by structured programming features like DO UNTIL and BEGIN-END constructs. In addition to filling ANSI X3.9-1978 requirements, the compiler also meets or exceeds MIL-STD 1753 and ISA S61.1 and S61.2 standards.

In addition to FORTRAN+ the family incorporates an integrated hardware/firmware/software version of the scientific runtime library (Scientific Accelerator) and two Softool performance analyzers. When combined with FORTRAN 66+, a highly optimized 3-pass processor that supports a superset of ANSI X3.9-1966 FORTRAN IV, and with the software runtime library, these products form a comprehensive family that satisfies users' performance requirements while protecting software investments.

A comprehensive set of subroutines that provide operating system services, the scientific runtime library supplies mathematical library routines, and language extensions for FORTRAN 66+ and 77+. It is available as a standalone product for execution-only systems without a FORTRAN compiler.

The scientific accelerator provides all scientific RTL features plus fully integrated hardware, software, and firmware to significantly improve FORTRAN program execution speeds. Performance up to 30% better can be obtained by linking to accelerator routines rather than RTL.

Softool Instrumentor Utilities aid in optimizing and debugging programs. Reporting on execution times and usage frequency of FORTRAN programs, they operate on the source program to determine how much time each statement or subroutine has spent executing. This enables realtime users to pinpoint most critical performance bottlenecks and logic flaws.

Circle 181 on Inquiry Card

Extended Pascal Implementations Execute Across Computer Family

In implementing Pascal for use with Data General computers running under the Advanced Operating System (AOS) Rational Data Systems, 245 W 55th St, New York, NY 10019 has provided a structured language that is compatible with the entire line—from Eclipse to microNova. All versions are source compatible and each can cross-compile for any of the other systems.

The compilers generate code for a hypothetical computer with an architecture optimized for Pascal execution. The instruction set for this computer is based on 8-bit bytes which are executed by the computer's interpreter. Each 8-bit instruction expresses a high level operation, greatly reducing memory space requirements. By using a dense byte oriented code to represent programs, the implementations can significantly increase the number of users and size of programs that may remain memory resident before swapping occurs. This results in less system overhead and quicker response times.

Five distinct implementations are included in the family. Each is optimized for a particular environment but is source compatible with and capable of cross-compilation for execution by any other implementation. Each can be configured to take advantage of specific hardware and software available. Such options include Eclipse, Nova, or microNova processor; hardware or software multiply/divide; hardware or software floating point; and Eclipse character or commercial instruction sets.

AOS, the first available implementation, is a high speed, single-pass recursive descent design that includes compile time source text "include" facility. Runtime facility is in the shared code partition. This means that no matter how many users are running programs, there will be only one copy of the interpreter in memory. No binding or loading is required. Output of the compiler is immediately ready for execution, thereby significantly reducing program development time.

This version includes these extensions to standard Pascal: string variables and intrinsics similar to those within PL/1; decimal variables for business applications; and terminal files to simplify interactive programs. Ability to randomly access files easily extends to ISAM and VSAM. Segment procedures and functions within the compiler permit a program to be divided into as many as 16 pieces that are handled automatically by a load-on-call mechanism, thus permitting execution of programs too large to fit into main memory. Another extension provides access to the host operating system facilities via a generalized SYSCALL procedure.

Implementations that complete the family are: RDOS/DOS single-user that requires a minimal system configuration; RDOS/DOS multiterminal in which all terminals execute common code (for dedicated applications such as order entry); and RDOS/DOS multiuser via swapping which provides a low cost system, typically for turnkey systems. In addition, RDOS multiuser via extended memory is a higher performance system that adapts to number crunching applications with many users and fast response time requirements.

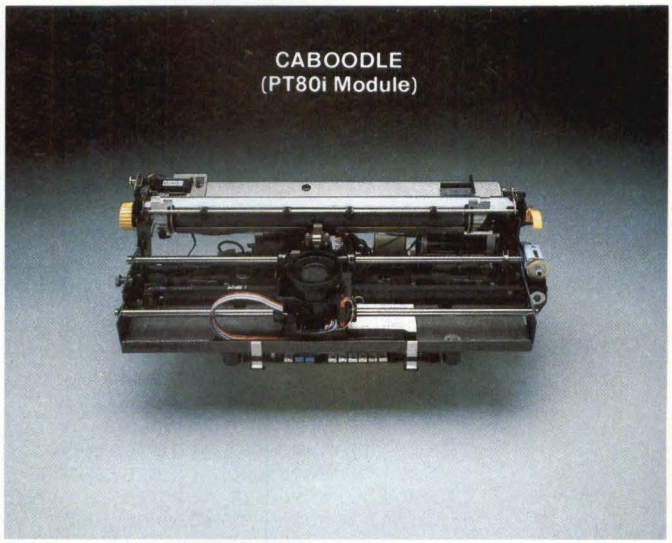
Speeds of the compilers vary depending on version and host system environment, but all are faster than most language processors available for Data General computers. As an example, using an S/130 processor running AOS with a 10M-byte disc, the compiler can compile itself in 8 min. A typical 1-page program (50 lines) compiles in less than 11 s.

All implementations are provided on Data General compatible floppy discs or 9-track magnetic tape. The AOS version is priced at $3500. Copies may be obtained on 5M-byte top loading cartridges for an additional $200/copy.

Circle 182 on Inquiry Card

SIEMENS

Take the whole kit & caboodle or the caboodle alone.



Freedom of choice is what you get from Siemens. The choice to select the quiet PT80i Ink-Jet Printer Terminal in a variety of platen widths, paper feeds, interfaces and configurations; or just the "guts" of this remarkably quiet unit, the PT80i Ink-Jet Printer Module; or, for those of you who would like to build your own quiet printer, the Ink-Jet Print Head with support electronics.

Aside from offering choice, the Siemens PT80i offers a bi-directional printing speed of 270 characters per second with nearly noiseless printing operation, ≦ 50 dB (A) at 270 cps. It also gives you high quality printing in a variety of type styles on standard paper.

Extraordinary Speed...Quiet Operation... Choice...Siemens Quality.

For more information about the PT80i Ink-Jet Printer, contact us at:

Siemens Corporation

OEM Data Products Division
1440 Allec Street
Anaheim, CA (714) 991-9700

District Offices:
Boston, MA (617) 444-6580
Iselin, NJ (201) 494-1000
Chicago, IL (312) 671-2810
Dallas, TX (817) 461-1673

The technology to do more.

CIRCLE 39 ON INQUIRY CARD

A UNIQUE CHOICE OF DATA ACQUISITION SYSTEMS FOR THE LSI-11/2 AND 11/23. NOW FROM ADAC.

When it comes to data acquisition systems, there is nothing quite like the ADAC System 1000 and the new System 2000.

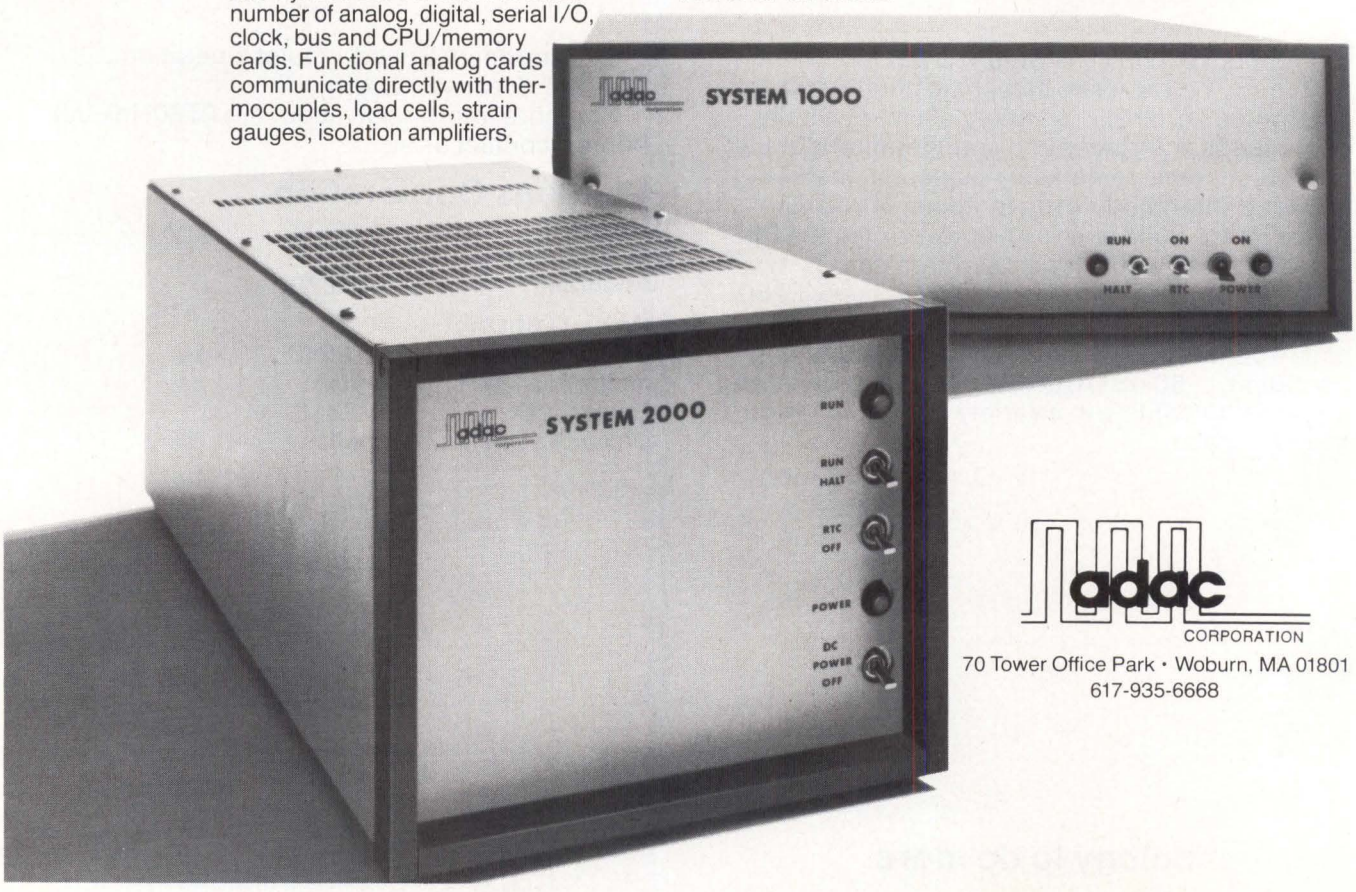
Both systems can operate as low cost peripheral expanders to any UNIBUS computer. When incorporating a DEC LSI-11/2 or 11/23 microcomputer the systems operate as stand alone control systems or as remote intelligent terminals.

The compact System 2000 is built to hold 13 half quad cards. If you need greater capacity, slave units can be utilized or you can go to the larger System 1000 which accommodates any combination of 11 quad size cards or 22 half quad size cards. Both systems can be bench top or rack mounted and have a universal power supply that can support up to 256 kilobytes of memory.

The real heart of both System 1000 and System 2000 is their incredible number of analog, digital, serial I/O, clock, bus and CPU/memory cards. Functional analog cards communicate directly with thermocouples, load cells, strain gauges, isolation amplifiers, transmitters and strip chart recorders to name a few. Discrete cards communicate with switch contacts, relays, thumb wheel switches, pumps, motors and other devices. All cards can be purchased as separate items.

A single System 1000 can be supplied with up to 700 high level analog input channels, or 128 analog low level input channels, or 700 digital I/O functions. A typical System 2000 contains a CPU, 64 kilobytes of memory, floppy disc controller, 16 channel A/D, 4 channel D/A, 32 TTL I/O lines, two serial I/O ports plus room for another six cards of your choice.

Another nice thing about both systems is their prices. They start at $995 for the System 2000 and $1550 for the System 1000. So you can choose the combination of price and capability that's just right for your application. Contact ADAC for full details.



adac CORPORATION
70 Tower Office Park · Woburn, MA 01801
617-935-6668

The Paper Tiger.™

At $995*, why settle for less.

The Paper Tiger has it all. Eight software-selectable character sizes. 80 and 132 column formats. 96 upper/lower case characters. Continuous duty cycle operation. Stepper-motor tractor feed. Forms control. Multi-part forms. Re-inking ribbon system. Microprocessor electronics. Parallel/serial interface. Self diagnostics. Paper-out sensor. Uni-directional print speeds to 198 char/sec. DotPlot™ graphics option, with 2K buffer. And more.

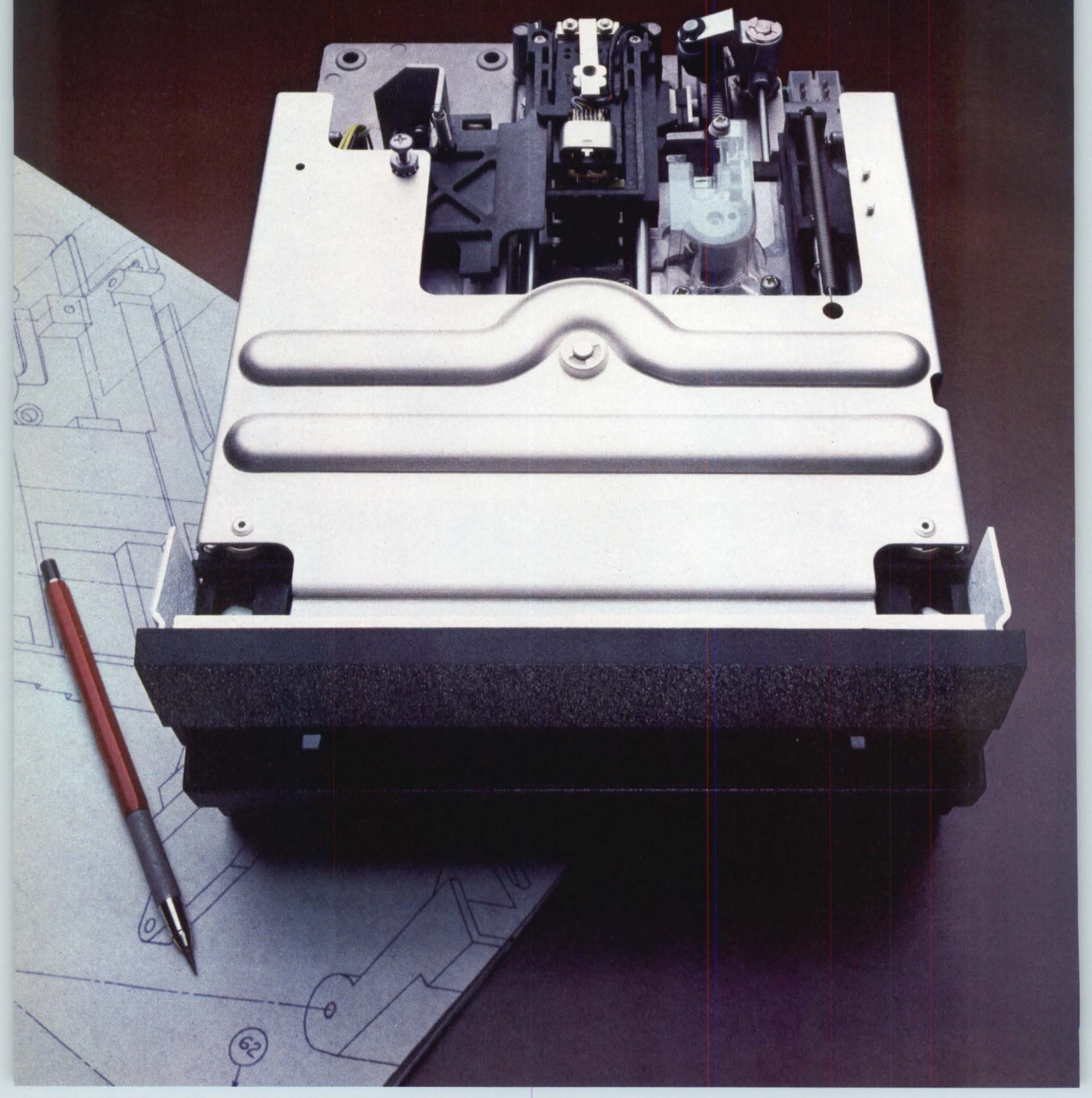
For a free brochure or print sample, write or call. Integral Data Systems, 14 Tech Circle, Natick, Massachusetts 01760. (617) 237-7610.

Integral Data Systems, Inc.

*Single unit price. Generous quantity discounts available.

CIRCLE 40 ON INQUIRY CARD

HOW MFE CAME UP WITH THE MOST ACCURATE, MOST RELIABLE, AND MOST EFFICIENT DOUBLE-SIDED FLOPPY EVER BUILT.



When diskettes went double-density, and later double-sided, drive manufacturers tried to adapt their original single-sided technology.

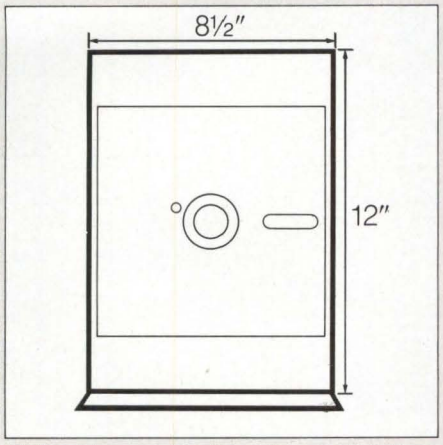
But at MFE, we saw that the old technology would simply be stretched to its limits. It was time to start again.

So based on where diskettes already were, and where they were headed in the future, we designed an entirely new disk drive from the ground up. For totally new levels of precision.

And the results are dramatic.

Our drive not only handles double-sided diskettes with ease, it even anticipates still greater disk densities—such as double-track and quad-density designs.

SMALLER IS BETTER.



The smaller package is a more stable base for high density disks.

We started with the packaging scheme.

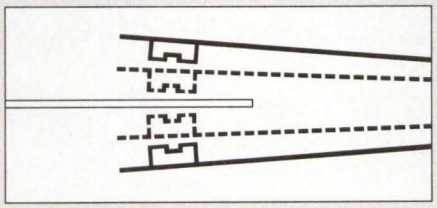
If you lay a standard 8" diskette on top of the MFE drive, you'll discover that the drive is barely larger than the diskette itself. It actually approaches the theoretical minimum size for a drive.

By keeping internal dimensions small, we achieved the tightest mechanical tolerances of any drive on the market. For example, only 3.4" separate the disk spindle from the stepper capstan, a reduction of 54% over the largest selling drive. And the baseplate, on which everything else is built, is a full 2½" to 3" shorter. So no moving part in the drive moves further than it has to.

And since we were designing from scratch, we made the entire drive modular. You can get to all the important components easily, and remove them without scraping your knuckles or taking apart the drive.

The new packaging alone yielded significant improvements. But we went much further.

THREE KEY INNOVATIONS.



IBM-compatible head eliminates scoring. Both heads move when unloaded.

1. To handle the double-sided problems, we designed a true IBM-compatible head, including tunnel erase. Both heads, when unloaded, move completely away from the diskette surface, eliminating any head or media wear.
2. We introduced a unique half-step positioning motor that drastically reduces error tolerances in track registration. Because the motor takes 154 steps per diskette side, instead of the usual 77, it operates far more smoothly and more accurately. In fact, it is 3½ times more accurate than the largest selling drive. And it's designed to be able to handle twice the number of tracks per inch.
3. Finally, we developed an optional DC brushless motor. In one stroke, we reduced speed variation of the disk spindle from 2% to a mere 0.4%. We decreased power consumption by 30 watts, and increased drive efficiency by an incredible 60-80%. And the DC motor runs so cool, you may even be able to mount multiple drives without a fan.

A NEW GENERATION.

The MFE drive is the only second generation double-sided drive, built from the ground up for higher precision and more reliable performance.

Where other companies have reached the end of their technology, we're just beginning.

And you can get our advanced design in single-sided versions, as well as double-sided.

WE'RE SHIPPING NOW.

In volume. From manufacturing facilities in the U.S. and Europe.

If you'd like a complete demonstration, call toll-free 800-258-3884.

And we'll show you the next generation of floppy disk drives.

(If you're outside the continental U.S. call the appropriate office listed below.)

U.S. Headquarters: MFE Corporation, Salem, NH 03079, Tel. (603) 893-1921, TELEX 947477.
West Coast Sales Office: Irvine, CA, Tel. (714) 851-0281.

European Headquarters: MFE Limited, West Lothian, Scotland, Tel. (0589) 410242, TELEX 727827.
U.K. Sales Office: MFE Limited, Colnbrook, England, Tel. (02812) 5941, TELEX 848039.

MFE has worldwide distribution. In Europe, contact MFE Products Sa, Vevey, Switzerland, Tel. 021/52 80 40, TELEX 451173, for the distributor nearest you.

MFE

Bit Slice Approach for Small Stack Processor Aids Design of Blending System

Gene A. Cummings
The Foxboro Company, Foxboro, Massachusetts

Gerald S. Miller
California Automation, Incorporated, San Diego, California

Control systems for high speed process operations often necessitate design of dedicated processors in order to provide the required power and flexibility. Often, of course, the manpower costs of such designs can be spread out since the resultant processors might fit the needs of other systems built by the company.

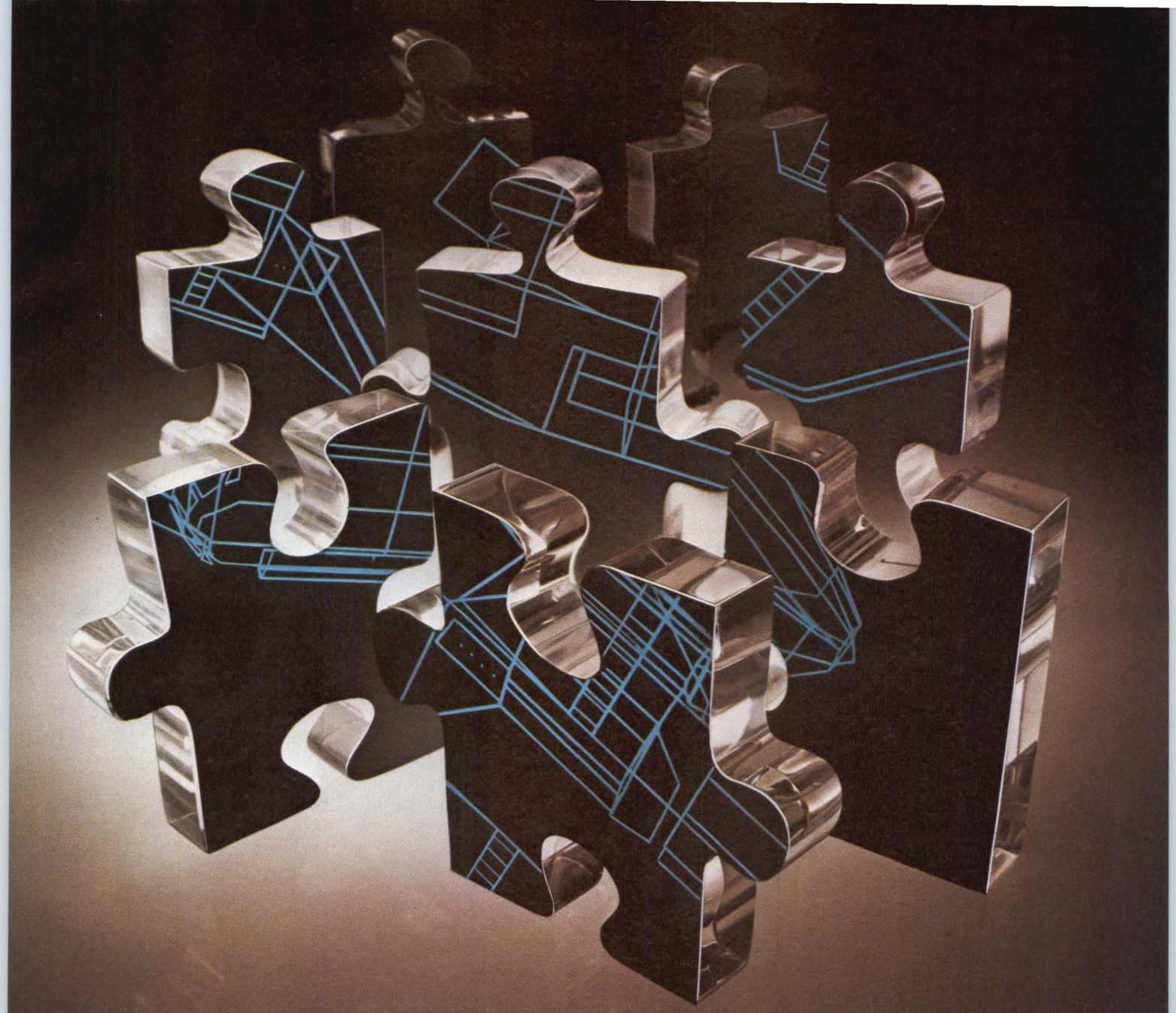
In the case of a high speed blending system for handling up to 24 components in either batch or continuous organization, the processor design was based on a bipolar bit slice approach. By utilizing microprogramming techniques, useful features could be incorporated from higher level systems and applications software.

Basic requirements—common to such process control and automation applications—include efficient use of program and data memory space; support of byte, word, and floating point data; and adequate computational power, including floating point. In addition, the system must provide efficient realtime input/output (I/O); support for multitask programming and interrupt handling; and a means for sharing system resources such as buffers, I/O devices, and the central processing unit (CPU) between tasks.

To meet these requirements, and yet do so with a relatively small processor, a microprogrammable bit-slice approach using the AMD2900 family of circuits was chosen. The decision was made in part because The Foxboro Co already utilized those circuits in several of its other processors and thus company personnel were familiar with them.

System Design Features

Model 99S micro-BlendTrol™ monitoring and control system (Fig 1) was designed specifically for batch or continuous blending operations. Basic portions are an input section that conditions pulse input signals from flowmeters, converts analog input signals into digital format, and reads digital (contact closure) inputs; a computation section that receives these data as input to



WHY PUZZLE OVER PIECES?

See the whole picture on Sanders' Graphic 7

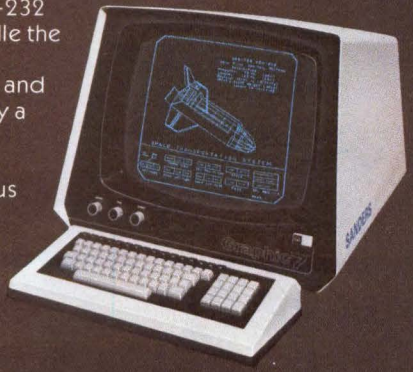
Sanders' Graphic 7 provides the whole picture by drawing bright, crisp vectors and symbols so rapidly that you see all the data you want. Benchmark tests with actual time measurements have proven Graphic 7 to be the refreshed cost/performance leader. This performance spells results for your application.

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 42 ON INQUIRY CARD

THE NEXT GREAT

Six years ago Biomation brought you the first logic analyzer. Today we bring you the industry's broadest selection. And there's more on the way.

Keeping abreast of the latest technological advances is half the battle these days. If you're designing with digital logic — especially microprocessors — you know how fast things are changing.

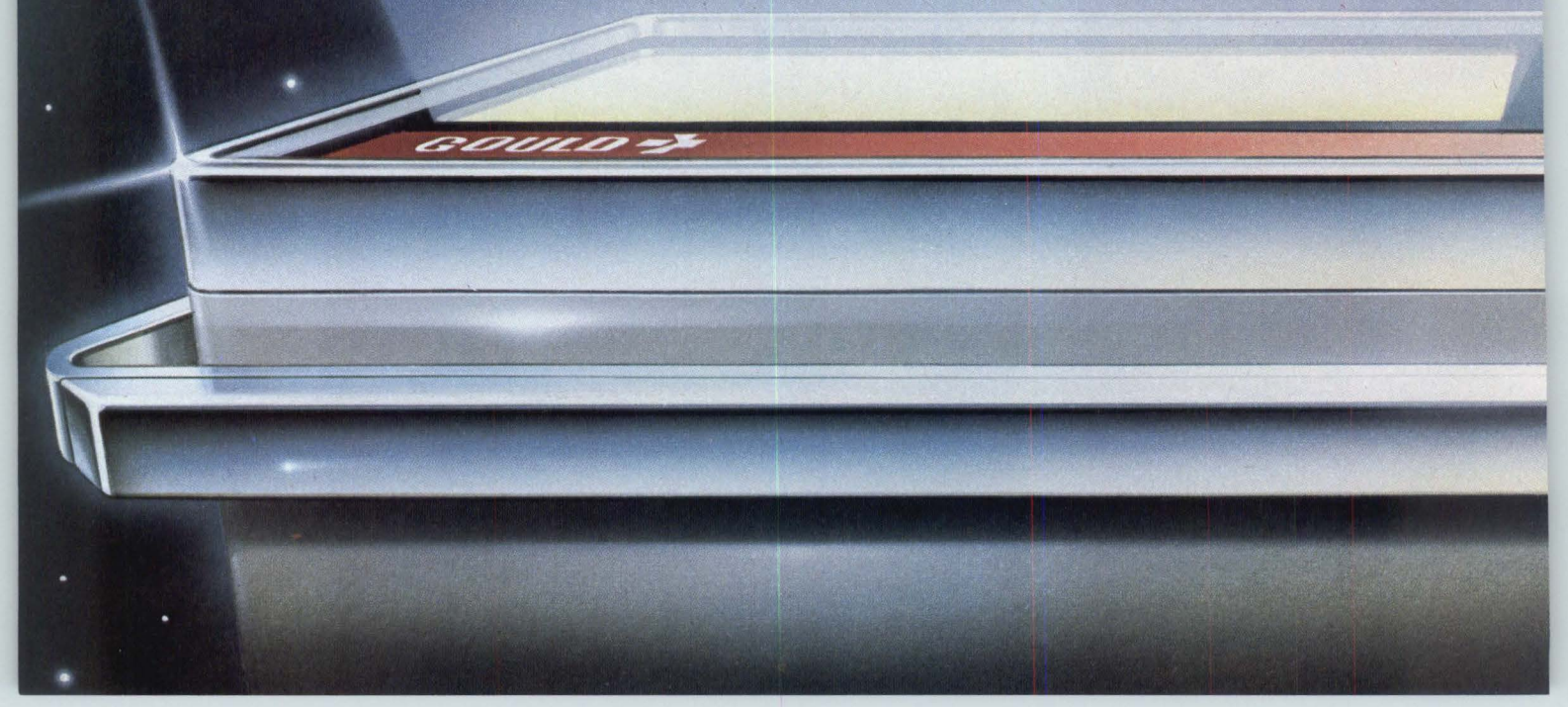
The new demands of digital logic are what Bill Moore, Biomation's first chief engineer, had in mind when he developed the logic analyzer, back in '73. He called it a "glitch fixer," designed to track and unravel the mysterious electronic glitches that plague digital logic designs.

Bill Moore was named Man of the Year by Electronics magazine for his invention.

We're proud of that. In fact, pride is a big part of everything we do. It's the secret ingredient in each logic analyzer in our broad line.

Our other "secret ingredient" is good hearing. We listen carefully to our customers. Then design our products to meet your needs. And we keep a finger on the pulse of technology. So we can understand the special demands it puts on you.

As a result, we've been first with each important logic analyzer advance. For example, when we developed "latch mode" we gave you the capabilities to latch onto glitches — random pulses — as narrow as 2 nanoseconds in current models.



GLITCH FIXER.™

Today our K100-D includes latch mode — and much more. It's the premier logic analyzer for the most complex logic problems. It combines built-in display, keyboard input, 16 channels (up to 32 with adapter) and 100 MHz sampling rate.

Not every application requires such a powerful tool. To meet your special needs, we can deliver seven models, with 8, 9, 16, 27 or 32 channels, sampling rates to 200 MHz and memory lengths to 2048 words.

Which glitch fixer is best for your application? Call us at (408) 988-6800 to discuss your needs — or any time you need technical assistance. Our application engineers are here to help. For more information on our complete line of logic analyzers, write for our catalog.

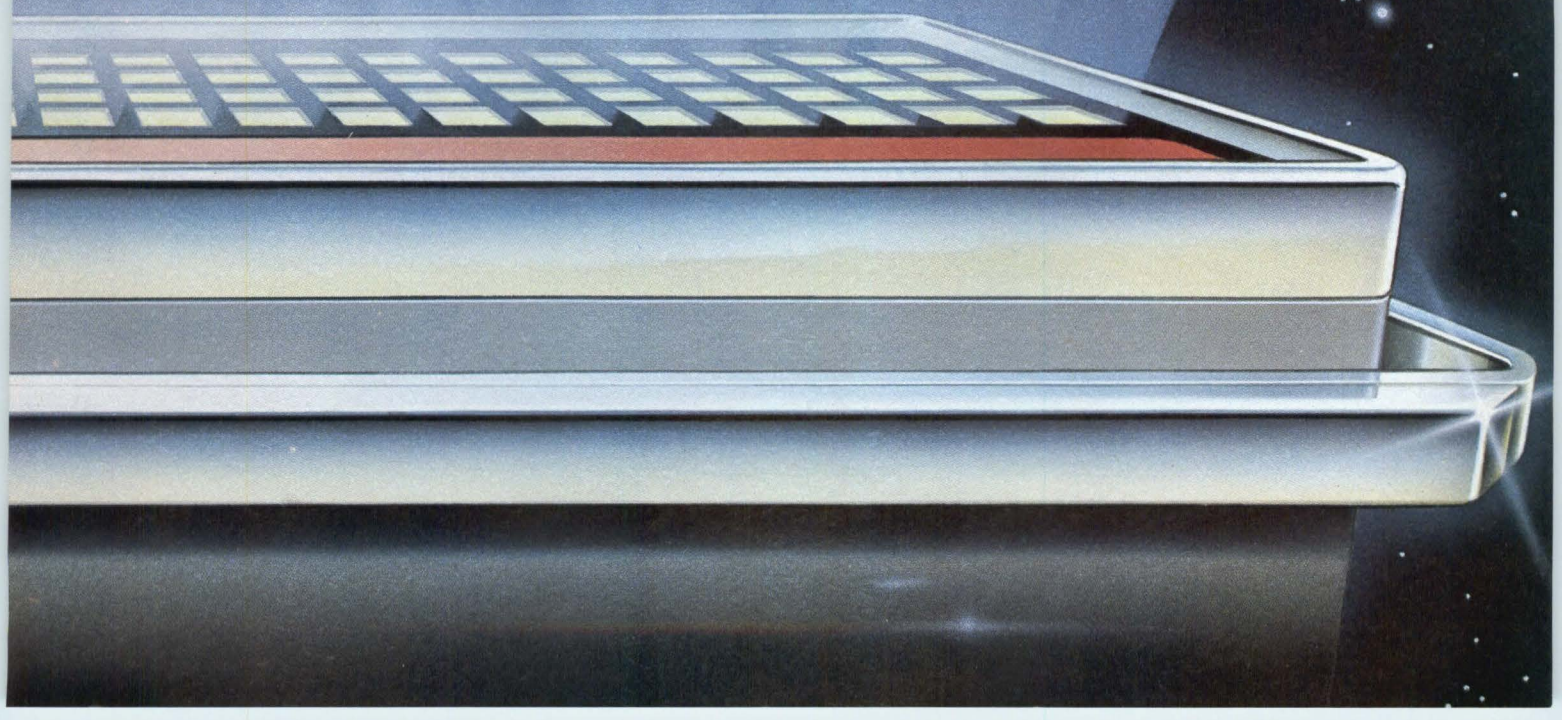
Write Gould Inc., Biomation Division, 4600 Old Ironsides Dr., Santa Clara, CA 95050.

And the next great glitch fixer? One thing you can be sure of. It — and the one after it — will be wearing our name.

GOULD

An Electrical/Electronics Company

Circle No 43 for information.



control algorithms in the programmable read only memory, calculates a new output value for continuous comparison to demand rates, and outputs alarm and blend status signals; and an output section that converts the new digital value to an analog signal for control purposes so that automatic adjustments can be made to maintain total blend specifications, and that drives alarm and blender status indicators. An operator's control panel enables the operator to enter tuning constants, to read or set the process variables, to define system and loop options, and to control the blender; a video display allows operators to monitor and evaluate the principal parameters more easily; and a communication interface enables loop data to be uploaded to a host or downloaded to a blender.

Core of the system is a microcoded processor (Fig 2) which drives a 16-bit data bus serving both memory and I/O devices. A 16-bit address bus allows either 8-bit byte or 16-bit word addressing on even byte boundaries. Address space is either 64k 8-bit bytes (at words 0 to 32k) or 64k 16-bit words (words 0 to 64k).

The arithmetic unit is 16 bits wide, made up of four AMD2901 arithmetic logic unit (ALU) bit slices. In addition to internal registers, a memory address register doubles as the instruction register and a mode register

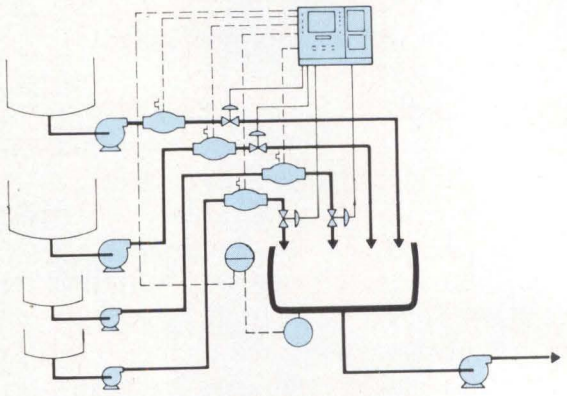


Fig 1 Model 99S micro-BlendTrol monitoring and control system. Greatly simplified flowchart shows control unit, flowmeters, and tanks

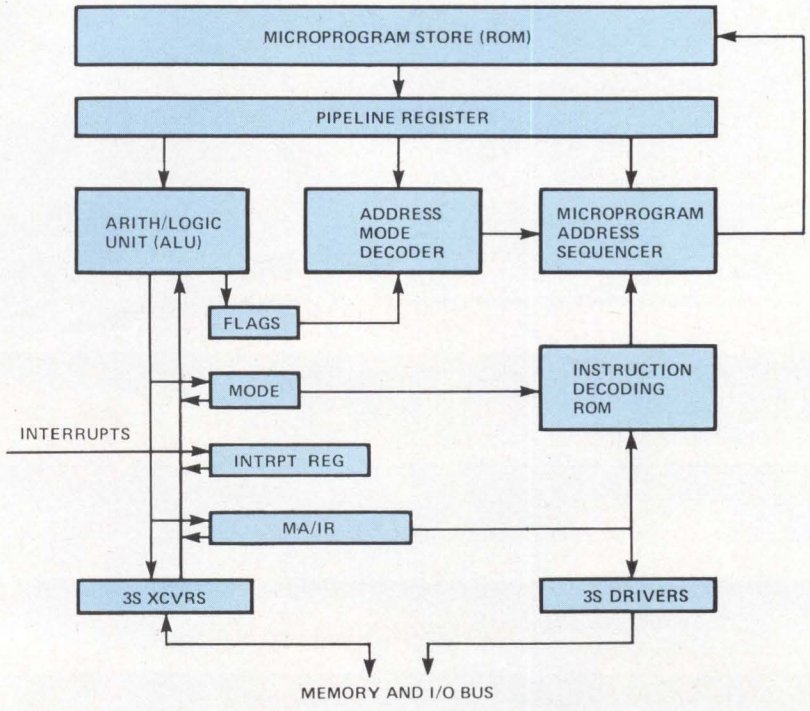


Fig 2 System processor. Included are four AMD2901 microcontroller unit 4-bit slices and three AMD2909 microcode sequencer slices, as well as onboard microprogram ROM with a capacity of 1k 24-bit words. Processor drives 16-bit data bus that serves both memory and I/O devices

How to get two pounds of Computation into a one pound box.

Use MAXIBOX.™

Only 15.75 inches high and easily mounted in a standard 19-inch NEMA cabinet, the MAXIBOX is the most compact, fully integrated 32-bit minicomputer available.

Small as it is, MAXIBOX is a full-scale 32-bit mini, designed to outperform any 16-bit minicomputer. More important, because it is fully integrated you can concentrate your design efforts on the functional aspects of your product with less concern over how to integrate the mini. For example, MAXIBOX comes fully equipped with power supply, cooling, and battery back-up. It operates on 115Vac. It is rack mountable with only eight screws.

We feel that for the product OEM concerned with simplified design and maximum return on investment, MAXIBOX is the best minicomputer available.

To find out more about the MAXIBOX, return the coupon for additional literature, specifications and pricing information. Or, call SYSTEMS toll-free.

☐ Have a representative call me.
☐ Send me a detailed technical summary. I plan to purchase in _____ months. 76

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

PHONE _____ ZIP _____

SYSTEMS
Proven COMPUTER Performance

SYSTEMS toll-free product information service 1-800-327-9716

Systems Engineering Laboratories, Inc., 6901 W. Sunrise Blvd., Ft. Lauderdale, FL 33313 • (305) 587-2900

©SEL 1979

CIRCLE 44 ON INQUIRY CARD

provides an additional two bits to the instruction decoding as a function of the current data type being processed. Three AMD2909 microcode sequencers and a programmable logic array (PLA) generate addresses for the 1k of onboard microcode read only memory (ROM).

A 7 x 11″ (18 x 28-cm) printed circuit board contains the entire processor. By also packaging memory and I/O on similar boards, the entire system was contained in a small enclosure similar to a cathode ray tube (CRT) terminal.

Organization of the microcode instruction format is designed primarily to permit the speed of simultaneous data and branching operations while minimizing the width of the microprogram control store required. Encoding of the 24-bit microinstruction, shown in Fig 3, accomplishes this through four different formats specified by a 2-bit field at the leftmost end of the word.

One format is devoted entirely to unrestricted arithmetic operations and another entirely to full address range branches. Of the two remaining formats, one allows a limited subset of the arithmetic operations while branching within a local page and the other permits similar operations as well as a multiple return to the macroinstruction fetch routine. The latter uses a separate mapping ROM to decode the machine language instructions (as modified by the arithmetic mode register) and branch directly to the proper microcode for their execution.

One advantage made of the microcoded machine is aimed at reducing the I/O hardware by substituting microcoded operations for the battery of pulse counters normally required for the flowmeters. The counters are kept instead in main memory and updated by high speed I/O routines triggered by interrupts serviced directly in microcode. Thus the microlevel machine is shared between the macrolevel instruction execution and these transparent counter routines.

Because of the flexibility and power inherent in microprogramming, a number of "wish list" features from higher level software could be added to its machine language operations. The choice of a stack architecture for the macrolevel machine was a fundamental part of this.

For example, use of the stack as a working space for temporary data and an implicit address for instructions allows control algorithms to be coded directly in Polish notation. Operands either are pushed onto the stack from other memory locations or reside there as the result of the previous operation. An operation such as ADD then adds the two data words on the top of the stack and replaces both words with the resultant sum. This becomes an operand for further operators or may be returned to a regular memory location. The generality of such operations permits identical instruction coding for variable byte, word, or floating point data types.

As a complement to its stack architecture, the processor also includes a higher level means of accessing data via descriptor tables. The descriptor is a location containing an address pointing to the actual data as well as a 2-bit field specifying its data type. Since the 6-bit descriptor table index can be packed into the 1-byte instructions pushing data onto the stack, data can be more efficiently addressed by this means. Also, by using such data references, the CPU can be automatically set for the appropriate arithmetic mode (byte, word, or floating point) according to the data type placed on the stack.

Perhaps the most outstanding feature incorporated in the firmware is the multitask program scheduler and interrupt handler, normally a part of operating system software (Fig 4). This feature is particularly useful in

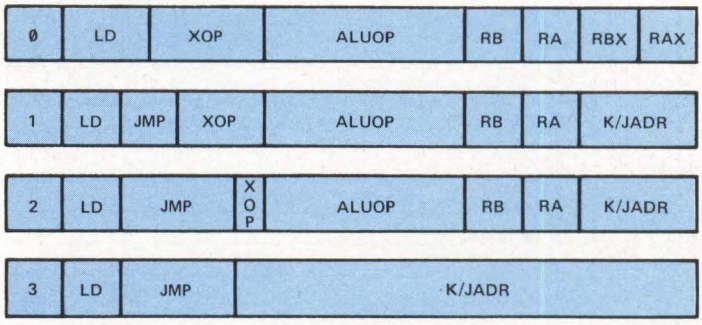
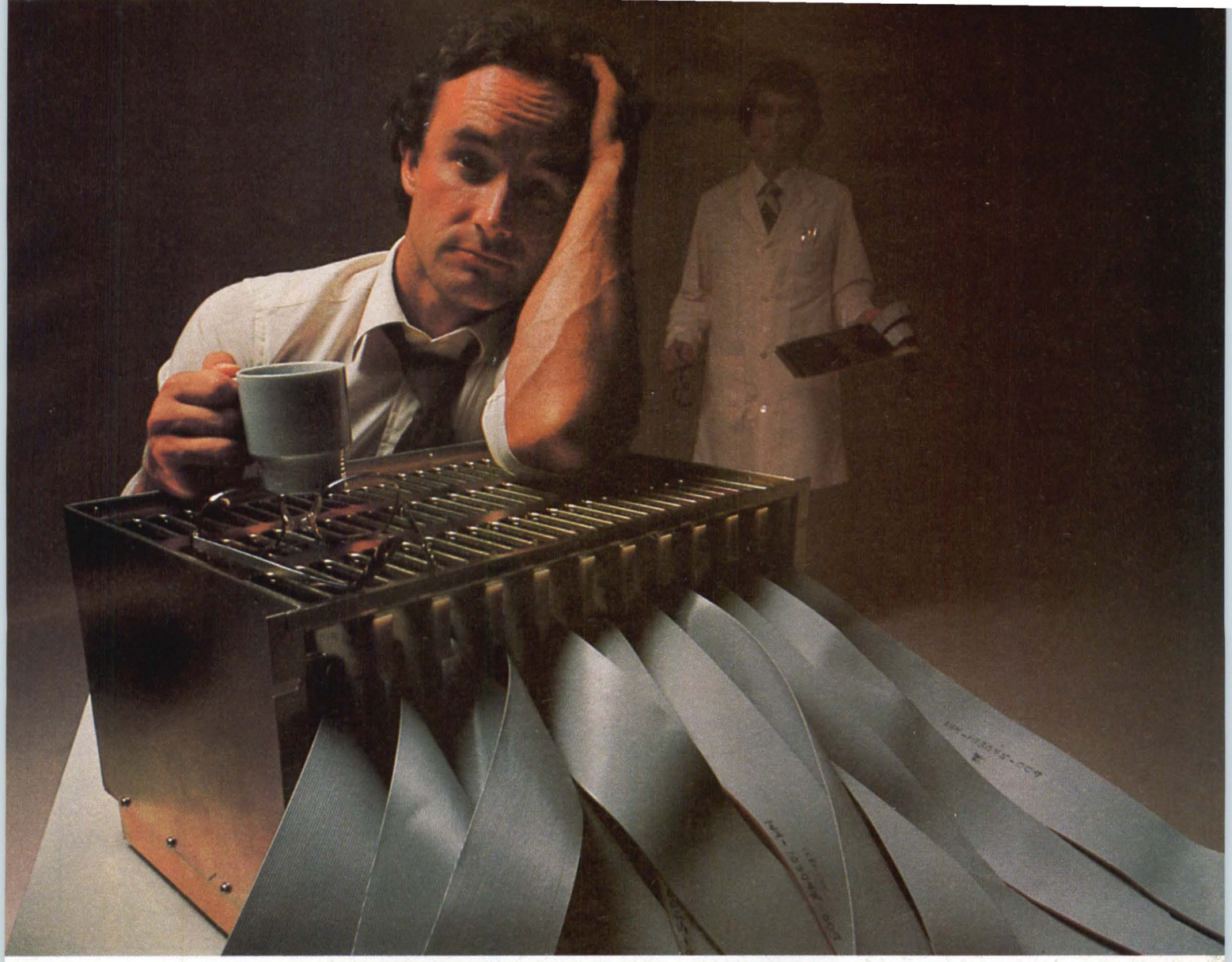


Fig 3 Microinstruction encoding. Four different microcode formats are determined by coding of 2-bit field at leftmost end of word. Sharing microcode fields in specialized combinations of functions minimizes microprogram storage



When your 16-bit computer starts running out of gas... you need MAXIBOX.™

MAXIBOX is a full-scale minicomputer designed to outperform any 16-bit and most 32-bit computers.

Any of the 15 slots in its flexible backplane can be used for I/O controllers, CPU options, peripherals interfaces, and up to 1 MByte of fast, economical MOS memory. Its standard 256 KByte configuration leaves you with 9 "nondedicated" slots for total design flexibility.

No other mini of any size can offer 26.7 MByte bandwidth on a computer that requires only a 115Vac utility outlet. With 600 ns ECC MOS memory for maximum computation speed and a virtually universal backplane, MAXIBOX is a must for "peripheral intensive" designs or products where speed, space and power are prime considerations.

Furthermore, MAXIBOX is fully compatible with the broadest 32-bit product line in the world. SYSTEMS' RTM, the most thoroughly field-proven 32-bit operating system available, is currently installed in hundreds of SYSTEMS processors.

Writable Control Store allows you to tailor the MAXIBOX to your product environment. Regional Processing Units let you develop sophisticated intelligent I/O controllers and give you parallel processing never before available; it's like having an independent processor attached to the MAXIBOX for discreet I/O functions.

We feel that for the product OEM concerned with simplified design and maximum return on investment, MAXIBOX is the best minicomputer available. To find out more about the MAXIBOX, return the coupon for additional literature, specifications and pricing information. Or, call SYSTEMS toll-free.

☐ Have a representative call me.
☐ Send me a detailed technical summary. I plan to purchase in approximately _____ months. 76

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

PHONE _____ ZIP _____

SYSTEMS
Proven COMPUTER Performance

SYSTEMS toll-free product information service 1-800-327-9716
Systems Engineering Laboratories, Inc., 6901 W. Sunrise Blvd., Ft. Lauderdale, FL 33313 • (305) 587-2900

© 1979

CIRCLE 45 ON INQUIRY CARD

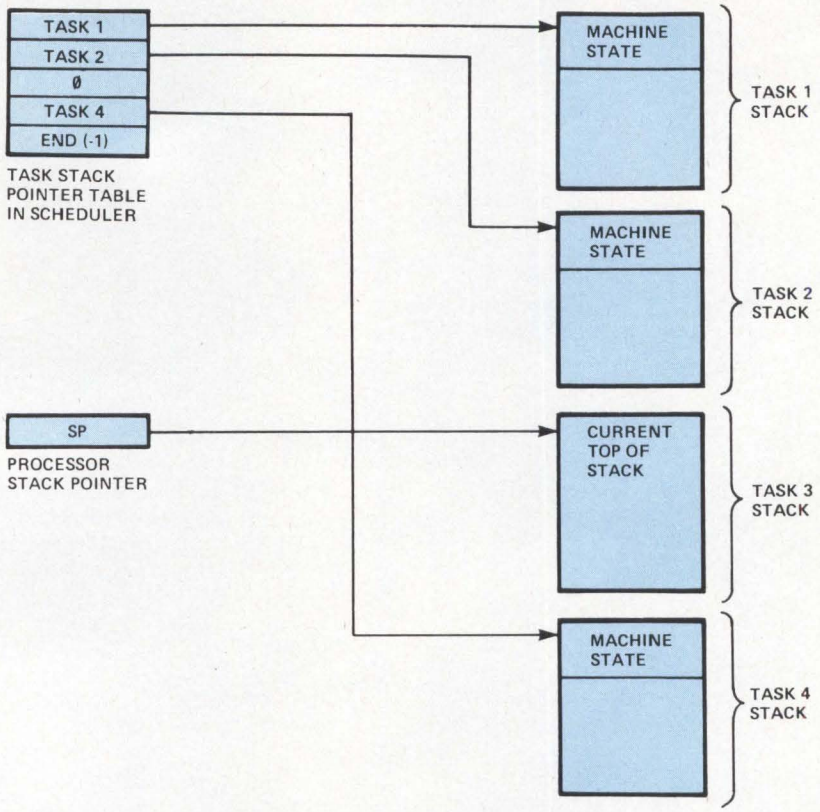


Fig 4 Scheduler's method of suspending tasks (Task 3 running). To run any suspended task, scheduler need only know where top of that particular stack is located, as indicated by stored pointer

realtime control systems to allow independent programming of the various activities that must take place—and interact with each other—in real time. The firmware scheduler automatically resolves their conflicts based first upon the system resources they require and then upon task priorities, and schedules their shared use of the processor. One task program will always be running in the processor at any time and the remainder will be suspended, their context stored as if interrupted, in various stages of completion.

Once these resource dependencies are programmed into each task, the programmer can treat them independently and the scheduler will handle their realtime interaction. Tasks are normally released from suspension either by the other tasks or by the interrupts which make the resources for which they are suspended available. Even the realtime clock can be treated as such a resource, thus allowing tasks to be run at regularly scheduled intervals such as once a second.

Controller Tasks

A standalone multiloop controller in the blender system contains keyboard, CRT display, communications interface, and analog and digital I/O. Individual tasks of the software configuration (Fig 5) are assembled as independent programs. A short initializer links the tasks to the scheduler, turns on the interrupts, and places the system in run mode.

The communications task is interrupt driven from the communications I/O interface. Multiple blenders can be connected to one communications line. Each blender is given a number by the user, which is entered using the blender keyboard. All blenders on a line listen to commands from the host, but the only blender which responds is the one having the identification number matching that in the command from the host.

A communications I/O driver buffers all messages to and from the host. The driver does not request the communications task to run until a complete message has been received or sent. At this time, the communications task either processes the message received from the host if waiting for a command, or sends the next line of the reply (if any) for the command it is currently processing.

Possible commands from the host include downloading, uploading, requests for selected data from a specified loop, requests for selected data from all loops, and

How can you get a bigger byte without a ballooning budget?

Use MAXIBOX.™

Simply stated, for the product OEM concerned with simplified design and maximum return on investment, the MAXIBOX offers the greatest price/performance advantages available in a 32-bit minicomputer.

To find out more about the MAXIBOX, return the coupon for additional literature, specifications and pricing information. Or, call SYSTEMS toll-free.

☐ Have a representative call me.
☐ Send me a detailed technical summary. I plan to purchase in approximately _____ months. 76

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

PHONE _____ ZIP _____

SYSTEMS
Proven COMPUTER Performance

SYSTEMS toll-free product information service 1-800-327-9716

Systems Engineering Laboratories, Inc., 6901 W. Sunrise Blvd., Ft. Lauderdale, FL 33313 • (305) 587-2900

© 1979

CIRCLE 46 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

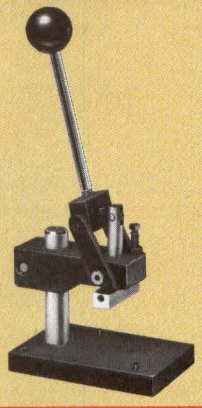
for high speed assembly using tooling you already have

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 47 ON INQUIRY CARD

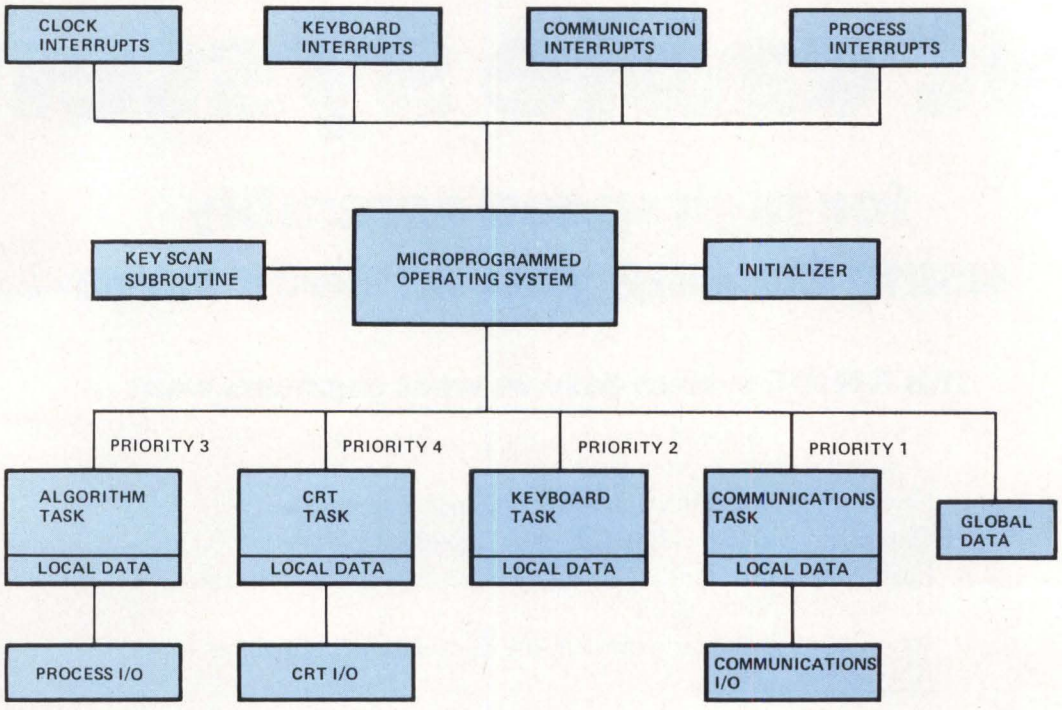


Fig 5 Software configuration. Individual tasks are assembled as independent programs, each competing for system resources according to its priority. CRT task—with lowest priority—runs only in free time

changing selected data in a specified loop. Download and upload data messages are sent as strings of hexadecimal ASCII characters in which two characters represent the binary value of one byte of data. Each download or upload record contains the record number, 60 hexadecimal characters, and a checksum.

The addressed blender always responds to each command from the host, either with an ACK for successful execution, a NAK for unsuccessful execution, or the requested data for those commands which request data. A total of 20 main commands is provided.

A keyboard task runs only when a complete command has been entered by the user at the blender keyboard, as determined by the keyboard scanning subroutine. This subroutine is called from the clock interrupt and executes a 3-state algorithm to identify a valid key, accept the key, and proceed to identify the next key. When a complete command has been entered (which can be a single key for some commands) the keyboard task is requested, through the microcoded executive, to run.

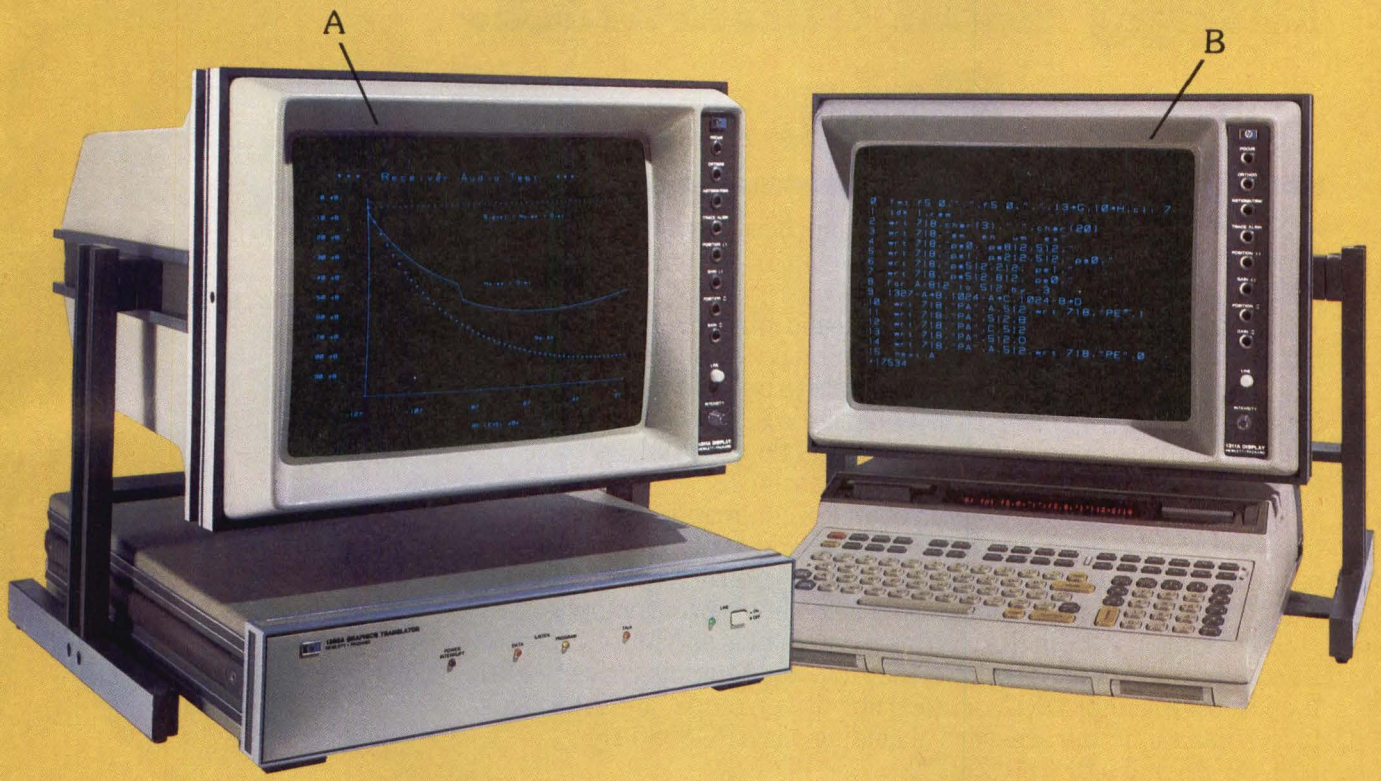
The keyboard task parses the commands, checks the parameters (if any), and makes context checks. If legal, the keyboard task then executes the command. Some commands have two cycles, in which the first cycle selects data to be displayed and the second cycle accepts a new value to store for the selected data. All of the program codes and loop address functions are 2-cycle commands. Data types which can be displayed and entered are binary masks, integer and floating point numerics, and ASCII strings.

All blender loops and control blocks are created and parameterized through the keyboard task. Also, all of the blend control buttons such as START, STOP, LOCAL, and COMP are processed by the keyboard task. A total of 116 program functions is provided, in addition to the dedicated key functions.

The algorithm task periodically processes all of the active blender loops and calculation blocks defined in the blender system. Each blender loop is executed every 0.1 s, and each calculation block is executed at the period assigned by the user. The algorithm task itself is requested to run each 0.1 s by the clock interrupt.

For each active blender loop, a transformation from turbine meter counts to control valve position is computed. The turbine meter counts used are those which have accumulated in the most recent 0.1-s period, and thus represent the flow rate increment received by that loop for that period. Variables which may be displayed or changed from the keyboard include loop name, loop engineering units, specific gravity, loop turbine meter K

Here's the fastest HP-IB* graphic peripheral available today... and it programs like a plotter.



With the HP 1350A Graphics Translator and one or more HP electrostatic CRT displays, there's no faster way of seeing your system's output. You can get a quick reading - then plot if hard copy is needed.

Because it's HP-IB* compatible, the 1350A is easy to add to your system. It lets you present different information simultaneously on up to four CRT displays.

And, it makes writing a program for a CRT display as easy as programming a plotter. An optional binary cassette tape for the HP 9825 Desktop Computer simplifies programming and lets you use the same routines on both CRT's and plotters.

The 1350A lets you update the display selectively. For example, in an application such as sequential testing, you can view multiple data plots (A) on a CRT and update only a portion of the display for rapid comparative measurements. It also provides convenient operator interaction. You can display program listings (B), normal and expanded displays, or a cursor and its coordinates.

Ideal for use with HP Data Acquisition and Network Analysis Systems, the 1350A Graphics Translator, priced at $3,450**, is a useful tool anywhere a fast, high-resolution graphic presentation of information is needed. Write for Application Note 271-1, or call your local HP field engineer for complete details.

*HP's implementation of IEEE Standard 488-1975
**Domestic U.S.A. price only

HEWLETT hp PACKARD

1507 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

088/12

CIRCLE 48 ON INQUIRY CARD

The world's best floppy disk controller. Plain.

Now there are two ways to get the simplicity, power and flexibility of our floppy disk controller: NEC's μPD765 chip, or the BP-2190 board from NEC Microcomputers.

The innovative μPD765, developed and introduced by NEC, has become an industry standard and will soon be second-sourced by a U.S. semiconductor company. It's simple to build into your system, because the standard 40-pin, +5V design is totally compatible with IBM single- or double-density format floppies and 5¼" mini-floppies, as well as standard 8" drives.

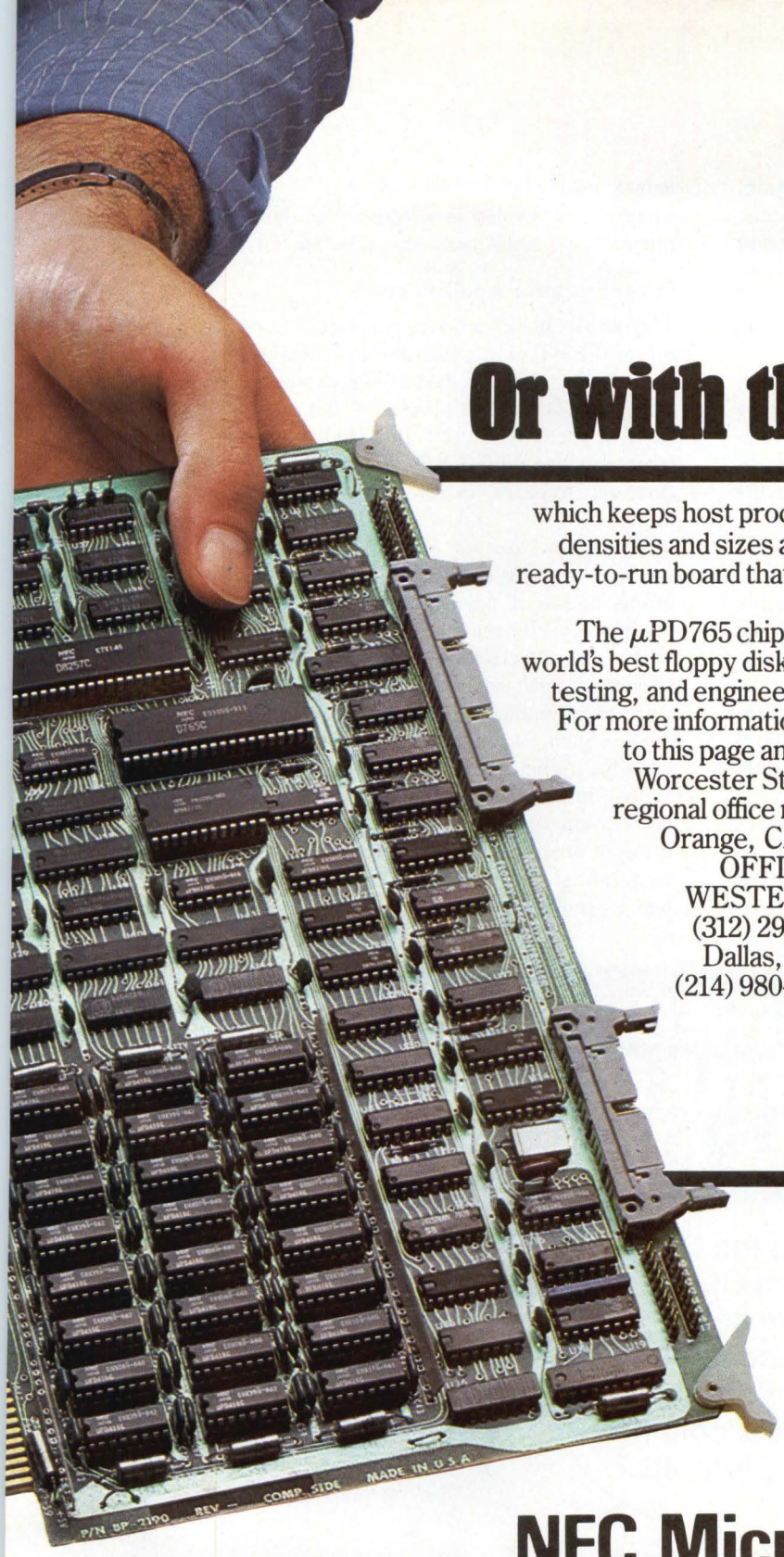
It's powerful too, executing 15 complex commands including many subroutines usually found in a disk handler software package. Plus it controls up to four double-sided drives.

And the 765 gives you unequalled flexibility in programming your controller system through such commands as Multi-Sector Reads and/or Writes, Track Formatting, and Multiple Drive Seeks. It operates in either DMA or interrupt-driven mode, and interfaces to all popular microprocessors, including our μPD8080AF, μPD8085A and μPD780 (Z80™).

For board applications, you get all the capabilities above and more. The BP-2190 board includes the 765 and 16K of dual-ported RAM (expandable on-board to 48K), along with priority and refresh logic. Disk-to-RAM transfers are under DMA control

Controller Chip REPS: Action Unlimited, Arlington, TX, Spring, TX; Cerco, San Diego, CA; Contact 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; K-Mar Enginerering & Sales, Inc., Grandview, MO; Kaytronics Limited, Ville St. Pierre, QUEBEC, Concord, ONTARIO, Surrey, BRITISH COLUMBIA; L & M Associates, Pikesville, MD, Montpelier, VA; Harry Nash Associates, Willow Grove, PA; R.C. Nordstrom & Company, Lathrup Village, MI; 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 Electronics Corp., Philadelphia, PA, Baltimore, MD; Bell Industries, Bellevue, WA; Century Electronics, Albuquerque, NM, Wheatridge, CO, Salt Lake City, UT; 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; Marshall Industries, Farmingdale, NY, Wallingford, CT; Milgray Electronics, Inc., Freeport, NY, Orange, CT; Quality Components, Austin, TX, Houston, TX, Dallas, TX; 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; Western Microtechnology, Cupertino, CA.



Or with the works.

which keeps host processor overhead to a minimum. And mixed densities and sizes are handled with ease. All of this on a single ready-to-run board that plugs directly into a Multibus™ system—and we'll supply the software drivers, too.

The μPD765 chip, or the BP-2190 board. Either way, it's the world's best floppy disk controller. Backed by full documentation, testing, and engineering help for specific application problems.

For more information, attach your business card or letterhead to this page and send to NEC Microcomputers, Inc., 173 Worcester Street, Wellesley, MA 02181. Or contact the regional office near you. WESTERN REGION OFFICE: Orange, CA at (714) 633-2980; EASTERN REGION OFFICE: Melville, NY at (516) 293-5660; MID-WESTERN REGION OFFICE: Des Plaines, IL at (312) 298-7081; SOUTHERN REGION OFFICE: Dallas, TX at (214) 980-6976.

Next time, think NEC.

™ Z80 is a trademark of Zilog Corporation.
™ Multibus is a trademark of Intel Corporation.

NEC

NEC Microcomputers, Inc.

Controller Board REPS: Action Unlimited, Arlington, TX, Spring, TX; Cerco, San Diego, CA; Contact Sales, Inc., Burlington, MA.; D/Z Associates, Inc., Denver, CO; Electronics Innovators, Inc., Minneapolis, MN; Eltron, Phoenix, AZ; Kaytronics Limited, Ville St. Pierre, QUEBEC, Concord, ONTARIO, Surrey, BRITISH COLUMBIA; Santana Sales, Costa Mesa, CA; Trident Associates, Inc., Sunnyvale, CA; Tri-Tronix, Albuquerque, NM; Tri-Tronix, NW., Mercer Island, WA.

DISTRIBUTORS: Almo Electronics Corp., Philadelphia, PA, Baltimore, MD; Bell Industries, Bellevue, WA; Century Electronics, Albuquerque, NM, Wheatridge, CO, Salt Lake City, UT; 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; Marshall Industries, Farmingdale, NY, Wallingford, CT; Milgray Electronics, Inc., Freeport, NY, Orange, CT; Quality Components, Austin, TX, Houston, TX, Dallas, TX; 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; Western Microtechnology, Cupertino, CA.

CD-2

factor, loop normalization factor, proportional gain, integral (reset) gain, high and low flow alarm limits, plus and minus quantity error alarm limits, plus and minus quantity error shutdown limits, loop pacing parameters, and valve position. All values and variables are entered in engineering units or customarily used units such as proportional band (PB).

For each active calculation block, an algorithm corresponding to the block type is executed. The block types include analog input, proportional/integral control, analog switch, contact input, equation, and constant. All parameters can be entered or displayed through the keyboard, in customarily used units, and the blocks may be linked together or to blender loops by keyboard selection. General parameters include period, block name, block units, and on/off status. Other parameters specific to the block type include hardware address, proportional gain, reset time, contact number, input designations, operands, and operators.

The CRT task selects and formats all of the displays presented on the CRT. It also checks the blend loop alarm limits and shutdown conditions, and calculates the rates for blend ramp up and ramp down.

This task is requested once each second by the clock interrupt. Each CRT display contains a static and a dynamic part. The static part contains those fields which do not change once they have been output, such as loop names and engineering unit labels; it is output only when a new display is selected. The dynamic part is output with the static part, and then each 1 s thereafter.

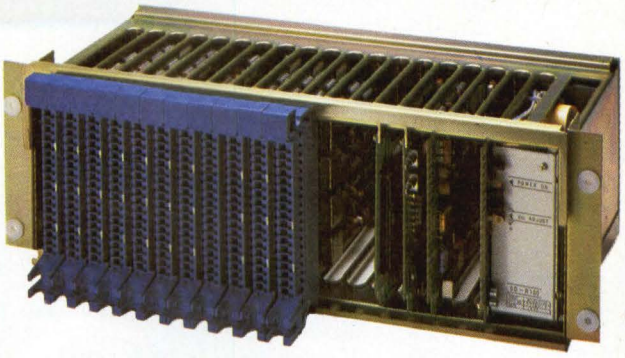
Other Processor Applications

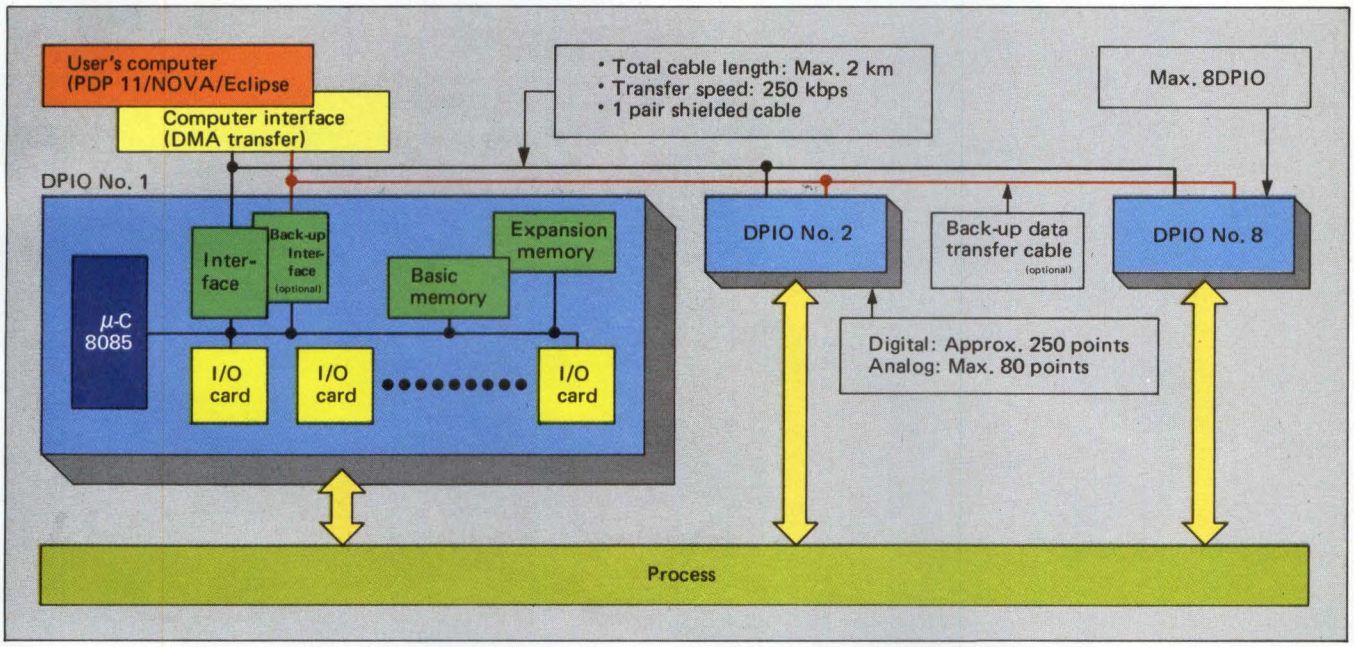
The small stack processor originally designed for the micro-BlendTrol application has also been used in the company's other products. For example, it controls the universal field multiplexer, a data acquisition system used in the SPECTRUM™ distributed process control system; and the same hardware emulating another instruction set appears in the MICROSPEC™ unit controller module.

While the loss of some speed owing to the extra memory accesses required for stack and descriptor operations makes it unsuitable for certain applications, the processor easily regains the advantage in any application that makes effective use of its higher level machine code. Obviously such code runs much faster than similar software programmed in a more conventional machine language. Such considerations would make it very adept at running higher level language interpreters, for example. Its use in products to date, however, has been limited to applications where dedicated machine language programming of small realtime process control systems has made its minimal use of memory and multitask operating system its most useful features. □

"We need a versatile data processor that will save on installation costs and reduce our programming concerns. What's available?"

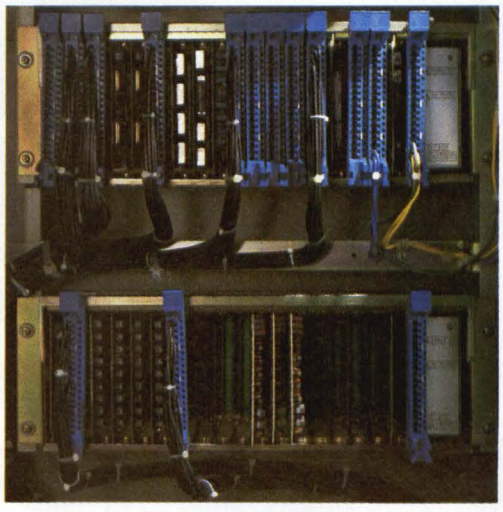
Hitachi's answer: the Distributed Intelligent Process Input/Output (DPIO) Subsystem.





DPIO answers your needs with these excellent features:

- Minimized cabling, an important factor in reduced installation costs.
- Front connector for direct linking with external cable (AWG Nos. 14-20) — a feature that minimizes field wiring.
- DPIO 7660's intelligence performing linearization, cold junction compensation, span calibration, limit check, etc.
- Extreme flexibility in adapting to different system sizes.
- Large repertoire of I/O cards . . . . . digital, analog, pulse and interrupt.
- Reduced power consumption by use of C-MOS circuit and low power input/output circuits.



Hitachi America, Ltd.

San Francisco Office
100 California Street
San Francisco, California 94111
Tel: 415-981-7871

HITACHI
Hitachi, Ltd. Tokyo Japan

CIRCLE 52 ON INQUIRY CARD

Power failure can happen in a flash. But volatile memories don't even notice with GE DataSentry®.

RAMS live in a violent world. ghtning strikes, generator switch- vers, accidental unpluggings, ower shutdowns within the uilding . . . all threatening to estroy volatile memory.

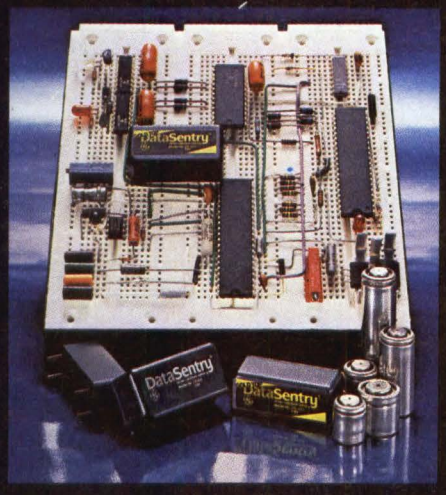
The simple, reliable, inexpensive olution is board-mountable ataSentry® standby power. Dual In- ne Packaged (DIP) DataSentry® bat- eries mount right on the circuit oard or in standard DIP sockets — liminating costly mounting hard- vare, interconnect wiring and ssembly costs. And the multi-pin esign and rugged, sealed plastic ase provide mechanical intergrity.

Now there's even a high-temperature Gold Top® DataSentry®.

Higher temperatures need no onger be a design problem for tandby power. The new Gold Top ataSentry® battery offers long life n high temperature environments, vith excellent durability even to 70° entigrade. If you've considered tandby power, but high emperature was a problem, Gold op DataSentry® should be the nswer!

A voltage to match your design requirements.

Both standard and Gold Top ataSentry® batteries are available n two voltages: 2.4 and 3.6 volts.



Multiples of these two sizes allow you to custom match standby power to the requirements of your system. For example: if you need 6.0V, simply combine one 2.5V and one 3.6V module. You can match the voltage you need by simply combining inexpensive standard components.

Versatile discharge rates.

At room temperature DataSentry® will typically support a small memory drawing 10 microamps up to 3 months, or a larger memory drawing half an amp for more than five minutes. And for even greater requirements, General Electric offers an extensive line of larger capacity batteries.

Reduced costs — increased reliability — maximum performance.

DIP configured DataSentry® batteries allow you to take full advantage of standardized board manufacturing techniques, as well as high volume soldering and cleaning processes. Which means less production time and low costs.

It took General Electric's technological leadership to combine the proven reliability and long life of rechargeable nickel-cadmium battery technology — with a standard DIP package. The result is a board-mountable battery that requires no maintenance, offers continuous overcharge capability, the versatility of both high and low discharge rates, a flat discharge voltage profile and a resealable safety vent. And recharging is easily accomplished by integrating an inexpensive charge circuit during board fabrication.

Write today for complete specs and a free sample. (Offer good through December 1980 — Limit one per inquiry.) GE Battery Dept. P.O. Box 861/Gainesville, FL 32602

Improving Your Designs with Rechargeable Standby Power.

GENERAL ELECTRIC

CIRCLE 53 ON INQUIRY CARD

Spectrophotometer System Analyzes Fabric Dye Shades Online

"On-the-run" adjustments to dye ranges—while the fabric is moving through the processing equipment at over 100 yd (91 m)/min—are possible with the Qualscan system installed at Greenwood Mills' Orangeburg, SC finishing plant. During a period of several months of continuous operation, over 10M yd (91M m) of cloth have been scanned.

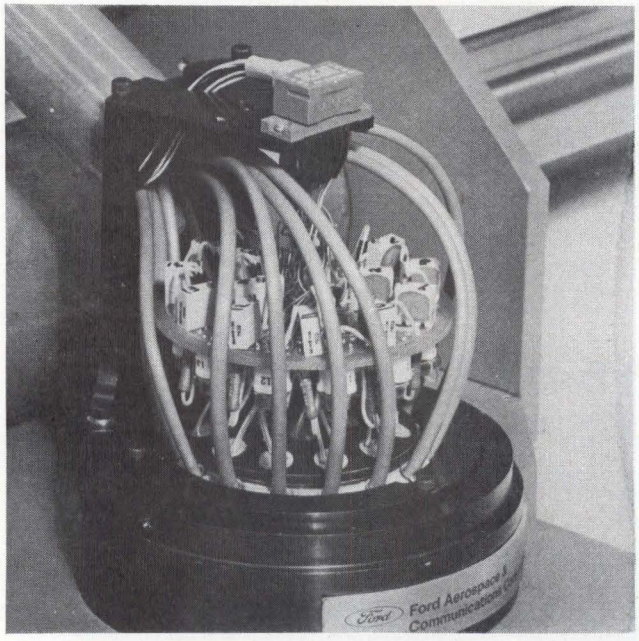
In standard industry practice for textile dye house operations, 18″ (46-cm) swatches of fabric are removed periodically, sewn together, and examined in a specially lighted area—by a human—for color shade acceptability. Because the production and material handling equipment is stopped only once every 2000 or 3000 yd (1800 or 2700 m), all cloth between stops might be defective.

The computerized online color analyzer, introduced by Ford Aerospace & Communications Corp, Process Control Products Operation, Charlotte, NC, electronically scans moving fabric and spots off-shade colors. There is no stopping of equipment, human-element decisions and possible variations in interpreting standards are eliminated, and color deviations are noted immediately.

Designed to provide color measurement by large scale fabric finishers for use on continuous dye ranges, the digital abridged spectrophotometer system contains a precision scanning color head that traverses the width of the cloth as it leaves the dye range. Within the head are 16 color-sensitive silicon detectors behind precision color filters of very selective bandwidths. To eliminate drift and instability in the color detection circuitry caused by heat from the light source, a remotely located quartz halogen lamp uses fiber optic light pipes to illuminate the fabric inspection area. Built-in reference standards check scanning head accuracy every 30 min.

In the procedures to locate shading inconsistencies, the system scans long runs of dyed fabric in side-center-side (across the fabric) as well as end-to-end procedures. Color information is presented to the dyer as a continuous CRT readout and as hardcopy on a high speed printer. Deviations from color shade values assigned by the dyer and placed in computer memory as shade tolerance thresholds are automatically flashed on the screen for immediate action.

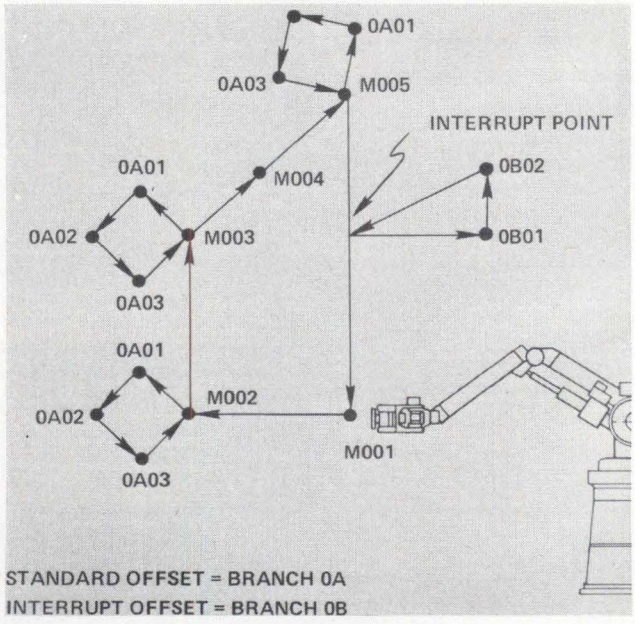
Circle 160 on Inquiry Card



Scanning color head (cover removed to show detail) in Ford Aerospace's fabric color analyzer. Data from 16 color sensitive silicon detectors are compared to shade tolerance thresholds in computer memory. Fabric illumination is provided via fiber optic light pipes

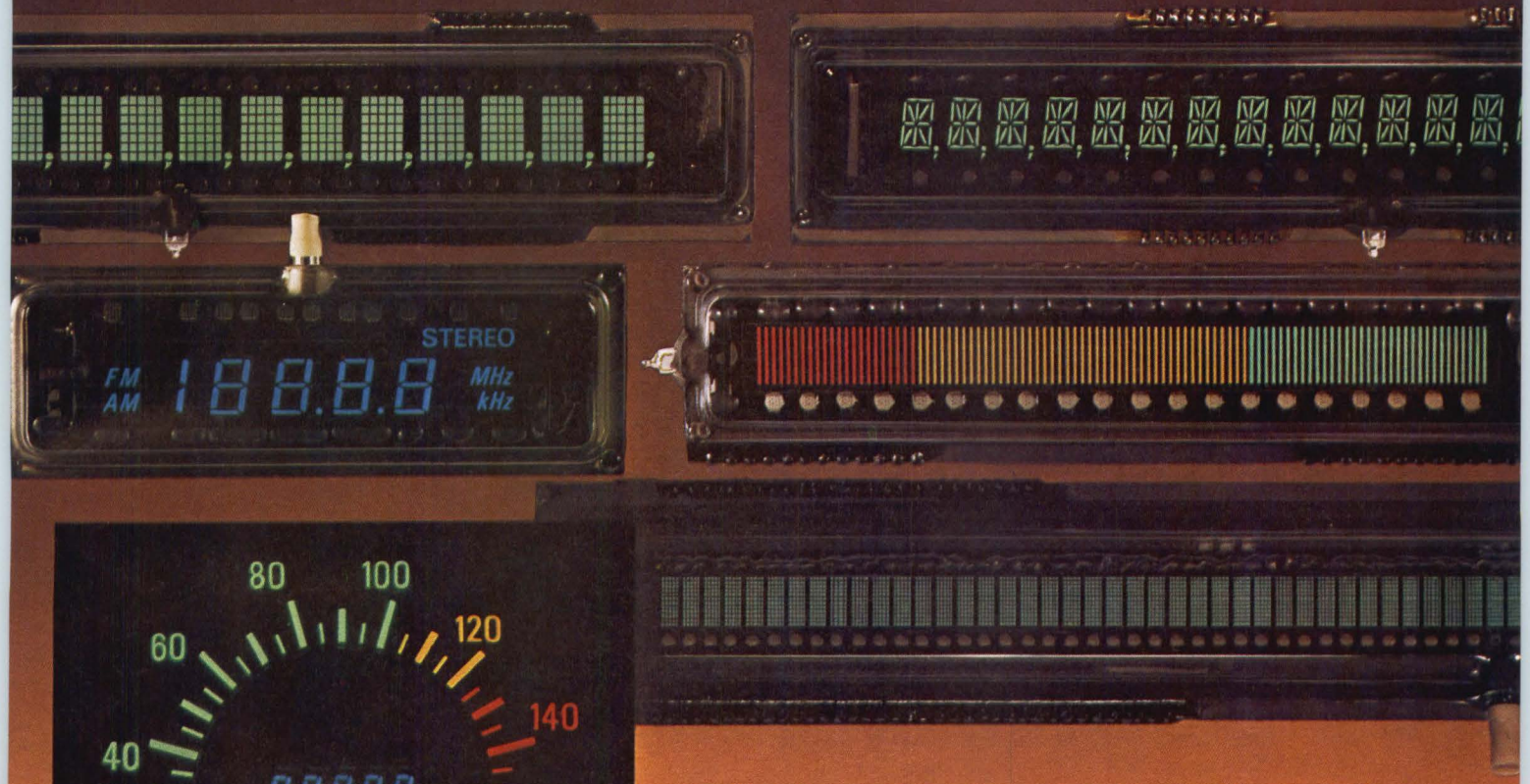
General Purpose Robot Taught to React to Unpredictable Deviations

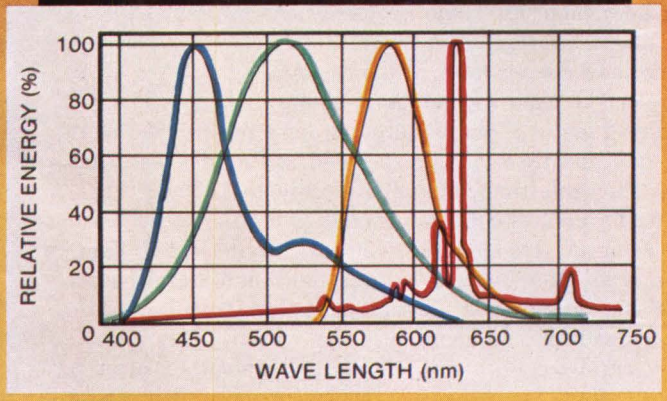
Teaching a computer controlled T³ industrial robot to perform its repetitive duties—but yet be able to deviate for changes in normal sequences—is greatly simplified by "walking" the robot through the intended sequence of events. Cincinnati Milacron, Cincinnati, OH 45209, has found that what might otherwise become a tedious



Offset branching programming for robot cycle. At each point where offset branch is programmed, proper input signal is checked and branch is entered if input is active. Interrupt offset allows for "anywhere, anytime" shifts in cycle to allow reaction to expected but unpredicted deviations

Make your readouts outstanding with the latest Itron innovations.





Multi-color configurations. Red, blue, yellow and blue-green arrays. 5 x 12 dot matrices for upper/lower case alphanumerics and 5 x 7 dot matrix displays. High density dot and bar graphic panels. 14-segment alphanumeric units. These latest, and all the other Noritake Itron advancements, are sure to open up new readout innovation opportunities for you.

And you'll realize all the advantages offered by Itron Fluorescent units over ordinary digital displays. Their cost-effective pricing and simple, fast installation will save you time and trouble, as well as a great deal of money. Interfacing with peripheral circuits is easy too; further reducing costs. They operate at low voltage and consume little power. Their bright fluorescent output and flat-glass packages make for easy readability, at a distance and at wide viewing angles, even under high ambient light conditions.

What's more, Itron displays have a proven long-life track record for reliable performance under stringent conditions. And we can quickly and economically fabricate custom configurations. Since there's much more you should know to make an optimum display selection, contact us for all the particulars.

itron®

FLUORESCENT DISPLAYS

Patented and manufactured by ISE ELECTRONICS CORP.

INTERNATIONAL REPRESENTATIVES

WEST GERMANY: Neumuller GmbH, Eschonstr 2, 8021, Taufkirchen, Munich Phone. 089/6118-245 Telex. 522106

FRANCE: Europavia, France, 5 Avenue Leon Harmel 92167 Antony Cedex Phone. 666-21-10 Telex. 42204381

UNITED KINGDOM: ITT Meridian, West Road, Harlow, Essex CM20 2BP Phone. 0279-35351 Telex. 817202

SWEDEN: AB Nordqvist & Berg, Box 9145 S-10272, Stockholm Phone. 08-690400 Telex. 10407.

HONG KONG: Phone. 5-232420 TAIPEI: Phone. 351-0293

NORITAKE ELECTRONICS, INC.

L.A. OFFICE: 22410 Hawthorne Boulevard, Torrance, CA 90505, (213) 373-6704, Telex: 67-4910
N.Y. OFFICE: 41 Madison Avenue, New York, NY 10010, (212) 481-3440, Telex: 12-5469

NORITAKE COMPANY, LIMITED

JAPAN: 1 - 1 Noritake Shinmachi, Nishiku, Nagoya-Shi, (052) 561-7111, Telex: J59738
EUROPE: Burotel Belgium SA, Rue de la Presse 3-5, 1000 Bruxelles, (02) 217-83-60, Telex: 4626962

Circle 54 for Sales Contact **Circle 55 for Literature Only**

procedure not only eases teaching but also simplifies operation.

An example of this is shown in the robot's "branching" ability. Three types of branching—conditional, offset, and interrupt offset—enable the robot to perform secondary functions: add, change, and delete. Such ability to make decisions based on input conditions permits tailoring of a general purpose robot to specific applications.

For conditional branching, a signal from an associated equipment would cause the robot to deviate from its normal sequence and to perform one of the secondary functions. For example, if the robot were loading parts into a turning center and a signal from that center indicated that the part was not ready, that the door on the machine was closed, that the spindle was still in motion, or that the previous part was not completed, the robot would not move forward in its sequence and load another part. Instead, it would either wait or go on to another step.

Teaching offset branching is simplified by software available in the robot control. In an example where the robot is loading or unloading parts onto or from skids and pallets, repetitive moves are taught as a subroutine. After one instruction period, the robot control remembers the subroutine (including such moves as stop above pallet, move down, release part, move up) and calls it up as needed during an actual job.

Interrupt offset, known as a utility branch, can be entered anywhere in the robot cycle after being triggered by an external signal. It is actually a contingency program for reaction to expected but unplanned events. For example, if welding tips stick and weld themselves to the workpiece—an expected occurrence in a spotwelding application, but one that is impossible to predict in time span—the robot would cause the welding tips to move in a series of previously taught twisting motions to free the tips. It could also simultaneously signal the operator that the welding tips require attention.

Circle 161 on Inquiry Card

Energy Management System Reduces Natural Gas Fuel Costs by Half

Decreased consumption of natural gas and/or propane during a 6-month test period—resulting directly from the installation of an energy management system—reduced fuel bills by 50% in the most energy inefficient building in Winnebego Industries' Forest City, Iowa complex. The company estimates that the cost savings during that period alone exceeded the cost of software development, hardware purchase, and installation. As a result, the system—designed by Billings Computer Corp, 2000 E Billings Ave, Provo, UT 84601—will be extended to the remaining 11 buildings.

In the full system, there will be at least one controlling microcomputer in each building, with very large buildings having several satellite computers connected to a master computer in order to simplify wiring to sensors and peripheral devices. All buildings will be monitored and controlled from a single keyboard in the maintenance building. Each master computer will function independently, managing its building according to a program and instruction tables and schedules loaded in from the central keyboard. Upon request each master computer will transmit status tables to the maintenance building.

At present, the system monitors temperatures at various locations in the building as well as flow rate of natural gas and/or propane into the building. All unit heaters, exhaust fans, and air make-up units are controlled according to predefined production schedules and schedules for the temperature setpoint of the building. Software also provides for error handling with alarm signals sent back to the maintenance building.

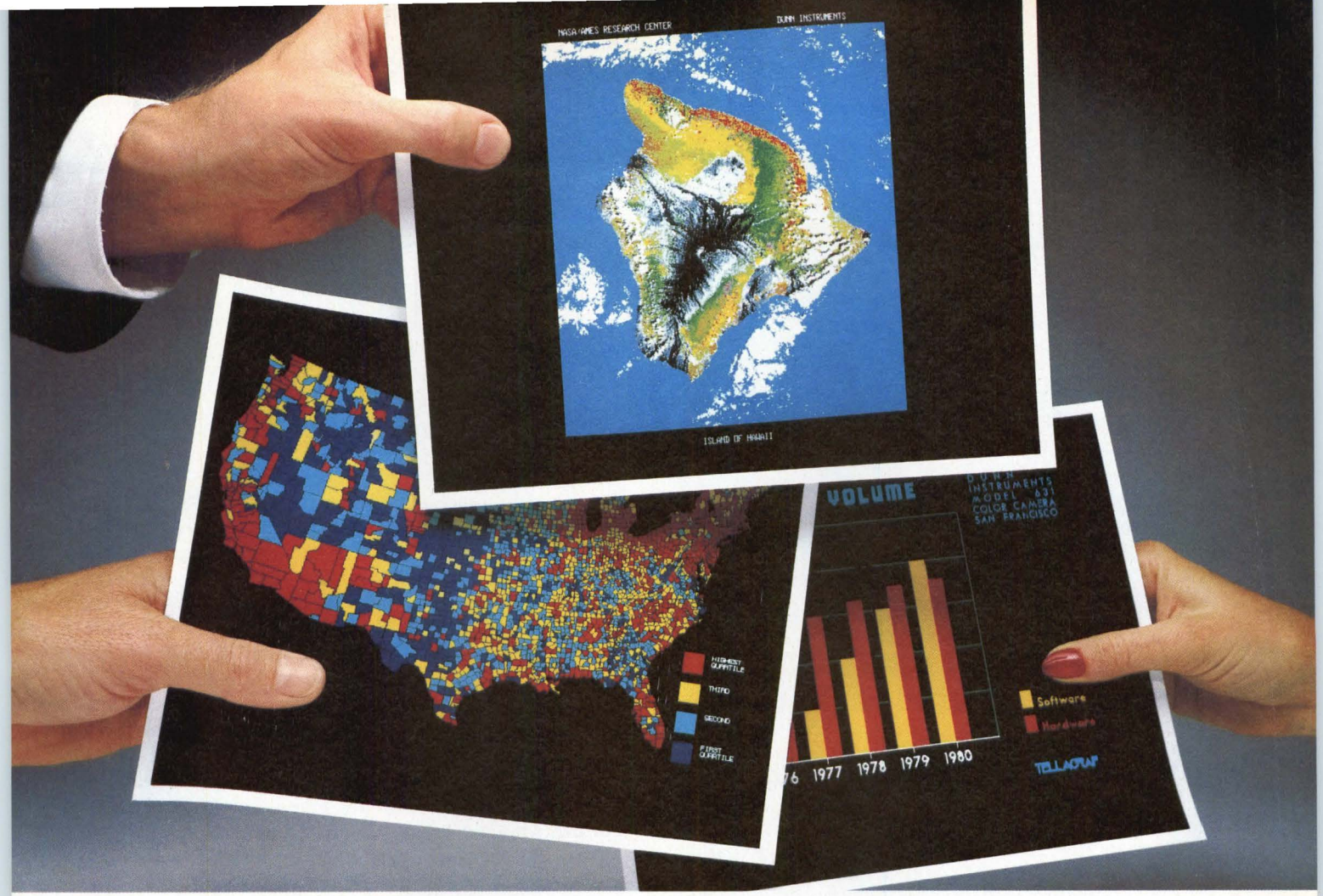
Data accumulation features in system software include current value tables, selectable accumulators, automatic accumulators, and weather station history. Requested data are summarized and saved in memory awaiting retrieval. More than 1 yr of information is accumulated in summary form of last month, last week, last day, last hour, and last 15-min intervals. As the tables fill up, the oldest information is summarized to form an element of the next higher table of the cascade.

Selectable data accumulators obtain high, low, integral, and average of a sensor output from a prespecified starting day and time to a prespecified ending day and time. The allowable time interval is 5 min to 110 yr.

Master control consists of a 64k-byte Microsystem with an external, 1M-byte, 8″ (20-cm) double-sided floppy disc drive, X-Y plotter, warning light, and alarm buzzer. The system addresses 16 separate inputs (monitoring devices) with measurement accuracy within 0.1%.

A parallel I/O board allows the system to open or close circuits to 24 separate devices or sense their operating modes. A relay section attached to the board contains an equal number of amplifiers and can drive signals over twisted pair cable for up to 500 ft (180 m). For applications with remote controlling requirements, a multiple input/output board containing four high current amplifiers will drive signals over twisted paid cable for up to 2 mi (3 km).

Circle 162 on Inquiry Card



Actual 631 images on Polaroid instant 8x10 film.

Color hard copy is finally at hand!

Color hard copy: the luminescent electronic image, captured in the permanence of photographic prints and transparencies. Dunn Instruments makes it brilliant, accurate and effortless to obtain from an affordable system. At last you can hold the new computer graphics and digital images in your hands.

The source is the 631 Color Camera System. It packs a high resolution, high linearity CRT, sophisticated optics and microprocessor exposure control into a compact, fast and friendly unit. For instant hard copy for immediate analysis, use it with Polaroid Type 808 film to make stunning 8x10 color prints. Add the optional motor-driven 35mm system for beautiful color slides. Or load 8x10 transparency film and produce images you can project overhead.

The 631 economically records the data from any raster scan CRT, for presentation, reproduction, access and display. Applications range from management information graphics to satellite remote sensing. Call or write for more information. We'll arrange for you to get your hands on actual results from the 631 Color Camera System.

Dunn Instruments, Inc.,
544 Second Street, P.O. Box 77172,
San Francisco, CA 94107.
415/957-1600.

The 631 COLOR CAMERA SYSTEM

"Polaroid" is a registered trademark of the Polaroid Corporation.

LANDSAT image courtesy NASA-Ames Research. Cartographic study courtesy Harvard Laboratory for Computer Graphics. Management information graphics courtesy ISSCO.

CIRCLE 56 ON INQUIRY CARD

DUNN INSTRUMENTS

From PERCOM - for Your Mini-Disk Drives ...

Low Cost, Ready-to-Use Power Supply - 1-, 2- and 3-Drive Enclosures

the PS-401

Used on Percom's LFD and TFD series of 5¼-inch mini-disk drives, the PS-401 power supply comes complete with ac power cord, dc connector, on-off switch and fuse. Install, plug into ac and your drive is ready.

The +5-volt and +12-volt outputs of the PS-401 are conservatively rated for most mini-disk drives including Shugart's SA-400 and SA-450 models, Pertec models FD-200 and FD-250, Wangco models 82 and 282, MPI's model B51 and the MOD I and MOD II units manufactured by Micropolis.

The PS-401 features thermal overload protection and short-circuit current limiting. Operating ambient temperature is from 0°C through 40°C. Storage is from -22°C to 50°C.

Input for the domestic version is 117 Vac, 50-60 Hz, 0.5 ampere (max). Foreign country version operates on 230 Vac, 50-60 Hz at ¼ ampere (max).

Order PS-401 power supplies by calling Percom's toll-free number: 1-800-527-1592.

Drive Enclosures

These pre-drilled metal drive enclosures may be ordered in standard blue, silver or brown enamel finish. Other colors are optional. Rubber bumpers for desk-top operation are permanently attached.

Order 1-, 2- or 3-drive enclosures by calling Percom's toll-free number: 1-800-527-1592.

* Price is for 100 quantity. Unit price is $55.00 for domestic version, $70.00 for foreign version. Call for foreign version OEM prices.

† Price is for 100 quantity. Unit price is $29.95. Call or write for 2- and 3-drive enclosure prices or price of optional finish colors.

PERCOM

PERCOM DATA COMPANY, INC.
Dept. CD
211 N. Kirby • Garland TX 75042
(214) 272-3421

DIGITAL CONTROL AND AUTOMATION SYSTEMS

DC&AS BRIEFS

Programmer/Controller Features Dual-Channel Operation

Self-learning process modeling and dual-channel output for independent control of two process variables are features of the MPC 3030 microcomputer programmer/controller. Introduced by Thermotron Industries, Automatic Control Systems Div, 468 Cleveland Ave, Holland, MI 49423, the unit offers 50 program intervals with independent transition rate control for each channel. By continuously updating its information through monitoring the previous control action and the current process variable level, the unit optimizes control response for a setpoint change and tailors the control response to the programmed profile. Program instructions are resident and are system prompted for ease of programming and editing. Selectable Celsius or Fahrenheit temperature scales, 25-char keyboard, eight on/off TTL compatible event outputs, and failsafe protection for power transients and/or power failure are included in the unit. Options include EPROM profile storage, emergency power back-up, event relays, and keyboard lockout. Power requirements are 115 Vac, 50/60 Hz, 50 VA max. Overall dimensions are 8.75 x 19 x 17.75" (22 x 48 x 45 cm). Ambient operating temperature is from 32 to 131 °F (0 to 55 °C); standard temperature range is −125 to 375 °F (−87 to 190 °C).

Circle 163 on Inquiry Card

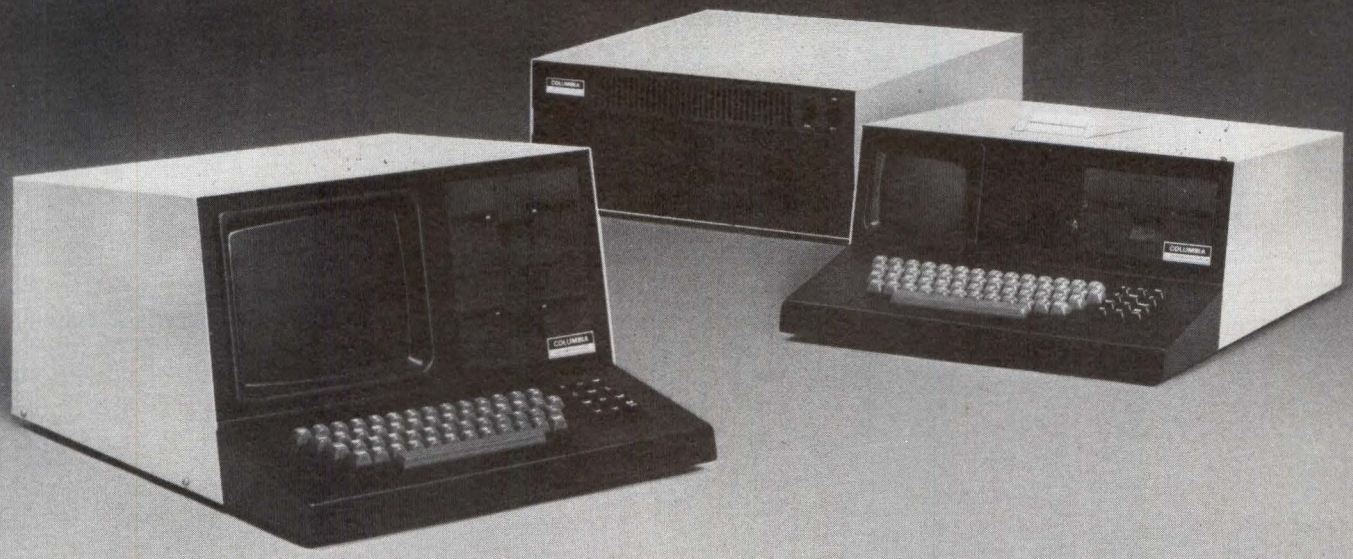
Interface System Based On Snap-In I/O Modules

An I/O interface system announced by Teledyne Relays, 12525 Daphne Ave, Hawthorne, CA 90250, consists of a mounting panel and up to 16 ac and dc input and output modules. Logic circuitry interconnect wiring in the mounting panel terminates in a choice of ribbon, edge card, or D-type connectors compatible with most microcomputer systems. Solid state modules for the model 674 I/O system snap into the panel without any wiring connections. Their features include optical isolation, noise immunity, and LED status indicators for troubleshooting. Output ratings are 4 A at 20 to 250 Vac, and up to 3 A at up to 250 Vdc.

Circle 164 on Inquiry Card

CIRCLE 57 ON INQUIRY CARD

Now, Computer Power In Your System For Under $3,000*



Executing PASCAL or MACRO Assembler, BASIC, COBOL, FORTRAN and Business Software under CP/M™

...With Commander

A unique family of computer systems, the Commander series includes the right configuration for your application. Stand alone Commanders have built-in mini-floppy disks with up to 320kb of storage. They include a full alphanumeric keyboard, user defined function keys, a five- or nine-inch CRT with graphics and soft screen, four RS-232 ports, composite video, parallel I/O port, and optional built-in thermal printer, IEEE and DMA I/O ports.

Our stand alone Commanders use dual Z80A processing whereby the user can access up to 16kb RAM on the CRT terminal processor independently of the 64kb RAM on the host processor.

A large capacity version of the Commander series provides 1 megabyte storage in dual SSDD 8 inch floppies...ideal for integrating your CRT terminals, modems and printers.

Applications Software

Not only does the Commander accept the higher level languages you and your customer want...but we also offer a host of proven application packages for a modest one-time charge, including diagnostic software.

- ☐ File Management, Editing and Word Processing Systems
- ☐ General Ledger, Accounts Payable and Receivable, Payroll and other accounting packages
- ☐ Mail List Management, Inventory Control and more general business packages

*OEM quantity 50 price for dual Z80A, 32kb RAM, 160kb disk, keyboard, CRT four RS-232 ports and parallel I/O.

™ Trademark of Digital Research

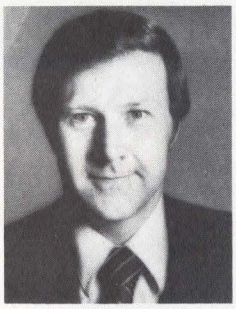
Commanders Are Available For Delivery In 30 Days.

COLUMBIA
DATA PRODUCTS, INC.

9050 Red Branch Road, Columbia, Maryland 21045 TEL: (301) 992-3400 TWX: (710) 862-1891

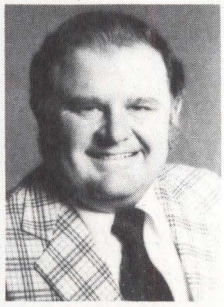
CIRCLE 58 ON INQUIRY CARD

Midcon/79



James Ralston
Convention Director

Electronics Convention and Exhibition
Chicago O'Hare Exposition Center and
Hyatt Regency O'Hare Hotel
November 6-8



Robert Betten
Program Chairman

How can the electronics industry meet the needs of manufacturing production and industrial design concerns, and what available technology can these companies utilize? With more than 40% of the United States' industrial production within a 500-mi (800-km) radius of Chicago, these questions represent an important aspect of Midcon/79. The O'Hare Exposition Center will function as the exhibit hall, and the Hyatt Regency O'Hare will be the site of more than 120 professional presentations for the 3-day convention.

Professional sessions will be held at 10 am and 2 pm, Tuesday, Nov 6 through Thursday, Nov 8. Those of interest to *Computer Design* readers deal with trends, applications, and present technology of microcomputers and microprocessors, of memories, and in control.

Featured in "Trends in High Performance Single-Chip Microcomputers" will be Synertek's SY6500/1, Motorola's MC6801, Zilog's Z8, and Texas Instrument's TMS 9940. These VLSI chips are enhanced CPUs surrounded with the elements necessary to offer a stand-alone microcomputer system on one chip. Although more expensive than their stripped down counterparts, the single-chip microcomputers offer a cost savings due to part count reduction in the overall system, and can be configured into more demanding applications.

The 16-bit microprocessor based systems to be discussed in another session are the MC68000 from Motorola, the 9445 Microflame II from Fairchild Camera and Instrument Corp, the 16-bit microprocessor family from Zilog, and the PDP-11/23 from Digital Equipment Corp. Since some of the 16-bit system vendors are minicomputer manufacturers and others are semiconductor manufacturers, this will afford a perspective on the evolution and revolution in 16-bit microprocessor architecture.

Software for many of these systems will be discussed in "Advanced Software Tools for Microprocessor Based Systems." These include the C high level programming language for Z80 and 8080 based microprocessor systems, the IDRIS operating system, Pascal for Motorola 6809 and 68000 microprocessors with support for commercial and industrial microprocessor applications, and the Pascal MICROENGINE processor.

Strides have been made to meet the demand for nonvolatile memories—during 1979 several manufacturers will be introducing memories that allow realtime system reconfigurations of nonvolatile storage. To be presented are trends in nonvolatile memories, the device technology, an overview of the market, and applications of electrically alterable memories.

Current solutions to the problem of providing nonvolatile storage for micro and miniprocessors and for small systems will be delivered in another session. Solutions include EPROM, NMOS, battery backup of semiconductor memories, bubbles, minicassettes, and minifloppies. A third session will present advances in static, CMOS, and static and dynamic NMOS RAMs that

Micro power

The first modular 2400 bps modem. That's Rockwell Micropower.

Now you can easily and economically integrate a 2400 bps modem within the functional system of terminals or communications equipment.

The reason—the versatile design of Rockwell's R24, a synchronous MOS-LSI modem. The R24 divides its functions into three modules: one for the transmitter and two for the receiver.

Each module is encased in a plastic package that can be plugged into standard connectors or wave soldered onto system PC boards. Total module area required is only about 25 sq. inches.

R24 gives designers functional flexibility, too. It's Bell 201 B/C and CCITT V.26 and V.26 bis compatible. And with a minimum of interfacing circuitry, it can be configured for operation on leased lines or the general switched network.

Rockwell gets you started in performance analysis and system design with an R24 modem on an evaluation board. Everything you need for your prototype design.

A new generation of modems from the leading OEM manufacturer of high speed LSI modems. That's Rockwell Micropower working for you.

For more information, contact D-727-A8 Microelectronic Devices, Rockwell International; P.O. Box 3669, Anaheim, CA 92803, or phone (714) 632-3729.

See us at TELECOM '79, Geneva, Switzerland, EIA/U.S. PAVILION, Stands #109, 110, 117, and 118.

Rockwell International

...where science gets down to business

CIRCLE 59 ON INQUIRY CARD

have been directed toward the development of memory systems with battery backup power to retain data during power down.

Until recently, low power CMOS devices were also low speed and low performance. Advances in CMOS technology have resulted in memory components, microprocessors, and supporting components that meet low power requirements without sacrificing speed.

Although bubble memories have been promised as a usable technology for several years, current status indicates that it is just finally becoming a practical reality. Bubble memory subsystems, scaling down bubble memory devices, and contiguous disc bubble devices are the topics that will be presented.

Computer use in manufacturing processes varies from direct machine control to information handling, and the hardware to implement these applications ranges from microprocessors to large scale data processing computers. Applications that will be detailed include a distributed manufacturing information system, distributed numerical control, minicomputers for furnace control, and an information display system for a manufacturing operation.

Industrial robots, using open-loop control systems, are an accepted element in industry today. The addition of sensors and "intelligence" from the incorporation of mini or microcomputers will expand their range of applications. State of the art development in robot control, sensors, programming language, the augmentation of man in space, and the problems of legged locomotion for robots will be expounded in the session entitled "Robots in Industry and Space."

Personal computers are finding applications in engineering, scientific, and industrial fields. Those to be discussed include a time clock/job accounting data entry system, data acquisition and control system for laboratory experiments, medical data acquisition, testing manufactured goods, establishing readability indices, and high capacity mobile telephone systems.

Computer graphics in computer aided design and manufacturing has demonstrated significant industrial productivity gains. Presented will be current computer graphics applications and considerations from the viewpoint of industrial research, hardware manufacture, the turnkey industry, and the university.

Three other sessions will present technology and trends in switching power supplies, data conversion, and CRT controllers. The present state of switching power supply technology is still not mature. New technologies include power FETs, and integration. Further developments may be necessary while safety specs call for higher isolation voltages, and emi pollution controls call for lower levels of conducted and radiated emi. A high speed bipolar DAC and a high speed microprocessor compatible ADC are among the trends in A-D interfacing to be covered. Other developments in this technology are IIL data converters, monolithic bipolar video speed data converter circuits, and high resolution low power CMOS data converters. "Directions in CRT Controllers" will present ICs now available and designs being readied for production.

The 500 booths in the O'Hare Exposition Center will be color-coded into specific exhibit areas. The four color groups encompass components, microelectronics, and fiberoptics; instrumentation and control systems; production, packaging, and test equipment; and mini/microcomputers and EDP peripherals. Exhibition hours will run from 9:30 am to 6 pm, Tuesday, Nov 6 and Wednesday, Nov 7; and from 9:30 am to 5 pm, Thursday, Nov 8. A free shuttle from the Caravelle Inn in Rosemont and the Horizon parking facility near the Sheraton O'Hare will service both the Hyatt Regency and the exposition center.

The all-industry reception, "Fun and Games with Electronics at Midcon," will be held Tuesday evening, Nov 6, from 6:30 to 8:30 pm in the Hyatt Regency's International Ballroom. Refreshments and an array of electronic games will be featured. Tickets can be purchased at the door for $10 apiece. Also to be a part of this year's Midcon is the Film theater which will screen scientific and engineering motion pictures from 10 am to 4 pm the three days of the show.

Registration for the conference will be $5 at the door; registration before Oct 22 is $3. For more information contact the Midcon office, 999 N Sepulveda Blvd, Suite 410, El Segundo, CA 90245, tel: 213/772-2965. Midcon is sponsored by regional and local chapters of the Institute of Electrical and Electronic Engineers and the Electronic Representatives Association. □

HERMETIC DIGITAL

DELAY-LINE

- Hermetic, metal 14-pin DIP (.870"L x .498"W x .250"D)
- 50ns-250ns Delays (ten 10% taps)
- ± 5% Total Delay Accuracy
- 4ns Rise Time
- Schottky Buffered 1/0
- Thick Film Hybrid
- Pin for Pin Compatible with other leading manufacturer

hytek microsystems incorporated
(408)358-1991
16780 LARK AVENUE
LOS GATOS, CA 95030

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

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

Find your reason here!

■ PERIPHERAL DEVICE CONTROLLERS

MLSI-LP11 Line Printer Controller
MLSI-CR11 Card Reader Controller
MLSI-PC11 Paper Tape Reader/Punch Controller
New! MLSI-LV11 High Speed Electrostatic Plotter Controller
(controllers above include 15 foot cable)
MLSI-XYV11 Incremental Plotter Interface

■ (P)ROM MEMORY MODULES

(memory not included)
MLSI-MRV-000 For 2704 and 2708 UV PROMS and 3624 PROMS
MLSI-MRV-001 For 1702 UV PROMS
MLSI-MRV-002 For 5623, 5624 PROMS or equivalent ROMS
MLSI-MRV-003 For 3625 PROMS or equivalent ROMS
New! MLSI-MRV-004 For 2716 or 2758 PROMS with on-board programmer
New! MLSI-MRV-005 For 2716, 2732, 2758 or similar devices

■ GENERAL PURPOSE LOGIC MODULES

MLSI-1710 General Purpose Interface Module
MLSI-DRV11P Bus Foundation Module
MLSI-11B General Purpose Direct Memory Interface
MLSI-WWB1 Universal Quad Wirewrap Module; sockets optional
New! MDB-W9501 Universal Quad Wirewrap Module

■ INTERPROCESSOR LINK SUBSYSTEMS

New! MDB/MLSI-DA11BOI Parallel DMA Interprocessor Link between PDP-11 and LSI-11 computers, differential drivers, optically isolated receivers.
New! MLSI-DA11BOI Parallel DMA Interprocessor Link between LSI-11 computers, differential drivers, optically isolated receivers. (Subsystems include 50 foot cables)

■ SYSTEMS MODULES

MLSI-IBV11 IEEE/488 Bus Interface
MSLI-DRV11C Parallel Line Interface
MLSI-SMU System Monitoring Unit
MLSI-KPV11 Power Fail/Line-Time Clock Generator
MLSI-KW11P Programmable Real-Time Clock
MLSI-TEV Bus Terminator Module
MLSI-REV-11 Bootstrap Refresh/Terminator Option

■ COMMUNICATIONS/TERMINAL MODULES

MLSI-DLV11 Asynchronous Serial Line Interface; modem control optional
MLSI-DUV11 Synchronous Serial Line Interface

■ CHASSIS ASSEMBLIES

MLSI-BPA84 Backplane/Card Guide Assembly, 16 dual slots
New! MLSI-BPA84A Same, with two slots wired for RLV01 disk controller, all others wired for Q-bus
MLSI-BA11 Rackmount Enclosure for BPA84
MLSI-H984 Roll-around cabinet, 30" mounting height

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

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

*TM Digital Equipment Corp. **Data General is a computer manufacturer unrelated to MDB

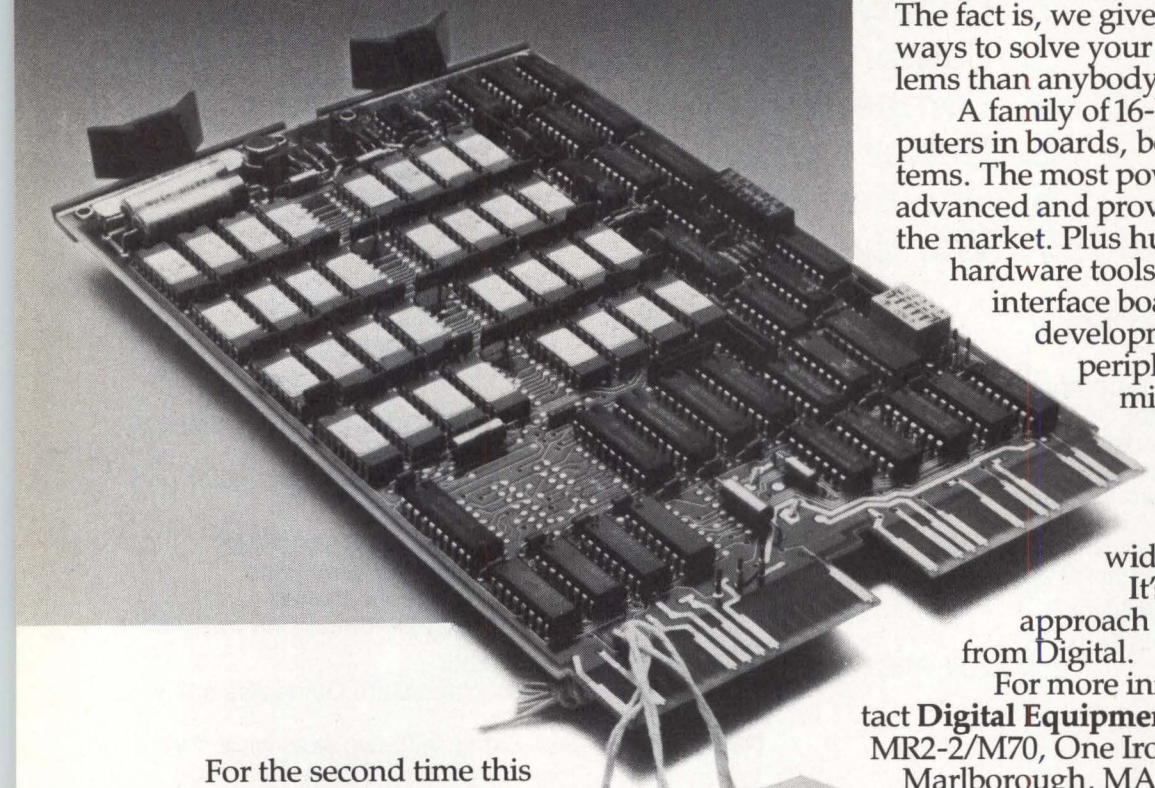
MDB SYSTEMS INC.
1995 N. Batavia Street
Orange, California 92665
714-998-6900
TWX: 910-593-1339

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

Circle 61 for LSI; 62 for PDP; 63 for DG; 64 for P-E; 65 for IBM.

Digital's RAMpart 64 micro memory.

The price just keeps getting better.



For the second time this year, we've cut the price on our 64Kb RAMpart 64 memory. Just $582 in 100's when purchased with similar quantities of LSI-11/2 CPUs.

So with every 16-bit LSI-11/2 microcomputer, you can get the memory that was made for it. With Digital's quality and reliability built right in—we actually burn-in and schmoo every board we ship.

Our RAMpart 64 memory gives you on-board refresh, selectable I/O page boundary, and a typical access time of just 210ns.

All on a 5.2" x 8.9" (13.2 cm x 22.8 cm) board.

Price is just one way we're committed to the micro market. The fact is, we give you more ways to solve your design problems than anybody.

A family of 16-bit microcomputers in boards, boxes and systems. The most powerful, advanced and proven software on the market. Plus hundreds of hardware tools—memory and interface boards, complete development systems, peripherals and terminals. And we back it all with over 11,000 support people worldwide.

It's the total approach to micros, only from Digital.

For more information, contact **Digital Equipment Corporation,** MR2-2/M70, One Iron Way, Marlborough, MA 01752. Or call toll-free 800-225-9220. (In MA, HA, AL, and Canada, call 617-481-7400, ext. 5144.) Or contact your local Hamilton/Avnet distributor. In Europe: 12 av. des Morgines, 1213 Petit-Lancy/Geneva. In Canada: Digital Equipment of Canada, Ltd.

It took the minicomputer company to make micros this easy.

digital

BIT SLICE TECHNIQUE MINIMIZES MICROCONTROLLER COST/COMPLEXITY

A bipolar LSI bit slice microcontroller bridges the performance/cost gap between metal oxide semiconductor microprocessors and discrete logic in a microprogrammable digital to analog system design

David Hooley Virginia Polytechnic Institute, Blacksburg, Virginia

Many control tasks require higher speed, wider data path, or more powerful computation than is provided by metal oxide semiconductor microprocessors. In applications such as mass storage controllers, minicomputers programmed in assembly language either cannot respond fast enough or should not be burdened with low level control tasks. Other applications, such as repetitive display or waveform generation, may be relatively simple, but require an excessive amount of processor time. Designers prefer a more general purpose solution to these problems than a specialized, discrete logic system, but without the expense of a full microprogrammed bit slice processor. A suitable controller design would provide a limited instruction set with subroutine and conditional jump capabilities, a large number of bits in the instruction word that are available for control of external registers, very fast instruction execution, read/write memory for the development phase, and the ability to use read only memory or programmable read only memory after completely debugging the system.

Control tasks which fit in this category of relatively fast operation with a few simple decision points can be efficiently implemented with a versatile, straightforward, microcontroller design. This controller consists of a large microprogram memory for storage of microinstructions and a next address generator that supervises the conditional branching indicated by external control bits. Cost and complexity of the microprogram sequencer are minimized by restricting its instruction set and addressing capabilities to meet particular application tasks. System design time is reduced considerably because physical hardware changes are seldom made, the designer does not need to thoroughly understand all the system details before starting the design, and similar applications may require only a minor software change to enable use of common hardware designs.

Microcontroller Characteristics

A microcontroller or microprogram sequencer furnishes addresses to control memory, which then presents a sequence of logic levels to the control lines of the microprogrammed device. The microcontroller has the capability of altering program flow based on conditions generated in the microprogrammed device; thus, the

microcontroller can be viewed as a primitive processor that governs external logic.

Several types of instructions for the microcontroller are needed to efficiently control such external logic as an arithmetic logic unit (ALU) of a minicomputer, a disc or tape interface, or a digital to analog converter (DAC) used for waveform generation. Conditional jumps or branches alter the microprogram flow depending upon selected conditions in the external logic. Subroutine control instructions allow the repeated use of a group of instructions which perform a commonly used function. In this manner, the number of words in an expensive microprogram memory can be reduced in comparison with straight-line programming methods. Also, the microcontroller may need to present a number of sequential logic levels to the external device without any control decisions being made; therefore, a next instruction or a no operation instruction is needed. In addition, unconditional jump instructions provide for convenient control of the program flow.

During the development phase, a read/write (R/W) microprogram memory enables the designer to try different microprogram approaches to the control problem more rapidly than if programmable read only memories (P/ROMs) were used. After the development phase is completed and the system is debugged, the ability to store the microprogram in nonvolatile memory is necessary to avoid the need to reload microprogram memory every time power is turned off. Therefore, a practical microprogram sequencer and microprogram memory would include the capability to use both R/W and read only memory (ROM). Loading of R/W memory under the control of an external computer system is probably the most practical method of entering a microprogram into microprogram memory.

System Design Requirements

A system application for a microcontroller involves a programmable waveform generator. A repetitive, stable, analog waveform with several simultaneous digital control signals is needed to control a measurement process (Fig 1). The obvious solution to this design problem is to program the waveforms in a P/ROM, whose contents are then sequentially applied to a DAC. Extra P/ROM output lines could be used for the required digital control signals.

Before committing the waveforms to P/ROM, a considerable amount of experimentation with the timing of the waveforms and the control pulses is required; thus, R/W memory rather than P/ROM is needed for the design phase. A microcontroller design is more powerful than needed for this application, but it has the exact architecture required for a waveform generator and related control tasks. R/W memory can be loaded by a minicomputer. If a program consisting of a series of absolute next (ANXT) instructions with an absolute jump (AJMP) instruction to address 0000 at the end of the ANXT instructions is loaded, the contents of the R/W memory are continuously accessed. If a DAC is attached to the controller memory output lines, the desired analog waveforms are easily generated. Furthermore, an off the shelf microcontroller large scale integration (LSI) chip is immediately available, whereas other devices would require extended design and construction time and cost.

In Fig 1, a 12-bit DAC is attached to the controller memory output lines. Several microcontroller external control lines (CL) furnish required control signals. Since control memory can be programmed for single-step operation, an external variable frequency clock is connected to an external reply line to control the rate of waveform generation. After the optimum rate and waveforms needed are determined, control memory can be set for continuous operation, and an appropriate crystal controlled clock and up/down counter can be applied.

The minicomputer is capable of loading microcontroller memory with the required waveform generation program and data by asserting the write enable line and loading the proper write data into controller memory, after which the program is automatically resumed by pulsing the microsequencer clear line. Obviously, the high speed capability of the microcontroller cannot be fully utilized in this situation since a 10-μs/step clock rate is needed due to the several microsecond settling time of the DAC, rather than applying the microcontroller's maximum clock rate of 100 ns.

Microcontroller Implementation

LSI circuits which perform the function of microprogram sequencers are readily available with varying levels of software support.[1,2] The Texas Instruments SN74S482 4-bit slice expandable control element has straightforward architecture and provision for relative addressing due to its full adder inputs.[3] Although microprogram controllers can be implemented with other available circuits, the SN74S482 was chosen because of its adder characteristics.

The microsequencer consists of three 4-bit wide elements, a full adder, a 4-word first in, last out (FILO) stack, and a clocked output address resistor or latch (Fig 2). Data flow through the sequencer is directed by two select control lines for each of the three elements. The clocked output register ensures that the data output lines are stable between rising edges of the clock. Likewise, addresses are transferred to or from the FILO stack only on a rising clock edge. Information on the data input lines can be loaded directly into the output address register or can be added to the contents of the output register via the full adder and multiplexer. It is also possible to push the current contents of the output address register onto the FILO stack via the full adder while loading the output register from the data input lines, thus implementing a jump to subroutine microinstruction.[3]

The complete microcontroller system design (Fig 3) comprises a microprogram control memory, microprogram sequencer, instruction decoder, clock synchronizer, and input source selector. Microprogram memory contains the control bit sequences for the external device under control, as well as the control program for three cascaded bit slice elements, which are used to generate 12 address bits for the next address to control memory. The architecture is purpose-

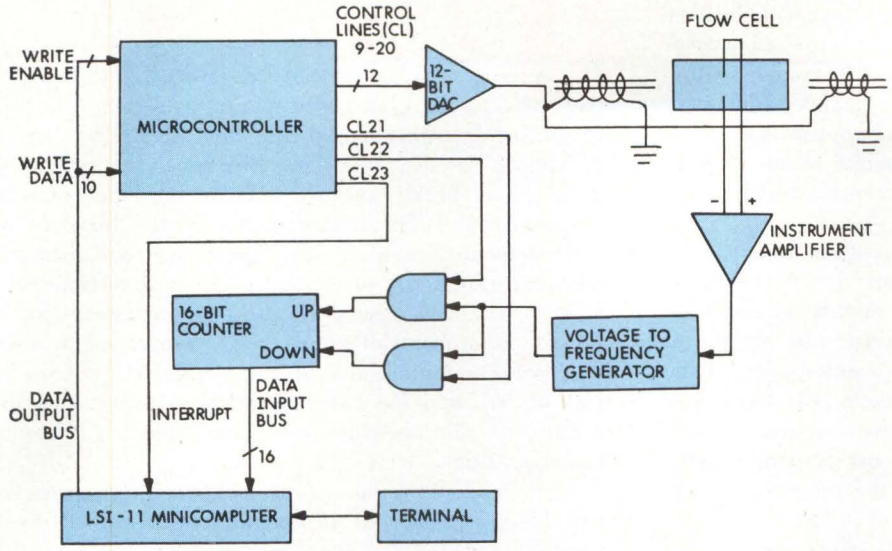


Fig 1 System design requirements. Microcontroller is applied as programmable waveform generator to relieve minicomputer of simple, but time-consuming, task of continuously generating analog signals. Several bits of microprogram memory are needed to control logic which generates digital number representing response of experimental system to various analog signals

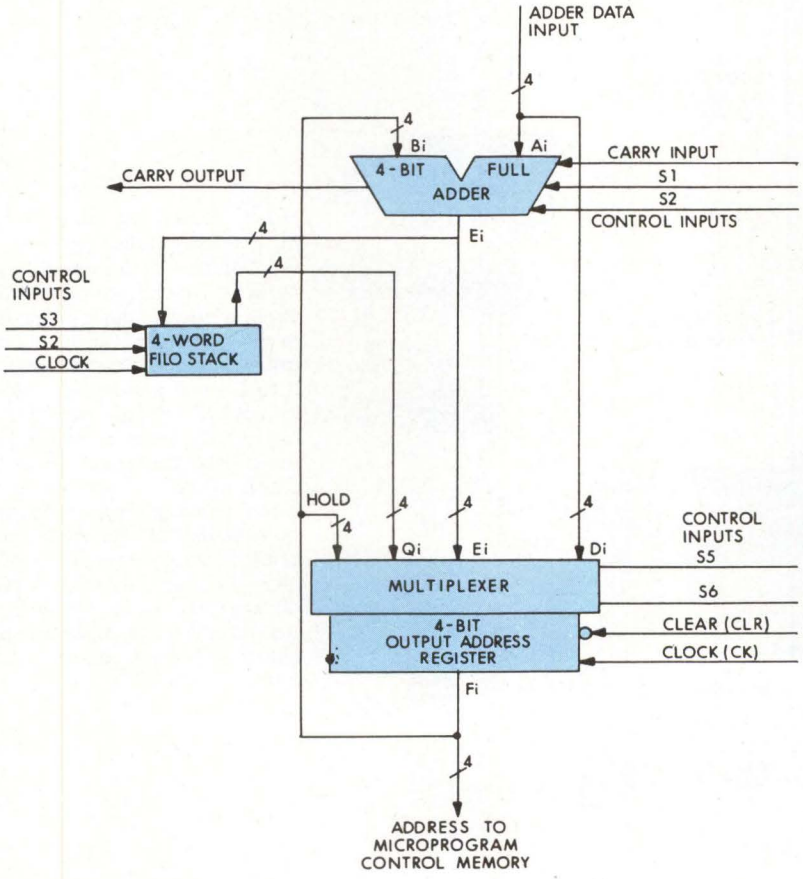


Fig 2 Functional block diagram of microsequencer. Four sources of data are delivered to 4-bit output address register. Addresses to control memory can be obtained directly from adder data input bus, output address register latch, and 4-word FILO stack. In addition, current address can be added to 4-bit full adder data on adder data input bus, as determined by control lines S1 to S6

ly designed to be straightforward, resulting in easier programming and debugging. The extensive capabilities of the bit slice control elements and the fast speed of the microprogram memory array often allow competitive performance with more complex pipelined architectures. Output lines of the microprogram memory control external logic systems, select input sources for the control elements, and specify microinstructions to be executed.

Full adder carry-input and carry-output lines allow cascading of the 4-bit slices. System design requires three cascaded slices, yielding a maximum address range of 2^{12} or 0000 to 4095, because use of up to 1024 words of control memory is anticipated. This system design resulted from tradeoffs of hardware implementation versus software restructuring, design time versus construction time, and cost considerations. The simple instruction repertoire of the microsequencer can often implement the functions of controllers with larger instruction sets by careful selection of the instructions available in combination with the full adder input. Since this system configuration can operate at 100-ns cycle times while using fast bipolar memories, the added speed of a complex pipeline structure is not necessary, thus considerably simplifying the overall microcontroller design.

Instruction Set

The microcontroller presents a desired series of control bits to the hardware under control. An ability to make decisions based on the results of previous operations is also required. Provision for repeating a sequence is highly useful; thus, a subroutine mechanism is needed. The manufacturer of the bit slice control element provides only hardware documentation, allowing designers to configure an instruction set to meet specialized needs. Therefore, an instruction set for the microcontroller has been formulated from the six useful combinations of the six select control lines (S1 to S6) and the carry input line, resulting in three groups of microinstructions—jump, next, and subroutine operations.

The first, or jump, group results in program control being transferred to the address specified by the source input selector. The second, or next, group adds one to the current address as calculated by the jump group. The third, or subroutine, group allows storage of the current address while a sequence of instructions is being executed, after which execution is resumed at the instruction following the address that called the subroutine.

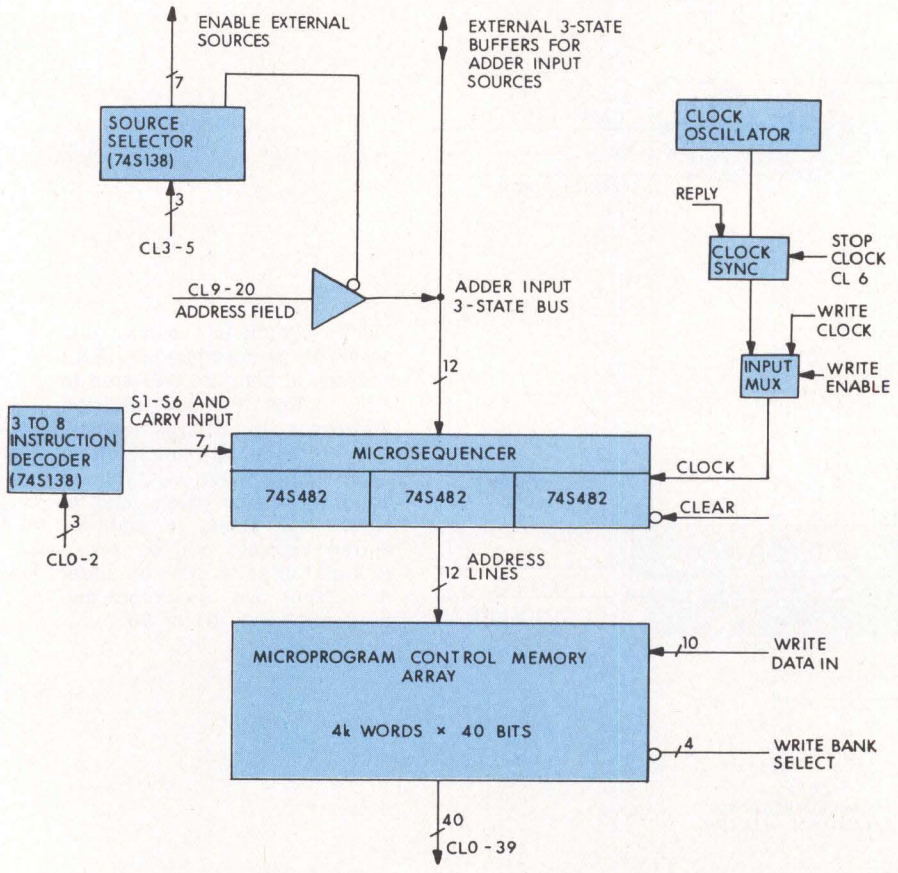


Fig 3 Functional block diagram of microcontroller system. Relationships of individual components of microcontroller indicate straightforward design, based on microsequencer and microprogram memory. Control lines (CL) 0 to 2 from memory are decoded to control microsequencer. Control lines 3 to 5 select adder input data. Control line 6 controls clock, while control lines 7 and 8 are unassigned so that instruction fields fall on octal boundaries. Control lines 9 to 20 are used by instructions that require address. If none is required, control lines 9 to 20 can be used for external control, as can control lines 21 to 39

A jump to subroutine (JMSA) microinstruction (Table 1) pushes the current contents of the output register plus 1 onto the 4-word internal FILO stack, and the output register is loaded from the data input lines. Execution of the microprogram then proceeds from the absolute address presented on the data input lines.

Nesting of subroutines beyond four levels must be avoided because the pushing of a fifth address onto the FILO stack will cause a stack overflow, losing the address at which execution will resume after returning from the first subroutine. To return from a subroutine (RETS), the top address on the stack is loaded into the microsequencer output register, allowing execution to resume at the next microinstruction after the call to the subroutine in the main microprogram. This operation pops the stack one position, making the address stored by a previous subroutine call available on top of the stack.

Jump and next microinstructions have two forms, relative and absolute. The relative form adds the contents of the output register to the data input lines, while the absolute form loads the output register directly from the data input lines. Thus, the absolute jump (AJMP) microinstruction can jump to the address in microcontroller memory which is presented on the data input lines. The absolute next (ANXT) microinstruction does not completely follow form because it merely increments the output register, causing the next microinstruction to be accessed.

The relative jump (RJMP) and relative next (RNXT) microinstructions allow alteration of the microprogram flow based on data presented on the data input lines. RNXT operates in exactly the same manner as the RJMP, except that the address loaded into the output register is one greater than that loaded by a corresponding RJMP microinstruction. RJMP adds the data input lines to the contents of the output register and then loads this sum into the output register. This microinstruction is used in a situation where a constant control bit pattern is desired until some quantity being tested assumes a nonzero value.

An external flag, which assumes a logic 1 value when the external device under control is ready for further operations, can be connected to the data input lines. At the point when the microprogram cannot proceed until the operation is done, an RJMP microinstruction is encoded to select this flag for the data input lines. As long as the flag is a logic 0, RJMP continuously repeats itself. Only when the flag goes to a logic 1 does the microprogram proceed to the next microinstruction. Naturally, the opposite condition could be selected by inverting the flag signal.

TABLE 1

Microcontroller Instruction Set

Octal Code	Mnemonic	Adder S1	Adder S2	Adder Operation	Stack S3	Stack S4	Stack Operation	Latch S5	Latch S6	Latch Operation	Carry-In Line
0	Jump Absolute AJMP	0	0	— — —	0	0	Hold	0	0	Di	0
1	Jump Relative RJMP	0	0	a + b + c	0	0	Hold	0	1	Si	0
2	Jump to Subroutine JMSA	1	0	b + c	1	1	Push	0	0	Di	1
3	No Operation NOOP	0	0	— — —	0	0	Hold	1	1	Hold	0
4	Return from Subroutine RETS	0	0	— — —	1	0	Pop	1	0	Qi	0
5	No Operation NOOP	0	0	— — —	0	0	Hold	1	1	Hold	0
6	Next Absolute ANXT	1	0	b + c	0	0	Hold	0	1	Si	1
7	Next Relative RNXT	0	0	a + b + c	0	0	Hold	0	1	Si	1

a—adder input
b—address output register contents
c—carry-inline
Di—adder input
Si—top value on stack
Qi—address output register

Complementing the data input lines would result in jumping backward one microinstruction in the microprogram. If the device flag is connected to a bit other than the least significant bit (LSB) on the data input lines, a jump of more than one microinstruction could be made. In fact, this mechanism is a particularly convenient method to implement a jump table. The offset into the table is impressed on the data input lines, and a relative jump or next microinstruction is executed. For example, the designer may be able to encode the major types of a computer's instruction set into several bits. When the microcontroller is ready to execute the next computer instruction, it selects the output of the instruction type encoder and does a relative next microinstruction. This instruction directs the microprogram through the jump table to the microinstructions which perform the function of the computer instruction encoded earlier.

Table 1 summarizes the microinstruction set, indicating the octal code assigned to each microinstruction, the states of the microsequencer control bits, and their results for the adder, stack, and latch sections of the control element. Microinstructions obtained from bits 0 to 2 of microprogram memory are translated by the instruction decoder into control signals S1 to S6 for the microsequencer. Operation columns indicate the instruction's effect on respective elements of the microsequencer. The state of the carry-in line is also indicated. Because the relative forms of the subroutine microinstruction have no useful result, they are called no operation (NOOP). However, these are critical microinstructions since they loop on themselves indefinitely. The only practical way to recover from a no operation microinstruction is to assert the clear line of the microsequencer, thus forcing address 0000 into the output register.

By comparing the microinstruction set in Table 1 with that of other microsequencers, the relative next and jump microinstructions can be used to implement conditional microinstructions present in most other microsequencers. Conditional jump to subroutine and return from subroutine instructions are not available, but these functions can be implemented by the sequence of a relative jump or next instruction, and then the desired subroutine microinstruction. Loop-until-count-goes-to-zero microinstructions could be implemented by testing the NOR function of an external counter output with a relative jump microinstruction. The relative jump microinstruction is repeated until the external counter output goes to zero, thus incrementing the microinstruction counter in the output register of the microsequencer. Except in cases where microprogram memory words must be conserved, control of such loops might be done more easily by repeating the complete microinstruction bit pattern using the absolute next microinstruction until the desired small number of operations are completed. The lack of conditional subroutine microinstructions may also require use of a few extra microprogram memory words. A short listing of the system application (waveform generator) program (Table 2) demonstrates the

TABLE 2

Waveform Generation Program

Address	Octal Instruction					Mnemonic	Comment
	ECB	ADDF	W	S	I		
0	0000	0000	1	0	6	ANXT WAIT	
1	0000	0200	1	0	6	ANXT 200 ADDF WAIT	(Start waveform ramp up)
2	0000	0400	1	0	6	ANXT 400 ADDF WAIT	
3	0000	1000	1	0	6	ANXT 1000 ADDF WAIT	(Max amplitude reached)
4	0001	1000	1	0	6	ANXT 1000 ADDF 1 ECB WAIT	(Enable count up
5	0001	1000	1	0	6	ANXT 1000 ADDF 1 ECB WAIT	(to integrate response)
						— similar instructions through address 371 —	
371	0000	1000	1	0	6	ANXT 1000 ADDF WAIT	
372	0000	0400	1	0	6	ANXT 400 ADDF WAIT	(Start ramp down)
373	0000	0200	1	0	6	ANXT 200 ADDF WAIT	
374	0000	0000	1	0	6	ANXT WAIT	
375	0002	0000	1	0	6	ANXT WAIT 2 ECB	(Enable count down for
376	0006	0000	1	0	6	ANXT WAIT 6 ECB	(baseline subtraction, set flag)
377	0000	0000	1	7	0	AJMP 0 ADDF CMEM WAIT	(Jump to contents of ADDF)

ECB—external control bits of microprogram memory
ADDF—address field
W—clock control bit
S—source select field
I—instruction select field

utility of the microcontroller instruction set. Partial listing of the waveform generator program shows the microprogram address, instruction, and source mnemonics. In this program, the address field is used for jump addresses and values for the DAC. Mnemonics ANXT and AJMP set the I field, ADDF sets the ADDF field, WAIT sets the W field to a 1, and CMEM sets the S field to 7 which selects the ADDF field as the source of addresses for the microsequencer. ECB sets the ECB field which controls external logic in this application.

Microprogram Memory

The 40-bit wide microprogram memory is arranged in six fields to facilitate software and conserve memory bits (Fig 4). The three LSBs (2, 1, and 0) select the desired microinstruction (Table 1). The next three bits (5, 4, and 3) select one of seven external sources for the data input lines. The eighth possible coding (bits 5, 4, and 3 are all 1s) selects the 12-bit address field of microprogram memory (bits 9 through 20). This field may be shared with other external control functions, in which case, care must be taken to avoid destroying data in the external device under control. Bit 6 is the clock control bit. Bits 7 and 8 are available for external control or may be used to expand the number of sources for the data input lines. Bits 21 through 39 are available for external control functions.

Space is available in microprogram control memory for both P/ROM and bipolar R/W memory depending on designer requirements. The capacity of memory installed is determined by the application requirements of a particular system.

Up to two banks of P/ROM may be installed in the current system design—256-word by 4-bit or 512-word by 4-bit memory units may be used by selecting the proper address lines from the control element output register and the chip select decoder. Similarly, one bank of 256-word by 1-bit or 1024-word by 1-bit bipolar R/W memory units may be installed with wiring modifications. The smallest implementation of microprogram memory would consist of 256 words of P/ROM or R/W memory, while the largest implementation would consist of 1024 words of R/W memory and 1024 words of P/ROM for a maximum microprogram of 2048 words by 40 bits wide. Larger configurations would require additional printed circuit area or another 4-bit slice if 4096 words are exceeded.

R/W memory is used as a writable control store, particularly to test microprograms before they are dedicated to P/ROM. To accomplish the writing process for test purposes, external logic asserts the write enable line (Fig 3), which stops the execution of the microprogram. This external logic then places the address to be written into on the data input lines and pulses the write clock, which loads the microsequencer output register with the desired address. Then, external logic applies proper data to the 10 write input lines for each of the four banks of R/W memory, pulsing the proper bank select line to conclude the writing operation. This procedure is repeated for all addresses that must be written into memory; after this, microprogram execution is restarted in an orderly fashion at microprogram address 0000 by deactivating the write enable line and pulsing the control element clear line.

Clock Synchronization Logic

In the clock synchronization logic (Fig 5), the enable flipflop (FF) is cleared by the rising edge of the wait signal generated from bit 6 (CL 6) of control memory. When the current clock pulse is completed, no more pulses are generated until the enable flipflop is set by the positive transition of the externally generated reply signal. Setup time with respect to the rising edge of the microsequencer clock is about 40 ns, which is the same period of time as the sum of the decode instruction and setup times (Table 3). Thus, setting bit 6 in the current microinstruction to 1 halts the

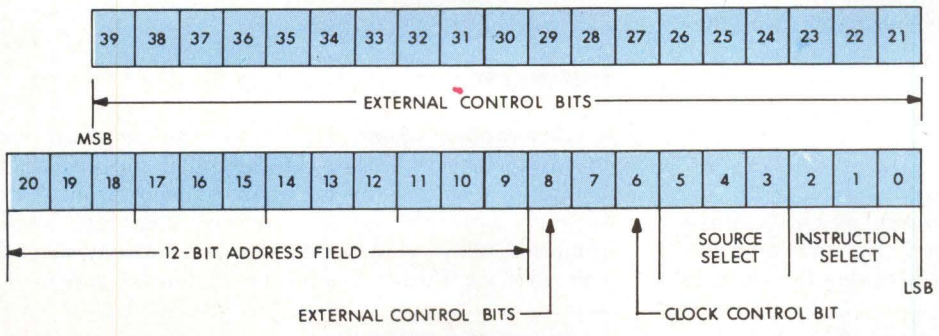


Fig 4 Microprogram memory control fields. Encoding of control fields in microprogram memory reduces number of bits required in memory. Bits 0 to 2 select one of eight possible instructions, of which six are used. Bits 3 to 5 select one of eight adder input data sources. Bit 6 halts microcontroller clock when high to allow synchronization with external logic. Bits 7 and 8 are unassigned so that address field (9 to 20) falls on octal boundaries, allowing easier programming. Address field of 12 bits may be used to control external logic as do external control bits (20 to 39), if it is not selected by source select field

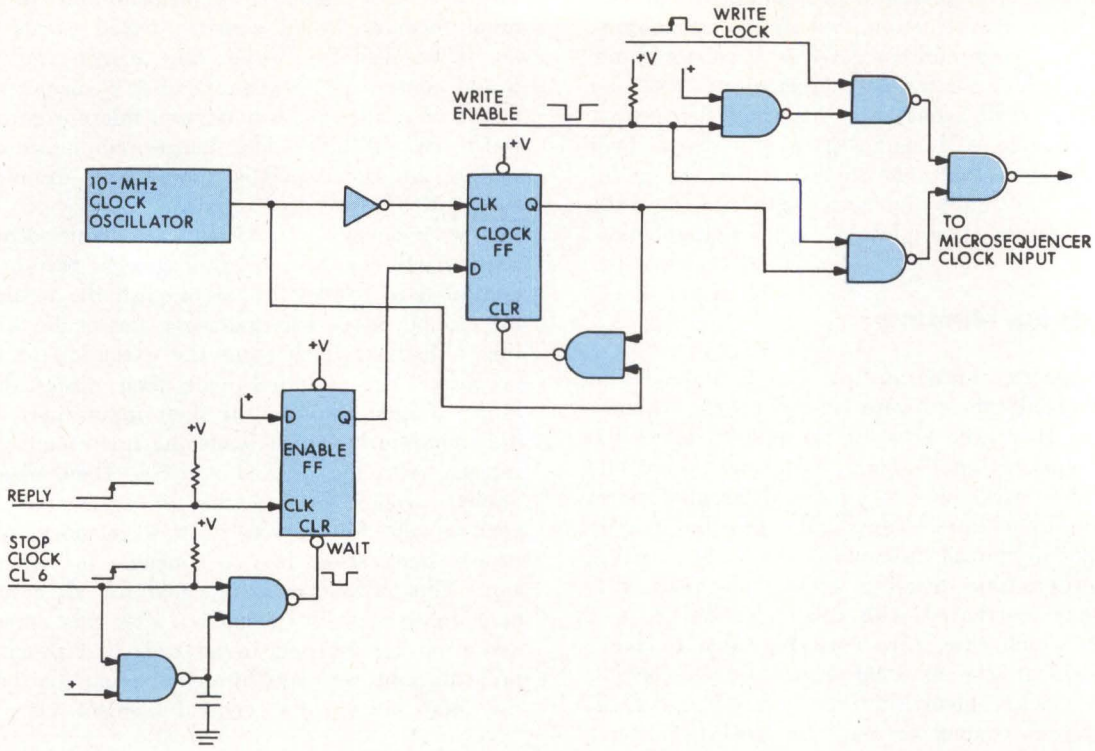


Fig 5 Clock synchronization logic. This circuit allows microcontroller to be halted by low to high transition on wait line derived from line CL 6 of microprogram memory. When low to high transition occurs on reply line, clock pulses are passed through clock flipflop, and microprogram execution resumes

controller clock before the next clock pulse can be generated.

If the enable flipflop is clocked by a positive edge 10 ns before the clock flipflop is clocked by a positive edge from the clock oscillator, a microsequencer clock pulse is generated immediately. Replies arriving later will not generate a pulse until the next positive edge appears on the oscillator output. Setup time with respect to the rising edge of the microsequencer clock is about 30 ns for the reply signal. Bit 6 in the microinstruction must be a 1 to start a wait state, after which the device that is addressed by other bits of the microinstruction holds the reply line low until device data are valid. At this time, reply is released by the device, a positive edge is generated, and the microprogram proceeds with the next positive edge generated by the oscillator.

Microcontroller Timing

Timing of the microcontroller with reference to the rising edge of the clock pulse is shown in Fig 6. Maximum, typical, and observed times (in nanoseconds) for the time parameters are given in Table 3. Numbers in parentheses are for the data input path, which is slower than the instruction decoding path, but does not require as much setup time in the microsequencer. Observed times are rounded to the nearest 5 ns.

Table 3 indicates that a 100-ns cycle time is achievable under typical conditions. Under extreme conditions or with chips that just meet specifications, a 150-ns cycle time is realistic. These numbers assume that the data to be placed on the data input lines are valid by the beginning of time tdi. This assumption is true for addresses obtained from control memory, but is not true if an operation controlled by the current control memory output must occur before control signals can be generated for the next microinstruction. Thus, the system designer must be aware of these timing relationships in order to assure a properly operating system.

Summary

Microcontroller design techniques can be used cost-effectively to save design time in small process control applications as well as in large computer control unit designs. Available microsequencers and fast bipolar memories allow a straightforward microcontroller design with significant capabilities to fill the gap in performance between metal oxide semiconductor microprocessors and conventional logic control. The addition

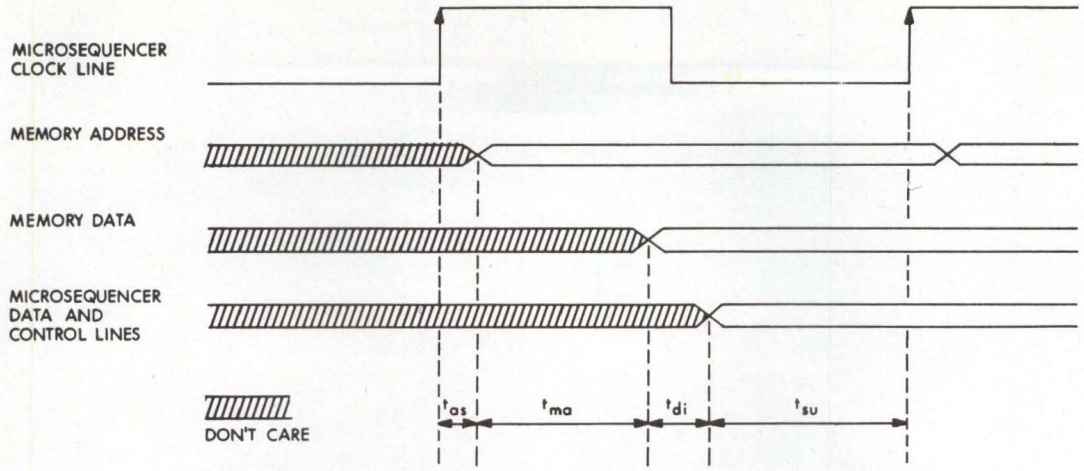


Fig 6 Microcontroller timing diagram. Timing is referenced to rising edge of microsequencer clock. Time parameter tas is address setup time for microsequencer. Note that memory address lines are valid a short time after rising edge of clock. Memory data are valid after memory address time, tma, has elapsed. Microcontroller instructions are decoded during time tdi. Microsequencer instruction and data lines must be valid by start of setup time tsu. Table 3 lists typical time values

TABLE 3

Microcontroller Timing Parameters

Time Parameter	Observed	Typical	Maximum
tas	15	12	25
tma (74S206)	40	35	55
tdi	10 (30)	12 (27)	21 (47)
tsu	30 (15)	30 (15)	30 (15)
Total	95 (100)	89 (89)	131 (142)

tas—microsequencer address set time from rising edge of clock
tma—memory access time
tdi—instruction decode time
tsu—setup time required for control signals (or data) before rising edge of microsequencer clock

of a carefully structured instruction set results in an efficient microcontroller system.

References

1. W. T. Adams and S. M. Smith, "How bit-slice families compare: Part 2, sizing up the microcontrollers," *Electronics*, Aug 17, 1978, pp 96-102
2. J. Brick and J. Mick, "Microprogramming ups your options in μP-system design," *EDN*, Jan 20, 1978, pp 105-110, Feb 5, 1978, pp 53-61, and Feb 20, 1978, pp 75-80
3. Texas Instruments, Inc, "Type SN74S482 4-Bit-Slice Expandable Control Element," *The Bipolar Microcomputer Components Data Book for Design Engineers*, Dallas, Tex, Dec 1977, Section 5, pp 41-46

Bibliography

S. Buchwald, "Microcode Increases Minicomputer Processing Capability," *Computer Design*, Oct 1977, pp 91-99

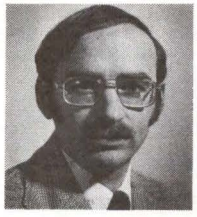
J. C. Conway, "Hardware Approaches to Microprogramming with Bipolar Microprocessors," *Computer Design*, Aug 1978, pp 83-91

P. Gordon and S. Stallard, "Microprogrammed CPU Architecture Offers User-Alterable Minicomputer Performance," *Computer Design*, June 1978, pp 91-100

F. J. Hill and G. R. Peterson, *Digital Systems: Hardware Organization and Design*, John Wiley & Sons, Inc, New York, NY, 1973

S. S. Husson, *Microprogramming: Principles and Practices*, Prentice-Hall, Inc, Englewood Cliffs, NJ, 1970

N. Sondak and E. Mallach, *Microprogramming*, Artech House, Inc, Dedham, Mass, 1977



David Hooley is a research assistant in the Chemistry Computer Laboratory at Virginia Polytechnic Institute. His design interests are involved with developing automated data acquisition systems for chemical instrumentation. He holds a BA in chemistry from Eastern Mennonite College and is currently a PhD candidate at VPI.

"Take it from me, flat is beautiful."

"Speaking as an expert on flat, I would like to recommend another expert: Spectra-Strip.

They really know that flat is where it's at. They delivered their first flat cable in 1956, and now offer more kinds than anybody. Their flat cable line includes gray and color-coded bonded, laminated, and extruded flat and twisted pairs, twisted pairs that can be mass terminated (Twist 'N' Flat®), transmission line and ground plane, and extruded jacketed cable (Spectra-Guard™) that can take a real beating.

They can also provide IDC receptacles, headers, DIP plugs and sockets, PCB transitions and card-edge connectors.

And when things get tight, they won't leave you flat: their value-added distributors can whip together standard jumpers and assemblies (single-ended, double-ended or daisy-chained), or Spectra-Strip can provide custom assemblies using their own products and *anybody else's* wire, cable and connectors. That way you get pretested assemblies that are usually less expensive than if you did them yourself.

For the name and number of your nearest distributor or rep, write Spectra-Strip, 7100 Lampson Avenue, Garden Grove, CA 92642, telephone (714) 892-3361. In the East, call (203) 281-3200.

Say that you heard about them from me and my dog Splat."

©Spectra-Strip 1979

When you're down to the wire

ADD-IN CACHE MEMORY DOUBLES MINICOMPUTER PROCESSING SPEED

Cache memory plugs into CPU backpanel with no hardware or software modifications. Resulting overall system speed increase is typically 30 to 70%, with more than 100% increase measured in some CPU intensive applications

Ronald N. Monroe Minntronics Company Incorporated, St. Paul, Minnesota

Regardless of particular application or variations in specific organizational details, cache memories rely on the basic concept that, in the step-by-step execution of a large program, a central processing unit originated fetch at an address has a high average probability of being repeatedly accessed. Fundamentally, a cache provides a small, high speed scratchpad overlay buffer memory, typically implemented in bipolar technology. Its capacity is only a fraction of that of main memory, which is generally of magnetic core or metal oxide semiconductor technology. Addresses and corresponding contents most frequently accessed by the central processing unit are automatically stored in cache memory, which significantly reduces the number of accesses to slower main memory, and increases the processing speed of the entire system.

The same result could probably be achieved by simply replacing slow core with high speed semiconductor main memory, but the relatively high cost and inherent volatility of the latter limit the performance/cost ratio. Replacing existing core memory systems is even more economically unattractive.

Minicomputer Selection

The PDP-11/45 minicomputer was chosen for a cache memory design because of several factors; however,

the central processing unit (CPU) selection process can be applied to other similar minicomputers:

1. This minicomputer has a basic CPU cycle time of 330 ns, three times faster than the speed of its main core memory/Unibus* combination.

2. It also has Fastbus*, a separate high speed bus that allows the CPU to run at its fastest speed. In addition, the timing relationship between the two buses neatly facilitates the application of a pluggable cache memory.

3. There are unassigned slots in the CPU backpanel in which to plug the cache with no mechanical or electrical modifications required. Power can be derived from either of two sources: from a separate 5-V power supply within the minicomputer power supply chassis, or from an existing supply. The entire installation can be accomplished in 10 to 15 min.

4. Cache in conjunction with core memory yields important advantages. There is a system speed advantage of Fastbus metal oxide semiconductor (MOS) memory throughout its entire 124k-word address range, without incurring its 32k-word limitation and volatility. In a mixed memory system of different cycle speeds, cache tends to minimize such differences; the slower the core memory, the greater is the percentage benefit from buffering with a cache. Also, the programmer need not allocate faster portions of memory to certain programs in order to optimize system speed.

Selection of Cache Memory Algorithm

Several alternative cache memory algorithms were considered and evaluated by means of computer simulation. A write through (WT) algorithm, conceptually the simplest, was selected as having the most favorable advantages. All write requests are referred directly to main memory with cache memory updating itself in parallel if it contains the specified address. The benefit of this concept is that the contents of addresses stored in main memory and in cache are always identical. This characteristic is especially valuable in systems with independent input/output data paths, such as in the PDP-11/45, and also for coping with an unplanned power interruption. A WT limitation concerns the fraction of reads ratio (FR), defined as the number of CPU read requests divided by the total number of CPU requests; for most programs, this ratio is approximately 0.7 to 0.8.

While considering various alternative algorithms, it was decided that the cache would have to be a pluggable board requiring no modification of the minicomputer. After carefully studying the architectural and physical design of the minicomputer, it became apparent that only the WT algorithm would allow the physical construction necessary to satisfy this design constraint.

Analytical results indicated that the WT algorithm could cut effective machine cycle time approximately in half, ie, double the average CPU processing speed. Theoretically, the maximum possible goal would be to triple the processing speed, due to the speed limitation of the CPU, if the program did no write operations and all fetches were satisfied out of cache.

The use of the WT algorithm turned out to be further justified because of the relative ease in dealing with direct memory address (DMA) and interrupt activities on the Unibus. In addition, this algorithm allows the cache to share Fastbus and be completely compatible with up to 16k words of MOS or bipolar memory.

Selection of Cache Size

Studies have shown that a cache memory size of at least 512 words is necessary for typical minicomputer programs in order to maintain an acceptably high hit ratio (HR), defined as the ratio of the number of times that the desired address is in the cache divided by the number of CPU fetch requests. Typically, HR equals 0.88 ± 0.03. The final cache memory size was chosen as 1k words (or 2k bytes) to significantly improve the HR while drastically decreasing chip count and halving power consumption by using 1k-bit Schottky bipolar RAM chips.

Cache Memory Architecture

The internal block diagram of the cache is shown in Fig 1. The control circuitry mainly provides the proper interfacing between Unibus, Fastbus, and the rest of the cache. The address multiplexer switches either the Unibus, Fastbus or internal initialization address into the memory section. The initialization circuitry, comprising a 10-bit counter that drives the internal address bus to the memory, initializes the cache by clearing all 1024 bits in the valid bit register (VBR). The memory is organized as a 1k- x 27-bit array. The 27 bits are comprised of 16 bits for the data, 7 for the directory, 1 for the VBR, and 3 for parity checking.

The compare circuitry compares the output of the directory to the bits <17:11> of the incoming address to determine a cache hit/miss. The parity error detection and display circuitry checks for parity errors on CPU fetches. If an error occurs, this section causes a CPU trap, disables the cache, turns on an LED, and sets the error bit in the control/status register (CSR). The CSR also has a bit which allows software or front panel enable/disable of the cache, and a diagnostic parity error flag disable bit.

Organizationally, the WT cache adapts to the PDP-11/45 as shown in Fig 2. Notice that the cache plugs

*PDP-11/45, Unibus, and Fastbus are registered trademarks of Digital Equipment Corp, Maynard, Mass

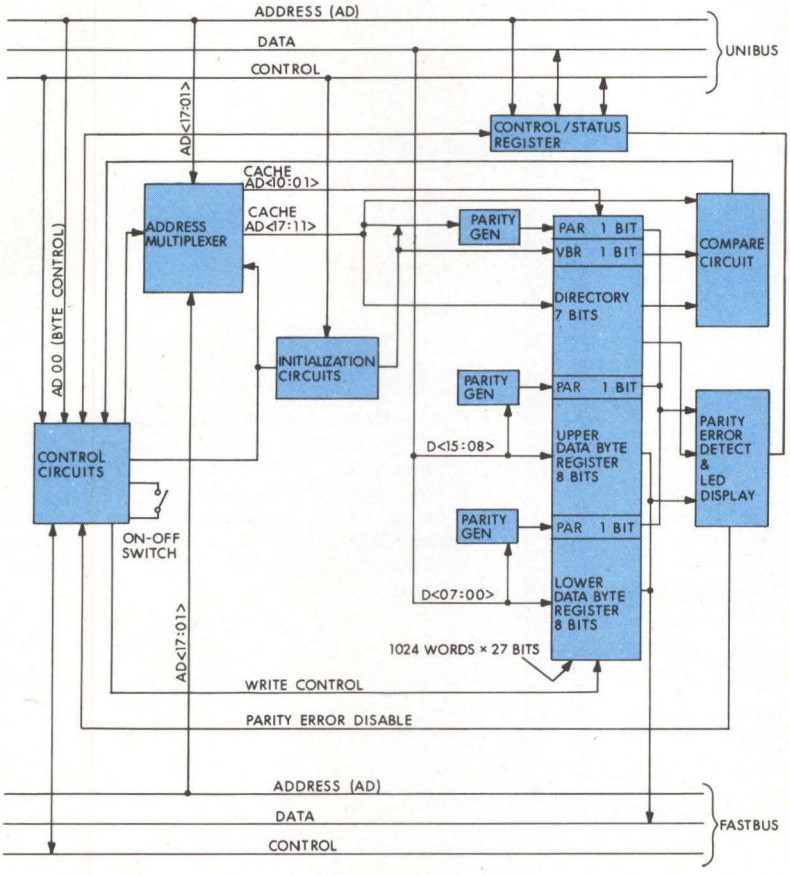


Fig 1 Block diagram for cache memory. External address bits <10:01> map external address and corresponding data into unique location in cache, where remaining bits <17:11> are stored in directory, and 16 data bits are stored in upper and lower data byte registers. Valid bit register (VBR) is set to valid, and three parity bits are generated and stored. Subsequent Fastbus access to same location causes data to be supplied, with parity checking, to Fastbus

into both Unibus and Fastbus. Thus, the cache is a dual-port memory, with certain differences. The cache is completely passive on the Unibus port; it can only receive Unibus signals, but not drive them. Conversely, the Fastbus port cannot receive data, but can drive the Fastbus data signals.

CPU Fetch Requests

Normally, the CPU initiates all memory requests on both buses simultaneously by asserting the specified address on the address lines for both. While waiting the required minimum time of 150 ns on Unibus before starting a core memory cycle, the cache is ready to accept a signal on Fastbus, indicating that the specified address is located within the cache. Figs 3 and 4 illustrate fetch read and write request responses, respectively. If the address is in cache and if the CPU memory request is a fetch, the cache transmits a response signal, causing the CPU to cancel the remaining Unibus cycle, which means that no core memory cycle will take place either. Data are available on Fastbus and the CPU is ready to start the next request 330 ns later, compared to about 1000 ns if the request had been filled from core memory.

If the specified address is not in cache, the CPU does not receive the Fastbus response signal, continues the Unibus cycle in the usual manner, and obtains the desired data from core. When data are available on the Unibus, the cache automatically copies and stores this information and the top portion of the corresponding address via the Unibus port; then, data

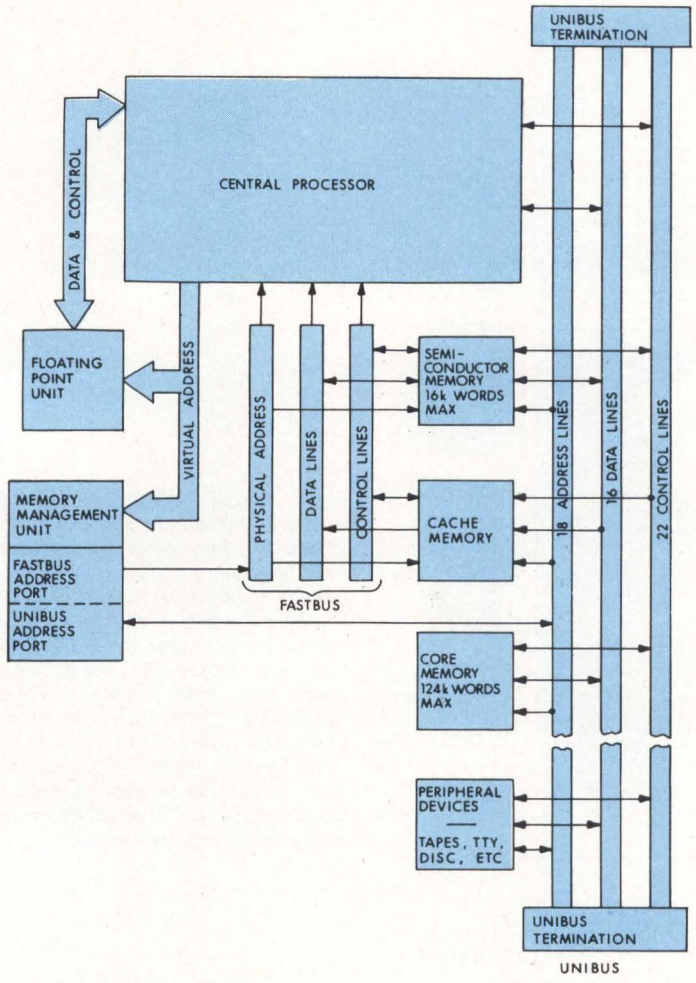


Fig 2 Cache plugged into minicomputer. All CPU fetches initially proceed simultaneously on both Fastbus and Unibus. If high speed memory device on Fastbus, such as cache, acknowledges having address, CPU takes desired data from that device off Fastbus and cancels Unibus memory cycle

are available from the cache for the next CPU fetch to that address.

CPU Write Requests

CPU write requests to core memory are filled on the Unibus just as if the cache were not present. However, when the address is in cache, new data are written into cache in parallel with core memory. This condition ensures that data in core memory are always current with those in cache, and that the inherent non-volatility of the core memory will guarantee against loss of data resulting from power failure. It also facilitates handling DMA activity.

DMA and Interrupts

DMA and interrupt cycles are entirely Unibus operations and do not involve the Fastbus. Consequently, these types of cycles do not insert new addresses into the cache; only CPU fetch cycles do that. However, if a DMA cycle should update an address in core that is also in cache, the new data are simultaneously written into cache also.

Cache Address Replacement Strategy

The many-to-one correspondence principle involved in a simple direct mapping scheme is illustrated in Fig 5. The address space of the PDP-11/45 is 131,072 words specified by 17 bits <17 : 01>. This address space can be divided into 128 blocks, each consisting of a block number and the lower address bits <10 : 01> that specify the position, or memory cell, of the address within the block. These same lower address bits also specify one of 1024 individual memory cells within the cache.

When an address is stored in cache, only the block number is physically stored in a 1k x 7-bit register

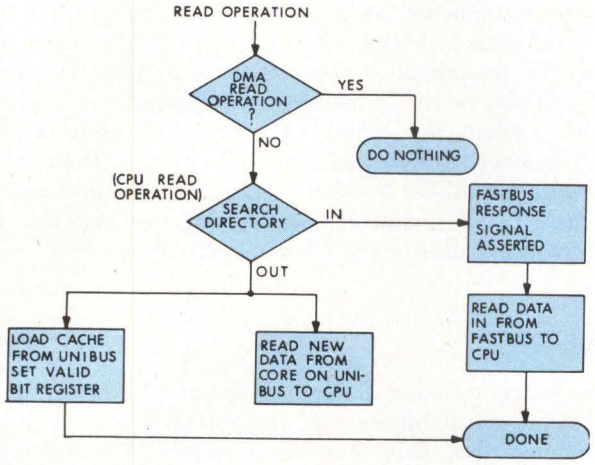


Fig 3 Cache response to memory fetch. Ignoring all DMA fetches, cache searches its directory only in response to CPU fetches. If hit occurs, cache acknowledges and supplies desired data on Fastbus. If it is a miss, cache does not acknowledge, and desired data are supplied by main memory to both CPU and cache simultaneously on Unibus

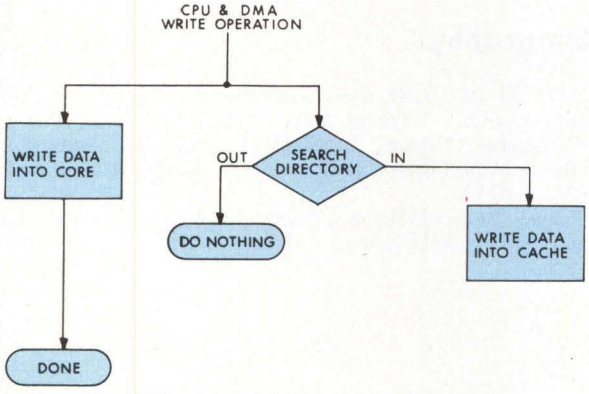


Fig 4 Cache response to write operation. Since cache does not acknowledge CPU writes on Fastbus, all writes, both CPU and DMA, occur on Unibus and are handled identically by cache. If address is in cache, its data are updated in parallel with that of main memory, and if not, contents of cache remain unchanged

called the directory. This directory is organized as a content addressable memory (CAM), meaning that when the cache is accessed, the 7-bit word readout of the directory memory cell specified by address bits <10 : 01> is compared bit-by-bit with the top seven bits of the incoming address bits <17 : 11>. If there is an equal compare, the address is said to be in cache, or that there is a hit.

Initialization Scheme

In order to clear out invalid contents in the cache, the cache automatically initializes itself by clearing all 1024 bits in the VBR. The process of initialization sets all the associated flag bits in the VBR for each of the 1024 locations in the cache back to zero. This condition has the effect of forcing "misses" from the cache; hence, the CPU will be satisfied only by the core memory until the cache is once again "reloaded" with valid data.

Initialization, which requires about 500 μs to complete, takes place automatically whenever either the dc power is restored to the computer system after a power interruption or when the Unibus initialization (INIT) signal is deactivated. This activity is completely transparent to the system.

The cache can be switched on or off, either mechanically or by software, to inhibit it from supplying data to the CPU. In this state, the system would run just as if no cache were installed; however, the cache would continue to load itself with current information. This on-off capability is useful for benchmarking and system debugging.

Parity Error Detection

Parity error (PE) detection is provided on the cache to improve overall system reliability. The method used is to divide the basic 1k x 24-bit memory array of the cache into three 8-bit bytes and add a parity bit to each byte, resulting in a 1k x 27-bit memory array. Three LED indicators provide visual indication not only of a parity error but also of the defective byte. In addition, bit 15 in the Unibus-addressable CSR is set, and bit 1 (on-off bit) is cleared when a parity error occurs. Furthermore, the cache automatically turns itself off line and flags the CPU with a dedicated PE line.

An addressable cache CSR provides the following error bits/functions:

Bit 15—normally clear, but is set if cache parity error occurs. Read-only capability.

Bit 1—on-off line control is cleared automatically if cache parity error occurs. May also be used to disable cache. (Can be overridden in ON state by mechanical switch.) Read/write capability.

Bit 0—normally set; when cleared, cache is inhibited

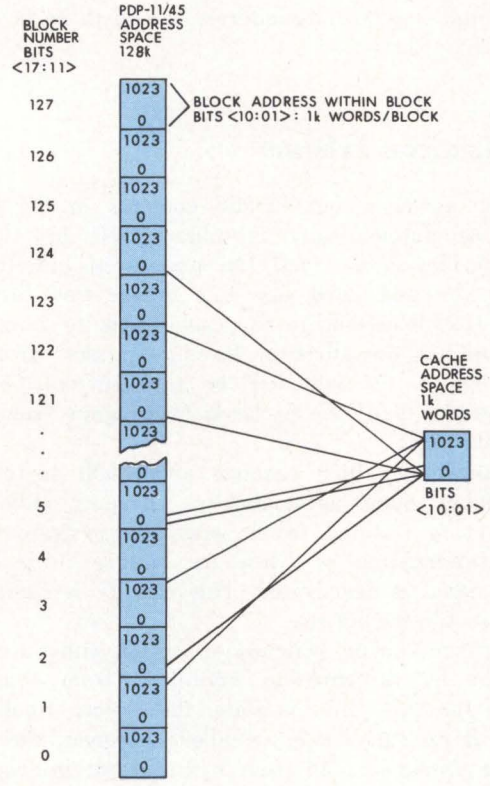


Fig 5 Direct mapping scheme for 1k-word cache. Any of 128 different addresses within 128k-word address space can be mapped one at a time into any given location, specified by its <10:01> of main memory address, within cache. Upper bits <17:11> are then stored in directory which functions as content addressable memory (CAM) during subsequent data retrieval to determine which actual address had been mapped into cache

from transmitting PE flag to CPU. (Used for diagnostic purposes only.) Read/write capability.

Benchmark Data

Benchmark tests have been run on large minicomputer systems using a wide variety of programs. For many programs, it was found that the cache could effect an increase in overall system processing speed of 30 to 70%, with more than 100% having been measured in some applications. It is important to note that reduction in runtime is not the same numerically as performance (throughput) increase. The runtime reduction ratio (RRR) is the inverse of the throughput ratio (TR). Thus, a runtime reduction of 40% (0.40) results in a RRR = 0.60 and a TR = 1/RRR = 1/0.60 = 1.67. The actual increase in throughput or productivity is 67% in this case.

Generally, cache memories are program sensitive, which accounts for some of the spread in performance improvement. Parameters HR and FR vary from program to program. Another factor, which can have a strong, if not dominant, bearing on the outcome, is the frequency of DMA and interrupt activity.

Summary

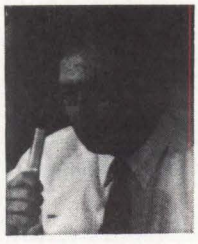
This cache memory design utilizes the 2-bus (Fastbus and Unibus) architecture of the PDP-11/45 CPU in such a manner that most CPU fetch requests are satisfied by the cache on the Fastbus (a hit) instead of by the core memory on the Unibus. When the address is not in cache (a miss), the CPU fetches it directly from core memory via the Unibus, from which the cache automatically incorporates it into itself, making it available on the Fastbus for the next fetch. All write operations are done on the Unibus to core memory and simultaneously to the same address (if present) in cache, thus guaranteeing power-failure data protection. If a parity error occurs, the cache will flag the CPU (causing it to trap to parity error vector at address 114), turn off the cache on the Fastbus, turn on the appropriate PE LED, and set bit 15 in the CSR.

Bibliography

DEC, *PDP-11/34, -11/40, and -11/45 Processor Handbook*, Digital Equipment Corp, Maynard, Mass

J. C. Mudge, "Design Decisions Achieve Price/Performance Balance in Mid-Range Minicomputers," *Computer Design*, Aug 1977, pp 87-95

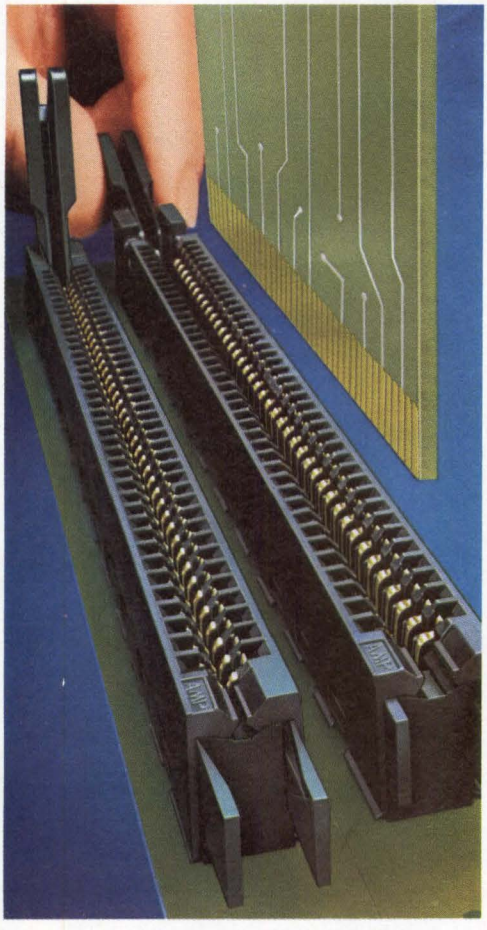
A. Pohm, "Buffered Memory Study," Electronic Research Institute, Iowa State University, Aug 1972

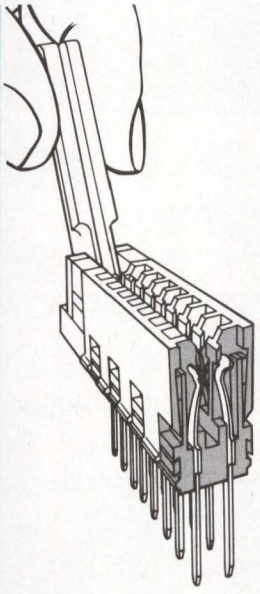


Ronald N. Monroe has had wide experience as a designer of digital and analog circuitry related to the computer industry. Before taking on the presidency of Minntronics Co, Inc, he designed the first commercially successful cache memory for the PDP-11/45 while at Fabri-Tek, Inc, as project engineer. Mr Monroe holds a BSEE from the University of Minnesota.

"Look, I'm convinced that the Zero Insertion Force concept is ideal for high pin counts. But can I reduce my overall panel costs?"

You sure can. AMP Linear ZIF.





AMP Linear ZIF Edge Connectors are one quick way to take the force out of your high pin-count applications. And a great deal of it. 110 pounds of push are gone, for example, when you install a dual 110 pin-count daughter card into a ZIF. And that means the end of jacking devices...mallets... worn contacts...damaged boards—the whole array of nuisance and disaster that often accompany edge card insertions.

What about economical backplanes? Easy. Linear ZIF Connectors come with ACTION PIN contacts for positive solderless retention in the pc board without hole damage.

Linear ZIF Connectors come preassembled and as components that allow easy repair of damaged contacts. And they give you more design freedom. You can use all edges of the board for I/O connections. You can use much larger pc boards. You can use much higher pin counts. Without any strain on you or your components.

Interested? Call the AMP Linear ZIF Information Desk at (717) 564-0100, Ext. 8400. Or write AMP Incorporated, Harrisburg, PA 17105.

AMP and ACTION PIN are trademarks of AMP Incorporated.

AMP has a better way.

AMP

CIRCLE 68 ON INQUIRY CARD

DIGI-DATA SERIES 40

the more OEMs demand of tape systems, the more we deliver.

OEMs are demanding. They want different models for different applications, the highest possible reliability, and value that reflects in their final product. Our Series 40 continues the 17 year Digi-Data tradition of satisfying these OEM requirements.

More Selection

Within our Series 40 family, they can choose from 192 combinations of NRZI, PE and NRZI/PE models with reel sizes from 7 to 10.5 inches and speeds from 12.5 to 75 ips — all featuring a new control block with more functions, such as a density select switch and an optional unit select switch.

More Reliability in a Simpler Package

Microprocessor controlled imbedded formatter improves reliability by reducing chip count as much as 50%. All versions occupy a single board, simplifying cabling and reducing spares requirements, while eliminating the need for separate outrigger housings. Improved transport modularity facilitates field upgrading, particularly data density and tape speed.

More Value

Our low inertia tension arm design provides gentle tape handling that ensures data reliability without the cost, complexity or maintenance problems of vacuum columns. Advanced transport packaging includes a metal frame door and self-aligning rack mounting.

OEMs who interface the PDP-11, Nova, Eclipse or HP-21MX can specify Digi-Data's complete microcomputer based tape systems at a cost savings of 20 to 50%.

Be demanding. Write or call for information.

DIGI-DATA CORPORATION
8580 Dorsey Run Road
Jessup, MD 20794
(301) 498-0200
®... First In Value

CIRCLE 69 ON INQUIRY CARD

LSI CHIPS EASE STANDARD 488 BUS INTERFACING

Time and cost disadvantages of interfacing to the IEEE Std 488 bus are overcome with a dedicated LSI chip set that incorporates most of its functional and electrical specifications

Ronald M. Williams Intel Corporation, Santa Clara, California

Historically, interface techniques proliferated as designers evolved customized links among instruments, controllers, and processors for realtime test measurements or data communications, resulting in excessive and expensive codes, formats, signal levels, and timing factors. Obviously, interface standardization was mandatory to save design costs for engineers, development costs for manufacturers, and system integration costs for users. Thus, IEEE Standard 488-1978 (a revision of ANSI/IEEE Std 488-1975) offers a universal instrumentation system approach to automatic operating measurement configurations that provides compatibility, versatility, and flexibility. This system approach establishes a suitable standard bus for interfacing programmable devices from different manufacturers. Outstanding advantages of the standard bus include byte serial, bit parallel digital data handling, synchronized communication among devices at varying data rates, and hardware interchangeability and interconnection in daisy-chained fashion. However, some restrictive disadvantages that have hindered implementation are highly complex logic protocol, time consuming design analysis, and lack of low cost components to perform the intricate logic control functions. To overcome these drawbacks, a large scale integrated (LSI) chip set has been designed with built-in IEEE Std 488 logic controls. Thus,

interfacing has been significantly simplified for properly connecting processor buses and programming system protocols.

Interface Overview

The IEEE Standard 488-1978 bus interface includes electrical, mechanical, and functional specifications* for interconnecting both programmable and nonprogrammable electronic measuring apparatus with other apparatus and accessories necessary to assemble instrumentation systems. The functional specifications occupy about 80% of the document and involve a proportional amount of system design time to implement. Bus functions encompass 16 active signal lines, 10 interface functions, the protocol by which interface functions send and receive messages, and logical and timing relationships between signal states.

Functional requirements of the standard can be incorporated in either hardware, software, or a combination of both. Some designers have chosen the hardware approach to incorporate all the interface functions, using about 200 medium scale integrated (MSI) and small scale integrated (SSI) packages. This technique costs about $1000 for a complete interface board. As a result, many cost sensitive implementations of the bus interface use only a subset of its functions custom tailored to the requirements of the devices involved, thereby reducing package count and expense by curtailing the interchangeability advantages.

Other designers have selected the software approach to implement the bus interface. One disadvantage of this approach is that programming is an expensive and extended project; another is that a subroutine has to be executed with each transferred byte. This overhead not only burdens the microprocessor within a device, but also reduces the overall speed of the bus. This approach costs about $200 for the interfacing functions.

*This article deals with the functional aspects (interface signals that exist on the physical bus) of IEEE Std 488-1978, and is not intended as a complete dissertation on the major elements of the standard. For detailed definitions of the mechanical (physical cable connections), electrical (timing, voltages, and currents), and operational (application software routines) technicalities, interested readers should consult the *IEEE Standard Digital Interface for Programmable Instrumentation*, IEEE Std 488-1978, Institute of Electrical and Electronics Engineers, Inc, New York, NY 10017, Nov 30, 1978—**Ed.**

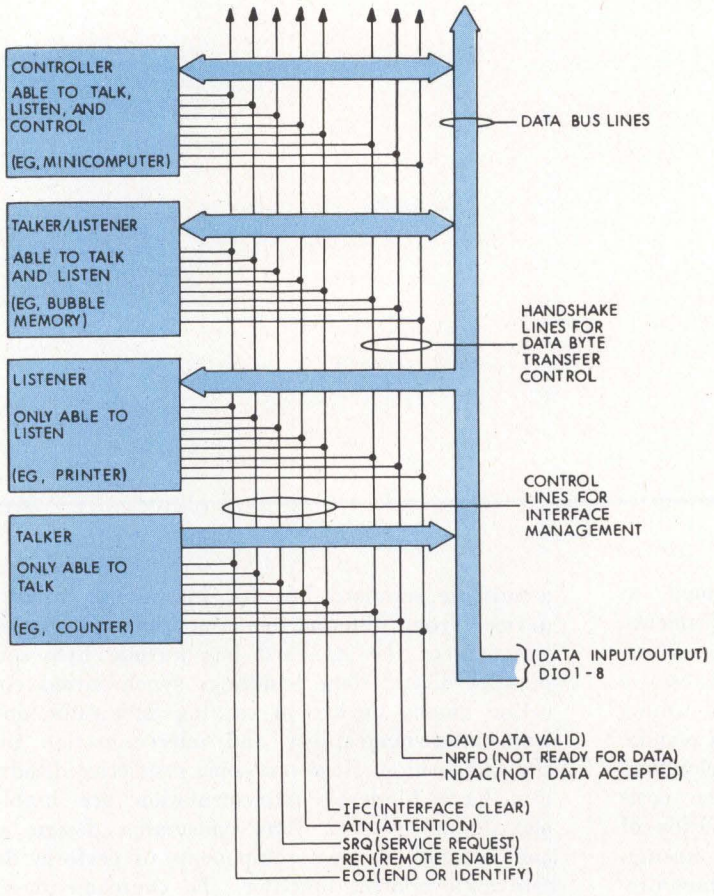


Fig 1 IEEE Std 488 active signal lines for multiple devices. Peripheral devices of different characteristics can be easily connected to standard bus interface. Controller (or processor), such as minicomputer, enables and disables talkers and listeners and manages overall bus activity. Bubble memory functions as both talker and listener. As listener, printer receives characters to be printed. As talker, counter transmits measurements to both controller and listeners

Combinational hardware/software approaches, although faster than direct software implementations, still require enormous design time and cost about $1000 for a typical interface board.

With a recent alternative approach, however, the bus interface is easier and less expensive to incorporate in instrument designs. LSI circuit chips now include as built-in capabilities most of the functional and some of the electrical portions of the Standard's specifications, significantly reducing design time and costing about $50 for bus interfacing. Additionally, Intel's 8291/8292 General Purpose Interface Bus (GPIB) peripheral chip set also incorporates capabilities for bus monitoring, data rate manipulation, and addressing to further simplify bus interface designs.

Bus Signal Definitions

The IEEE Std 488 signals are defined as negative true, where the high state (0 = false, ≥2.0 V) and the low state (1 = true, ≤0.8 V) are based on standard transistor-transistor logic (TTL) levels. Of the 16 active signal lines, 8 are data lines, 5 are interface management lines, and 3 are handshake lines (Fig 1). Data input/output lines (DIO1-DIO8) carry ASCII-coded information, as well as device addresses, universal commands, or program instructions. Interface management lines help to supervise the data lines. The primary management line—Attention (ATN)—determines how data lines are processed. When ATN is true, data lines are interpreted as addresses or universal commands by all bus connected devices. When ATN is false, only those devices addressed can use the data lines; in this case, data transmitted are typically device-dependent. With another management line, Interface Clear (IFC), the bus controller returns the system to a known quiescent state. The Service Request (SRQ) line can be used by any device on the interface bus when it has data to send (talker) or needs to receive data (listener). The Remote Enable (REN) line determines whether the system is under front panel or program control. The End Or Identify (EOI) line can be used as a delimiter by a talker (sending) device to indicate an end of message, or by the controller as a polling line.

Handshake lines control the timing relationship of the interface bus (Fig 2). The Data Valid (DAV) line

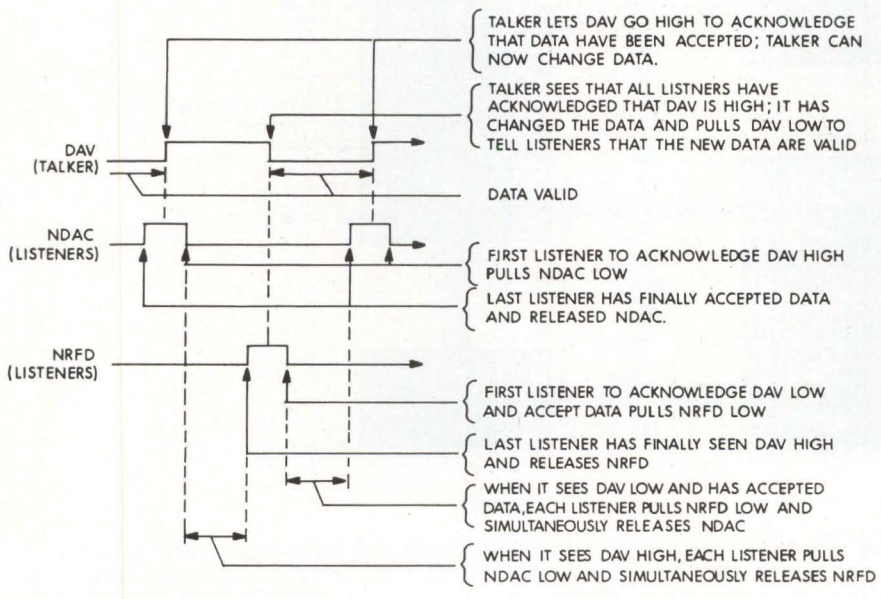


Fig 2 Three-wire handshaking between single talker and several listeners. Before transfer begins, listener indicates it is ready by asserting Ready For Data (RFD) message to true. Talker then drives all eight data input/output lines. Following settling time specified by standard, talker asserts Data Valid (DAV) message to true. While data are being read, RFD message is asserted to false since device is unable to receive additional data. As each listener completes its read, it indicates acceptance by asserting Data Accepted (DAC) message to true; DAC is not sensed true by talker until all listeners have completed read. After each device indicates acceptance, it indicates readiness for data by asserting RFD to true. New cycle begins when all devices have asserted RFD to true

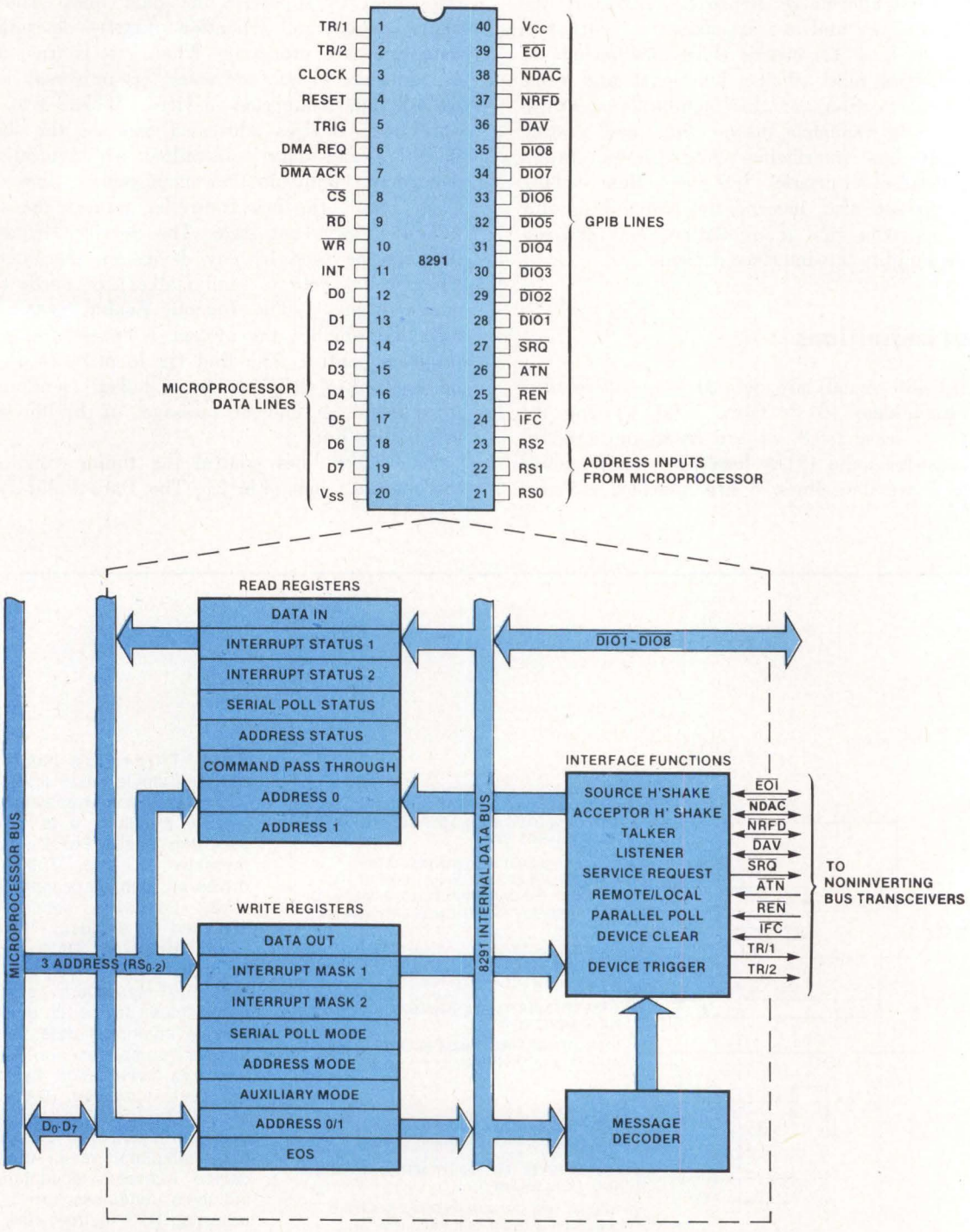
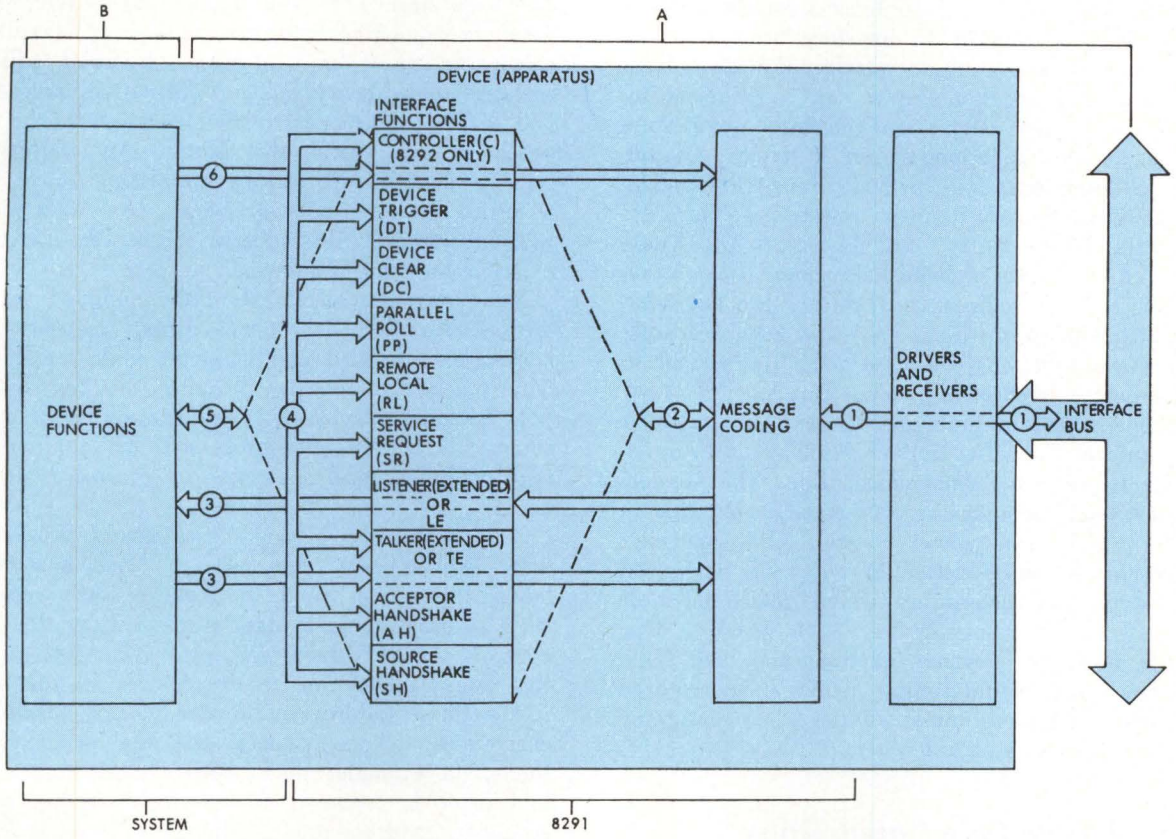


Fig 3 GPIB talker/listener chip. 8291 chip connects 8-bit microprocessor to noninverting bus transceivers, which, in turn, connect to IEEE Std 488 bus. Microprocessor manipulates data bytes after receipt or before transmission, and monitors talker/listener status. Single chip handles all IEEE Std 488 interface functions, except controller functions



A - CAPABILITY DEFINED BY 488-1978 STANDARD
B - CAPABILITY DEFINED BY DESIGNER
1 - INTERFACE BUS SIGNAL LINES
2 - REMOTE INTERFACE MESSAGES TO AND FROM INTERFACE FUNCTIONS
3 - DEVICE DEPENDENT MESSAGES TO AND FROM DEVICE FUNCTIONS
4 - STATE LINKAGES BETWEEN INTERFACE FUNCTIONS
5 - LOCAL MESSAGES BETWEEN DEVICE FUNCTIONS AND INTERFACE FUNCTIONS (MESSAGES TO INTERFACE FUNCTIONS ARE DEFINED; MESSAGES FROM INTERFACE FUNCTIONS EXIST ACCORDING TO DESIGNER
6 - REMOTE INTERFACE MESSAGES SENT BY DEVICE FUNCTIONS WITHIN CONTROLLER (8292)

Fig 4 Bus interface functions. Messages received from interface bus can cause state transitions, just as state transitions can cause messages to be sent on bus (1 and 2). Device dependent data are transferred automatically to microprocessor, without affecting state transitions (3). State changes in one function can cause state changes in another function, resulting in message to be sent (4). Microprocessor can also send local messages to interface functions (5) or remote messages to interface (6)

is used by a talker device to indicate that data are ready to transmit. The Not Ready For Data (NRFD) and Not Data Accepted (NDAC) lines are used by a listener to indicate readiness to receive data and receipt of data, respectively. As a result, a talker knows when all listeners on the bus have received an 8-bit byte of information. Thus, the transmission rate of the bus is only as fast as the slowest listener.

Messages conveyed by all 16 lines are true or false, depending on the states of 10 interface functions. The standard defines each of these interface functions with state diagrams. A function's state can be changed by a controller, another device on the bus, or a state change in another function within a device. Of the 10 interface functions, four provide basic communication capabilities: Source Handshake (SH), Talker (T), Acceptor Handshake (AH), and Listener (L). These functions affect the three handshake lines (DAV, NRFD, and NDAC), eight data lines (DIO1-DIO8), and EOI management line. The Device Clear (DC) and Device Trigger (DT) interface functions are used to initialize and to trigger a device, respectively. The Parallel Poll (PP) function acts with the EOI line to send a single bit of status information. The Service Request (SRQ) function controls the SRQ management line. The Remote Local (RL) interface uses the REN management line in conjunction with front panel control. The Controller (C) function, which is active in only one device on the bus at a time, determines which device talks or listens.

To date, these 10 interface functions and their intricate interrelationship and timing factors have required difficult and time consuming efforts when designing the interface bus into a digital system.

Talker/Listener Chip Capabilities

The 8291 GPIB talker/listener chip, a 40-pin LSI device (Fig 3), performs the inversion necessary to connect an 8-bit microprocessor bus to the negative true IEEE Std 488 bus. In addition, this chip implements most of the Standard's required functions. The microprocessor sets the talker/listener chip to an initial state, manipulates bytes before or after transmission, performs interrupt service routines, causes state changes, monitors other state changes, and enables and disables chip capabilities.

Without microprocessor involvement, the talker/listener chip implements all interface functions, except controller performance, such as handling data transfers, handshake protocols, listener/talker address procedures, device clearing and triggering, service requests, and parallel and serial polling schemes (Fig 4).

Within the chip architecture are eight read (output) and eight write (input) registers. One input register holds the data that are to be moved from the bus to the microprocessor when a device is listening. An output register holds the data byte that is to be transferred to the bus when a device is ready to talk. The other seven write and seven read registers control various chip functions.

Interrupt status registers 1 and 2 store 12 different interrupt flags. For example, one bit in the Interrupt Status 2 register reflects changes in a device's addressed state. The microprocessor can poll both registers to determine which flag caused the interrupt, and can then branch to the appropriate service routine. Two corresponding interrupt mask registers allow designers to mask any interrupt. A serial poll status register holds device status information, and a serial poll mode register is available so that the microprocessor can verify this status. An address mode register contains a device's addressing mode, as determined by the microprocessor. An address status register monitors the address status (ie, active talker or active listener) of a device.

Two address registers store the assigned device addresses. An End-Of-Sequence (EOS) register contains a designer specified end of string code for delimiting data block transfers by flagging the last byte with EOI. A command pass-through register feeds non-GPIB commands to the microprocessor. An auxiliary mode register holds local messages to control reset, power on, etc.

Among the chip's capabilities are a programmable data transfer rate from 62k to 525k bytes/s, three addressing modes, and an EOS message recognition. With a programmable data transfer rate, the designer controls the handshake rate of the interface to match the data transfer rate to the devices on the bus.

The three addressing modes permit flexibility in designating talkers/listeners. The dual primary address mode, for example, allows both a talker and a listener address to be assigned to a device. With the primary/secondary address mode, multiple devices of the same type can have the same primary address, but a different secondary address. In the third addressing mode, devices can have both dual primary and dual secondary addresses.

Data block transfers are made easier with the EOS register. This register holds the character that signals an end-of-block transfer. When a data byte loaded into the data-out register matches the byte in the EOS register, the talker/listener chip asserts the EOI line, signaling an end of transfer.

Controller Chip Capabilities

The 8292 controller chip (Fig 5) implements the controller function of the Standard. In conjunction with the 8291, the controller forms a complete standard interface, including the capability of handling the transfer control protocol. This ability gives the designer an option to accommodate multiple controllers on a single bus.

Additionally, the 8292 performs all the tasks necessary in a complete controller design. It responds to

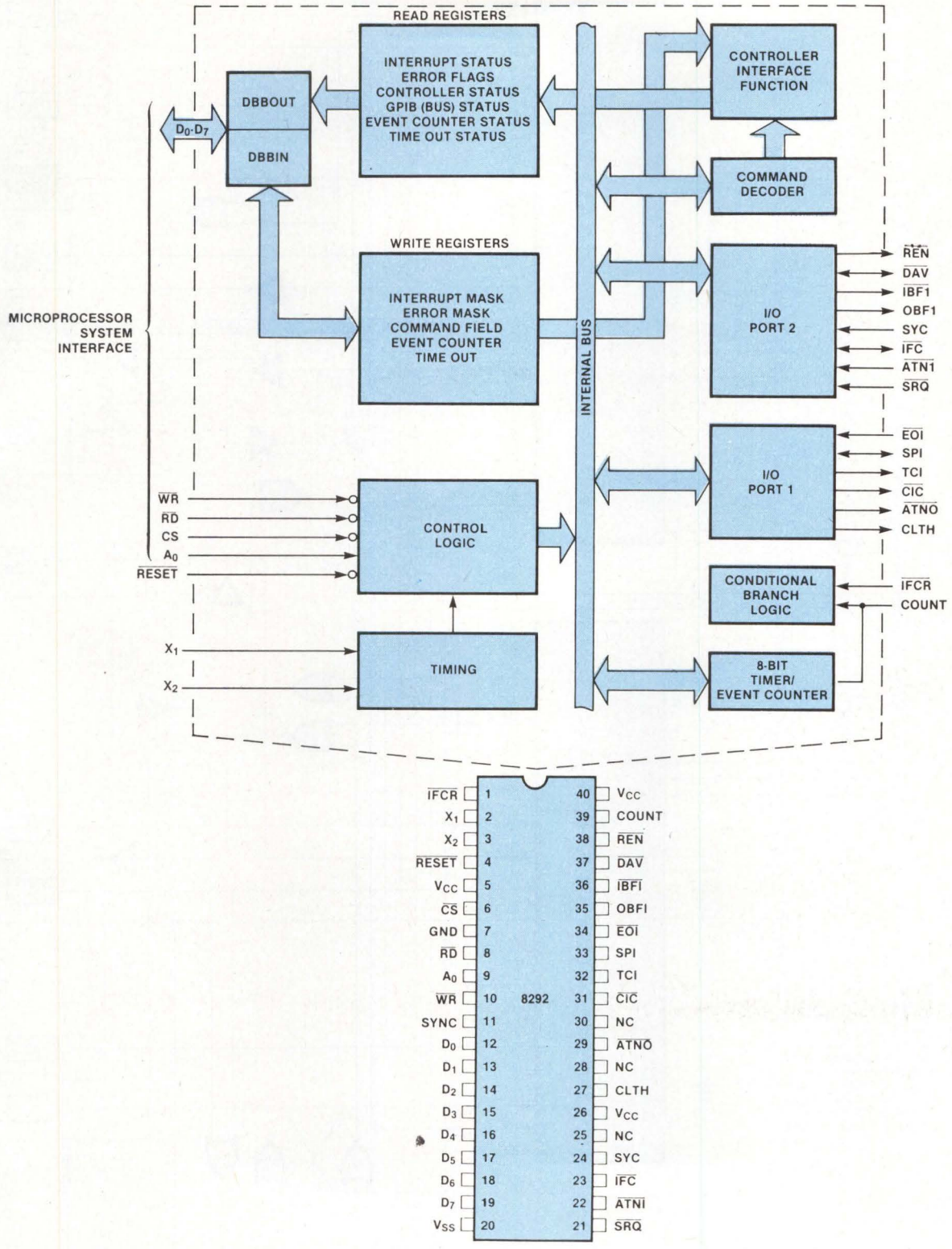


Fig 5 GPIB controller chip. 8292 chip works in conjunction with 8291 to perform GPIB controller interface functions. It implements local control commands from microprocessor according to IEEE Std 488 protocol. Additionally, it processes such inputs from bus as SRQ and EOI. Furthermore, it can send the full repertoire of GPIB control messages, including REN, IFC, ATN, and EOI

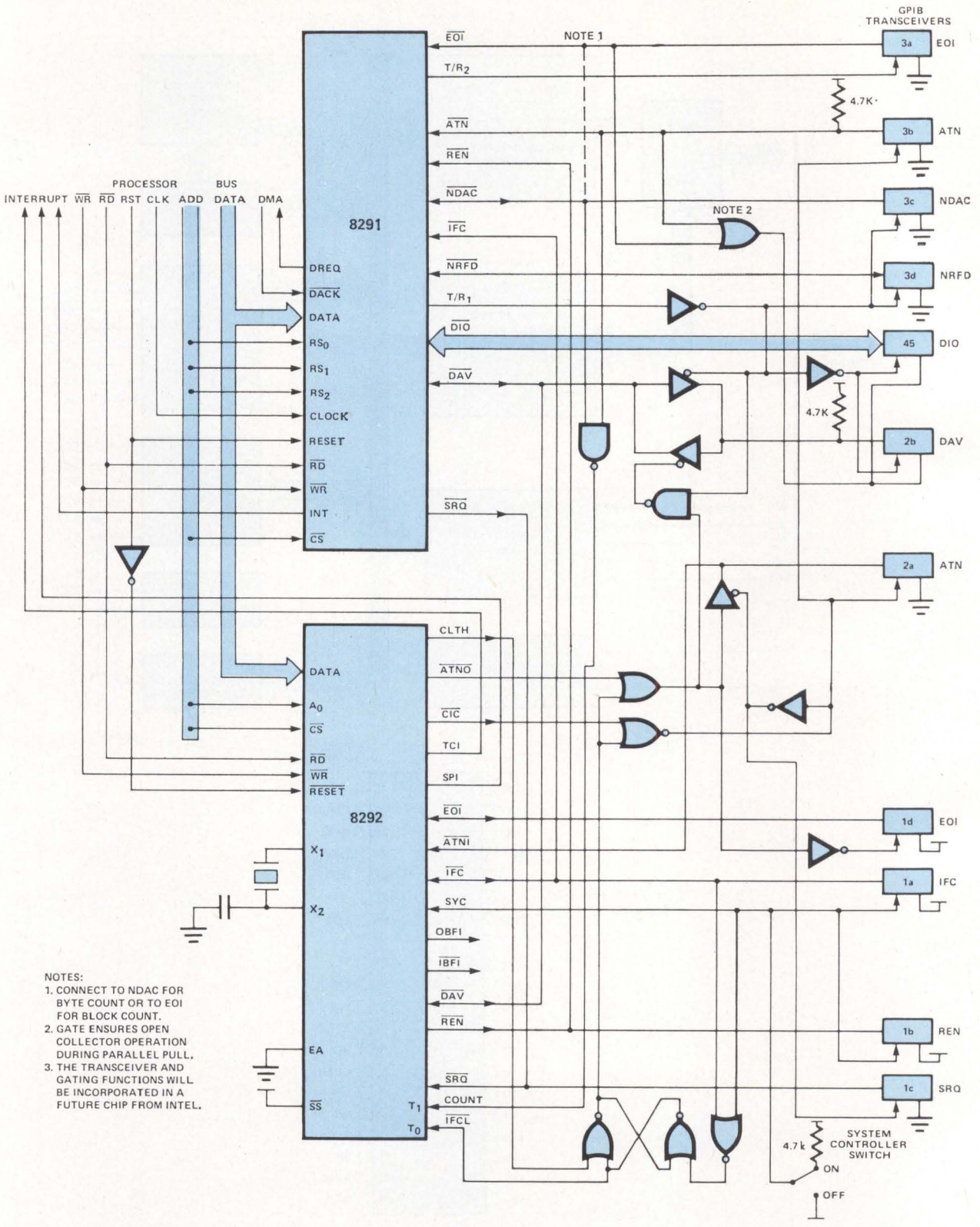


Fig 6 System configuration using chip set. In conjunction with 8291, 8292 performs complete controller function. Together with shared bus transceivers, chip set forms a complete IEEE Std 488 interface. In addition, DMA interface may be implemented through 8291 with 8237 DMA controller

service requests (SRQs), configures other devices on the bus for remote control by sending Remote Enable (REN), and sends Interface Clear (IFC), allowing for control seizure to reinitialize the bus. More importantly, the controller chip can take control of the bus synchronously with the handshake, preventing the destruction of any data transmission in progress.

Internally, the controller chip has 10 dedicated registers for programming and for monitoring status. Through the use of the Interrupt Status and Interrupt Mask registers, the designer can configure the controller to interrupt the microprocessor on selected events. An Event Counter and a corresponding status register are available to monitor and control either byte counts or block counts. A Time-Out register may be set by the designer to program a time-out error function; a corresponding status register contains the current value in the time-out counter. In conjunction with these registers, error control can be programmed with the Error Flags and Error Mask registers. Finally, Controller and GPIB Status registers are available. Each of these registers is read or programmed through a dedicated command buffer.

Chip Set Application

The talker/listener and controller chips connect to the standard interface bus through noninverting bus transceivers (Fig 6). These transceivers provide the 48-mA bus drive capability needed to meet the electrical portion of the IEEE Std 488 specification—not directly possible with existing metal oxide semiconductor (MOS) parts. The talker/listener chip can interface directly to microprocessor memory through a direct memory access (DMA) controller, such as an 8237.

The microprocessor drives the talker/listener with a short stored program (see Table), containing initialization conditions, such as data transfer rate, address mode, and other designer requirements. Microprocessor data handling is limited to taking bytes off the bus after they arrive or putting bytes of data on the bus. Interrupt service routines are necessary for each unmasked interrupt. Although 12 interrupts are available, not all have to be used. All other standard bus functions are handled by the 8291.

To send a byte of data, the microprocessor writes the byte into the talker/listener data-out register. The chip then transmits the data byte over the bus lines in conjunction with the handshake lines. Next, the NRFD line is checked to see if it is ready for data. If a ready for data message is detected, the talker/listener sends a DAV signal until it receives a data accepted message from the interface's NDAC line. The 8291 also generates a Byte Out (BO) interrupt, setting the BO flag in the interrupt status register. When its interrupt pin is activated, the microprocessor reads the interrupt status register and responds to the interrupt with an appropriate service routine.

The 8292 handles all hardware aspects of the controller function: SRQ input, ATN, IFC, EOI, and REN outputs. Meanwhile, the designer defined aspects of a given GPIB system are handled by processor software. For example, the processor is responsible for knowing which device on the bus corresponds to which device address. The processor then uses the 8291 to transmit coded Controller commands as the 8292 asserts ATN.

Talker (Transmitter) Initialization

8291 Register	Data	Comments
5W	02H	Reset
4W	01H	Address Mode 1 (Primary-Secondary)—Note that talk only could be selected here, eliminating need for controller address
6W	02H	Address 0 = 02H
6W	92H	Address 1 = 12H
0W	FFH	Enable All Interrupts
1W	3FH	Enable All Interrupts, DMA
5W	A4H	Enable High Speed Data Transfer
5W	00H	PON, Release Initialization State

Summary

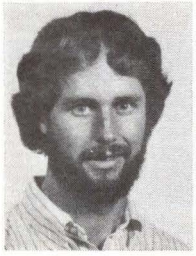
Bus interface designs that previously required 150 or 200 MSI/SSI chips may now be implemented with a GPIB peripheral chip set. For designers, this hardware set means less design time and cost, resulting in increased reliability and versatility in IEEE Std 488 bus interfaces custom programmed for dedicated applications.

Bibliography

S. C. Baunach, "Design Advantages and Limitations in Connecting Computational and Readout Equipment to the GPIB," Western Electronic Show and Convention, Sept 1976

A. Kaminker and A. Menachem, "LSI Facilitates GPIB Implementation," *IEEE Proceedings on Microcomputer Based Instrumentation*, June 1978

D. C. Loughry and M. S. Allen, "IEEE Standard 488 and Microprocessor Synergism," *Proceedings of the IEEE*, Feb 1978

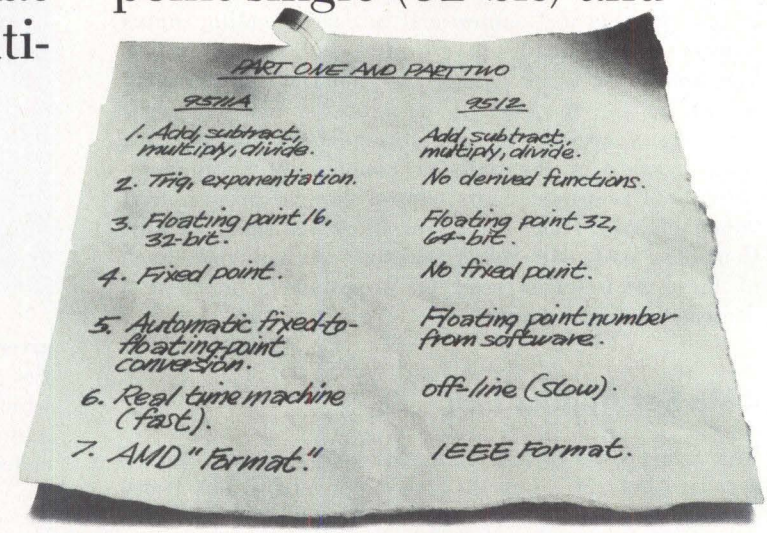


Ronald M. Williams is a product manager for peripheral controllers in Intel's Microcomputer Components Division. In addition to GPIB devices, he has been involved in introductions of dynamic RAM and CRT controllers. He holds a BS degree from Trinity College, an MS degree from Rensselaer Polytechnic Institute, and an MBA degree from the University of Chicago.

Last year, we introduced the Am9511. It took the industry by storm. Now there's a device that does for four-function, high-precision applications what the Am9511 does for multi-function, high-speed applications.

Announcing The Am9512.

It's a monolithic arithmetic processor in the IEEE format that offers the full range of simple math functions with floating-point single (32-bit) and



MATH CHIPS: PART TWO.

double (64-bit) accuracy.

The Am9512 replaces dozens of TTL devices and hundreds of interconnections. It increases throughput by two orders of magnitude over software implementation. And it's compatible with all of the most commonly used 8-bit and 16-bit microprocessors on the market.

(And, as always, with the Am9512 you get MIL-STD-883 for free.)

If you want the whole story on arithmetic processors, call or write Advanced Micro Devices.

We wrote the book.

Advanced Micro Devices

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

CIRCLE 70 ON INQUIRY CARD

TECH NOTE

Thermal Printhead Technology and Design

Three common thermal printing technologies, transistor-resistor silicon mesa, silk screened thick film resistive, and vacuum deposited thin film resistive, are evaluated for a high speed, high resolution thermal printhead design

William Boles

Hewlett-Packard Company, Desktop Computer Division,
Fort Collins, Colorado

Thermal printing technology has steadily advanced from earlier designs of heated styli and wax coated paper used on strip chart recorders to a high performance process with the latest innovations in integrated circuit designs for fabricating printheads, and in sophisticated chemical formulations for producing high contrast, fade resistant papers. Design considerations for a pagewide printhead with uniformly spaced resistive print elements, capable of fast print rates and high print quality, demonstrate the significant strides achieved in thermal printing technologies.

Technology Advantages and Disadvantages

As with other printing technologies, thermal printing will not solve all print output needs, but does offer distinct advantages, such as speed, reliability, quiet operation, and compactness. Similar to other nonimpact methods, thermal printing provides high speed output since there are no hammers, fingers, belts, chains, or ribbons to increase complexity. In its simplest form, that of a full width printhead, virtually the only moving parts in thermal printing are paper and platen. This simplicity translates into higher speeds and more reliable operation. Mean time between failures (MTBFs) of 2k-h or 100M characters are common. Because it is a nonimpact method, thermal printing is quiet; sound pressure levels of less than 55 dBa are normal for thermal printers without sound-deadening enclosures. While not often considered a major advantage, thermal printing is clean because it requires no inks, ribbons, aluminized papers, or toners. These advantages, which also contribute to convenience and ease of use, plus compactness, make thermal printers

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.

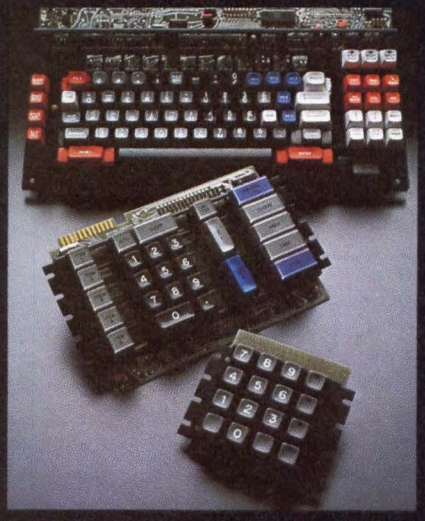
There are also wired-only assemblies or separate modules available. And you can pick from the industry's largest legend library.

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 71 for Data

ideal for integration into desktop computers, instruments, computer terminals, and analytical systems.

There are, however, some definite drawbacks. Among these are the cost of thermal paper, lack of simultaneous multiple copy capability, nonpermanency of image, and occasional problems of making copies from thermal paper. Thermal paper is more expensive than plain—up to \$0.05/8.5 x 11″ (21.6 x 27.9-cm) sheet for high quality, high contrast paper—compared to less than \$0.02/sheet for plain paper. However, this higher paper cost is gradually decreasing as thermal printing applications expand. Simultaneous multiple copies are not practical, but the high speed of thermal printing often makes sequential copies of output feasible if only occasional multiple copies are required. Improved chemical formulations, especially in black printing, have increased the fade resistance of thermal papers so that they are only slightly affected by sunlight or moderate heat. Paper reproducing in black also eliminates copying problems associated with some blue printing papers.

Image Forming

Thermal paper involves coating a normal base paper with a heat sensitive film of only a few micrometers thickness. This film contains particles of two separate colorless components—a dyestuff and a phenolic color former suspended in a solid binder. When heat is applied, the coating fuses and the two components flow together. Chemical reaction causes a colored image to appear; blue and black are the most common colors.

Printhead Technologies

There are several methods of applying heat to thermal paper in order to produce an image, the most common technologies being silicon mesa, thick film resistive, and thin film resistive. In silicon mesa technology, patented by Texas Instruments, printing elements are constituted of discrete silicon chips with a transistor-resistor pair deposited on the base (Fig 1). This chip is epoxy-bonded to a ceramic substrate in an array

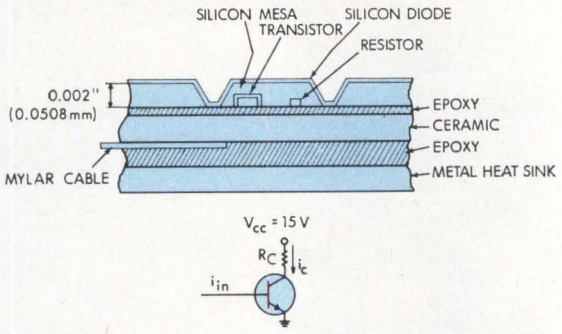


Fig 1 Silicon mesa technology. Transistor-resistor pair is deposited on silicon chip. Transistor controls current through resistor, heating silicon chip contacting thermally-sensitive paper

to form the print element. A small base current (i_{in}) controls a large current (i_c) through the resistor. Power dissipated by this resistor heats the silicon chip that is in contact with the paper. Print elements are thermally isolated from each other by a coating of silicon dioxide. Since silicon is highly resistant to abrasion, paper quality, and therefore cost, need not be as high as with other thermal technologies.

In thick film resistive technology, introduced by NCR, a resistive paste is silkscreened onto a ceramic substrate to produce individual print elements (Fig 2). Current is passed through these elements, and the power dissipated causes each to heat up while in contact with the paper. Depending on the thickness of the film, this method is also highly resistant to abrasion.

In thin film resistive technology, used extensively by Hewlett-Packard, the print elements are basically a resistive film, like the thick film method, but are only 500Å thick (Fig 3). The film is deposited on a ceramic substrate using a vacuum deposition method similar to that used in manufacturing integrated circuits. Because this method is more precise than silkscreening, higher print element densities are possible. This technique also produces a print element with a very low thermal mass. Elements can be heated and

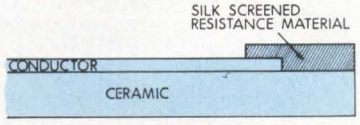


Fig 2 Thick film technology. Thick film of resistive paste is silkscreened onto ceramic substrate over conductive traces. Current through these resistors causes them to heat up and form image on thermally sensitive paper

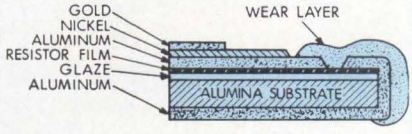


Fig 3 Thin film technology. Very thin (500-Å) resistive film is vacuum-deposited on ceramic substrate over conductive traces. Wear layer of aluminum oxide sputtered over print elements protects them from abrasion

Solid engineering and 340 lpm speed make the TermiNet 340 a more rugged, productive line printer.

Any way you measure them, TermiNet® 340 line printers are more productive performers

Don't let the compact size of the General Electric TermiNet 340 line printer fool you. Because no matter how hard you work it, it won't quit on you. It's that tough, that dependable and that much better than typical line printers. And it's available now.

A true 100% duty cycle printer

Unlike ordinary line printers, the TermiNet 340 can take the punishment of the broadest range of operating environments—from front office to factory floor—without complaining. The key reason? A tough, ruggedly engineered design. As a result, it keeps on performing under tough-use conditions when other line printers would sputter and break down.

Engineered to stay on the job.

From top to bottom, the compact TermiNet 340 line printer is engineered with long-life components designed to keep the printer on-line. And businesses on schedule.

One reason: extra-thick, heavy-duty, environment-resistant materials chosen for the base and housing. Together, they provide this rugged printer with the impact strength, dimensional stability and resistance to adverse environments needed to keep working.

More reasons: print and ribbon systems that won't wear out prematurely and won't cause the problems other line printers do. Which is why the proven rotating-belt print system will last billions of characters. And why the ribbon cartridge will maintain very high print quality for at least 100 million characters.

Fewer service problems keep it working longer

The fact is, TermiNet 340 line printers are such productive workers, they require very little attention and very little maintenance once they're up and running. Should service be needed, you can count on getting these printers back on-line in a hurry. That's because of convenient self-test features that make troubleshooting easy and fast. And because of a responsive nationwide service network that keeps downtime to a minimum and operating costs low.

Find out for yourself. Mail the coupon today and see why so many companies have chosen the more productive TermiNet 340 line printer to get their work done.

Quality that will make a lasting impression

GENERAL ELECTRIC

CIRCLE 72 ON INQUIRY CARD

Mail today to:
J. Walsh,
General Electric Company,
TermiNet 794-43,
Waynesboro, VA. 22980
Telephone: (703) 949-1474.

☐ Send me more information about the TermiNet 340 line printer.

☐ Have a sales representative contact me.

☐ I'm also interested in a TermiNet 340 line printer demonstration.

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Telephone _____

cooled quickly, allowing much faster printing than other methods, without smearing. To provide protection from abrasion, a wear layer of aluminum oxide is deposited over the print elements; low abrasion papers are recommended for maximum printhead life.

Printhead Mechanisms

For each thermal printhead technology, there are several methods of producing printed page copy. Most thermal printers produce characters made up of a dot matrix, with a 5-horizontal by 7-vertical dot array being the most popular. Patterns for these character sets are generally contained in a character buffer connected to a character read only memory (ROM), which translates 7- or 8-bit ASCII data-in characters into appropriate dot energization formats.

Characters are printed on thermal paper either by scanning a small printhead array across the page or by moving the paper past a fixed pagewidth row of dots. The pagewidth row of dots may be either a single monolithic printhead or several smaller segments joined end-to-end. The segmented printhead is cheaper to produce, since the yield of a smaller segment is higher than that of a larger monolithic head. However, the requirements of matching resistances for uniform print quality and the mechanical complexity of precisely aligning the segments often overcome the initial lower cost of a segmented printhead. Inexpensive scanning head printers are usually lower in performance. Printing speed is limited by mechanical constraints to approximately 120 char/s, while fixed head printers can print up to 500 lines/min.

Thermal Printhead Architecture

As an example of recent thermal printhead architecture, mechanical construction and data transfer design techniques are described for the 9876A 80-col thin film monolithic head thermal graphics printer. In the monolithic printhead (Fig 4), 560 equally spaced print resistors are positioned on 0.013″ (0.33-mm) centers, across a 7.28″ (185-mm) width, to print both alphanumeric data and high resolution graphics data. Printing and plotting are accomplished by moving thermally sensitive paper vertically in front of the print resistors while they are being selectively energized. The heating process causes the paper to darken where information is to be recorded. Print resistors are deposited uniformly and thinly on a ceramic substrate, and because of their low thermal mass, they can be heated and cooled rapidly so that speeds of up to 480 lines/min can be attained.

ASCII character data or control instructions pass into the printer through the interface chip, which

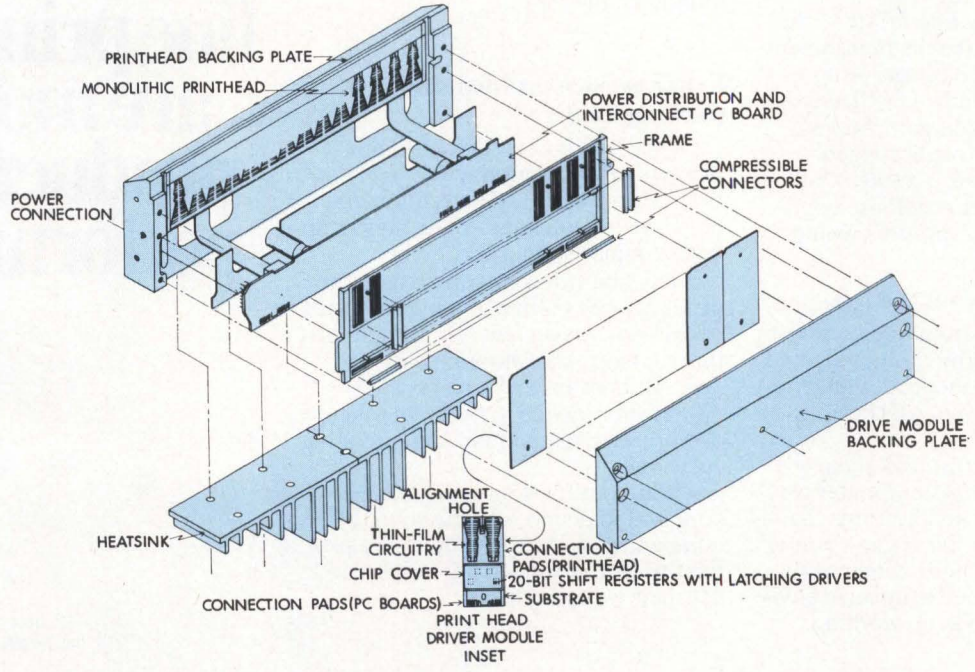
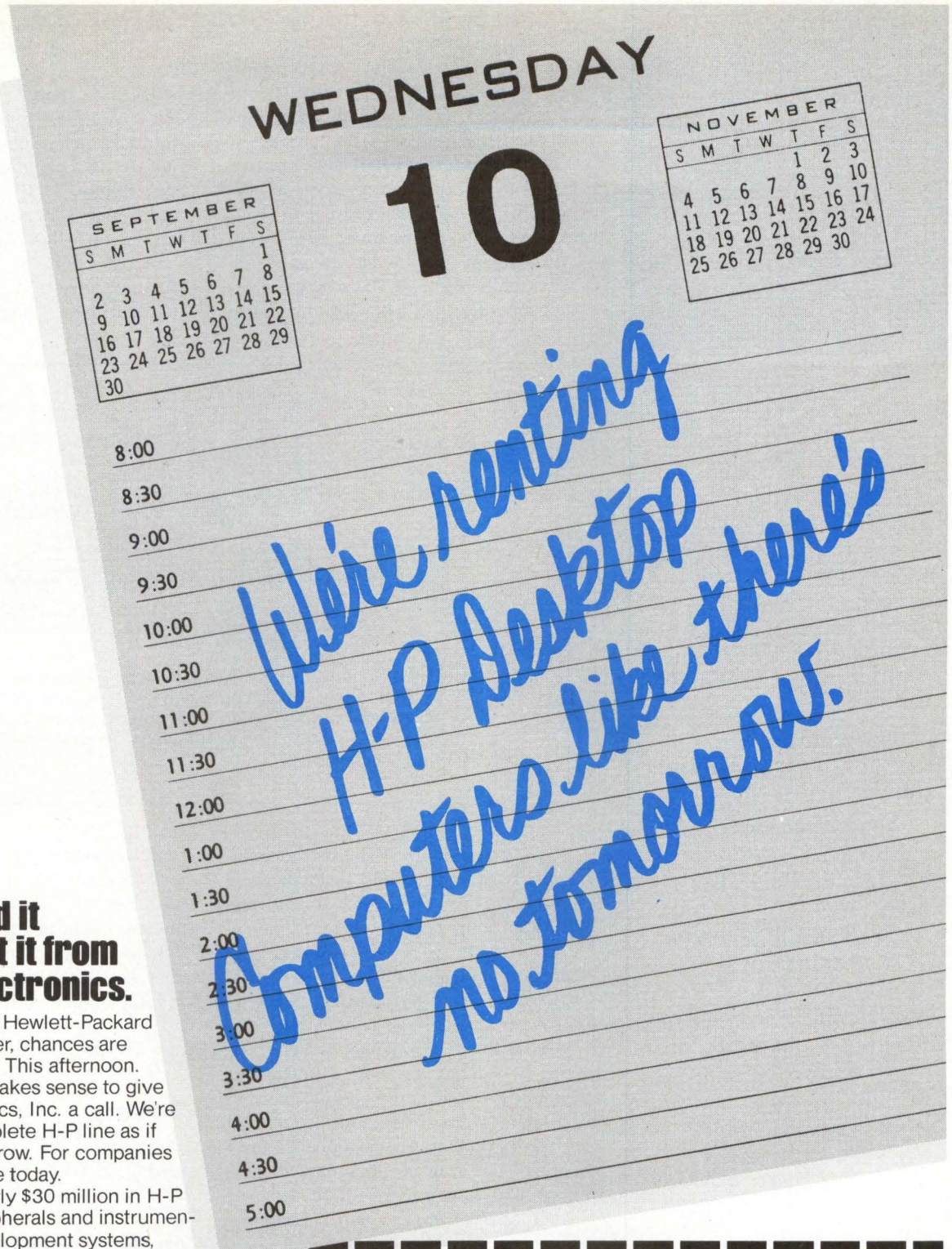


Fig 4 Exploded view of thermal printhead assembly. Each of seven printhead driver modules contains four 20-bit shift registers with latching print resistor drivers. These modules connect to monolithic printhead using compressible elastomeric connectors. Power and burn information come through single connector cable onto printed circuit board, which also connects to printhead with conductive elastomeric connectors. Two rigid backing plates hold entire printhead assembly together



If you need it today, rent it from Rental Electronics.

When you need a Hewlett-Packard desktop computer, chances are you need it now. This afternoon.

That's why it makes sense to give Rental Electronics, Inc. a call. We're renting the complete H-P line as if there's no tomorrow. For companies that need service today.

We've got nearly $30 million in H-P computers, peripherals and instrumentation, Intel development systems, Tektronix scopes and electronic gadgetry from all the top manufacturers. So we're sure to have precisely what you need—even the very latest equipment.

Our on-line, real-time computer system means we can give you price and availability information instantly, even if the equipment you need is in another of our ten warehouses across the continent.

Give us a call at 800-227-8409 (415-856-7600 in California) if you need H-P 9845, 9835A and 9825 desktop computers. Or any of the complete line of H-P peripherals. And do it today.

For immediate action, return this coupon to Rental Electronics, Inc., 19347 Londelius St., Northridge, CA 91324.

☐ Send me your Rental Catalog. ☐ Send me your Equipment Sales Catalog—I may be interested in buying some of your "previously owned" equipment.

☐ I have an immediate need for the following rental equipment: _____

Please have someone from your nearest Inventory Center phone me at _____.

Name _____ Title _____

Company _____ Phone _____

Address _____ Mail Stop _____

City _____ State/Zip _____

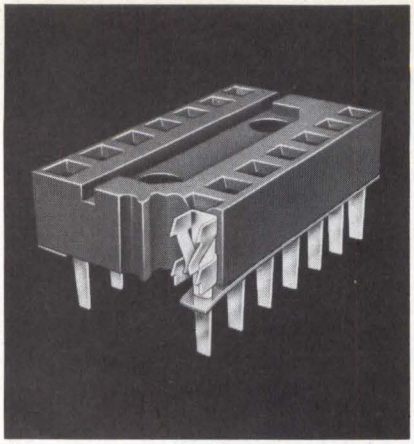
Rental Electronics, Inc.

An AMERICAL company

... a different breed.

CD10

CIRCLE 84 ON INQUIRY CARD



Cambion Low-Profile Solder Tab Sockets feature solid engineering... plus KAPTON™ film!

- all contacts sealed tightly on board side with Kapton—DuPont's polyimide film which inhibits solder or flux entry. Temperature resistance: −269°C to +400°C. Flame retardant, resists organic solvents.
- unique inverted spring design overcomes insertion force resistance.
- dual leaf spring for redundancy of contacts means four times the reliability.
- excellent DIP retention (low insertion, high extraction forces).
- *all* popular pin types in tin or gold plating: 8, 14, 16, 18, 22, 24, 28, 40 and 64-pin.
- massive availability.
- Send for our latest socket brochure and Catalog 121. Cambridge Thermionic Corporation, 445 Concord Avenue, Cambridge, MA 02238. (617) 491-5400.

CAMBION®
The Right Connection.

Kapton—Trademark of Dupont Corporation

controls handshaking with the data source. Character data enter the random access memory (RAM) buffer, which can store up to 80 characters, and then go to the character ROM, which encodes the characters into dot patterns. Character information to be printed arrives at the printhead one dot row at a time from the character ROM. Each printhead resistor can be accessed individually through seven shift register modules (Fig 5), with four driver chips per module. Printing information is shifted serially through these modules and then latched into the driver chips, and current passed through the resistors "burns" the information onto the paper. Printing time is saved by loading the next dot row of data into the shift registers while the previous information in the latches is being printed. Dot patterns arrive in parallel format to the shift registers, and are shifted serially across the printhead until a full dot row is accumulated. This dot row is printed, and the stepper motor advances the paper vertically by an increment of one dot row. The sequence repeats until a full row of characters is printed. Then, the stepper motor advances the paper by a full line feed for spacing and the next line of text is initiated.

If graphics rather than character data are to be printed, a control instruction precedes the graphic data. The microcomputer interprets the data, not as ASCII characters, but as eight bits of graphic data. Via a multiplexer, these data pass directly to the parallel-in, serial-out shift register, bypassing the character ROM, and then into the printhead.

Because power requirements to drive all 560 dots simultaneously would be excessive, maximum current to the printhead is limited to approximately 10 A. This value means that a maximum of 100 dots can be turned on at once. If more than 100 dots in a row must be "burned," several passes must be made with an increase in printing time. However, the decrease in normal printing speed or graphics applications is slight. In a typical alphanumeric printout, over 90% of the dot rows contain less than 100 dots that need to be "burned." In graphics mode, this percentage may increase or decrease according to dot density of the graphics output.

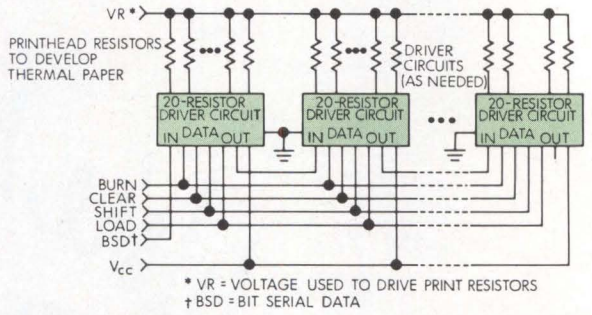


Fig 5 Shift register/driver modules. Twenty-eight 20-resistor driver chips containing shift register latches receive burn information from microcomputers, shift data serially across printhead, and energize individual printhead resistors

Summary

Depending on required printing speed, thermal printhead tradeoffs involve cost and wear characteristics for a particular application. Speeds on the order of 500 lines/min are available with printers using thin film resistive technology and page-wide fixed head mechanisms. Also, fixed head printers are capable of generating raster graphics. Offering easy interfacing as well as quiet reliable output, thermal printers are increasingly being used with computer terminals, mini- and microcomputers, automatic test equipment, graphics and medical systems, analytical laboratory systems, and data logging instruments. □

CIRCLE 74 ON INQUIRY CARD

"Golly, I found a pain in my parity."

The only GCR tape sub-system for minis that troubleshoots itself 3 ways.

This GCR tape transport subsystem gives you three self-diagnosing systems, each in a different mode.

First, there's the only continuous self-circuit-checking system on the market. Then, in the off-line mode, via a built-in key-board, there's full fault isolation right down to the board level. And finally, in the on-line mode, there's PCC's superior total check-out diagnostic system which also has fault isolation to the board level.

Besides this unique 3-level diagnostic capability you get GCR recording density of 6250 bpi and a transport speed of 125 ips all in a 19"x24" package.

You also get the simplest interface in the business. By far. Direct parallel transfer 16-bit words, all in only 29 lines.

The PCC GCR–the tape transport system with three built-in doctors. So there's no waiting.

PCC PERIPHERALS
PERTEC COMPUTER CORPORATION

For further information, call toll-free 800-528-6050, Ext. 1323
(In Arizona, call 800-352-0458)

CIRCLE 75 ON INQUIRY CARD

TECH BRIEF

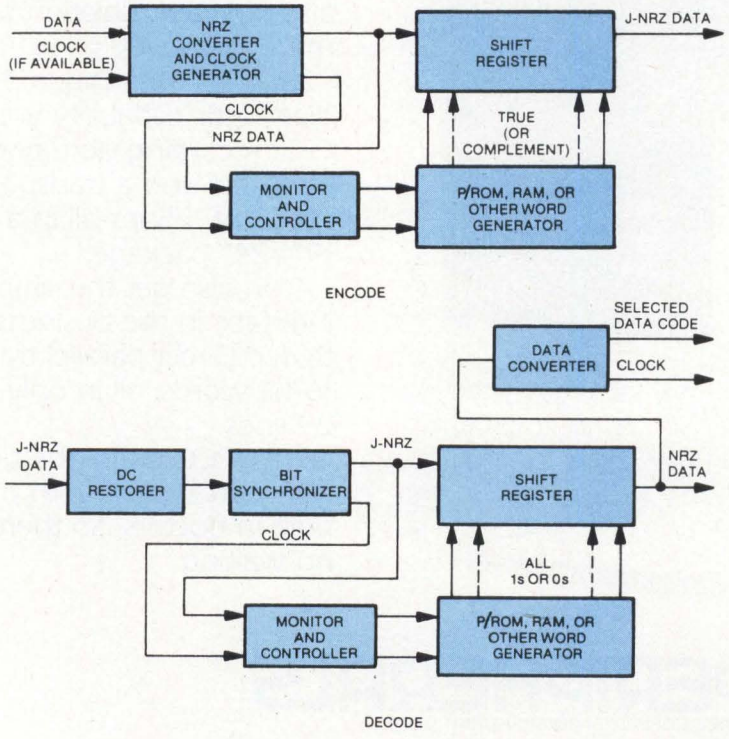
Efficient Digital Encoding Scheme

Modified NRZ code immunizes record and playback systems against dc drift and bit slippage

Although the conventional nonreturn to zero (NRZ) code is the most efficient for recording digital data (if efficiency is measured by bits to unit length of tape ratio), it is subject to dc drift and bit slippage whenever long strings of 1s or 0s are encountered. Codes that insert check bits in the data to break up long strings alleviate this problem, but only at the expense of recording efficiency.

An improved code, called J-NRZ, gives 100% of NRZ efficiency yet also solves the dc drift problem. It does so by adding check bits in a specified format only when a long string is encountered. The rest of the data stream is encoded in standard NRZ format.

One such system is programmed to search for 32 consecutive identical bits. The playback system is able to handle up to 64 identical bits without drift, thus ensuring a 2:1 error margin.



J-NRZ digital encoder-decoder. J-NRZ replaces long strings of 1s and 0s in NRZ stream with preselected word, or its complement. Since most data are unaffected, bit overhead is kept low

As shown in the Figure, the system converts the input data into NRZ, and a clock is generated from the data. If the input is already NRZ with a clock, it is routed to the next stage.

A preselected 32-bit word is stored in P/ROM, RAM, or other word generator. The word is symmetrical, ie, the same when played back in the forward or the reverse direction, and it is balanced with an equal number of 1s and 0s.

The circuit includes a counter that runs off the clock and resets each time there is a data transition. If the counter reaches a predetermined number (32 in this system), it triggers the controller to shift either the stored word, for a string of all 1s, or its complement, for all 0s into the data stream.

A shift register accepts the NRZ data bits in a serial train and holds them while the monitor, controller, and storage/transfer systems have time to function. If the predetermined number of 1s or 0s has been detected, the word is parallel shifted out of storage and into the shift register to replace the long string. The register then resumes serial transfer of the data.

On playback, the coded data are routed to a dc restorer and bit synchronizer. The input J-NRZ is processed by a monitor and controller stage that initiates a shift of all 1s upon detection of the coded word or of all 0s for the code word complement. Upon command from the controller, the storage P/ROM or RAM shifts all 1s or 0s back into the shift register, restoring the data to their original form.

Note

This work was done by David E. O'Brien III of Johnson Space Center. No further documentation is available. (MSC-18267)

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States Government assumes any liability resulting from the use of the information contained in this document, or warrants that such use will be free from privately owned rights.

New high resolution graphics from the leader in low-cost color.

With our 8001G graphics terminal, ISC pioneered low resolution color graphics at black and white prices. Now we're able to offer the world's most cost effective high resolution capabilities – at prices that are true-to-ISC tradition.

Announcing the 8001H. It's based on the 48-line 19" intelligent display terminal that has revolutionized the process control industry. But the 8001H gives you the added advantages of high resolution capabilities, making it more than sufficient for all work required in process control and most other applications, including limited imaging.

The high resolution graphic hardware consists of 512 software programmable characters, each comprised of a 6 x 8 dot matrix with all 48 dots addressable by software. This translates into a 480 x 384 resolution for random vectors and symbols, resulting in a 6x improvement from the standard 8001G.

Three main modes of operation are available, including a special character mode, ISC standard plot mode, and the high resolution plot mode for drawing bar graphs, vectors and point plots. Eight brilliant communicative colors are at your disposal, to convey information quickly and accurately, with critical control over detail.

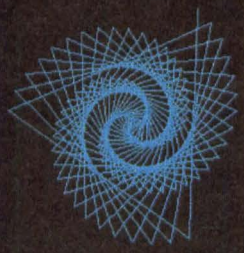
The 8001H has an 8080A microprocessor capable of handling data on a two megahertz processing cycle. It provides 2K of ROM, RS-232C interfacing capabilities, and flexible editing made still easier by a keyboard with color and numeric key clusters.

And its cost is nothing short of phenomenal.* $3695 is all you pay for a single unit;* $2695 each for 100 or more.

If you'd like to upgrade your present 8001G units to high resolution, hardware and software options are available for as little as $1500 per single unit; $1000 for 100 or more.

All Intecolor terminals are covered by a six month warranty, and cash with order guarantees delivery of a single evaluation unit at $2990 within 30 days, or your money back. If you need high resolution color, but have found the cost prohibitive, here's your opportunity. Now that Intecolor is perfectly capable of high resolution color, you can be, too. Call your ISC rep today.

Color Communicates Better



Unretouched photo of screen

*U.S. domestic prices.

ISC SALES REPRESENTATIVES: AL: 205/883-8660, **AZ**: 602/994-5400, **AR**: (TX) 214/661-9633, **CA**: Alhambra 213/281-2280, Goleta 805/964-8751, Irvine 714/557-4460, Los Angeles 213/476-1241, Los Altos 415/948-4563, San Diego 714/292-8525, **CO**: 303/779-0666, **CT**: 203/624-7800, **DE**: (PA) 215/542-9876, **DC**: (VA) 703/569-1502, **FL**: Ft. Lauderdale 305/776-4800, Melbourne 305/723-0766, Orlando 305/425-5505, Tallahassee 904/878-6642, **GA**: Atlanta 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**: (OH) 513/429-9040, **LA**: 504/626-9701, **ME**: (MA) 617/729-5770, **MD**: (VA) 703/569-1502, **MA**: 617/729-5770, **MI**: Brighton 313/227-7067, Grand Rapids 616/393-9839, **MN**: 612/822-2119, **MS**: (AL) 205/883-8660, **MO**: 816/765-3337, **MT**: (CO) 303/779-0666, **NB**: (MO) 816/765-3337, **NH**: (MA) 617/729-5770, **NJ**: (No.) 201/224-6911, (So.) 215/542-9876, **NV**: (AZ) 602/994-5400, **NM**: 505/292-1212, **NY**: Metro/LI (NJ) 201/224-6911, N. Syracuse 315/699-2651, Fairport 716/223-4490, Utica 315/732-1801, **NC**: 919/682-2389, **ND**: (MN) 612/822-2119, **OH**: Cleveland 216/398-0506, Dayton 513/429-9040, **OK**: (TX) 214/661-9633, **OR**: 503/620-5800, **PA**: (E) 412/922-5110, (W) 215/542-9876, **RI**: (MA) 617/729-5770, **SC**: 803/798-8070, **SD**: (MN) 612/882-2119, **TN**: 615/482-5761, **TX**: Dallas 214/661-9633, El Paso Area (Las Cruces,NM) 505/523-0601, Houston Only 713/780-2511, **UT**: 801/973-7969, **VT**: (MA) 617/729-5770, **VA**: 703/569-1502, **WA**: 206/455-9180, **WV**: (PA) 412/922-5110, **WI**: (IL) 312/564-5440, **WY**: (CO) 303/779-0666,

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 057-546-55, **UNITED KINGDOM**: Bournemouth 0202-293-115, **WEST GERMANY**: Koblenz (0261)-31025/6, **AUSTRALIA & NEW ZEALAND**: Auckland 814-9385, Canberra 58-1811, Chermside 59-6436, Melbourne 03-543-2077, Sydney 02-808-1444, Wellington 64-4585, **CANADA**: Dorval 514/636-9774, Ottawa 613/224-1391, Toronto 416/787-1208, Vancouver 604/684-8625, **CENTRAL AND 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**: (GA) 404-581-0284, **IRAN**: Tehran 891-148, **ISRAEL**: Tel Aviv 266-291, **KUWAIT**: Kuwait 438-180/1/2, **LEBANON**: Beirut 221731/260110, **SAUDI ARABIA**: Jeddah 27790, Ryadh 25083-39732.

For sales and service in other countries contact ISC headquarters in Norcross, GA., U.S.A.

Intelligent Systems Corp.· Intecolor Drive • Technology Park/Atlanta • Norcross, Georgia 30092 • Telephone 404/449-5961 • TWX 810-766-1581

CIRCLE 76 ON INQUIRY CARD

IMAGINE

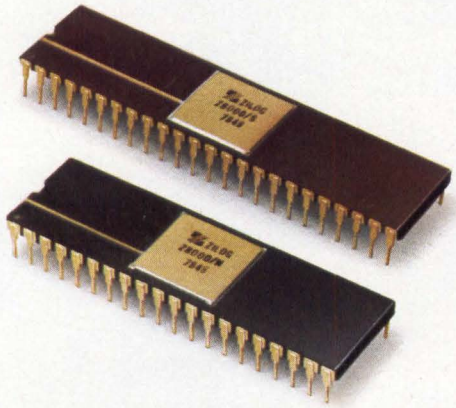
Zilog rockets out in front again to launch a new generation.

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.

A revolution in sophistication.

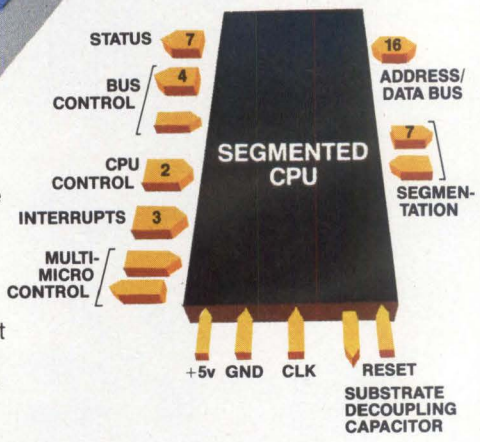
The Z8000 has been designed from the ground up with options to fit your application needs exactly. For the full 8 MB addressing capability, choose the 48 Pin DIP version. Its companion device, the Memory Management Unit, opens the way to dynamic relocation, memory protection and multi-tasking applications.

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.



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.

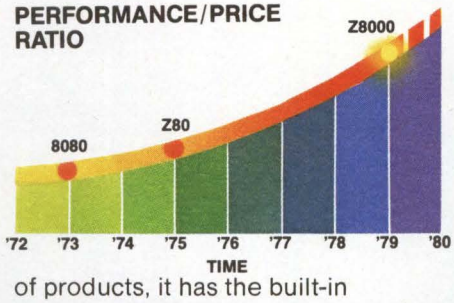
Wait 'till you meet the family.

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.

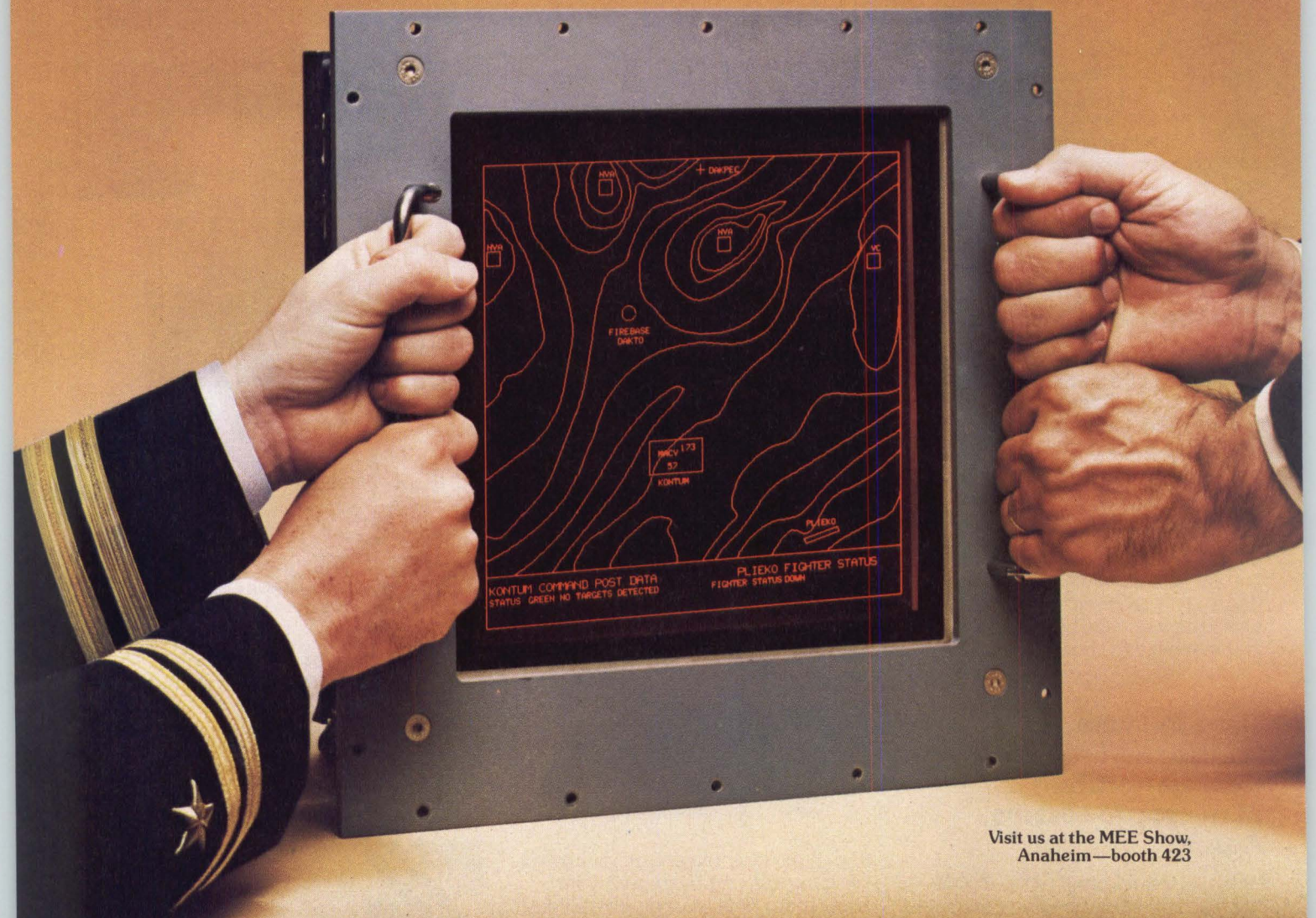
10460 Bubb Road, Cupertino, CA 95014
(408) 446-4666 TWX 910-338-7621
EASTERN REGION: (617) 667-2179
MIDWESTERN REGION: (312) 885-8080
SO. WESTERN REGION: (714) 549-2891
NO. WESTERN REGION: (408) 446-4666
EUROPE (ENGLAND): (0628) 36131/2/3
WEST GERMANY: (08106) 4035
JAPAN: 03-476-3010

An affiliate of EXXON ENTERPRISES INC.

Zilog

CIRCLE 49 ON INQUIRY CARD

Until today you couldn't get your hands on a plasma display without the terminal. Today you can.



Visit us at the MEE Show, Anaheim—booth 423

Introducing Interstate's PDA 300 Plasma Head. Tough, bright, with more than 10,000 hours of service life.

Now you have the flexibility to design in a rugged, long-life plasma display in tough system environments with Interstate's flat-panel PDA 300 Display Head. It displays alphanumerics/graphics, and is TTL compatible for easy interface. Inherent memory eliminates display refresh, and the unit is totally digital with no analog circuits. It has a thin profile and is designed to help meet your system RFI/EMI requirements. Optional equipment includes a touch panel, variable brightness control, rack mount, and remote-mounted power supply.

Today, for your best buy decision, consider how the PDA 300 designs into your display system. Deliverable Immediately.

For more information, call or write Don Poulos, Product Manager, Interstate Electronics, 1001 East Ball Road, P.O. Box 3117, Anaheim, CA 92803. (714) 635-7210.

CIRCLE 77 ON INQUIRY CARD

INTERSTATE ELECTRONICS CORPORATION

SUBSIDIARY OF ATO

Information Processing and Display. Systems. Products. Services.

MICRO DATA STACK
COMPUTERS, ELEMENTS, AND SYSTEMS

INTERFACING FUNDAMENTALS: 6800 I/O AND SYSTEM CONFIGURATION

Jonathan A. Titus and Christopher A. Titus
Tychon, Inc

Andrew C. Staugaard
Jamestown Community College

Peter R. Rony and David G. Larsen
Virginia Polytechnic Institute and State University

Hardware aspects of the 6800 microprocessor require discussion in order to balance and augment the previous coverage of the chip's internal organization and instruction set. Examination of the pinout in Fig 1 shows that this microprocessor requires a single 5-V power supply and two nonoverlapping signals, which are labeled as $\phi 1$ and $\phi 2$. The standard 6800 chip has a maximum clock frequency of 1 MHz; however, 1.5- and 2.0-MHz versions are available—the 68A00 and 68B00, respectively. The $\phi 1$ clock signal is used for internal instruction sequencing, whereas the $\phi 2$ signal serves as an input/output control line for timing and synchronizing the 6800 with input/output devices. The usual 16 address lines, A0 through A15, and eight bidirectional data lines, D0 through D7, are provided to make up the external address and data buses, respectively.

Control signals for read/write (R/W) operations between memory and the 6800 chip are provided by the valid memory address (VMA) and R/W control lines. The R/W line indicates the direction of data transfer, being at a logic 1 for read and at a logic 0 for write. The VMA line goes to a logic 1 whenever the microprocessor places a valid 16-bit memory address on the address bus.

Hardware interrupts are provided through the RESET, IRQ, and NMI pins on the 6800 chip. These are all vectored interrupts that directly access interrupt service routines at specific memory locations. The 16-bit addresses of these locations are contained in the memory

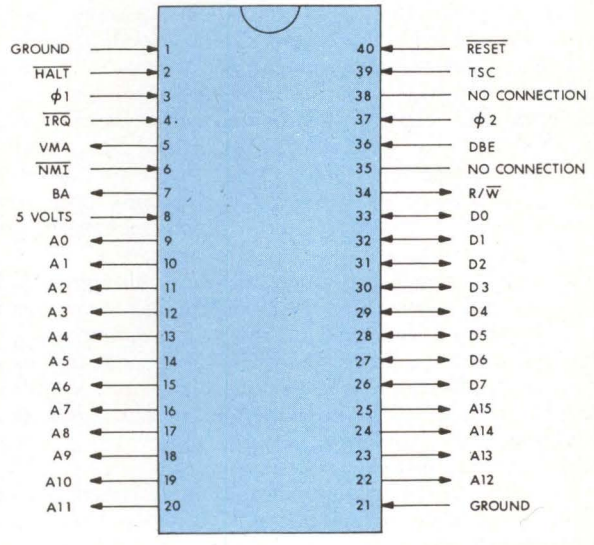


Fig 1 Pin assignments for 6800 chip. Motorola's 40-pin microprocessor—available in 1-, 1.5-, and 2.0-MHz versions—requires 5-V supply. Featured are two nonoverlapping signals, 16 address lines, and 8 bidirectional data lines

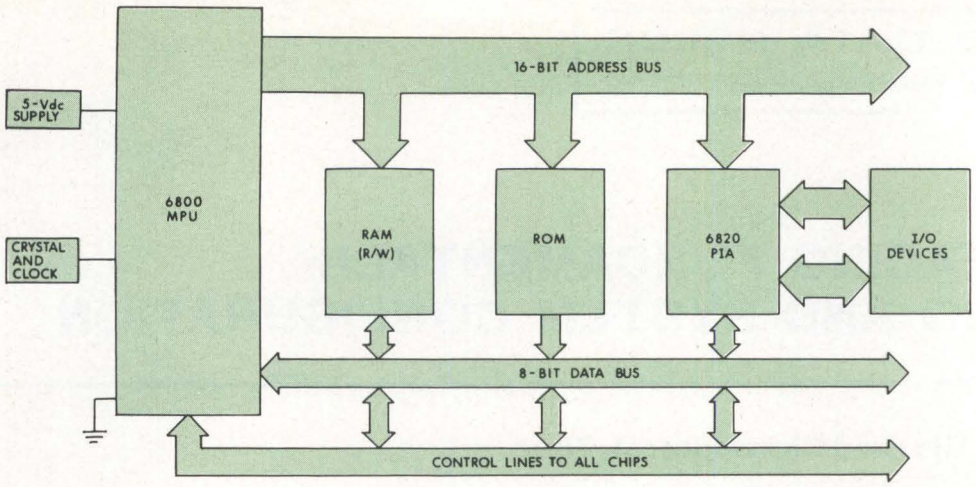


Fig 2 Microcomputer system configuration. Typical 6800 system which interfaces to I/O devices can handle majority of applications that are mainly aimed at small dedicated uses

region, FFF8H through FFFFH, where the letter H represents hexadecimal code. Three pairs of 2-byte addresses are stored in this region to facilitate the three different types of hardware interrupts. For example, $\overline{\text{RESET}}$ is used for system initialization and restart; the address for the routine is contained in locations FFFEH (high byte) and FFFFH (low byte). The $\overline{\text{IRQ}}$, or interrupt request, input is a maskable interrupt line that is ignored if the I flag bit in the internal condition code register is set. The address for the maskable interrupt routine is contained in locations FFF8H and FFF9H. Finally, the NMI, nonmaskable interrupt, input can never be masked out and is normally used for emergency interrupt situations. The address for the nonmaskable interrupt routine is contained in locations FFFCH and FFFDH. The microprocessor automatically stores its internal register contents on a stack in R/W memory when either the $\overline{\text{IRQ}}$ or $\overline{\text{NMI}}$ interrupts are acknowledged.

External bus control is provided with the bus control lines BA (bus available), DBE (data bus enable), and TSC (3-state control). These lines are normally used to effectively disconnect the microprocessor from the external bus system to allow direct memory access by external devices.

Fig 2 is a schematic diagram of a minimum 6800 system configuration. This type of configuration should accommodate at least 80% of the microcomputer applications since most microcomputers are used for small dedicated applications. The address bus contains address lines A0 through A15, the data bus contains data lines D0 through D7, and the control bus—which provides timing, synchronization, and supervision of data exchange between the microprocessor and external devices —normally contains $\phi 2$, VMA, R/$\overline{\text{W}}$, interrupt lines, and bus control signals.

Also shown in Fig 2 are R/W memory, read only memory (ROM), and the peripheral interface adapter (PIA). The PIA is a programmable input/output (I/O) chip that simplifies interfacing with the "outside world." It provides decoding, latching, and 3-state buffering for I/O devices such as switches, keyboards, displays, analog to digital (A-D) and digital to analog (D-A) converters.

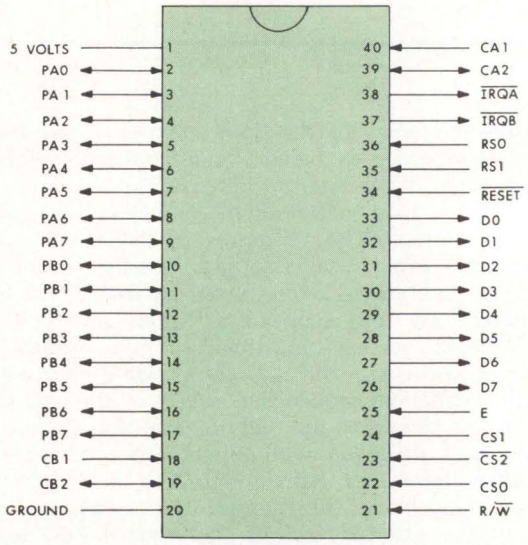


Fig 3 PIA pin assignments. Motorola's 6820 programmable PIA chip interfaces with peripherals. Functions performed are decoding, latching, and 3-state buffering. Ports A and B are both 8-bit I/O ports; CA and CB are two control lines for each port

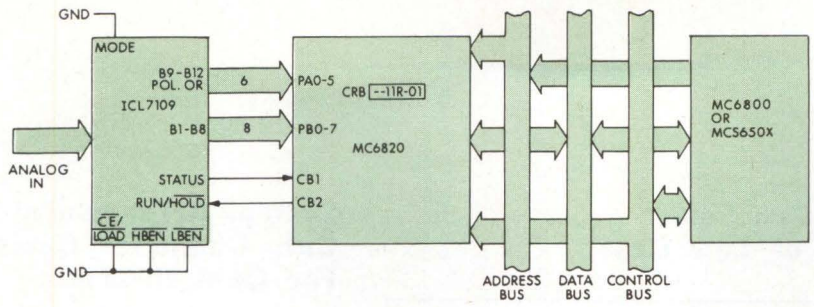


Fig 4 Interface to A-D converter. Microcomputer system is interfaced to 7109 A-D converter through 6820 chip. Both PIA ports are configured as input ports (Courtesy of Intersil, Inc)

The 6820 PIA contains two 8-bit I/O ports, called port A and port B. The eight bits within each port can be independently programmed as either input or output with the use of an associated internal data direction register (DDR) assigned to each port. For each port the PIA also has two control lines—CA and CB—that provide partial or complete handshaking capability. In the complete handshaking mode, one control, CA, is used as an interrupt input line and the other, CB, is used as an output strobe. The pin configuration for the 6820 PIA is shown in Fig 3.

Data communication between the microprocessor and an I/O device is provided through the use of the technique called memory mapped I/O. With memory mapped I/O, each I/O device is treated as a memory location or group of memory locations. No special input or output instructions are needed. For example, to send data to an I/O device, a store accumulator in memory (STA) instruction is executed; to read data from an I/O device, a load accumulator from memory (LDA) instruction is executed. Each port in the PIA chip in Fig 2 has a unique address assigned to it; to input or output data, memory R/W operations that address the proper port are executed.

Fig 4 demonstrates how the system in Fig 2 can be interfaced to an A-D converter. The A-D device used is the low cost Intersil 7109 12-bit A-D converter, which provides up to 30 conversions/s and can be operated in a direct or a complete handshaking mode. Given an analog input signal, the A-D converter provides 14 bits of data to the PIA: 12 data bits (B1 through B12) plus a polarity bit (POL) and an overrange bit (OR). The 12 data bits are divided into a low order data byte (B1 through B8) and a high order data byte (B9 through B12). The low order byte is connected to PIA port B lines PB0 through PB7; the high order byte, including POL and OR, is connected to port A lines PA0 through PA5. Therefore, both PIA ports are configured as input ports.

The PIA control line CB1 acts as an interrupt input and is programmed to generate an interrupt request to the 6800 on a high to low transition of the A-D converter's STATUS pin. Control line CB2 is programmed as an output line and is connected to the A-D converter via the RUN/HOLD pin. If CB2 is held high, the A-D converter is permitted to provide continuous conversions by interrupting the 6800 via the CB1 line as soon as each conversion becomes available; this is the RUN mode of operation. The A-D converter contains an output latch so that data will not be lost before the microprocessor acknowledges the interrupt. If CB2 is held low, the conversion process can be halted. When desired, a conversion can be initiated by strobing the A-D converter with a pulse from the CB2 line. Similar considerations for the newer Motorola microcomputer chips will be examined, commencing with the MC6802 and MC6808.

This article is based, with permission, on a column appearing in *American Laboratory* magazine.

ROLLS & TAPES for every business need

. . . THE BEST FOR MODERN DATA PROCESSING EQUIPMENT

PAPER TAPE — 7 Colors plus Black Opaque; Printed Top/Arrow; Oiled and Unoiled Rolls: **FOLDED TAPES** — For specialized applications.

THERMAL PAPER — Rolls and Folded. Marginally punched and cross perforated for all types of printers and calculators.

MYLAR TAPE — Paper/Mylar Laminations; Foil/Mylar Laminations; Metalized Mylar.

FOLDED LISTER PAPERS — For Digital Print-out Units.

TELETYPE ROLLS: Single copy; Multi-copy Carbon inter-leaved and Carbonless Friction Feed Sprocket feed.

CONTINUOUS TELETYPE FORMS: 8½" x 11" Carbon inter-leaved 1 through 6 part; Carbonless 1 through 6 part (NCR).

esco

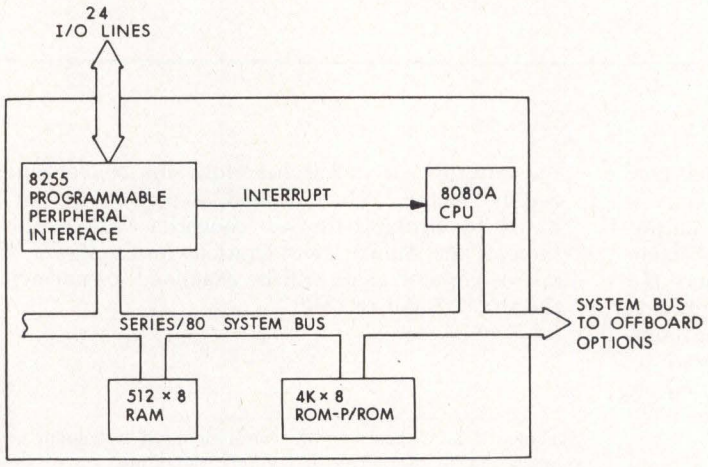
Send for Brochure

Branch Office
Mt. Laurel, N.J. 08054
609 234-1276

Branch Office and Warehouse
Northfield, Ill. 60093
312 446-8780

EASTERN SPECIALTIES COMPANY, INC.
P. O. Box 350, Holyoke, Ma. 01040, Tel: 413 533-7103

Board Level Microcomputer Can Solve Dedicated Control Problems at Low Cost



Single-board configuration of National Semiconductor's BLC-80/07 packs power of 8080A CPU, 512 bytes of RAM, and optional ROM, plus Series/80 system bus for addition of options to further expand its capabilities

Dedicated control and processing applications are handled by the BLC-80/07 single-board computer that offers the computing power of a BLC-80/10 at a lower cost of $365. Based on the 8080A microprocessor, the MULTIBUS™ compatible computer can use BLC/SBC Series/80 hardware and software products. Expansion at a reasonable incremental cost is possible with the addition of such modules as a 4-slot chassis, power supply, RAM and ROM in combinations up to 64k bytes, various I/O controllers, and digital and analog I/O. National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95051, burns in all boards at 55 °C for 8 h.

System components are the 8080A CPU, 512 bytes of static RAM, sockets for up to 4k bytes of P/ROM, 24 parallel I/O lines, and a system clock. The TTL compatible I/O lines are controlled by an INS8255 programmable peripheral interface circuit. The lines configure to various unidirectional/bidirectional modes. Compatible I/O terminator modules are a 220/330-Ω divider and a 1-kΩ pullup. The variety of driver circuit types for this I/O section are inverting, noninverting, high voltage, and open collector combinations with sink current capacity ranging from 16 to 48 mA. The computer addresses 64k bytes of memory and has an access time of less than 500 ns.

The CPU's single-level interrupt for recognition of events may originate from four sources OR-tied to the single level. When an interrupt is received, an in-process instruction is completed and the program is then suspended. The CPU passes control to a user defined interrupt service routine which saves system conditions while the interrupt is processed.

Addressing modes are direct, register, register indirect, and immediate. There are 111 instruction types, six 8-bit general purpose registers, an 8-bit accumulator, 16-bit program counter, and 16-bit stack pointer. A subroutine mechanism uses the stack pointer with push and pop instruction to implement call and return instruction types. All address, data, and control signals are Tri-State™ TTL compatible.

System Arrangement Cuts Computer Costs For OEM Houses

The Semi-System concept of OEM computer systems was conceived by General Robotics Corp, 57 N Main St, Hartford, WI 53027, as a practical means of saving money. The OEM buys the system without the LSI-11 processor and disc drives installed; these are then purchased directly from Digital Equipment Corp and a disc drive manufacturer, eliminating the cost markup that a full system supplier would add.

Assembly of the whole system is easy. The LSI-11 PC module plugs into the backplane, and cables are plugged into the disc drive. Floppy disc drives are mounted with two bolts, and a cartridge disc drive is mounted in a rackmount cabinet.

The first floppy disc configuration is based on the company's GEMINI package with space for two floppy disc drives to be packaged in a 10.5″ (26.7-cm) high rackmount or desktop box. It is complete with power supplies and fans, backplane and card cage, 64k bytes of RAM, hardware bootstrap, line frequency clock, and serial RS-232 port; the other configurations all contain these same features. A floppy disc controller handles either single- or double-sided double-density floppy discs using GCR techniques and storing up to 2.5M bytes. Shugart, Qume, and CDC are among the compatible drives. Price is $4200 for quantity 50.

Based on the TRISTAR, the second floppy disc configuration can handle up to three floppies mounted in a separate box provided with the system. The controller is contained in a separate 5.25″ (13.34-cm) rackmount or desktop box. The quantity 50 price is $4900.

A hard disc system is similar, with a controller in a 5.25″ (13.34-cm) package. Standard cartridge type drives that interface the LSI-11 Q-Bus include Pertec, CDC, EM&M, Western Dynex, and Diablo. The cost is $4200 (quantity 50). Storage module drives, configured the same as this system, are $4900 in quantity 50. It interfaces with most standard drives which have an SMD interface.

Circle 410 on Inquiry Card

HP's computer-controlled logic analyzers...they love the jobs you hate.

Now you can give those tedious development tasks to an HP computer-controlled logic analyzer and free yourself for the challenges of problem solving.

In interactive situations, a desktop computer can simplify analysis and extend a logic analyzer's capabilities. In routine or repetitive measurements, the computer can control and monitor analyzer operation while you work elsewhere.

Interfacing one of HP's logic analyzers to an HP desktop computer is simple via the HP-IB*, and programs are easier to write for most development applications. Your small up-front investment in time will be paid back over and over again with time saved in data reduction, documentation, analysis and monitoring. For example:

Data reduction. Now you can have a desktop computer process analyzer data and display results on the analyzer CRT. Store your microprocessor's instruction set, for example, and display mnemonics beside op codes on the analyzer data listing.

Documentation. Couple an HP logic analyzer to an HP-IB compatible printer and you can save hours documenting analyzer listings and setups. With HP's 1615A Logic Analyzer and 7245A Plotter/Printer, you can obtain timing displays (including glitch information) in hard copy for lab notebooks. In many applications the HP-IB "talk only" mode lets you do this without a computer.

Babysitting. Now the computer can watch for intermittent problems while you concentrate on system solutions. The computer/analyzer combination can take "snapshots" of program flow, make comparisons with stored data, then stop a program, restart a test or reprogram itself to gather different data.

Characterization. Repetitive measurements are a natural for these systems. Applications include determining failure rates for component evaluation or to establish field maintenance schedules. Or plotting execution times as a function of data values. And because the analyzer and computer are external to the system under test, you can characterize it in its true operating mode.

Four analyzer choices. Combine an HP desktop computer with the 1602A Logic State Analyzer ($2100**) for low cost systems. A 1610A Logic State Analyzer ($11,800**) is ideal for tailoring to your microprocessor based system applications. For synchronous/asynchronous interaction problems the 1615A Logic Analyzer ($7200**) is your choice. And for computer networks, select the 1640A Serial Data Analyzer ($6275**).

Your local HP field engineer can help eliminate those jobs you hate. Call him for details today.

* HP's implementation of IEEE 488-1975
** Domestic U.S.A. price only with HP-IB option

089/6

HEWLETT hp PACKARD

1507 Page Mill Road, Palo Alto, California 94304

For assistance call your nearest regional office: Eastern: (301) 258-2000; Midwestern: (312) 255-9800; Southern: (404) 955-1500; Western: (213) 877-1282.

CIRCLE 79 ON INQUIRY CARD

Essential Small Business Computer Elements Are Reduced To Three Cards

The minimum configuration electronic package of the model 770 consists of a CPU/video board, memory combination board, and I/O board—all 7 x 12″ (18 x 30 cm)—in a 7-slot card cage with power supply and system cables. Psytek Computer Systems, 1900 Pickwick Ave, Glenview, IL 60025, has disregarded general purpose features and has instead included only the basic elements of concern to small business computer manufacturers and users. Physical compatibility with Intel's MULTIBUS™ structure permits expansion with peripheral cards that use this format.

The standard system comes with 48k characters of internal memory and with system diagnostics and load procedures resident in P/ROM. Two IBM compatible full-size floppy discs store 0.5M characters. These can expand to 294k characters internally and 35M characters externally. The 12″ (30-cm) video monitor delivers 30 lines of 80 upper/lower case characters. A detachable keyboard also contains a separate numeric pad. Several printers can be attached to the parallel interface.

The CPU/video board contains a Z80A microprocessor, bus control electronics, and video system with 4k bytes of memory for the CRT display and the CPU's scratchpad. The 48k bytes of RAM and 4k bytes of ROM are on the memory board which allows 16 banks of 16k-byte RAM to be used in the system. The first of these banks is on this card; other banks are added with an optional PC card.

The final board interfaces the computer with up to four floppy drives, one keyboard, and one printer. Programmable tone generator and system control logic allow implementation of the computer's front panel on the system keyboard. Optional boards are a serial/parallel I/O board, a graphics display board for B/W and color graphics, and extended memory boards with four switchable 16k-byte banks of RAM.

System software includes extended BASIC, text editor, Z80 assembler, program debugger, I/O and utility routines, and a disc operating system with sequential and random files, all of which run under the company's Supervisor. This allows the modules to interact efficiently. Software business applications are available. The system supports CP/M™; thus, users have a choice among several BASICS, FORTRAN IV, COBOL, PASCAL, and APL.

Circle 411 on Inquiry Card

Desktop Computer Options Add Communications and Storage Capabilities

A dual diskette drive and two communications packages are major additions that Durango Systems Inc, 10101 Bubb Rd, Cupertino, CA 95014, is offering as options to the portable F-85 computer (see *Computer Design*, Dec 78, p 132). Model 8705 auxiliary drive option adds two 5.25″ (13-cm) 473k-byte diskettes to extend the basic system's online storage to four drives totaling approximately 2M characters. It enables separate device oriented files and reduces diskette manipulation during processing. Housed in an 8.55 x 7.75 x 13.25″ (21.72 x 19.69 x 33.66-cm) self-contained enclosure with power supply, the $3085 unit connects to the computer via a single logic cable through an existing back connector. Drives, assigned physical addresses 2 and 3, operate in the same manner as integral drives 0 and 1.

Communications options transmit and receive data from remote computer systems. Both packages consist of a hardware and software module. The 8535 asynchronous package works over switched telephone network or private point-to-point lines. It supports features used by other computer manufacturers when operating in ASCII asynchronous serial bit mode. Included are batch, interactive, or combined modes; switched or private line operation; several full- or half-duplex protocols; error logging; and a horizontal tabbing facility. Transmission rates are from 50 to 9600 baud. The software provides data routing to a printer, video screen, or mass storage.

Using binary synchronous communications procedures, the 8535 package emulates the protocol used by IBM 2780 and 3780 data communications terminals. The emulator operates under control of the DX-85 operating system in batch mode. On transmission to the F-85, all data are transferred from a named mass storage file while received data can be routed to the printer, video screen, or mass storage. Operation is in either point-to-point or multipoint mode. The protocol also includes block checking and automatic retransmission. Rates range from 2000 to 9600 baud.

Both packages contain command sets for specification of various line parameters and operating states. Prices are $625 and $1275, respectively. A $115 security lock provides controlled access to the computer through a keylock switch on the keyboard. Three positions are disable, enable, and supervisory. A random access fixed disc drive with a storage capacity of 12M bytes is planned for the fourth quarter of 1979.

Circle 412 on Inquiry Card

Storage Ranges From 250k to 1.2M Bytes With S-100 Floppy Discs

S-100 systems running at 2, 4, or 5 MHz can accept any of three 8″ (20-cm) full-sized floppy disc subsystems. Drives are mounted in single or dual cabinets with self-contained power supply, detachable line cord, and detachable 50-conductor signal cable. Also included are the Disk/ATE operating system and the BASIC-V advanced BASIC language interpreter with virtual memory addressing.

The single-density DISCUS I™ system holds 250k bytes of data, using IBM soft-sectored format, as do the other two systems. It uses the Disk Jockey I™ single-density controller which has 0.5k of ROM with disc utility subroutines, 256 bytes of RAM, and a software drive serial I/O port.

Quad-density DISCUS 2+2™ uses double-sided floppy disc drives to store 1.2M bytes of data. DISCUS 2D™ is a double-density floppy disc system with a capacity of 600k bytes; it uses a single-sided drive.

Thinker Toys, 5221 Central Ave, Richmond, CA 94804, has developed the Disk Jockey 2D™ controller for both of these systems. It features a serial I/O port with a UART and programmable baud rate generator, 1k of RAM, and 1k of ROM which executes such disc functions as read sector, write sector, and bootstrap. Jump start logic automatically loads standalone systems on power-up.

Circle 413 on Inquiry Card

Thinking Computers?

Think of the Possibilities–A Complete Computer for $1485*

All You Add Is The Terminal, Printer, And Applications Software — And You've Got A Complete System!

The HORIZON® is a complete computer—Z80,® 32K RAM, Disk and I/O—priced so that the only limit to application in your system is your imagination! And, the HORIZON is packaged in a natural wood cover, adding sales appeal to your system! Think of the possibilities if you're designing a system for education, small business, process control, word processing, engineering, or whatever is on your mind.

Over 15,000 North Star Systems In Use!

We offer you the maturity and reliability to meet the needs of demanding, high-volume applications. HORIZON performance and reliability are assured through the use of the proven Z80A microprocessor and industry standard 5¼" 180K and 360K byte disk drives. Our professional approach to design (for example, memory parity) has been proven in thousands of installations.

Complete Software Support: DOS, BASIC, and MONITOR!

We provide you with the tools (bundled system software) for writing the application programs that will make your system work! Our BASIC is a full extended disk BASIC! Hundreds of commercial software application packages have been developed using North Star BASIC.

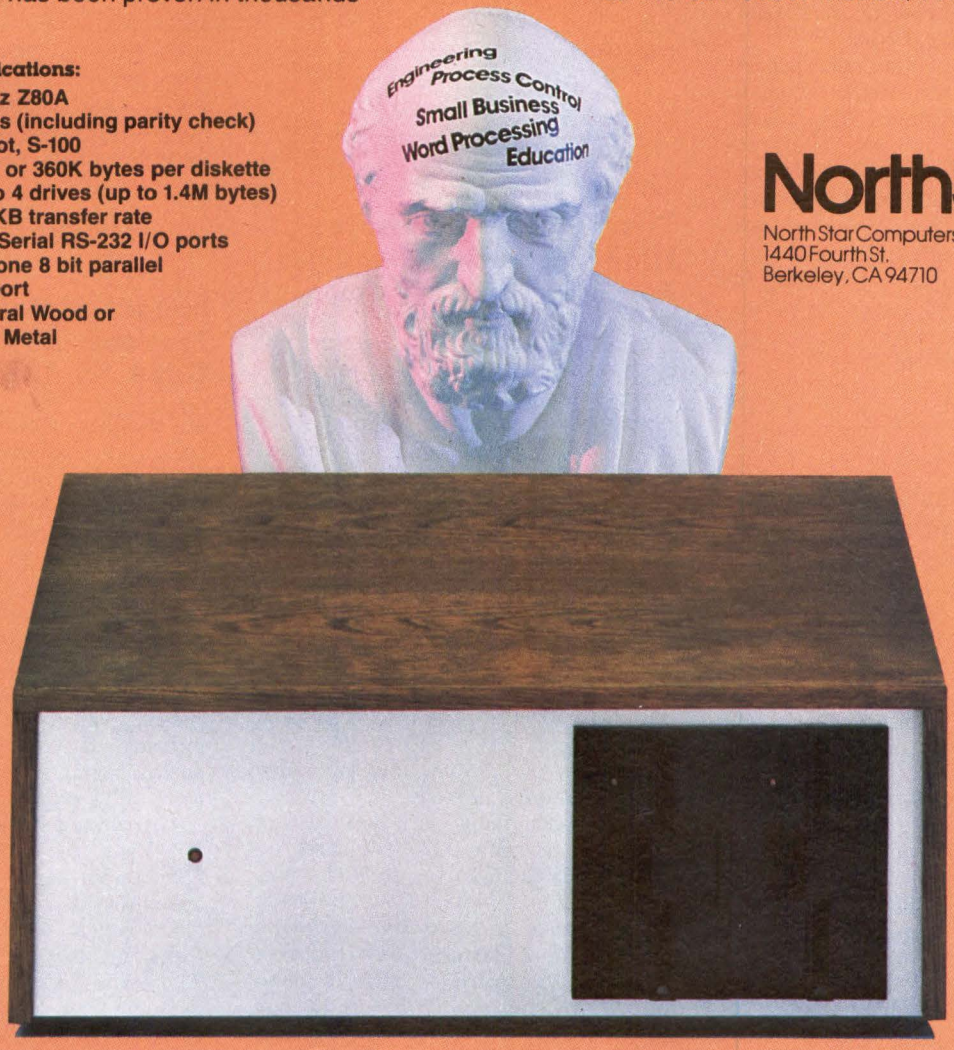
Expand Your Horizon!

The HORIZON can be expanded to 56K bytes or more of RAM, four double density or quad capacity (two-sided) mini disk drives and 18M byte hard disk. Performance can be enhanced by the addition of the North Star hardware floating point board. Also, S-100 bus products from other manufacturers may be used to expand the HORIZON.

For complete information call Bernard Silverman at 415-527-6950. TELEX/TWX 910-366-7001.

North Star Specifications:

CPU:	4 Mhz Z80A
RAM:	200ns (including parity check)
Bus:	12 slot, S-100
Disk:	180K or 360K bytes per diskette
Controller:	Up to 4 drives (up to 1.4M bytes) 250 KB transfer rate
I/O:	Two Serial RS-232 I/O ports and one 8 bit parallel I/O port
Cover:	Natural Wood or Blue Metal



NorthStar

North Star Computers Inc.
1440 Fourth St.
Berkeley, CA 94710

Z80® is a registered trademark of ZILOG Corporation.

*32K byte RAM and one 180K byte double density drive system in OEM quantities of 100 or more.

CIRCLE 81 ON INQUIRY CARD

Faster Execution of Instructions Enhances 6800 Microprocessor

Using a 2.5-MHz clock, S68H00 executes one data access instruction/two clock cycles, obtaining a processing speed that is claimed to be 2½ times that of the standard 6800. High speed processing in instruments and numerical controllers can be performed more efficiently. American Microsystems, Inc, 3800 Homestead Rd, Santa Clara, CA 95051, is supporting the processor with the newly introduced S68H21 peripheral interface adapter which has a 2.5-MHz speed. This enables configuration of a high speed microcomputer using two of the company's S2114 1k x 4 RAMs and an S4216B 2k x 8 ROM.

Other aspects of the microprocessor are identical to earlier versions. Available in ceramic and plastic packages, it uses 8-bit parallel processing, has an 8-bit bidirectional data bus, 16-bit address bus, and a 72-instruction set with seven addressing modes. Execution is from two 400-ns machine cycles for most instructions up to 12 cycles for a software interrupt.

Circle 414 on Inquiry Card

Slave Processor Aids Systems Requiring Distributed Power

The intelligent, Z80 based 1861A peripheral controller has up to 16k of memory and can address all the memory and I/O in the Flexibus II system to which it is added. Its four independent serial channels are configured by onboard jumpers to synchronous or asynchronous operation with internal or external clocks. Independent single-channel communications adapters provide full signal flexibility and modem control for each channel. These serve to interface standard TTL signals, output from the processor to 20-mA/PCS party lines, EIA RS-232-C, -422, or -423 interface signals. Internal clock rates are program selected. Data rates up to 500k bits/s are possible.

Communications channels are hardware compatible with such industry communications protocols as async, BSC, SDLC, HDLC, ADCAP, and Canadian, U.S., and European virtual telecommunication networks. Thus, the system can control subsystems from several manufacturers.

A multiprocessor debug tool has been announced simultaneously by Process Computer Systems Inc, 750 N Maple Rd, Saline, MI 48176. The accessory for the controller allows simultaneous debugging of multiple CPUs. Any memory locations in a designated processor can be examined and altered synchronously or independently. Breakpoints are set, cleared, or coordinated from either the local or development system console.

Circle 415 on Inquiry Card

Two Boards Generate High Resolution Graphics For MULTIBUS Systems

The RG-SBC-VGI vector generator and RG-SBC-MI refresh memory form the RG-SBC configurable graphics generator to produce a composite TV signal for display on a standard 525-line (625 optional) TV, used in conjunction with Intel MULTIBUS™ systems. Up to eight refresh memory boards combine with one vector generator to give graphics in black and white, color, or up to 16 shades of gray. Three refresh memory boards are required for red, green, and blue outputs for color monitors that accept TTL level RGB inputs. Resolution ranges from 320 x 240 to 640 (H) x 480 (V). Complex displays may be programmed in BASIC.

The instruction set that Raster Graphics, PO Box 23334, Tigard, OR 97223, has included controls the vector generator which automatically starts, issues a busy signal to the status port, and stops when the vector is written into the refresh memory. Instruction ports reside in one page of user selected I/O address space. Hardware performs the task of creating the vector, writing it into refresh memory, and producing the TV signal, all transparent to the user. Chaining vectors together creates symbols, shapes, and patterns.

Single-refresh memory configurations are used with static display formats that are updated infrequently, or where higher resolution is required, using all the available memory. Dual-refresh memories are necessary for complex moving displays in order to eliminate objectionable R/W interference that occurs when data are written or read from the same memory. Users may display data from either refresh memory by issuing the switch command. Previously displayed data may be optionally erased or retained when memories are switched, thus providing stored and nonstored modes of operation. Single-refresh configurations need one stored and one nonstored mode; dual-refresh configurations require two of each mode.

Circle 416 on Inquiry Card

Impact Matrix Printer Produces μComputer Hard Copy at 132 Char/s

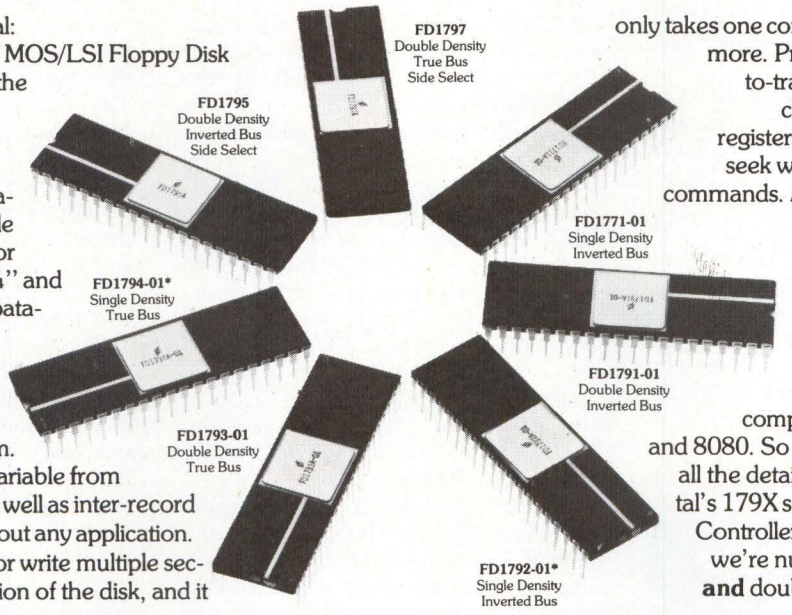
A stepper motor driven integral tractor mechanism with precision incremental paper motion and forms width and thickness adjustments, continuous loop ribbon with reinking roller for 3M- to 5M-character life, and only two moving parts to drive the printhead and drive motors are mechanical features of the model 801 that assure high quality for microcomputers such as Radio Shack's TRS-80, the Apple II, and the Compucolor. It connects via either an RS-232 serial interface or Centronics compatible parallel interface.

Distributed by Vitek, 1160 Barbara Dr, Vista, CA 92083, the unit prints 132 upper and lower case characters/s, 80 columns wide, on up to five copies of standard computer forms up to 9.875" (25 cm) wide. The standard set consists of 96 ASCII characters. A 127-character line buffer is standard. The printer produces a 7 x 7 dot matrix.

Circle 417 on Inquiry Card

The only complete family of floppy disk controllers

From Western Digital: a complete family of MOS/LSI Floppy Disk Controllers to meet the demand of double-density head-on. Introducing the 179X. A new generation of Single/Double density controllers for use with both the 5¼" and 8" drives. Full compatability with the IBM 3740 and System 34 formats is standard. Need more storage? No problem. Sector lengths are variable from 128 to 1024 bytes as well as inter-record gap sizes to fit just about any application. You can even read or write multiple sectors within 1 revolution of the disk, and it only takes one command. But there's more. Programmable track-to-track access time, on-chip track and sector registers, and an automatic seek with verify on all step commands. A simple 8-bit interface allows your microprocessor to access eleven powerful macro commands. True Bus versions are compatible with the Z80 and 8080. So join the family. Get all the details on Western Digital's 179X series of Floppy Disk Controller chips, and see why we're number one in single **and** double density designs.



***Compatible with FD1791 and FD1793**

Single and double density compatible

WESTERN DIGITAL
CORPORATION

REGIONAL OFFICES:

Northwestern
Burlingame, CA
(415) 344-1165

North Central
Chicago, IL
(312)635-6069

Northeastern
Marblehead, MA
(617) 631-6466

European
London, England
01-542-1035

Southwestern
Newport Beach, CA
(714) 851-1221

South Central
Dallas, TX
(214) 386-9450

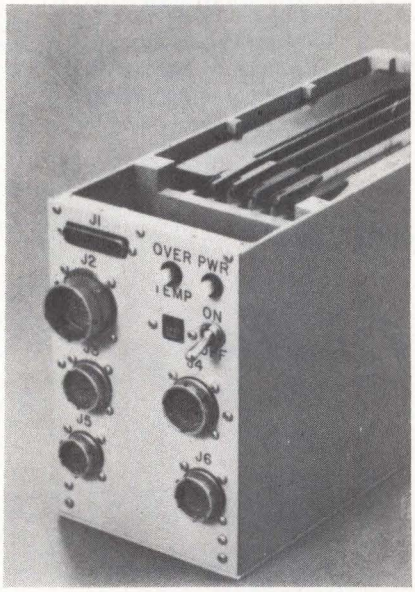
Southeastern
Marblehead, MA
(617) 631-6466

CORPORATE OFFICE:
Newport Beach, CA
(714) 557-3550
TWX 910-595-1139

Support Modules Erect Severe Environment Microcomputer System

A building block approach to designing a custom microcomputer system for industrial, military, and other severe environment applications simplifies the task and cuts development costs. The base of the SECS 80 system is the SECS 80/10A, a ruggedized version of Intel's iSBC™ 80/10A single-board microcomputer (see *Computer Design*, Jan 79, pp 146, 148). Support modules offer a choice of I/O expansion board, RAM, P/ROM, EPROM, digital tape recorder and controller, high speed arithmetic unit, A-D converter, power supplies, and chassis.

All modules are mounted on standard 9 x 6″ (23 x 15-cm) full-ATR compatible PC cards. A half-ATR chassis with side ventilation houses either six cards or four cards and a power supply (28-Vdc or 115/220-Vac versions). Meeting MIL-E-5400, -16400, and -4158 requirements, the cards use NAFI style fork and blade connectors which withstand vibration levels as high as 20 g without intermittent connection. Each is uniquely keyed and may be blind mated.



Ruggedized module boards for harsh applications include I/O, memory, tape recorder and controller, arithmetic, and ADC that fit into EMM/SESCO's chassis with SECS 80/10A CPU card to form SECS 80 system

Integral heatsink and stiffening bars offer structural strength and thermal conduction efficiency. All microcircuits have been processed to MIL-STD-883 Level B. Operating temperature is −55 to 85 °C.

The 80/116 single-board RAM has 4k x 1 static devices, resulting in a 16k x 8-bit capacity. Starting address for 16k contiguous addresses is jumper selectable. R/W data buffers are included, and all data, address, and command signals on the bus are TTL compatible. Cycle time is 450 ns and access time is 385 ns.

The EPROM-P/ROM offers optional versions of 2k, 4k, 8k, 16k, and 32k. Addresses are jumper selectable for each 8k block. Programming is handled under software control from the SECS 80 bus. Both types of memory expansion are through direct SECS 80 bus interface.

The interface between the MIL-STD-1553 bus structure and that of the SECS 80 bus is handled by the 80/1553 bus interface. A microprogrammed controller, ALU and associated registers, control file, SECS 80 port, and two independent 1553 bus ports comprise the first section of the card. The second part is a memory port which allows the interface to appear as an I/O port with independent DMA capability. The final section contains two 1553 bus interfaces each consisting of an 8-bit shift register, Manchester encoder/decoder, and transmitter/receiver. The interface acts as a remote terminal or as a bus controller.

Up to four SETS-1 tape recorder units are directly interfaced and controlled by the TC1. It provides Manchester data encoding and decoding, preamble and postamble, and CRC generation and checking. Data transfer rate is 48k bits/s using phase encoding. EMM/SESCO, 20630 Plummer St, Chatsworth, CA 91311, has also included three 16-bit registers for command status and I/O register data.

Three other modules round out the system. The 519 programmable I/O expansion board has 72 programmable I/O lines with jumper selectable I/O port address and interval timer. Intel's 8259 programmable interrupt controller (PIC) provides vectoring for eight interrupt levels.

Algebraic, trigonometric, inverse trig, and logarithmic functions are provided by the AU1 board, with single-precision (16-bit) fixed point format, double-precision (32-bit) fixed point format, or 32-bit floating point format. A 16-bit counter monitors the Advanced Micro Devices AM9511 arithmetic processing unit. An option generates system interrupts 4, 5, 6, or 7 at the end of an operation.

Last, the A-D converter, a complete analog I/O subsystem, provides 16 single-ended input channels in its data acquisition section, along with sample/hold, programmable gain, and instrumentation amplifiers, and a 12-bit ADC. Analog output capability is possible with two optional 12-bit DACs and two optional 4- to 20-mA current outputs.

Circle 418 on Inquiry Card

Microcomputer Speaks With Help of Peripheral Card and Software

Verbal operator prompting or warnings are an added dimension to computer programs, made possible with the SuperTalker peripheral system. The card from Mountain Hardware, Inc, 300 Harvey W Blvd, Santa Cruz, CA 95060, plugs into the peripheral slot on the Apple II microcomputer to output high quality human speech through a loud speaker (or a PA or stereo system) under program control. It is particularly useful in control or monitoring applications.

The board's electronic circuits convert the analog microphone signals into a digital pattern that is stored in RAM; these stored speech data are manipulated like any other stored data. The board also accepts the digital patterns and transforms them back into audible signals through the loudspeaker.

The SuperTalker disc operating system allows output of human speech under program control with direct I/O routines. It also provides a preparation program for creation of voice files on diskette. The BASIC routines require only 1-line statements to output a word or phrase; the routines also support cassette storage.

Specifically, the operating system and editor package—VPS (Vocal Preparation System)—allows the user to develop a phrase diskette which may contain many tables of phrases (the basic data element accessible by the peripheral). Each table can contain several words, phrases, or whole sentences. Up to 47 phrase tables can be held on each diskette; 454 sectors on the diskette are available for the phrase tables.

The VPS is structured with three main levels. The main command level

Why is the DigiTec 3000 already the most popular data acquisition system in the world?

PROVEN PERFORMANCE

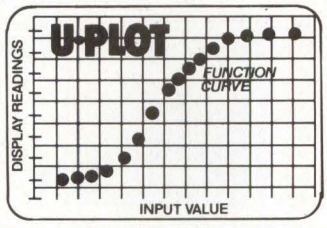
DELIVERY NOW

most powerful & easiest to use

The Datalogger 3000 puts more power in your hands than any other datalogger.

MORE DATA ACQUISITION. The 3000 handles the widest variety of inputs: ac and dc voltages, ac and dc currents, resistances, *all* thermocouples, RTD's, thermistors, digital and contact closures – *all standard.*

MORE COMPUTATION. The 3000 opens up the power of mathematical computation. It can determine an Average, Difference, Deviation from a Mean, extract Square-Roots and more. You can easily convert to engineering units with 30 programmable offset and scale factors. That's 900 different m x + b equations. Two unique tables feature the exclusive "U-PLOT" function (User-Programmable Linearization Tables). This powerful feature provides linearization for any transducer or transmitter.



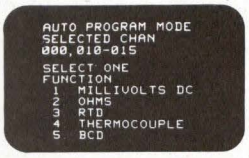
MORE DECISIONS. The 3000 offers 100 programmable setpoints for alarm detection. You can assign up to 4 different limits, with priority levels, to each channel for "High," "Low," or "Equal to" decisions. You can Alarm on rate of change or alarm transition. Ten *standard* Alarm Relays provide outputs for annunciation and control. And, only DigiTec Dataloggers visually spell out alarm messages on a built-in CRT.

Behind all these standard features is 32K of memory. That's enough power to support a system of up to 1000 points.

The Datalogger 3000 . . . more powerful than any other datalogger.

The Datalogger 3000 is as easy to use as it is powerful. All communication is in everyday English. We spent man-years developing programming innovations so you can program your system in minutes.

PROGRAM PROMPTING. A built-in CRT display provides prompting to guide you through each step of your program. The Datalogger asks you simple questions in plain English and supplies multiple-choice answers. This interactive prompting assures quick and accurate program entry. Programming is further simplified by utilization of conventional data acquisition terms, no need for complex, computer languages.



CASSETTE LIBRARY. Once your program requirements have been defined, they can be saved on the built-in cassette. This lets you create a library of application tapes. Simply drop in a cassette and the Datalogger will completely program itself. Changing programs, therefore, is as easy as changing cassettes. The same cassette deck can be used to record measured data for future reference.

COMPLETE COMMUNICATION. The built-in CRT provides more information than possible with conventional datalogger displays. You can see 10 channels of system information at a single glance. For hard copy, *a standard,* built-in alphanumeric printer quietly records data. To communicate with peripheral devices, the 3000 offers the widest variety of interfaces. ASCII outputs, both serial and parallel, relay outputs, external condition input, and composite video output are all *standard.*

The Datalogger 3000 . . . easier to use than any other datalogger.

For a free brochure or "hands-on" demonstration, just call collect, (513) 254-6251

See us at ISA '79
Booth No. 916

DigiTec. UNITED SYSTEMS CORPORATION

918 Woodley Road, Dayton, Ohio 45403
(513) 254-6251, TWX (810) 459-1728

Information Only Circle 80

Demonstration Only Circle 83

affects whole phrase tables. At this first level, the user enters the configuration and confirmation mode, verifying the number of disc drives, the slots in which the controllers are located, and the drive numbers. Commands are included to delete, edit, initialize, list, and output phrases.

The second level is the Edit Command level, entered from the first level. Basically the same as the main level, these commands affect only one phrase table and those phrases within it. The bottom level—voice creation—is entered from the previous level. The user types a character string (up to 40 characters long) and then records the vocal phrases for the current phrase table.

In addition to software control of record and playback modes, the user may select the digitizing rate—512, 1024, 2048, and 4096 bytes/s of speech—and the playback volume—four software selectable levels. The higher the digitizing rate, the better the quality; the most useful rates are 2k and 4k/s. Frequency response is filtered to 300- to 3000-Hz human voice range for clarity.

The $279 peripheral consists of the card, microphone, loudspeaker, software, and two ready to run programs—Accent, a talking language translator, and Talking Color Math. A 50-s realtime speech output can be stored at a 2k-byte rate on one Apple II diskette. A 2-W audio amplifier is contained onboard to drive the speaker.

Circle 419 on Inquiry Card

Design Method Integrates LSI-11/2 μComputer With IEEE/CAMAC Standard

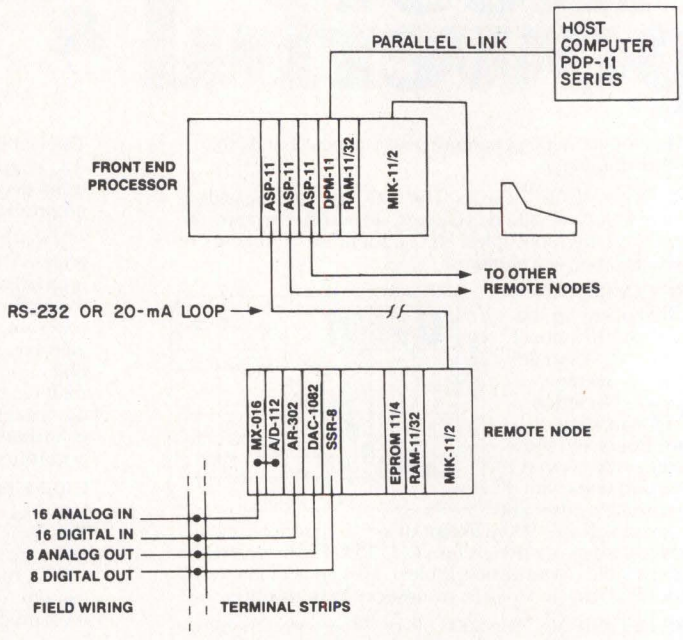
Packaging of Digital Equipment Corp's 16-bit LSI-11/2 microcomputer on a single-width CAMAC (computer automated measurement and control) board, allows the computer to be integrated into the MIK-11/2 system, which serves either as a standalone unit or as an auxiliary unit. The other elements—an asynchronous serial port for RS-232-C or 20-mA loop interfacing (functionally identical to DEC's standard serial port), a controller that interfaces the computer bus and CAMAC Dataway, 16k- to 32k-word RAM with automatic refresh, and a 256-word ROM with Dataway, memory, and register diagnostics—are compatible with the existing MIK-11 bus. Software support includes RT-11 and RSX-11 operating systems, BASIC, FORTRAN, APL, FOCAL, and MACRO II, as well as other PDP-11 compatible software.

Characteristic of the Dataway interface is that it is mapped into a segment of Unibus address space, making it transparent to the LSI-11. Each subaddress and station number is assigned an LSI bus word address; thus for 16-bit transfers, the full power of the microcomputer's 400-instruction set is brought directly to the Dataway. Control status register and high data register contain all information relevant to a Dataway cycle. Both registers are readable and writable from the computer.

Standard Engineering Corp, 44800 Industrial Dr, Fremont, CA 94538, expands the capabilities of the LSI-11/2 by adapting it to process control, data acquisition, distributed processing, and computer networks. Combination of several satellite crate controllers with a larger host CPU offers one powerful configuration.

Selection of various options alter the system with the addition of a 16k- or 32k-word RAM with internal refresh and 256-word bootstrap P/ROM, 4k EPROM with onboard programming capability, 8k dual port static memory for sharing of a memory block by two processors, and dual floppy discs and interface. In addition, there are add-on asynchronous and synchronous serial communication port modules and a peripheral interfacing adapter board for all LSI-11/2 compatible devices.

Circle 420 on Inquiry Card



CAMAC interfaced computer system is designed by Standard Engineering around DEC's LSI-11/2 CPU board. Standalone CAMAC crates with high speed data acquisition and software development capability are offered; distributed processing and computer networks can also be configured. Options which may be attached to satellite computers in typical process control system include ADCs, DACs, 16-bit isolated input register, asynchronous serial communication port, various memories, multiplexers, and solid state relays

THE ADVANCED CIRCUITRY BACKPANEL:

It's hard to improve on a 99.93% quality record and ± .007" pin tip location– but we're working on it.

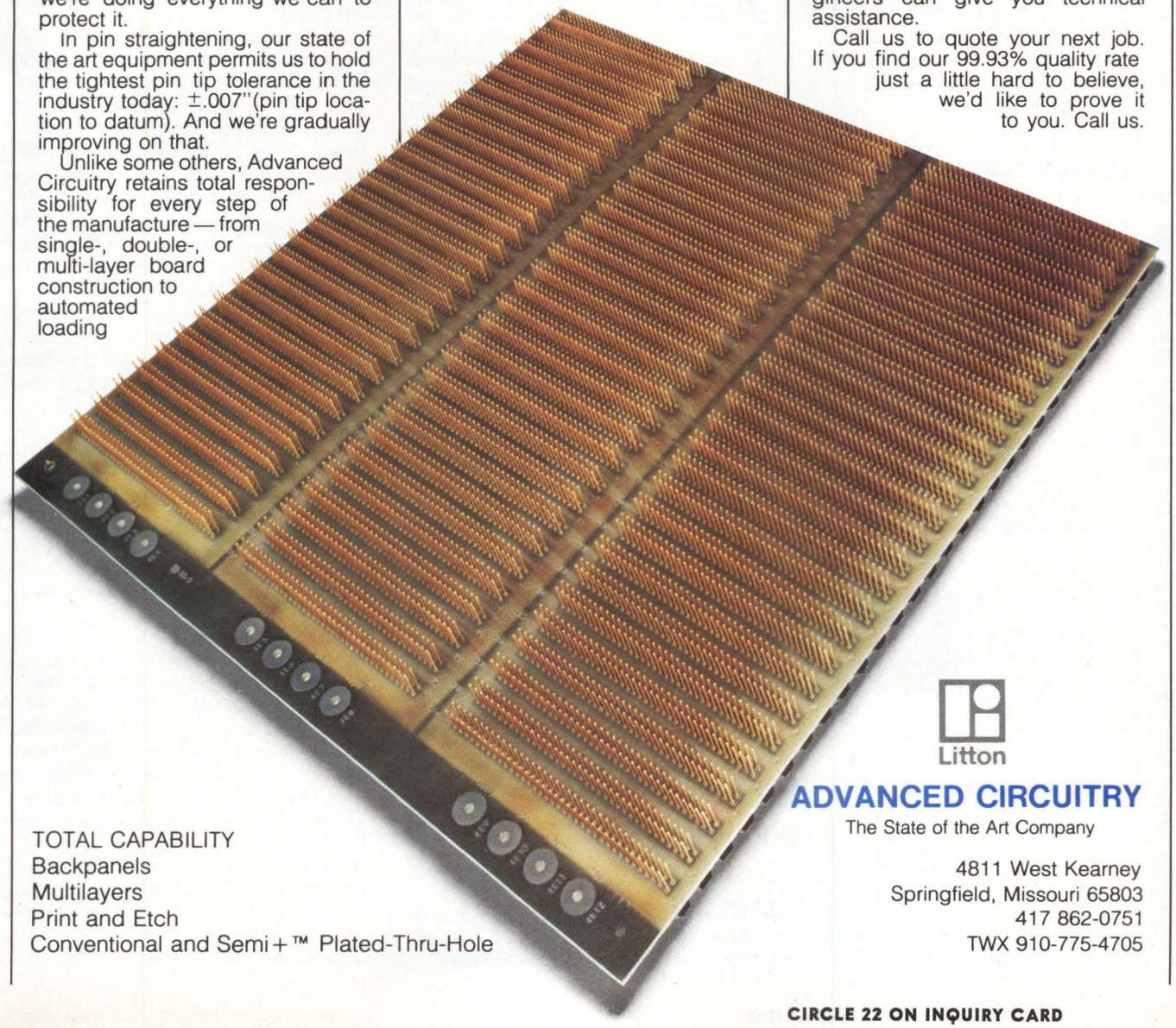
In the three years we've been in the printed circuit backpanel business, we've set some pretty high standards for ourselves and for the industry — like a 99.93% quality record. (We've never had a single backpanel system returned because of printed circuit or assembly problems.) That's our record — and we're doing everything we can to protect it.

In pin straightening, our state of the art equipment permits us to hold the tightest pin tip tolerance in the industry today: ±.007"(pin tip location to datum). And we're gradually improving on that.

Unlike some others, Advanced Circuitry retains total responsibility for every step of the manufacture — from single-, double-, or multi-layer board construction to automated loading of square peg or conformal fitting pins. In-house control of critical parameters, such as plating density and hole size, assures optimum push-out and electrical interface characteristics. On-premises electrical testing is the final step toward a 100% reliable assembly.

As an additional service, for non-standard pin or hardware assemblies, Advanced Circuitry has designed and tooled a fully automatic loose-piece hardware inserter. Talk with us about any special requirements you may have in this area. From prototypes to high-volume runs, our seasoned design engineers can give you technical assistance.

Call us to quote your next job. If you find our 99.93% quality rate just a little hard to believe, we'd like to prove it to you. Call us.



TOTAL CAPABILITY
Backpanels
Multilayers
Print and Etch
Conventional and Semi+™ Plated-Thru-Hole

Litton

ADVANCED CIRCUITRY

The State of the Art Company

4811 West Kearney
Springfield, Missouri 65803
417 862-0751
TWX 910-775-4705

CIRCLE 22 ON INQUIRY CARD

Selections of Add-On Cards Range From Memory To Math To Controllers

Additions to the MD Series™ of OEM microcomputer boards are all STD-Z80 BUS compatible (see *Computer Design*, April 79, p 148). Joint design of the bus by Mostek Corp, 1215 W Crosby Rd, Carrollton, TX 75006, and Pro-Log uses the Z80 CPU, producing a cost-effective OEM microcomputer system bus that supports the Mode 2 interrupt structure. The motherboard interconnect system concept handles any MDX card in any card slot. The 4.5 x 6.5″ (11.4 x 16.5-cm) board size allows system partitioning by function and also makes system packaging easier. In general, the boards require only a single 5-V power supply. Most will also be offered in 4-MHz versions as well as 2 MHz.

MDX-SRAM cards are available in 4k, 8k, or 16k x 8 sizes. They use the company's MK4118 static RAMs with selectable starting address on 4k boundaries. Another memory card, MDX-EPROM-4, contains eight sockets for maximum storage of 8k x 8 using 2758s (1k x 8), 16k x 8 using 2716s (2k x 8), and 32k x 8 using 2732s (4k x 8). Wait-state generate circuitry is included for 4-MHz operation. A universal memory card has eight sockets for use with MK4118 (1k x 8) and MK4802 (2k x 8) static RAMs, MK2758 (1k x 8) and MK2716 (2k x 8) EPROMs, and MK30000 (1k x 8) and MK34000 (2k x 8) ROMs. There are 16 memory configurations with 4k boundary addressing and selectable wait-state for each socket. It can run at 2.5 and 4 MHz.

An AMD 9511 math chip and an onboard MK3881 PIO chip perform the MDX-MATH card's data transfer and interrupt handling. Add, multiply, divide, subtract, trig and inverse trig functions, square roots, logarithms, exponentiation, and fixed and floating point operations are among the math functions performed. Also contained onboard are a 2-MHz crystal controlled clock for asynchronous operation and wait-state insertion.

Containing a WD1771 controller chip and MK3883 DMA controller, MDX-FLP controls one to four drives with four software controlled select times. Drives may be 5 or 8″ (13 or 20 cm), single- or dual-sided. However, all drives connected to the controller must be of the same type. It is compatible with IBM 3740 or other formats. Features include single-density operation, soft sector format with variable length sectors, automatic track seek with verification capability, diskette initialization/formatting capability, DMA or programmed data transfer, and interrupt driven or polled operation. It performs single-sector, multi-sector, or full-track data transfers. There are provisions for DMA daisy chain operation.

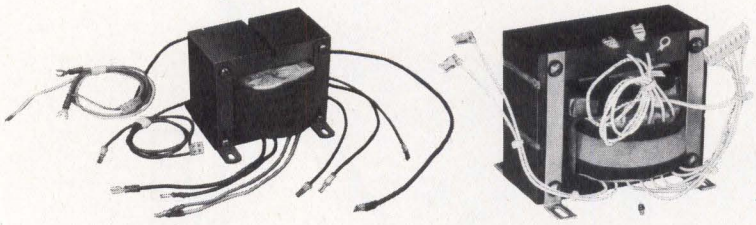
An operator interface with control switches and display readouts onboard, and a pushbutton for system reset comprise the system controller/diagnostic module. An onboard chip handles data transfer and interrupts. Space is available for up to 10k of EPROM or ROM, with memory address selectable on a 2k boundary within a given 16k boundary of the Z80 memory map. Software packages for the MDX-SC/D include monitor, handler, and diagnostic test for the MD series boards.

Offering 16 single-ended or eight differential input channels and two 8-bit analog output channels, the MDX-A/D analog I/O subsystem has I/O ranges from 0 to 10, ±5, and ±10 V. It features input overvoltage protection to 35 V and a sample/hold amplifier for inputs. There is a single onboard precision reference circuit for the analog outputs, onboard dc-dc converter, and memory mapped I/O.

The final module—an A-D card—uses the MK5160 A-D chip and an onboard MK3881 PIO for data transfer and interrupt handling. MDX A/D8 has 16 multiplexed single-ended analog inputs and an 8-bit binary output; a sample/hold module is optional. Conversion time is 140 μs. Three full-scale input ranges are from 0 to 1, 0 to 3, and 0 to 5 V. Accuracy is to ±½ LSB with no adjustments required and no missing codes. Provisions allow additional channel expansion.

Circle 421 on Inquiry Card

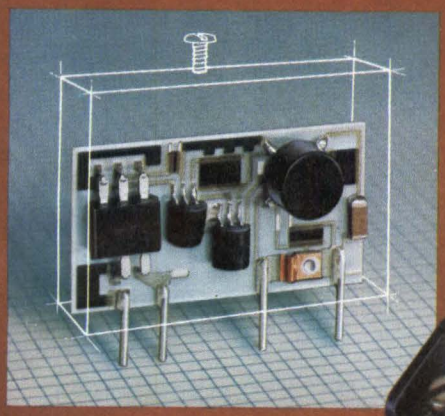
From Frame to CRT...
we've built Linear and Constant Voltage Transformers - U.L. and C.S.A. Listed - and for use in equipment conforming to these international specs: IEC-380; IEC-435; VDE-0730; VDE-0804
What can we do for you?

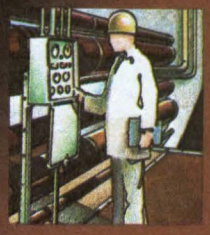


Just give us a call 618-654-2341 Nationwide Reps

Basler Electric
Highland, Illinois
BOX 269 HIGHLAND, ILLINOIS 62249 TWX 910-996-2522

Gordos Introduces the First Hybrid Thick Film I/O Modules





Higher Reliability at Less Cost

Optimized circuit design and performance — standard or custom. Better electrical uniformity and reliability. Better thermal properties and noise immunity. High-volume availability with tighter production tolerances — i.e., component values laser-trimmed to within 0.3%. Superior reliability, even when exposed to severe vibration or physical and thermal shock. Complete interchangeability with other industry-standard modules. 600V blocking and VDE specs available.

These are the performance benefits of the new Gordos hybrid thick film I/O modules — compared with discretely assembled versions of similar specs. In addition, individual part cost is lower due to higher yield from our semi-automated production facility.

Whatever your application, Gordos has a model to match. Choose from the world's broadest in-stock line of SSRs, reed relays, reed switches, and mercury switches. Or talk with one of our sales engineers about your special requirements.

For a fast response, send in our coupon — or call us. Today.

★ Gordos field return rate is less than 0.5% — well below the industry average.

*The Reliability Standard in SSRs**

GORDOS

Gordos Arkansas, Inc.
1000 N. Second Street • Rogers, Arkansas 72756 U.S.A.
501 636-5000 • TWX 910 720-7998

Please send me the following information:

- ☐ New Hybrid Thick Film I/O Systems
- ☐ Reedac® and All-Solid-State Relays
- ☐ Reed Relays, Reed Switches, Mercury Switches

Name/Title _____

Company _____

Address _____

City/State/Zip _____

Area Code _____ Phone _____

Gordos Arkansas, Inc.
1000 N. Second Street • Rogers, Arkansas 72756 U.S.A.

Enclose one U.S. dollar ($1) for requests from outside the U.S.

CIRCLE 165 ON INQUIRY CARD

EMM Wins the Megabyte Memory Race

with higher speed and lower maintenance than rotating disks and drums.

A Real Thoroughbred

Our tough EMM/SESCO inspector has a real winner in our Megabyte Memory, which, for fast throughput and low maintenance, beats rotating disks and drums hands down!

A real thoroughbred, Megabyte gives you one million 8-bit bytes of dependable, non-volatile core storage on a single pluggable module. As an entry, a 4-megabyte system, including interface, takes up only 17.5 inches of chassis space.

A New Track Record

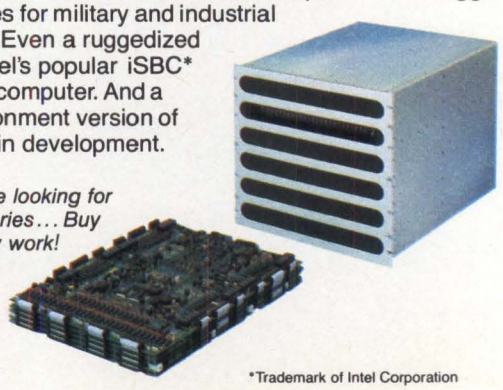
This all-electronic mass memory is orders of magnitude faster than disks and drums. And by interleaving Megabyte memories, a data transfer rate of greater than 16 million bits per second can be achieved.

Speed AND Dependability

Maintenance on disks and drums is complicated and expensive. With our megabyte core memory, however, service downtime is virtually eliminated since there are no moving parts to wear out. And if maintenance is ever needed, our modular design makes it simple. This all adds up to higher system performance at a lower total life cycle cost.

Plenty of Memories

There are plenty of memories in store for you at EMM/SESCO. Up to 256K bytes of semiconductor memory on a single card for the commercial user. A complete line of ruggedized memories for military and industrial applications. Even a ruggedized version of Intel's popular iSBC* 80/10A microcomputer. And a severe environment version of Megabyte is in development.



So when you're looking for winning memories... Buy SESCO... they work!

EMM SESCO

A Subsidiary of Electronic Memories & Magnetics Corporation

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

*Trademark of Intel Corporation

CIRCLE 85 ON INQUIRY CARD

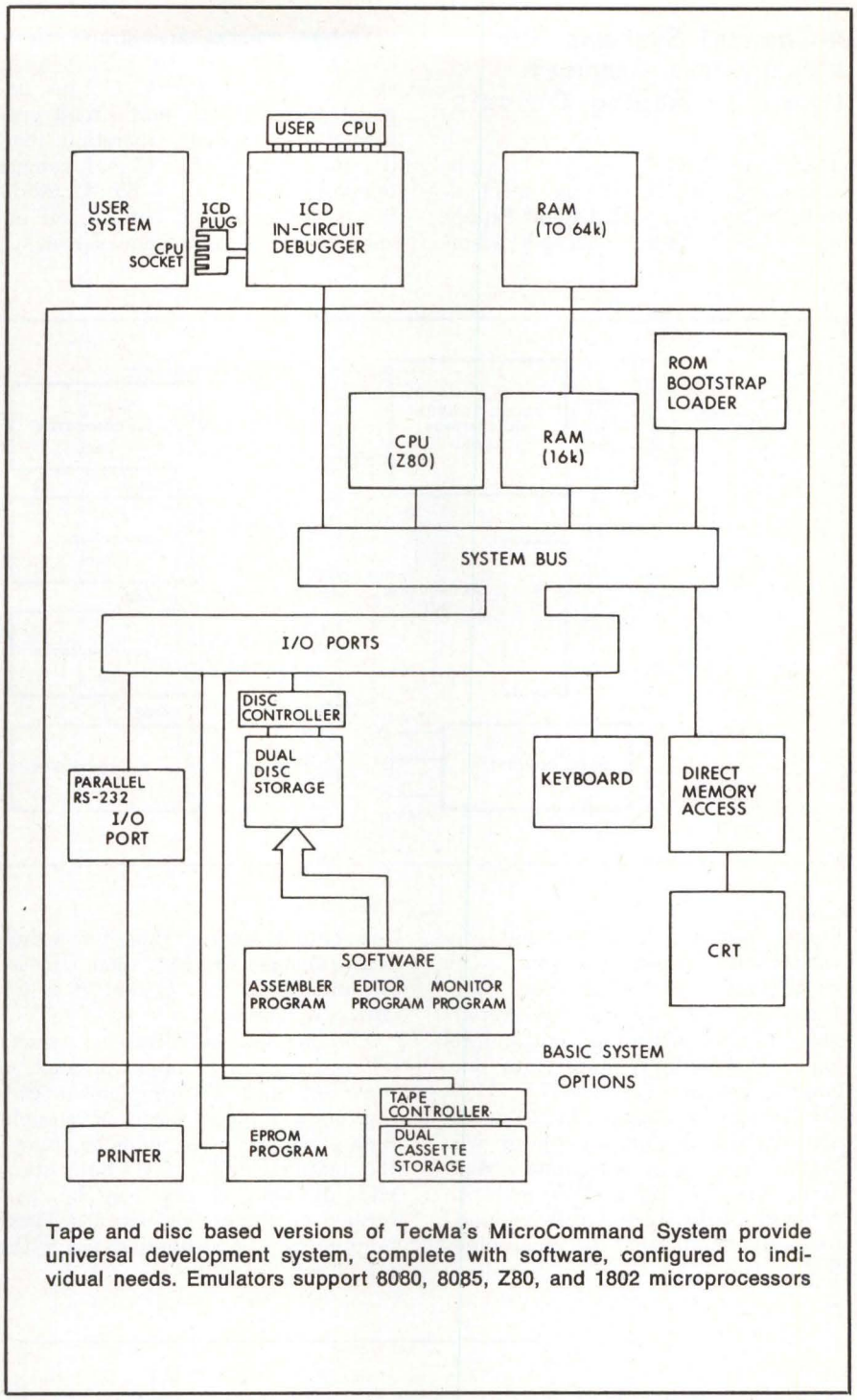
User Convenience Is Key to Nondedicated Development System

Supporting four realtime emulators —the 8080, 8085, Z80, and 1802 (with others under development), the ICC/MCS microprocessor development system is a universal low cost solution for users requiring additional in-circuit emulation stations. Designed with a dual-processor architecture, the system has inherent 16-bit capability. Expansion plans cover high level debug software, relocating macro assembler, and linking loader.

Both tape and disc based operating systems, complete with a free form CRT oriented editor, assembler, and monitor, are available. A Z80 based BASIC compiler is optional. The debugging monitor provides full register and selected memory region display, plus extended commands structure comprised of set/clear/display/execute on breakpoints, read/write object program, enable/disable user I/O, single step, enable/display high speed trace memory, and transfer memory contents. Also included are the DOS command set and text editor commands. Digital Research Corp's CP/M™ operating system allows the MCS to be used not only as a development system, but also as a business, scientific, and data processing system.

The in-circuit debugger, MCS ICD™, features a multiple architecture to support several microprocessors; therefore, the system CPU does not have to be converted from one object CPU to another. The debugger provides debug, test, display, and control capabilities.

MicroCommand System uses a Z80 processor for its internal logic; it provides an 8-level vector interrupt capability, as well as 16k to 64k of static RAM. The 512-byte load only ROM contains the bootstrap loader. A 40 x 24-char display CRT operates through DMA for fast display updates. Other components are a built-in ASCII keyboard, either dual 5″ (13-cm) quad-density or dual 8″ (20-cm) double-density floppy disc system, parallel and serial RS-232 output ports, EPROM programmer, and optional dual cassette storage units.



Tape and disc based versions of TecMa's MicroCommand System provide universal development system, complete with software, configured to individual needs. Emulators support 8080, 8085, Z80, and 1802 microprocessors

TecMa, Inc, 2366 Walsh Ave, Santa Clara, CA 95051, has introduced three configurations. The dual cassette tape system, priced at $4995, has the capability of disc based systems, but at slower speeds. Data transfer rate is 2000 bits/s. This is suited to uses requiring limited software development, but much debug and emulation, such as testing and product checkout. The two disc based systems start at $8450. Quad-density discs provide 315k bytes/diskette and a data transfer rate of 250k bits/s. The double-density discs offer 512k-byte diskettes with a data transfer rate of 500k bits/s.

Circle 425 on Inquiry Card

4-Channel Systems For μComputers Convert Inputs to Analog Outputs

The MP1104 analog output peripheral board, electrically and mechanically compatible with Digital Equipment Corp's Q-Bus, accepts 12-bit inputs from the data bus and converts them to analog outputs with an accuracy of ±0.025% FSR. Consisting of four 12-bit D-A converters plus address decoding and control logic, the system plugs into any empty slot in the LSI-11, -11/2, -11/23, PDP-11/03, and -11/23 microcomputers and simply requires wiring of the analog connector. Minimum card spacing is 12.7 mm. An onboard dc-dc converter is included for operation from the computer's 5-Vdc supply.

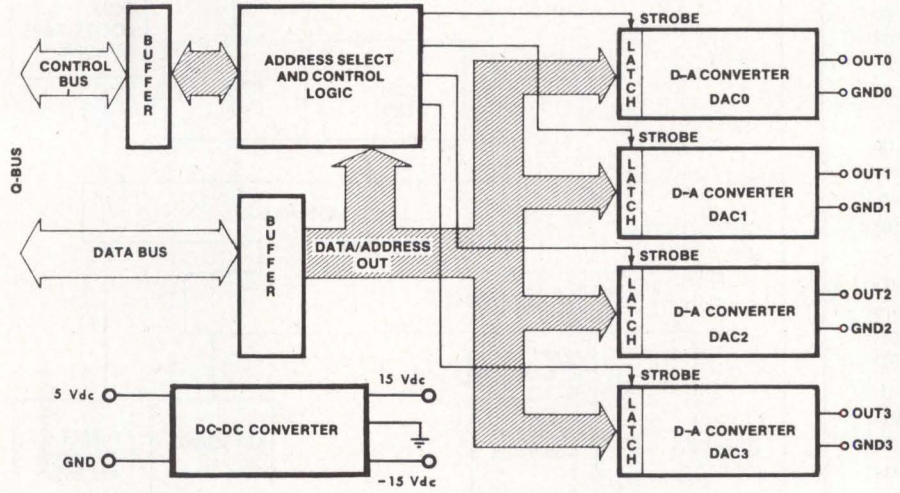
Output ranges are strap selectable at ±10, 0 to 10, ±5, 0 to 5, and ±2.5 V at 5 mA. Output impedance is 0.01 Ω. Short circuit protection is included. Operating temperature is 0 to 70 °C and storage temperature is −25 to 85 °C. Additional specs are a tempco of accuracy drift of ±30 ppm of FSR/°C, and output settling time for a full-scale change of less than 10 μs. Burning in at 70 °C for 48 h improves reliability.

On system initialization (reset) all D-A converter inputs are set to logic 0. With 2's complement coding on a bipolar range or straight binary coding on a unipolar range, the outputs go to 0 V. Both static and dynamic checks can be performed on the analog outputs. These outputs can be calibrated using the LSI-11 and its monitor.

Burr-Brown Research Corp, International Airport Industrial Pk, PO Box 11400, Tucson, AZ 85734, has designed the system so that each D-A converter output may be filtered by adding an onboard feedback capacitor to each output op amp. This filtering may be used to smooth the output by limiting its bandwidth. The feedback capacitor is in parallel with each DAC's internal feedback resistor.

The board is programmed as memory locations and any write instruction can be used. The DAC input occupies the 12 LSBs of a word. The address block is user selectable and can be placed anywhere in the upper 4k of memory. The base address of a board can be set to any 4-word boundary by jumpering (with wirewrap jumpers) its address selector.

Circle 426 on Inquiry Card



Four DACs with address decoding and control logic comprise Burr-Brown's microcomputer analog output system that interfaces to DEC's Q-Bus. Each DAC is wirewrap jumpered for ±10-V operation with 2's complement coding. Jumpers onboard can be altered, however, for other output voltages and coding

Asynchronous Receiver/ Transmitter Offers Two Full-Duplex Channels

Performing asynchronous serial data communications functions in microcomputer systems, the Z80 DART peripheral component has two independent full-duplex channels with separate modem controls. Quadruply buffered receiver data registers, doubly buffered transmitter, programmable interrupt vector, "status affects vector" mode for fast interrupt processing, and standard Z80 peripheral daisy chain interrupt structure for automatic vectoring without external logic are all featured.

The dual asynchronous receiver/transmitter in 40-pin plastic or ceramic DIP can be used as a serial to parallel, parallel to serial converter/controller. Data rates are 0 to 500k bits/s with a 2.5-MHz clock or 0 to 800k bits/s with a 4.0-MHz clock. Break generation and detection include parity, overrun, and framing error detection.

Zilog, Inc, 10340 Bubb Rd, Cupertino, CA 95014, offers programmable options of 1, 1½, or 2 stop bits and odd, even, or no parity. Clocks may be 1, 16, 32, and 64 times the data rate in asynchronous modes. Temperature ranges are standard, extended, or Mil Spec.

Circle 427 on Inquiry Card

A lot of complex thinking goes into the Teletype* model 40 printer. And, incredibly, it all fits on this 9″ by 19″ circuit card.

More brains; less brawn.

That's the advantage of an electronic printer like our 300 LPM model 40 series. The LSI (Large Scale Integration) circuitry tucked underneath the printer can perform functions with greater reliability than mechanical hardware.

And it can perform them in a fraction of the time with a fraction of the parts. Plus, fewer moving parts means less maintenance and increased printer life.

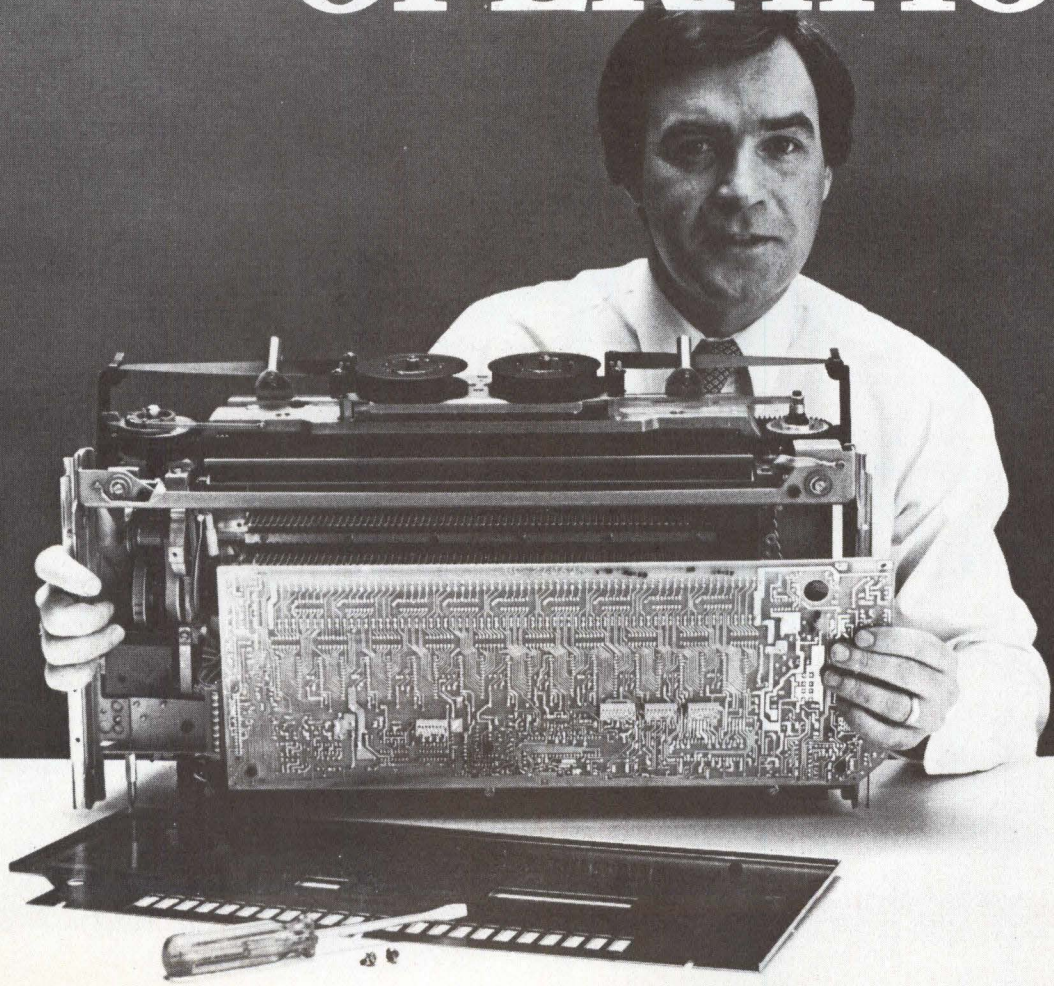
All you have to do is plug it in.

Just attach the AC power and a serial signal source and your model 40 is ready to go to work. There are 32 switch-selectable options and self-diagnostics available at no additional cost. Housed in an attractive cabinet, if you need one. And our technical assistance is never extra.

So for not much money, the brains behind our operation can become the brains behind yours.

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

MEET THE BRAINS BEHIND THE OPERATION.



CIRCLE 18 ON INQUIRY CARD

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

SOFTWARE

Program Recovers And Salvages Files From Diskettes

Data files can be salvaged from a diskette on which the directory has been partially or totally destroyed, or recovered if mistakenly deleted using the automatic SALVAG ISIS-II disc utility program. The utility extensively analyzes any remnants of the directory. For any valid entries, the associated files are copied to a designated object diskette.

The utility next searches the source diskette sector by sector for data file link blocks. Those that are found are analyzed for validity, and at that point the associated data file is copied to the object diskette.

The user may optionally specify that files with an active directory entry be skipped. This is used when recovering files that were accidentally deleted. If the specified source and object drives are the same drive, the utility pauses to allow diskette swapping. Thus, the program from Xener Corp, 6641 Backlick Rd, Springfield, VA 22150, can be used on systems with a single disc drive.

Circle 428 on Inquiry Card

Dual In-Circuit Emulators Debug Systems That Have Multiple Microcomputers

To alleviate the problems of multiprocessor development which previously required two development systems, each with its own in-circuit emulator, Intel Corp, 3065 Bowers Ave, Santa Clara, CA 95051, has announced a software package that allows a single Intellec® Microcomputer Development System to control operations of two in-circuit emulators. The coordinated ICE™ units debug most multiple microcomputer based processing and control systems.

This single-system Multi-ICE approach allows the user to enter commands for both emulators on one console and to record a coordinated set of trace information (up to 1022 microprocessor operating cycles), thus determining if related programs will mesh in realtime execution and providing an overview of multiprocessor operations. The seven types of microprocessors that are presently supported are 8085 CPUs, 8748, 8049, 8048, 8039, 8035, and 8021 single-chip microcomputers.

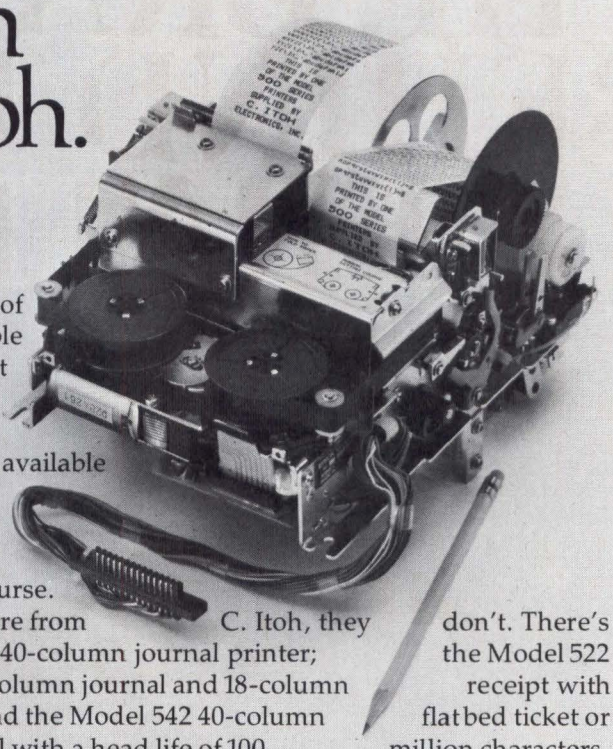
The resident software option for disc based Intellec model 800 and Series II model 220 and 230 development systems runs under the standard ISIS-II diskette operating system. As a software interface between the user and the ICE units, it executes a host process and two ICE processes. The host process translates commands from the console or diskette files into execution lists for itself and the two processes which then control the ICE units. Users control the ICE units individually or in combination. A dispatcher software subsystem provides overall coordination by determining the sequence in which tasks should be performed.

Software synchronization starts and stops two in-circuit emulators. For hardware synchronization, a sync line also allows either ICE unit to start or stop the other's emulation.

The interactive command language in plain English provides a common syntax for using the ICE units. It handles macro commands, symbolic debugging, assembler mnemonic displays, and other debugging techniques. □

Circle 429 on Inquiry Card

Mini-printers from C.Itoh.



The 500 series from C. Itoh contains some of the most reliable 40-column, dot matrix impact print mechanisms currently available to the industry. They should cost a lot more, of course. But since they're from C. Itoh, they don't. There's the Model 512 40-column journal printer; two-stage 18-column journal and 18-column logo stamp; and the Model 542 40-column slip printer. All with a head life of 100 million characters, and a mechanism MCBF of five million lines; all bi-directional with a print speed of 152 CPS. And, of course, all from C.Itoh, the name to trust in printers of any size. Detailed specifications on any or all three are yours for the asking. Write to us.

Small wonders.

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

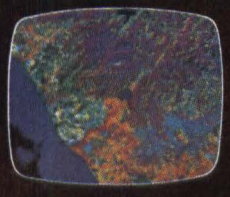
C. Itoh Electronics is part of the C. Itoh & Co. Ltd. world-wide trading organization.

When you need color graphics, Ramtek has it all.

Color. A surprisingly powerful way to add information, manage it, increase the efficiency of its use. However you plan to use it, there is only one company with the breadth of line, the technological mastery, to give you the choices you need without compromise—or needless costs.

It's Ramtek. For color graphics. For imaging. Ramtek has what you need:

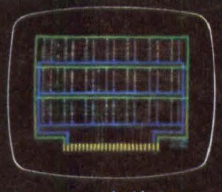
The Ramtek 3000. Eight models let you explore the possibilities of color graphics the moment you plug in your application software. Stand alone image processing and graphics. Fully integrated and ready to go. Desk configuration.



The Ramtek 9000 Series Display Controller. Four models. Total modularity. Buy just what you need; add to it at any time. The high-performance family. The industry standard in imaging and graphics raster scan color.

The Ramtek 9050 Series Display Controller. Four models. The most popular elements of the 9000 Series are here packaged for economy. All are software compatible with the 9000, have expandable memory and interactive capabilities.

The Ramtek Colorgraphics Computer Terminals. Three models let you choose between economy, optimum price-performance, or maximum resolution-performance. Easy to program. Easy to use. Easy to interface. Interfaces to the Xerox 6500 Color Graphic Printer for color hard copy output. These are the price, industry and performance leaders in raster scan color graphics terminals.



The Ramtek Monitor Family. Nine models. Up to 1024 line addressability on the screen in color or black and white. CRT sizes 13" or 19". Cabinet or rack mounted versions.

Ramtek Large Screen Projection. Interface Ramtek's or your own large screen projection unit easily, quickly.

And there's more to come. From Ramtek, the world's largest independent manufacturer of raster scan color graphics and imaging equipment. Direct sales in the U.S. and Canada. Distributors worldwide plus a worldwide network of customer service and depot repair stations.

For more information, write:
Ramtek, 585 N. Mary Ave.,
Sunnyvale, CA 94086.

ramtek

Our Experience Shows

REGIONAL OFFICES: Sunnyvale, CA (408) 735-8400 • Newport Beach, CA (714) 979-5351 • Dallas, TX (214) 422-2200 • Huntsville, AL (205) 837-7000
Cleveland, OH (216) 464-4053 • Washington, D.C. (301) 656-0350 • Metropolitan N.Y. (201) 238-2090 • Boston, MA (617) 862-7720 • West Germany (0611) 771070

CIRCLE 87 ON INQUIRY CARD

VARIABLE MICROCYCLES IMPROVE SPEED OF BIPOLAR BIT SLICE PROCESSORS

Hank Brineen

National Semiconductor Corporation
Santa Clara, California

Advanced process and circuit technique improvements have enabled the fabrication of bit slice designs that promise dramatically increased system speeds over earlier low power Schottky bit slice implementations. Substantially increased throughputs (as much as 50 to 75%) are possible using various new approaches. Among these are "pipeline prediction" techniques in microprogram control, coupled with variable microcycle timing.

Critical Timing Paths

To identify potential areas for speed improvement using high speed 2900 type bit slice components, it is helpful to review the critical timing paths in a typical bipolar microprogrammed processor. Consider first the simple system organization shown in Fig 1. In this system, the address register is clocked at the beginning of the microcycle. When the microinstruction is valid at the read only memory (ROM) output, two basic paths must be considered.

One path consists of accessing data from the registers, propagating it through the arithmetic logic unit

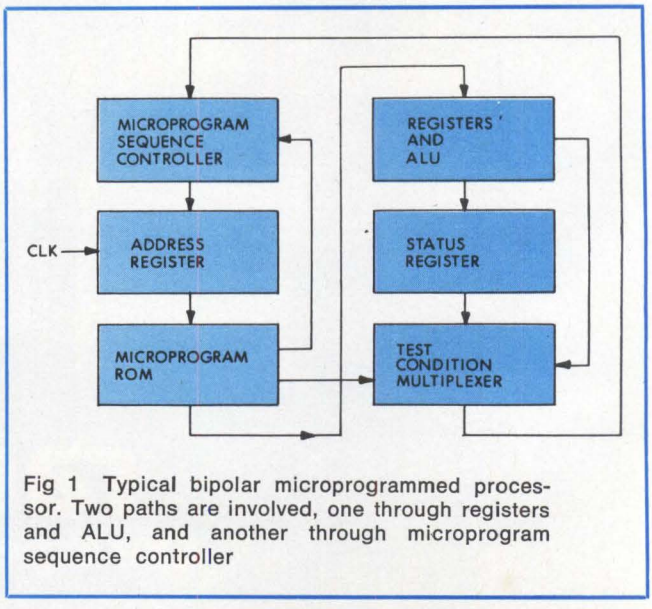
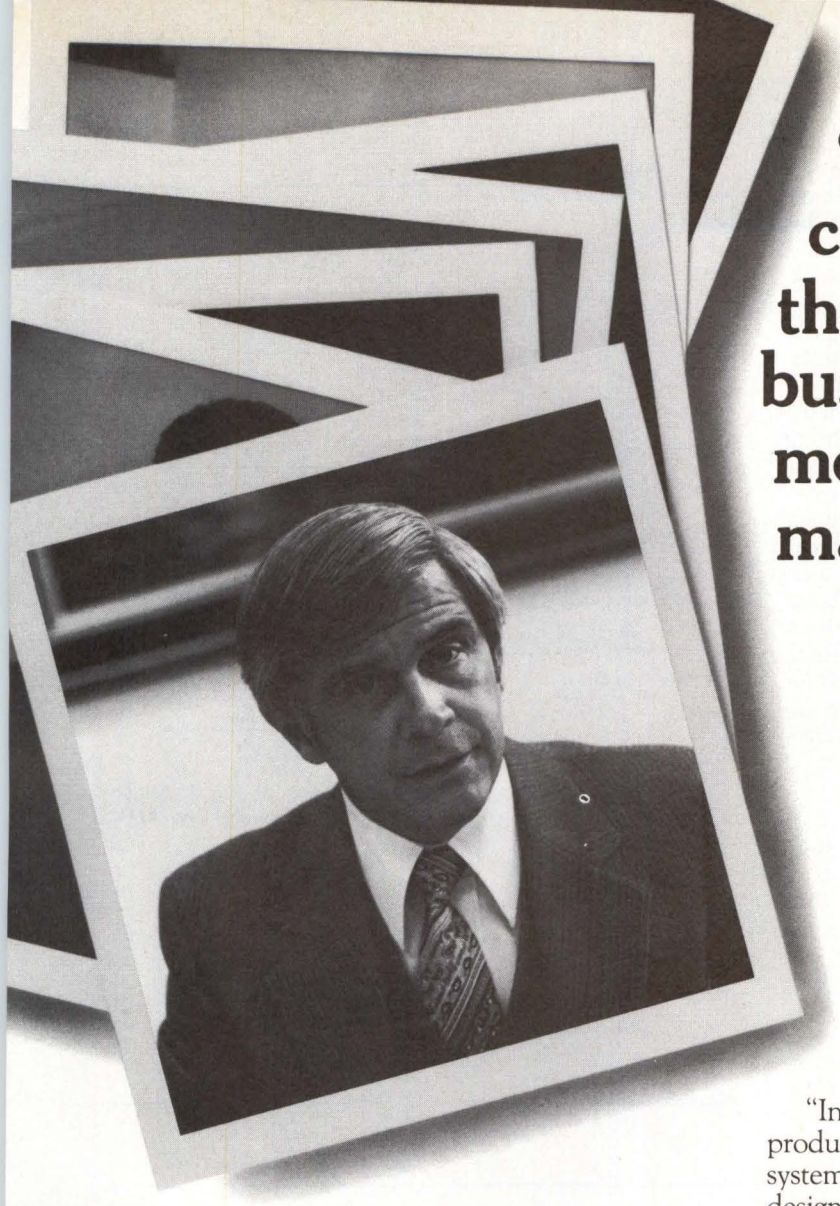


Fig 1 Typical bipolar microprogrammed processor. Two paths are involved, one through registers and ALU, and another through microprogram sequence controller



"The more competitive the video terminal business gets, the more Intel helps us maintain leadership."

Sal Nuzzo, President, Hazeltine Corporation

Sal Nuzzo: "Intel's introduction of the microcomputer revolutionized the computer terminal industry. We were first to use a microcomputer in a terminal — Intel's 8008, years ago, and we've maintained a price/performance edge over the years by quickly taking advantage of Intel's breakthroughs.

"This is a tough, competitive industry. Getting a product to market first can make all the difference. Any company that doesn't move fast to take advantage of new technology will simply get left behind. So at Hazeltine, a key part of our strategy is to work closely with technology leaders — such as Intel. They introduced the microcomputer, and have continued to innovate with developments such as the 16-bit 8086 microcomputer. Taking advantage of their new products has enabled us to consistently give our customers higher performance and greater reliability.

"Intel makes it easy for us to apply their new products. An example is the Intellec® development system. Frankly, I don't see how any company can design a product that uses microcomputers without a system such as the Intellec system. The Intellec system features such as in-circuit emulation (ICE) and PL/M programming language are essential time-savers. With our Intellec systems we can convert our existing programs for the 8080 microcomputer to Intel's new 16-bit microcomputer, the 8086, quickly, and increase throughput ten times. That's flexibility."

Intel's Intellec® Development System

Intel® microcomputer products and development systems can make the competitive difference for your company. For more information, contact your local Intel sales office or distributor, or write Intel Corporation, Literature Department, 3065 Bowers Avenue, Santa Clara, CA 95051. 408/987-6475

intel® delivers.

Circle No 88 for Information.

(ALU), and storing the result in a data register and status register. The other path involves the test condition multiplexer and sequence controller. The timing diagram (Fig 2) illustrates the relative timing for a system such as this. In a typical system design, the minimum microcycle period is limited by the delay path through the registers and ALU (shown as "ALU results may be clocked").

An organization frequently referred to as "pipelined" is illustrated in Fig 3. This nomenclature results from the fact that while one microinstruction is being executed, another is simultaneously being accessed. A microprogram register is added to the output of the ROM, and the clock causes the next microinstruction to appear at the output of this register. Output from the sequencer is allowed to acccess the microprogram ROM, fetching the next microinstruction while data are propagating through the registers and the ALU. This microinstruction will be ready to place in the microprogram register on the next clock. In this fashion, the access time of the ROM overlaps the execution of the microinstruction by the registers and the ALU.

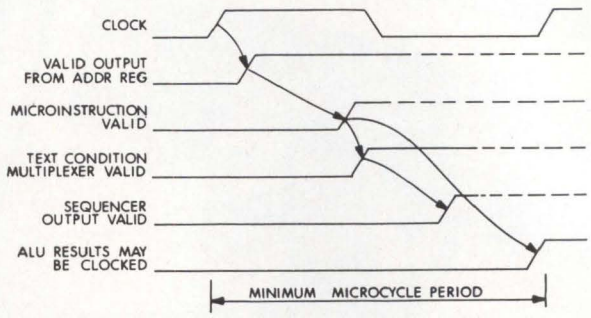


Fig 2 Timing diagram for processor of Fig 1. Minimum possible microcycle period is established by ALU path

Pipeline Prediction

As shown in the timing diagram (Fig 4), the sequencer output was valid early enough for the total access time of the ROM to be overlapped. To satisfy this condition, the test condition multiplexer inputs must be valid at an early point in the microcycle. This requirement is unfortunate, since it means that the test conditions based on the result of ALU operations in the current microcycle cannot be used.

An effective solution to this problem is the use of pipeline prediction; that is, the system is designed so

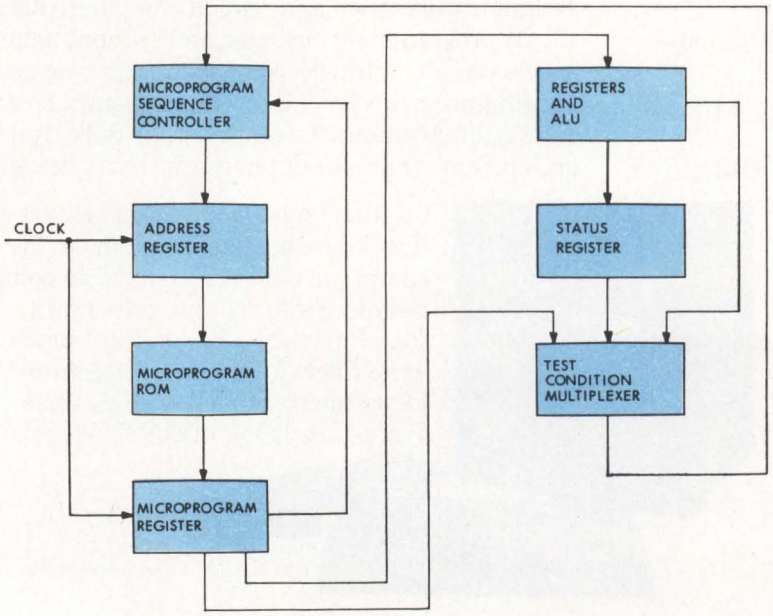


Fig 3 Pipelined organization utilizes microprogram register at ROM output. Sequence controller is able to access instruction n+1 while nth instruction is being executed in ALU path

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 89 ON INQUIRY CARD

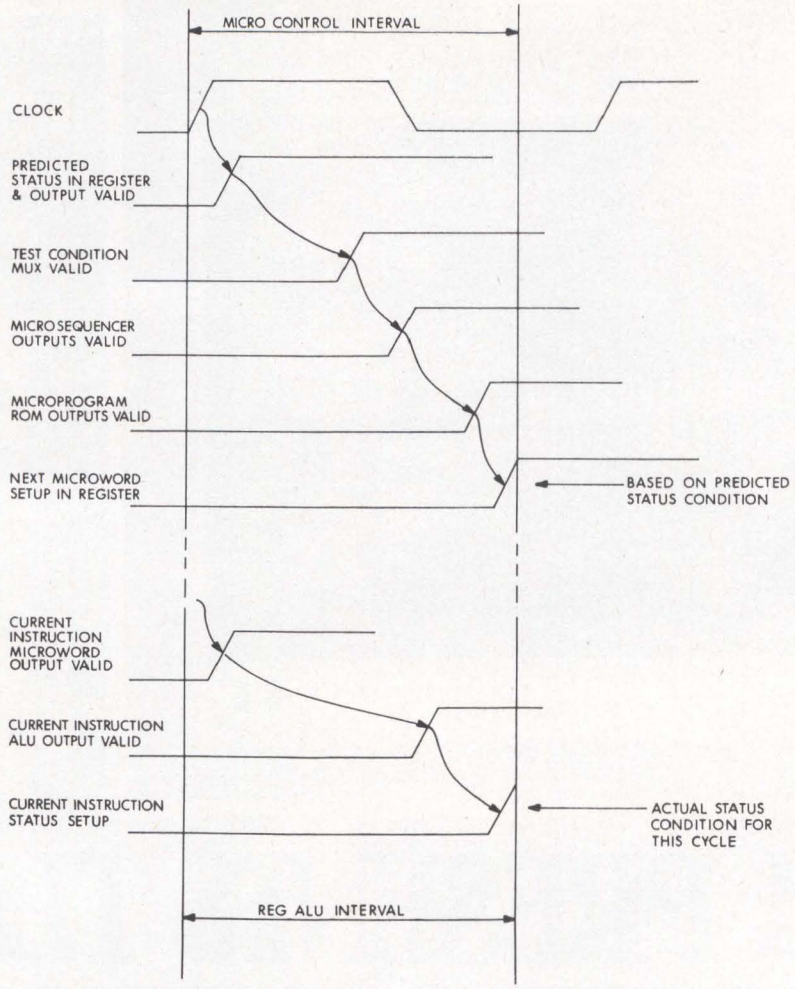


Fig 4 Timing diagram for processor of Fig 3. If predicted status matches ALU status, then next microcycle may immediately proceed. Otherwise new instruction word must be fetched

that the sequencer logic is conditioned on the basis of a predicted value for the test condition multiplexer output, and the ROM is accessed on this assumption. After the ALU result is stable and has propagated through the test condition multiplexer, the predicted value of the multiplexer output is compared with the actual value of its output. If the predicted value is correct, the next microinstruction in sequence (that is, the one being accessed) is executed. On the other hand, if the predicted value differs from the actual value, the conditioning of the sequencer logic is modified correspondingly, and the time duration of the microcycle is extended to allow time for the modification to propagate through the sequence controller logic and access the ROM.

Since the microprogrammer can frequently predict the results of test conditions with much better than 50% success frequency, a relatively small fraction of the microcycles must be extended. For example, in a microprogrammed multiply or divide algorithm, a loop counter must be tested on each pass through the loop. In a 16-bit machine, the test would typically be performed 16 times, but the result could be accurately predicted 15/16ths of the time.

Variable Microcycle Periods

As discussed previously, the delay through the registers and ALU is typically the path that limits system performance. The magnitude of this delay can vary considerably depending on which microoperation is being performed. Table 1 lists a variety of operations together with the microcycle period requirements for a pipelined system. Note that the longest operation requires about 75% more execution time than the shortest. The most straightforward design approach is simply to calculate the worst case time period and design the clock generator circuit to provide that time for all operations. However, it is evident that a speed improvement could be obtained if the clock generator were programmed to modify the microcycle time in accordance with the requirements of the operation to be performed.

System Performance Comparisons

It is helpful to look at numerical values obtained from a design study of five system organizations utilizing bit slice components such as the IDM2900 family from National Semiconductor. By performing a similar analysis

using specifications of available components, the designer can make realistic decisions of cost versus performance when choosing a system organization for a new design.

System 1 is a nonpipelined organization and test conditions are based on results of operations performed on the previous microcycle. A fixed microcycle period of 225 ns is used, necessitated by the multiply instruction (Fig 1).

Pipelined system organization (Fig 3) defines System 2. Test conditions are based upon results of previous microcycles and a fixed microcycle time of 172 ns is used. The pipelined organization allows the microcycle period to be reduced to 48 ns less than the cycle time for System 1.

System 3 is the same as System 2 except that test conditions based on results of the current microcycle are used and the technique of predicting test condition results is utilized. The microcycle period is fixed at 172 ns; the time necessary for the result of the current operation to propagate through the test condition multiplexer and determine whether an extended cycle is needed. An extended cycle adds 86 ns, one-half microcycle, to the normal microcycle period.

The configuration of System 4 is the same as that of System 2 except that a variable microcycle period is used. Test conditions are based on the results from the current microcycle; however, no prediction of test conditions with an extended cycle for incorrect prediction is performed. Instead, those microinstructions which require more time to allow for propagation of the result through the test condition multiplexer and sequence controller are simply programmed to be of longer duration. Microcycle periods of either 103, 137, 172, or 206 ns could be used depending on the needs of each microinstruction. Although this approach may require more microcode locations, it does offer even greater flexibility in tailoring the microcycle period to the needs of the operation being performed.

System 5 combines the techniques used in Systems 3 and 4. Variable length microcycles can be used. The technique of predicting test condition results is used, and, when the cycle is extended due to an incorrect prediction, an additional 86 ns is added.

Table 2 shows instructions typically used in a minicomputer that is configured in one of the previous system organizations. Execution times specified in Table 2 for each instruction type are derived by using the execution time of System 1 as a baseline reference.

TABLE 1

Pipelined Microcycle Period Requirements

Operation Performed	Microcycle Time (ns)
Logic operation, status register not modified, no test of result	98
Arithmetic operation; status register not modified; no test of result	133
Add and shift; status register not modified; no test of result	172
Multiply cycle; Q_0 used to determine I_1 of 2901	172
Arithmetic operation; status register modified; no test of result	169
Arithmetic operation; status register not modified; result used as test condition (no extend caused by incorrect prediction)	165

TABLE 2

Bit Slice Instruction Execution Times (ns) As Function of System Organization

System Organization	Instruction Type				
	LD, JMP, ST	JSR	BOC	ADD	Loop for MOVE
System 1: Nonpipelined: test condition from previous microcycle	920	1610	920 or 1150	920	920N
System 2: Pipelined; no prediction; test condition from previous microcycle	688	1204	688 or 860	688	688N
System 3: Pipelined with prediction; test condition from current microcycle	688	1204	599 or 731	688	688N
System 4: Pipelined; no prediction; variable length microcycle; test condition from current microcycle	480	960	482 or 619	549	617
System 5: Pipelined with prediction and variable microcycle length	480	892	412 or 549	549	549N

Note: The reason JSR and Loop for MOVE don't improve with System 3 is that a way was found to write a code without an extra cycle

TABLE 3

Relative Instruction Execution Rate With Various System Organizations

System Organization	Instruction Type: LD, JMP, ST	JSR	BOC	ADD	Loop for MOVE
System 1: Nonpipelined, test condition from previous microcycle	1.0	1.0	1.0 or 1.0	1.0	1.0
System 2: Pipelined, no prediction, test condition from previous microcycle	1.34	1.34	1.34 or 1.34	1.34	1.34
System 3: Pipelined with prediction, test condition from current microcycle	1.34	1.34	1.64 or 1.57	1.34	1.34
System 4: Pipelined, no prediction, variable length microcycle, test condition from current microcycle	1.91	1.67	1.91 or 1.85	1.67	1.49
System 5: Pipelined with prediction and variable microcycle length	1.91	1.80	2.23 or 2.09	1.67	1.67

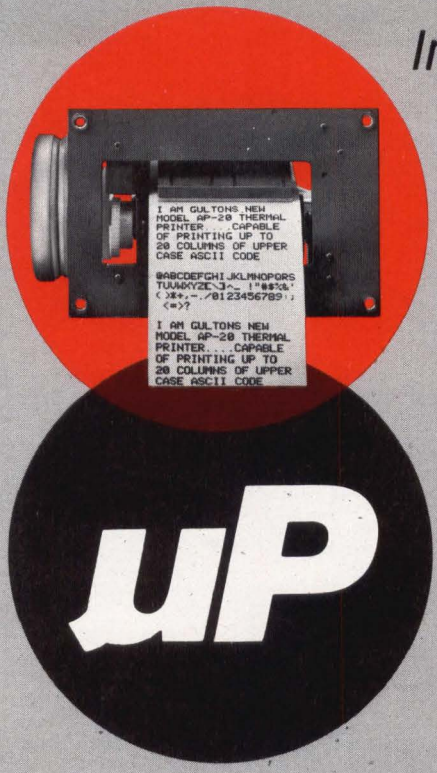
The relative execution speed for each of the five systems can best be appreciated by examining the data in Table 3, a transformed version of Table 2 that shows relative instruction execution rate with various system organizations normalized to System 1.

Variable Microcycle Potential

Popular as it has been with many system designers using bit slice architecture, the usefulness of the variable microcycle approach may be shortlived, due to the increasing speed of bit slice components. As the microcycle interval becomes shorter and shorter—from 100 ns down to 65 or 70 ns for a simple add, and from 125 ns down to 75 or 80 ns for an add and shift—the advantages of the variable microcycle approach are severely diminished. There are alternatives available, however, and these are to be discussed in a later column.

silent partners

Interface a silent Gulton fixed head thermal dot printer to your microprocessor . . . and get unmatched reliability.



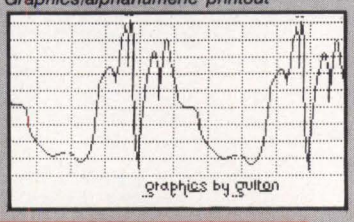
Gulton printers and mechanisms give you the quietness and reliability of thick film technology. With only one moving part you are freed from the problems of ink supplies, ribbon mechanisms, hammers and other moving parts. Graphics, numeric and alphanumeric printers are available. MTBF is 10 million character lines.

ASCII format printout

I AM GULTONS NEW
MODEL AP-20 THERMAL
PRINTER. . . .CAPABLE
OF PRINTING UP TO
20 COLUMNS OF UPPER
CASE ASCII CODE

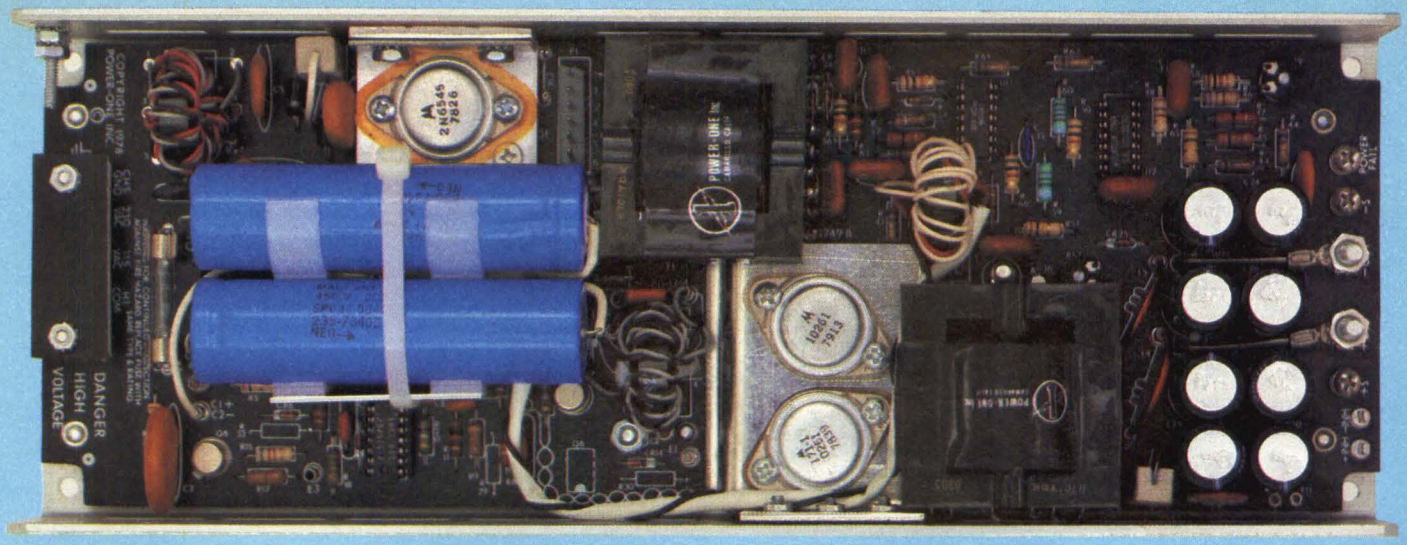
@ABCDEFGHI JKLMNOPQRS
TUVWXYZ[\]^_ !"#$%&'

Graphics/alphanumeric printout



gulton®

Measurement & Control Systems Division
Gulton Industries Inc., East Greenwich, Rhode Island 02818
(401) 884-6800 • TWX 710-387-1500



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.

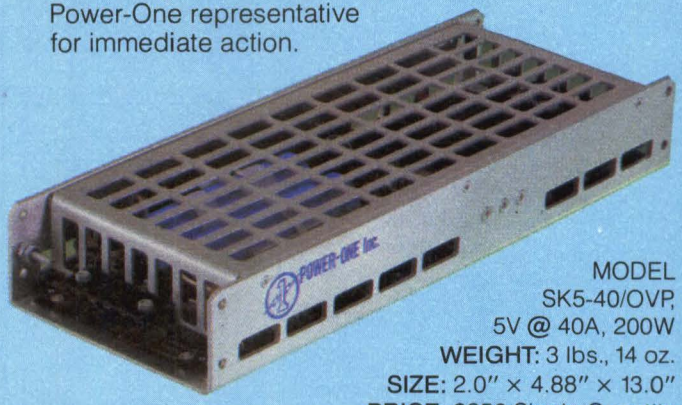
Safeguard Design

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 91 ON INQUIRY CARD

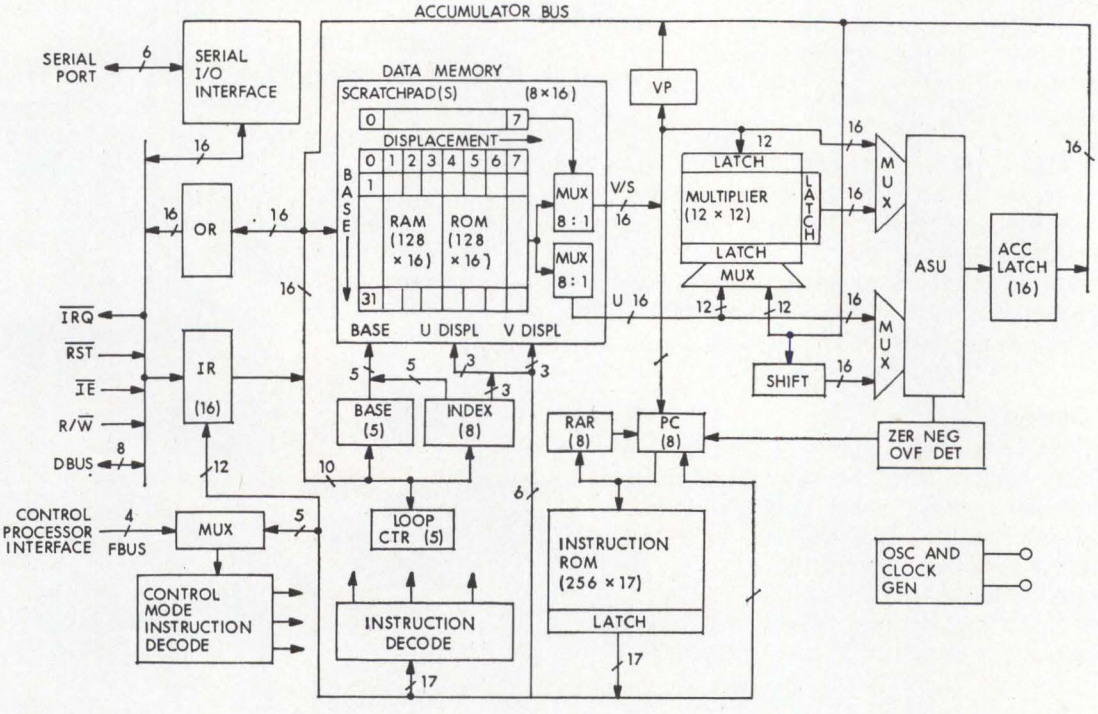
Signal Processing Chip Operates As Microprocessor Peripheral

Customer developed arithmetic routines are available from a high speed VMOS signal processing peripheral (SPP) when it is interfaced to a microprocessor. The S2811 from American Microsystems Inc, 3800 Homestead Rd, Santa Clara, CA 95051, is a special purpose processor with onchip ROM, RAM, multiplier, adder/subtractor, accumulator, I/O, and 20-MHz crystal oscillator circuit, organized in a pipelined structure. Operating on 12-bit numbers, it can provide a multiply, add, and store sequence in 300 ns.

The microprocessor can call up an arithmetic routine by giving a command to the SPP. A powerful instruction set (including branching and one level of subroutine) permits the SPP to function independently once the initial command is given. This leaves the microprocessor free to perform other operations until it is interrupted by the peripheral upon completion of the task. The high speed number crunching capability of the SPP gives a standard microprocessor system the necessary computational speed to implement complex digital algorithms in real time. (For a comparison between this and other approaches to arithmetic processing, see "External Arithmetic Processors" by S. Smith, *Computer Design*, Dec 1978, pp 144-149).

User programs are stored in a 256 x 17 read only memory. Of the 256 instruction locations in this ROM, 250 are accessible to the user, the remaining 6 locations being reserved for chip testing. The 17-bit wide instruction word facilitates multiple operations per instruction. One example of the programmable capability of the SPP is its use as a second order digital filter section. A second example is that of a sincos subroutine that computes the values of sin ω and cos ω using an approximation formula, useful in applications that require carrier generation. In general, the SPP is programmable for digital processing of signals in voice-grade communications systems and other applications with signals in the audio frequency range.

A high speed serial port provides direct interface to an analog to digital converter. In many applications,



Monolithic signal processing peripheral. S2811 from AMI permits user to utilize 256 x 17 instruction ROM for special arithmetic requirements. Fast 12-bit parallel multiplier on chip provides 300-ns (max) multiplication time

WHEN IT COMES TO PUTTING IT ALL ON DISPLAY, THE ORION-60/S4 STANDS ALONE.

Magnavox combines the superior display and control features of the plasma-panel-based Orion-60 terminals with the powerful S4 Micro-Computer System.

The result is a stand alone graphics system that allows you the freedom to develop a wide variety of graphics application and development programs—while maintaining complete control over program storage, program-generated data, library routines and other facilities.

The Orion-60 display terminal offers full graphics with floppy-disc storage, as well as optional rear-projection functions. It lets you create your own displays and enter data by simply touching the screen with your finger. So you can program your own character sets and generate vectors of any length to absolute coordinates. And because the Orion-60 is plasma-based, you'll get bright, high-contrast images free of jitter or distortion.

The S4 Micro-Computer has system software with development capabilities that are as good or better than those found in many larger computer systems.

Features include CP/M* 8080 system utilities, Fortran with 32K RAM, and a full range of graphic utility routines including window, zoom, sub-image movement and rotation.

The Orion-60/S4.

For a demonstration, call or write Tyler Hunt at Magnavox Display Systems, 2131 South Coliseum Boulevard, Fort Wayne, Indiana 46803, (219) 482-4411.

Magnavox
DISPLAY SYSTEMS

**CP/M is a trademark of Digital Research.*

CIRCLE 92 ON INQUIRY CARD

realtime processing of sampled analog data can be performed within the SPP without tying up the main microprocessor. Data transfer to the microprocessor occurs upon completion of the peripheral processing.

An onchip data memory is divided into RAM and ROM sections, each organized as 128 x 16. There is a single input port to the total memory and two output ports, allowing simultaneous readout of two words.

Separate input and output registers exchange data with the SPP data ports. Serial interface logic converts the parallel 2's complement data to serial 2's complement or sign + magnitude format. Data format and source (serial or parallel port) is software selectable.

Four address lines define several control modes and operations to facilitate the interface between the SPP and a control processor. The SPP is a memory mapped peripheral, occupying 16 locations of microprocessor memory space. Providing the proper address will activate the corresponding control mode. Control modes include such operations as resets, specifying of MSB or LSB, the conversion between 2's complement and sign-magnitude serial data, and the enabling of specified ports. The control modes and the LIBL command (load input register contents to base register and loop counter) enable realtime modification of programs. This permits a single SPP program to be used in several different applications. For example, the peripheral might be programmed as a universal digital filter, with cutoff frequency, filter order, and data source (either serial or parallel port) selected at execution time by the control microprocessor.

A realtime in-circuit emulator for this device, the RTDS2811, is under development. This is a fully compatible hardware emulator with software assembler/disassembler and editor for rapid program development and debugging.

Absolute maximum ratings for the signal processing peripheral include an upper limit of 7 Vdc for supply voltage, with voltage at any pin limited to a range from $V_{SS}-0.3$ V to $V_{CC}+0.3$ V. Temperature must remain between 0 and 70 °C during operation and between −55 and 125 °C in storage. The device is provided in a 28-pin dual-inline package.

Circle 350 on Inquiry Card

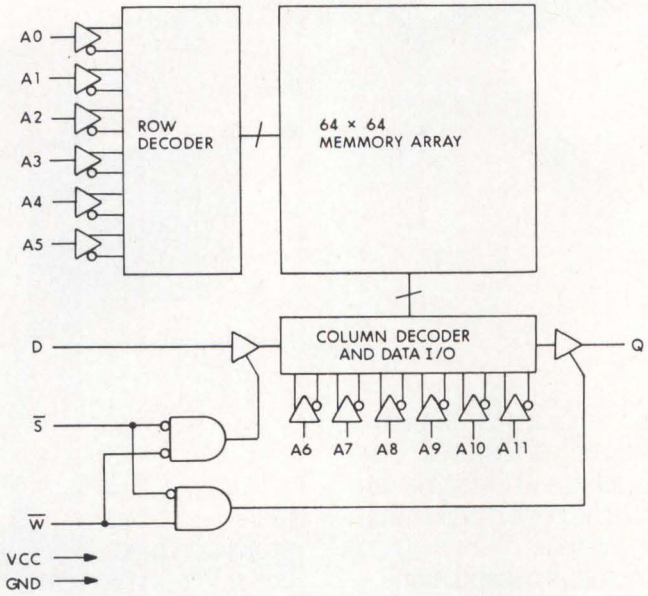
4k Static RAM Features Low Supply Current

A 4096-bit static random access memory, the 2147, pin and function compatible with the industry standard 2147 RAM, is being sampled by Intersil Inc, 10710 N Tantau Ave, Cupertino, CA 95014. Typical operating supply current is 50 mA, or (for the faster -3 suffix version) 60 mA, an approximate 50% reduction relative to the standard part. Maximum ratings are, respectively, 160 and 180 mA. Access time is 70 ns (55 ns for the -3 version). Both models are being manufactured by an advanced 3.5-μ fine-geometry NMOS process.

These RAMS feature a fully automatic power-down mode, controlled by chip select ($\overline{S}$). Less than one cycle time after $\overline{S}$ goes high, supply current drops from 160 mA to a standby level of 20 mA, or from 180 to 30 mA for the -3 model. The completely static device requires no clock, and inputs and 3-state outputs are TTL compatible, allowing for direct interfacing with common bus system structures.

This memory is organized as 4096 words by 1 bit and operates off a single 5-V power supply with a ±5% supply fluctuation tolerance. Data are read out nondestructively with the same polarity as the input data. The device is available in an 18-pin ceramic dual-inline package.

Absolute maximum ratings require that VIN, voltage on any pin relative to ground, lies between −0.5 and 7 V, and that IOS, short circuit output current, does not exceed 20 mA. Ambient temperature under bias must remain between −10 and 85 °C and storage temperature between −65 and 150 °C. Power dissipation must not exceed 1 W.



2147 static RAM from Intersil. Pin compatible with industry standard, device provides same access time, but with approximately 50% lower typical supply current. Pins A0-A11 are address inputs, D and Q are data input and output (respectively), $\overline{S}$ is chip select, and $\overline{W}$ is write enable

Circle 351 on Inquiry Card

Another new terminal from Hazeltine!

Hazeltine 1552

Announcing a significant enhancement to the renowned Hazeltine 1500 Series. With an inventory of Standard Features so impressive, this new video terminal commands your attention for conversational applications.

Standard Features

All 128 ASCII Codes
95 Displayable Characters including Lower Case plus 31 graphics symbols
✓High Resolution Characters using a 7 × 10 dot matrix
ANSI Standard Typewriter layout
Cursor Control Keys
Function Keys
Alternate Key Pad Mode
Separate Integral Numeric Pad
Hold Screen Mode
Graphics Mode
✓Dual Intensity
Cursor Addressing and Sensing
EIA and 20 MA Interface
Baud Rates up to 9600 Baud
✓Auxiliary EIA Output
Remote Editing Commands
✓Standard or Reverse Video
✓Programmable Key Switch Audio Feedback
VT-52 Compatibility
✓Clear Screen
✓Clear Foreground
Clear to End of Line
Clear to End of Screen (background spaces)
Audible Alarm
Backspace
✓Keyboard Lock
✓Keyboard Unlock
✓Insert Line
✓Delete Line
✓Field Tab
Column Tab
Enter/Exit Hold Screen Mode
Enter/Exit Alternate Key Pad Mode
Enter/Exit Graphics Mode
Send Terminal ID
✓Set/Reset Audio Key Switch Feedback
Cursor Address (XY)
Incremental Cursor Control
✓Read Cursor Address
Home Cursor

We interrupt this advertisement to bring you this special message...

VT-52 Users, here's the terminal you've been looking for. The Hazeltine 1552.

Besides fitting directly into your DEC system, it costs you much less. And it's available for immediate delivery!

But that's just for starters. Of even greater significance are these two important bonuses:

"QUALITY" BONUS...the kind of Quality you've come to expect with every terminal bearing the famous Hazeltine name, backed by Hazeltine's exceptional Warranty Program. Ask for details!

"FEATURES" BONUS... with the impressive roster of Standard Features listed on this page, the Hazeltine 1552 more than matches the VT-52. Plus! All Features checked (✓), while standard on the Hazeltine 1552, are not available on the VT-52!

We now return you to the ad in progress.

It's a Hazeltine naturally!

Hazeltine

Hazeltine Corporation, Computer Terminal Equipment, Greenlawn, New York 11740, (516) 549-8800 Telex 96-1435
New York (212) 586-1970 • New Jersey (201) 584-4661 • Chicago (312) 986-1414 • San Francisco (415) 342-6070 • Atlanta (404) 952-8444 • Arlington (703) 979-5500
Orlando (305) 628-0132 • Dallas (214) 980-9825 • Los Angeles (213) 553-1811 • Columbus (614) 889-6510 • St. Paul (612) 698-0801
England 01-948-3111 Telex (851) 928572

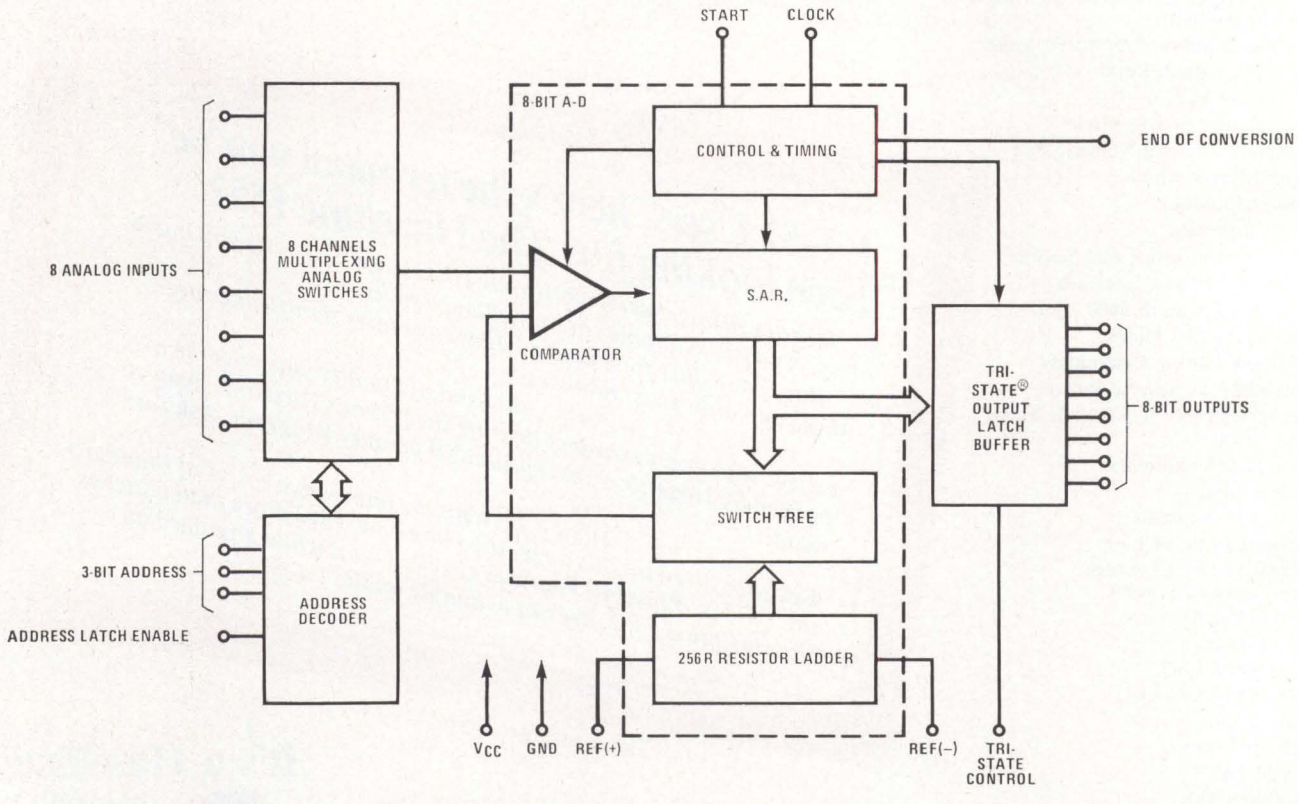
µProcessor Compatible Data Acquisition System Implemented On One Chip

Incorporating all the essential elements of a microprocessor data acquisition system, a monolithic CMOS integrated circuit includes an 8-bit analog to digital converter, an 8-channel multiplexer, and microprocessor compatible control logic. The device requires no offset or scale adjust and features a single 5-V supply and 15-mW power consumption.

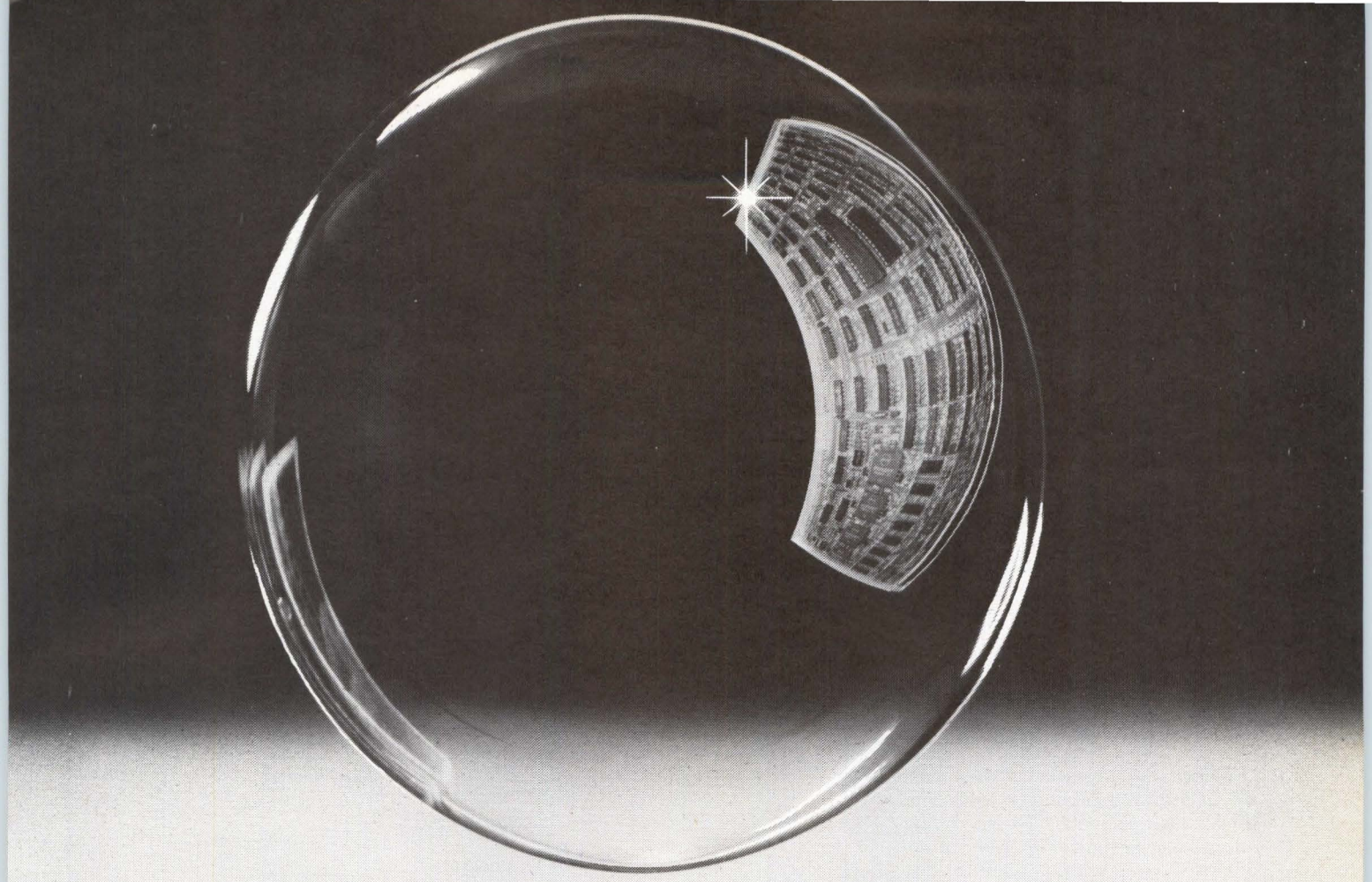
A successive approximation conversion technique is used, employing a high impedance chopper-stabilized comparator, a 256-resistor voltage divider with analog switch tree, and a successive approximation register. The chopper-stabilized comparator is said to provide the most effective and accurate conversion possible, making the entire device extremely immune to temperature, long-term drift, and input offset errors. This is done by transforming the dc input signal into an ac signal before amplification and then restoring the dc level after amplification. The 256-resistor ladder network approach was chosen over the more conventional R/2R ladder technique because of its inherent monotonicity, which guarantees no missing codes.

Produced bv National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95051, the system is available in two versions. The ADC 0808, supplied in a 28-pin cavity dual-inline package, features a linearity error of ±¼ LSB (typ) and ±½ LSB (max), a total unadjusted error of ±¼ LSB and an absolute accuracy of ±¾ LSB (typ) and ±1¼ LSB (max). Supplied in a molded DIP configuration, the 28-pin ADC0809 has a linearity error of ±½ LSB (typ) and ±1 LSB (max), a total unadjusted error of ±½ LSB, and an absolute accuracy of ±1 LSB (typ) and ±1½ LSB (max).

Features common to both versions include the ability to perform a conversion in 100 µs, 8-bit resolution, zero error and full-scale error of ±¼ LSB, and quantization error of ±½ LSB. The 8-channel multiplexer can directly access any of eight single-ended analog signals. Latched and decoded address inputs and



National Semiconductor's ADC0808/0809 CMOS data acquisition system. Implemented on single chip, 8-bit converter uses successive approximation, employing chopper-stabilized comparator. Device interfaces to most 8-bit microprocessors



Plessey bubble memories

standard add-ons and custom-built

Now you can confidently incorporate UK-originated bubble memories in your next development: Plessey is fully equipped to design and produce to your spec. Or you can buy add-in bubble memory cards for your Intel SBC systems. Plessey has a range of compatible systems actually in production – the first in Europe. Shouldn't you be talking to us now?

Here are some Plessey bubble memory pluses:

- Rugged, maintenance-free, non-volatile storage at a lower cost than CMOS + battery.
- More compact, more reliable and faster than disc or cassette.
- 64 k or 256 k byte Multibus*compatible cards.
- Software compatible.
- Low power requirement.

Reliable products from a specialist manufacturer with many years' experience of standard and custom-built memories — and, currently, Europe's only source of bubble systems.

Contact Plessey Microsystems sales office to discuss your needs for the future, or send for your copy of the Bubble Memory Systems literature folder.

SEE PLESSEY BUBBLE MEMORY SYSTEMS

at COMPEC, 6-8 November on Stand 868.

PLESSEY MICROSYSTEMS

Plessey Microsystems Limited, Water Lane, Towcester, Northants NN12 7JN.
Telephone: Towcester (0327) 50312. Telex: 31628.

Plessey Microsystems Inc, 19546 Clubhouse Road, Gaithersburg, Maryland 20760.
Telephone: (031) 948 2791. TWX: 710 828 9708
and at 1641 Kaiser Avenue, Irvine, California 92714.
TWX: 910 595 1930.

CIRCLE 94 ON INQUIRY CARD

*Intel trademark.

latched Tri-State® TTL outputs facilitate easy interfacing to most 8-bit microprocessors, including the 8060 SC/MP (by the same manufacturer), 8080, 8085, Z80, and 6800.

These 8-bit data acquisition chips are designed for users who may not require the full 16-bit multiplexing capability of the ADC0816, an existing monolithic device in the same product line. The newly announced units use the same techniques to provide fast, accurate operations with minimal power consumption. They are particularly suited to such applications as process control, industrial control, and machine control.

Octal Buffer/Latch Simplifies Interfacing Of Peripherals to μPs

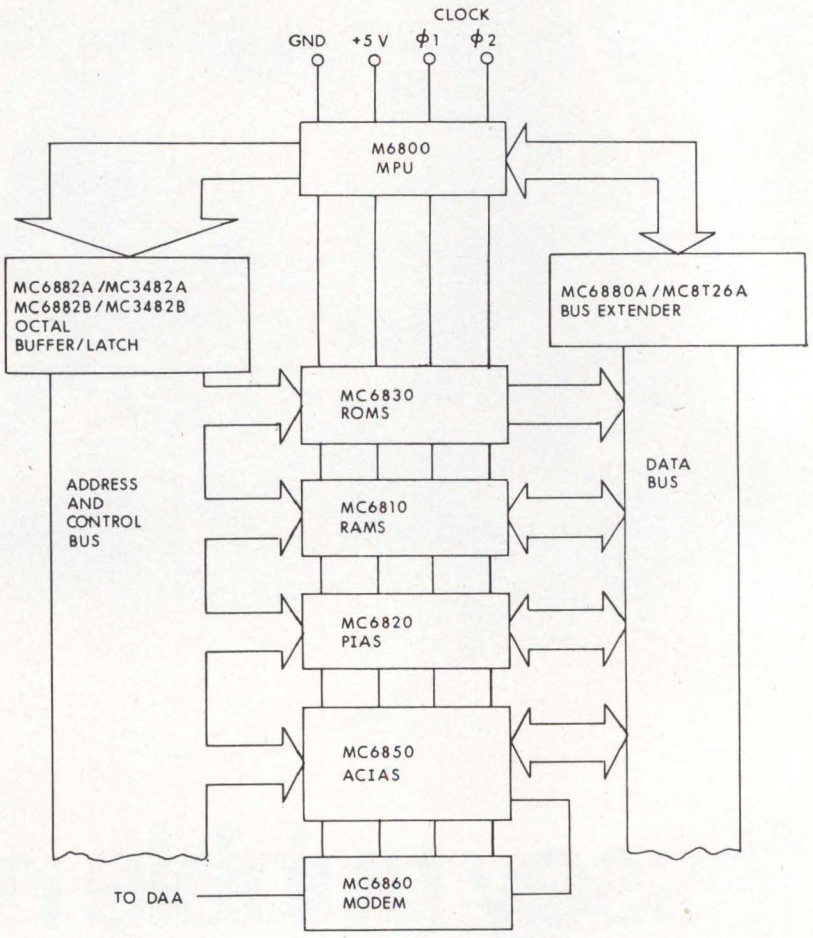
Designed to interface between an 8-bit microprocessor and a loaded address bus, an octal 3-state buffer/latch has a propagation delay of only 8.0 ns (typ), with an output drive capability of 48 mA. Two octals eliminate the need for three previously used hexadecimal buffers and two octal latches, offering a cost saving and allowing higher system speed.

Eight transparent latches and buffers are included in a single package. The combined unit from Motorola Semiconductor Products Inc, PO Box 20912, Phoenix, AZ 85036, is designated as the MC6882/MC3482. These devices are offered in both inverting (A suffix) and noninverting (B suffix) versions. The manufacturer indicates that they are pinout and functionally compatible with the SN74LS373, a 3-state latch, while offering over double the output drive capability with equivalent speeds. In addition, they feature buffered control inputs, and all inputs have hysteresis to improve noise rejection.

Additional characteristics include a single 5-V power supply, full parallel access for loading and reloading, and high impedance pnp inputs to assure minimal loading of the bus. The devices are based on Schottky technology and interface with a wide range of microprocessors, including M6800 microprocessor systems.

Absolute maximum ratings limit power supply voltage, V_{CC}, to 8.0 Vdc and input voltage to 5.5 Vdc. Allowable temperature range is 0 to 75 °C in operation and −65 to 150 °C in storage. The devices are provided in 20-pin ceramic dual-inline packages. Prices in hundreds are $2.80 for the inverting and $2.90 for the noninverting models.

Circle 352 on Inquiry Card

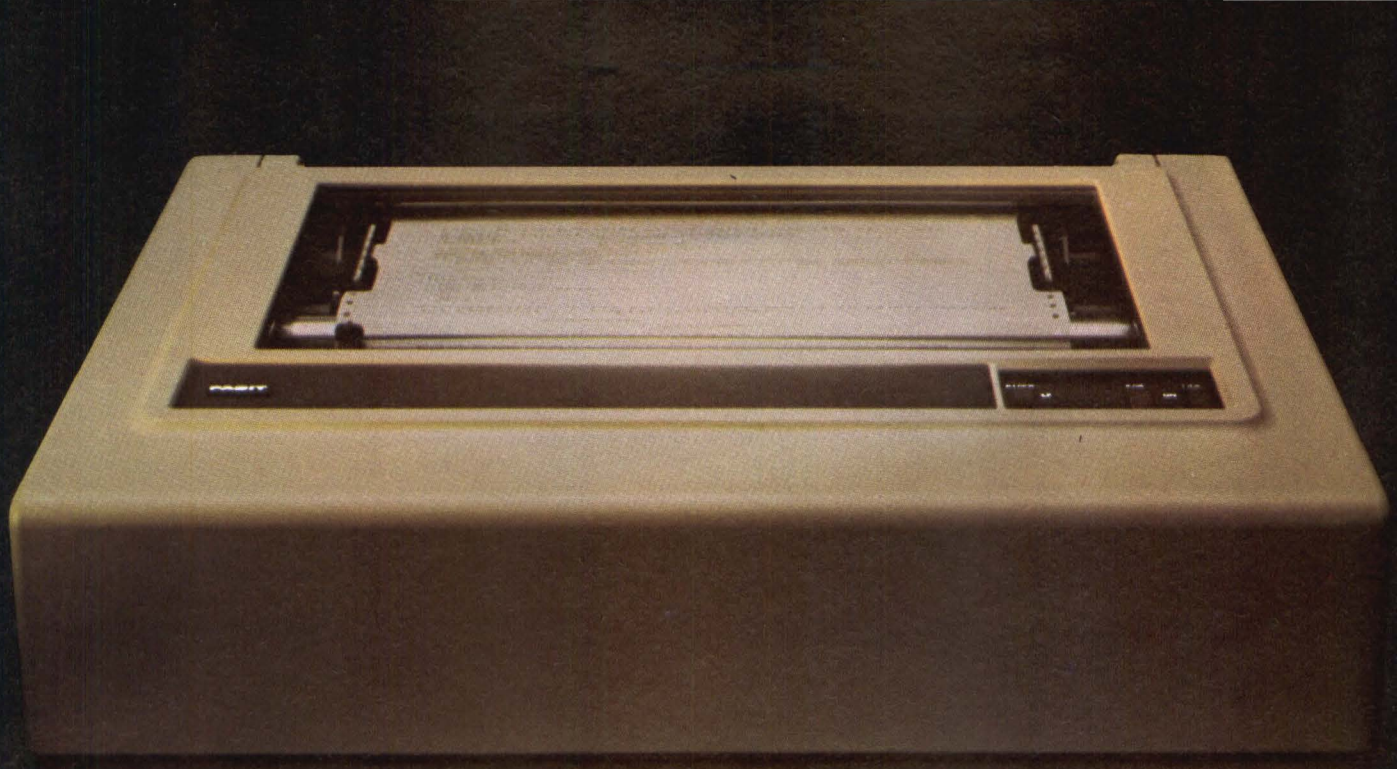


Microprocessor bus extender application utilizing MC6882/MC3482. Combined octal buffer/latch from Motorola can be used in latched or unlatched mode depending on application

Floating Point Chip Performs 32- And 64-Bit Operations

Single precision (32-bit) and double precision (64-bit) add, subtract, multiply, and divide operations are provided by a floating point arithmetic peripheral processing unit. All transfers, including operand, result, status, and command information, take place over an 8-bit bidirectional data bus, compatible with a wide range of 8- and 16-bit microprocessors. Internally, the monolithic device employs a microprogram controlled, stack oriented architecture with 16-bit wide data paths. Operands are pushed onto an internal stack, and a command is issued to perform operations on the data in the stack. Results are then available to the host processor by popping the stack, or additional commands may be entered.

The Am9512 floating point processor unit (FPU) from Advanced Micro



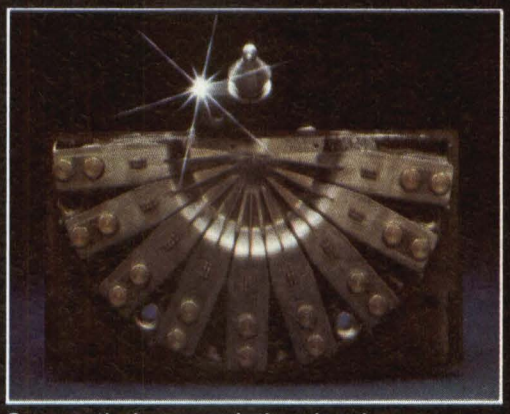
THE FACIT 4540 PRINTER REALLY USES ITS HEAD.

The printhead on the Facit 4540 Serial Matrix Printer is so advanced, it practically thinks for itself.

A new concept of printhead design uses 9 stored force flexible hammers to print a 9 x 9 dot matrix pattern bi-directionally at 250 cps.

The printhead movements have been reduced to a minimum. The printing principle assures extraordinarily long printhead life. With no adjustment, no lubrication and practically no wear. In fact, outstanding sharp and consistent printing results are guaranteed for more than a minimum of 500 million characters before any service might be required on the printhead.

The Facit 4540 is a prime example of the integration of mechanics and electronics which has made Facit peripheral data products world famous.



Our revolutionary printhead makes Facit 4540 a matrix printer with line printer speed.

Write for more detailed information on how the 4540 Printer can get the most out of your system.

Facit, Inc., 66 Field Point Road, Greenwich, CT 06830

FACIT DATA PRODUCTS

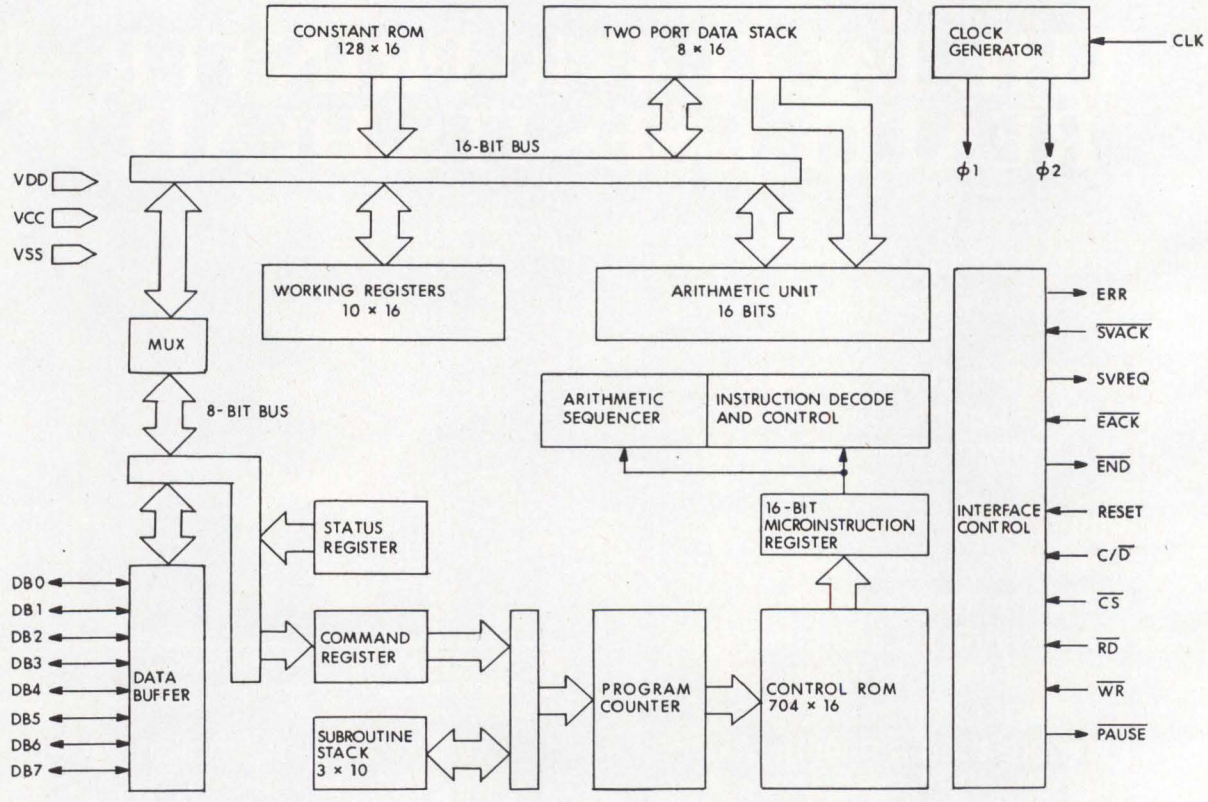
CIRCLE 95 ON INQUIRY CARD

Devices Inc, 901 Thompson Pl, Sunnyvale, CA 94086, supplements the existing Am9511A by the same manufacturer (see "External Arithmetic Processors" by S. Smith, *Computer Design*, Dec 1978, pp 144-149). Each is intended for nearly mutually exclusive markets, with the higher execution speeds and derived functions of the earlier device better suited for realtime applications. The newly announced FPU, on the other hand, is particularly oriented toward applications requiring high precision and wide dynamic range, such as data processing, scientific instrumentation, and educational systems.

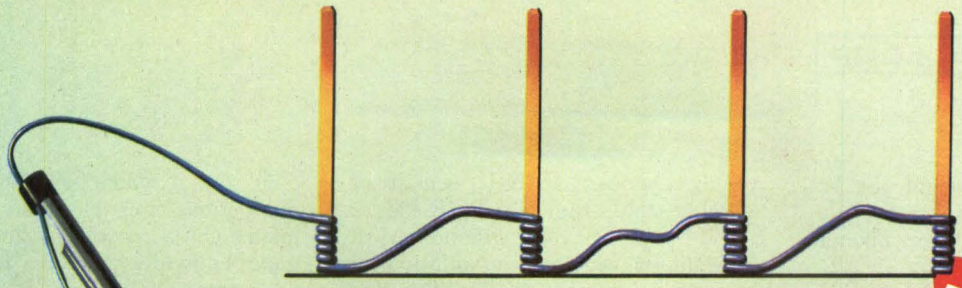
Transfers to and from the 9512 can be handled by the associated processor using conventional programmed I/O, or by a direct memory access controller for improved performance. Upon completion of each command, the FPU issues an end-of-execution signal that can serve as an interrupt to the CPU, helping to coordinate program execution. It also provides an error-output signal and status register to indicate the specific error.

In its single-precision 32-bit mode, it has a dynamic range of $2^{\pm 127}$ (6-bit exponent plus sign) and 24-bit precision. Double-precision or 64-bit operations increase the dynamic range to $2^{\pm 1024}$ (10 bits plus sign) and precision to 52 bits. Minimum command execution times for single-precision operations using a 2-MHz clock are 28 μs for an add or subtract, 93 μs for multiplication, and 111 μs for division. Equivalent double-precision execution times are 276, 253, 768, and 2043 μs, respectively. A complex rounding algorithm causes it to be slightly slower than the Am9511A, which truncates results.

Other characteristics include versatility of interface (to almost any microprocessor), 12- and 15-V power supplies, and 850-mW power dissi-



Am9512 floating point processor. Peripheral device, from AMD, implemented on single chip provides single-precision (32-bit) and double-precision (64-bit) arithmetic operations upon request from host microprocessor



WHY CUT? WHY STRIP? WHY SLIT?
WHY NOT...

NEW

JUST WRAP™

WIRE WRAPPING TOOL

- AWG 30 Wire
- .025" Square Posts
- Daisy Chain or Point To Point
- No Stripping or Slitting Required

...JUST WRAP™...

- Built In Cut Off
- Easy Loading of Wire
- Available Wire Colors: Blue, White, Red & Yellow

traditional Wire-Wrapping

JUST WRAP Wire-Wrapping

U.S.A., FOREIGN PATENTS PENDING

JUST WRAP TOOL WITH ONE 50 FT. ROLL OF WIRE		
COLOR	PART NO.	U.S. LIST PRICE
BLUE	JW-1-B	$14.95
WHITE	JW-1-W	14.95
YELLOW	JW-1-Y	14.95
RED	JW-1-R	14.95
REPLACEMENT ROLL OF WIRE 50 FT.		
BLUE	R-JW-B	$ 2.98
WHITE	R-JW-W	2.98
YELLOW	R-JW-Y	2.98
RED	R-JW-R	2.98
JUST WRAP-UNWRAPPING TOOL		
	JUW-1	$ 3.49

ok®

OK MACHINE & TOOL CORPORATION 3455 CONNER ST., BRONX, N.Y. 10475 (212) 994-6600/TELEX 125091

*MINIMUM BILLING $ 25.00/ADD SHIPPING CHARGE $ 2.00/NEW YORK CITY/STATE RESIDENTS ADD APPLICABLE TAX.

CIRCLE 96 ON INQUIRY CARD

pation (typ). The command list includes add, subtract, multiply, divide, copy, delete, exchange, change sign, and push zero.

Fabrication is based on n-channel, silicon gate MOS technology. The device is provided in a 24-pin package and undergoes 100% MIL-STD-883 reliability assurance testing.

Circle 353 on Inquiry Card

Fast-Settling 12-Bit DACs Need No Trimming

A maximum settling time of 1 μs to $\pm\frac{1}{2}$ LSB is provided by 12-bit monolithic CMOS digital to analog converters, featuring double layer metal interconnections for improved high speed operation and lower cost. Precision thin-film deposition resistors provide 12-bit linearity without laser trimming, thus eliminating any long-term instabilities that laser trimming might introduce. The use of compensating FET switches in the feedback resistor at the end of the ladder chain reduces gain error temperature coefficient to a max of 2 ppm/°C.

Input current requirement is 2 mA (max) with less than 30 mW of power dissipation. The multiplying DACs, pin for pin replacements for Analog Device's AD7541, consist of a highly stable thin film R-2R ladder and 14 CMOS current switches. Most applications require the addition of an output operational amplifier and a voltage or current reference.

The 8641 from Teledyne Semiconductor, 1300 Terra Bella Ave, Mountain View, CA 94043, is the premium part with guaranteed 12-bit linearity for the designer who requires $\pm\frac{1}{2}$ LSB (0.012%) accuracy. The 8640 provides reduced accuracy of ± 1 LSB (0.024%) linearity error with 12-bit resolution.

Circle 354 on Inquiry Card

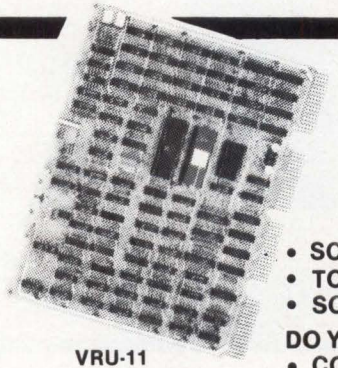
Quad Op Amps Combine Bipolar Programming With FET Characteristics

Consisting of four independent, high gain, internally compensated BIFET op amps, a family of programmable quad operational amplifiers combines the high input impedance and wide bandwidth characteristics of FET input devices with the programming capability of conventional bipolar devices. The four op amps within one of these amplifiers can be externally programmed by a separate set of control signals. This allows the user to optimize the performance of any one op amp on the chip for a given allowable power dissipation, to select such performance characteristics as slew rate and gain-bandwidth product. The circuits are suited to active filter applications in telecommunication systems and channel bank filters, where circuit power dissipation is often a critical factor.

Produced by Exar Integrated Systems, Inc, 750 Palomar Ave, Sunnyvale, CA 94088, the 18-pin XR-096, the most versatile of the family, permits independent programming of each of its four op amps. The other two models are provided in 16-pin DIPs and have two independent programming pins. In the XR-094, one pin controls three of the chip's op amps and another controls the fourth, while in the XR-095, each programming pin controls two op amps, allowing the user to program them in pairs. These three monolithic circuits are the programmable versions of Texas Instruments' TL-074 and TL-084 series operational amplifiers.

Absolute maximum ratings establish allowable ranges of ± 18 V for supply voltage, ± 15 V for input voltage, and ± 30 V for differential input voltage. Package power dissipation may not exceed 625 mW for the plastic package (derated by 5.0 mW/°C above $T_A = 25$ °C) or 750 mW for the ceramic package (derated by 6.0 mW/°C above 25 °C).

Circle 355 on Inquiry Card



VRU-11
for the PDP-11/04
through 11/70

Also available for
the PDP8A, E, F, M

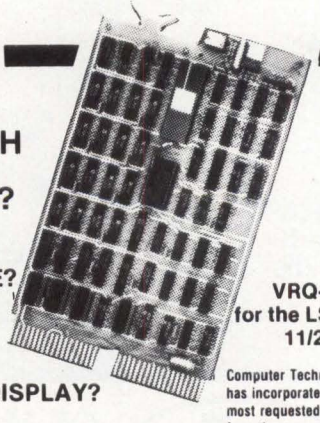
DEC USERS

ARE YOU HAVING PROBLEMS WITH
YOUR CRT DISPLAY APPLICATION?

- SCREEN UPDATES BOGGING DOWN SOFTWARE?
- TOO MANY INTERRUPTS TO SERVICE?
- SCREEN GLITCHES AND POOR APPEARANCE?

DO YOU NEED?

- COMBINED INTERACTIVE AND BACKGROUND DISPLAY?
- NEED FORMAT FLEXIBILITY?
- NEED GRAPHICS, LIGHT PEN?



VRQ-11
for the LSI-11/2
11/23

Computer Technology has incorporated the most requested features from three years of video display experience into its newest cross-compatible family of video products. These features are available to your application NOW.

CHECK THE CAPABILITIES OF THE LATEST VIURAM
PROGRAMMABLE DIRECT ACCESS VIDEO INTERFACES

COMPUTER TECHNOLOGY 3014 LAKESHORE AVENUE OAKLAND, CALIFORNIA 94610 (415) 465-9000

MULTIBUS® compatible memory systems

MONOLITHIC LOWERS PRICES UP TO 33%!

4K to 64K RAM Up to 16K EPROM on one board.

Now you can have RAM and EPROM on the same board and buy as much or as little memory as you need. And because our memories use 16 pin memory element sockets you can change your memory when you change your mind.

Speaking of changing your mind, when you want to change address locations of either RAM or EPROM, it's done with two, on-board switches—providing 16 possible start locations for each memory.

Compare these features with our much improved read, write and refresh cycle times and you'll choose MSC first.

16K RAM Version

Up to 16K x 8 of RAM and up to 16K x 8 of EPROM on the same board.

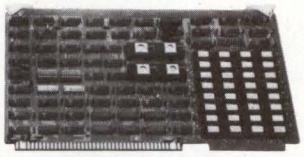
RAM expandable in 4K x 8 increments and EPROM expandable in 1K, 2K or 4K x 8 increments.

On-board DIP switches to select any of 16 address start locations for RAM and 16 address start locations for EPROM.

Cycle times:
Read, 350 nsec.
Write, 500 nsec.
Refresh, 500 nsec.

Totally MULTIBUS hardware and software compatible.

Limited one year warranty on parts and labor.



MSC 4502 . . . . . *$710*

NOW $675* (16K)

64K RAM Version

Up to 64K x 8 of RAM and up to 16K x 8 of EPROM on the same board.

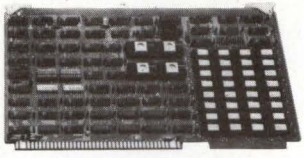
RAM expandable in 16K x 8 increments and EPROM expandable in 1K, 2K or 4K x 8 increments.

On-board DIP switches to select any of 16 address start locations for RAM and 16 address start locations for EPROM.

Cycle times:
Read, 350 nsec.
Write, 500 nsec.
Refresh, 500 nsec.

Totally MULTIBUS hardware and software compatible.

Limited one year warranty on parts and labor.



MSC 4602 . . . . . *$2175*

NOW $1690* (64K)

More MULTIBUS

Monolithic Systems has a full line of MULTIBUS compatible hardware and software products, including the MSC 8001, Z-80 based single board computer.

For more information call us today.

MULTIBUS compatible systems... from the leader.

Monolithic Systems corp.

14 Inverness Drive East
Englewood CO 80112
303/770-7400

MULTIBUS is a registered trademark of Intel Corporation.

©1978, Monolithic Systems Corp.

*Even greater savings on quantity.

12-Bit ADC Replacement Operates Faster and Uses Less Power

A 12-bit hybrid analog to digital converter provides a 5-μs conversion time and $\pm\frac{1}{2}$ LSB ($\pm$0.012% fsr) linearity error, with power consumption of 1.6 W (typ). The ADH-8586 is a pin compatible replacement for the industry standard ADC-85, but operates at twice the speed, with reduced power, and extends the maximum operating temperature from 85 to 125 °C.

Typical applications include data acquisition systems, automatic test equipment, and electronic countermeasure systems. Produced by ILC Data Device Corp, Airport International Plaza, Bohemia, NY 11716, the ADC is processed to MIL-STD-883. With optional burn-in, its MTBF is 1.6 x 10^6 hours for ground fixed conditions and 25 °C case temperature.

The converter has five pin programmable input voltage ranges: 0 to 5 V and 0 to 10 V with complementary binary coding, or $\pm$2.5, $\pm$5, and $\pm$10 V with complementary offset binary coding. An internal input buffer amplifier can be used to increase the input impedance to 100 MΩ with only a slight reduction in speed. Speed can be increased by short cycling and by programming the internal clock for higher clock rate. A 3-μs conversion time and 300-kHz word rate can be obtained with 10-bit resolution.

Two power supplies of $\pm$15 and $\pm$5 V are required. The device is housed in a 32-pin hermetically sealed triple DIP metal case, having dimensions of 1.75 x 1.05 x 0.22″ (4.45 x 2.67 x 0.56 cm) and a weight of 0.67 oz (19 g). A lower speed option, the ADH-8585, consumes only 1.2 W (typ) with a 10-μs conversion time.

Circle 356 on Inquiry Card

Low Noise Op Amps Are Second Sourced

Monolithic operational amplifiers having equivalent input noise voltages of 4.0 and 3.5 nV/$\sqrt{\text{Hz}}$ (both typical values) are being offered on a second source basis by Texas Instruments Inc, PO Box 225012, Dallas, TX 75265. The devices are, respectively, the NE5534 and NE5534A, designed to be interchangeable with the Signetics parts having the same designations. In addition to the typical equivalent input voltage of 3.5 nV/$\sqrt{\text{Hz}}$, the -A suffix model has a guaranteed maximum of 4.5 nV/$\sqrt{\text{Hz}}$.

These op amps typically exhibit a unity-gain bandwidth of 10 MHz, a common mode rejection of 100 dB, a large signal differential voltage amplification of 100 V/mV, a pk-pk output voltage swing of 32 V, a high slew rate of 13 V/μs, and the ability to drive a 600-Ω load. They operate over a large range of supply voltages, $\pm$3 to $\pm$20 V, and have output short circuit protection and input diode protection. Both models are characterized for operation over the commercial temperature range of 0 to 70 °C.

The op amps are internally compensated for a gain equal to or greater than three. Optimization of the frequency response can be achieved by use of an external compensation capacitor.

Circle 357 on Inquiry Card

Low Resolution Monolithic 4-Bit ADC Samples 30M Bits/s

Claimed by its manufacturer, TRW LSI Products, PO Box 1125, Redondo Beach, CA 90278, to be the industry's only monolithic 4-bit analog to digital converter available off the shelf, the TDC-1021J is available at $29 in hundreds. It can digitize an analog signal at rates from dc to 30M samples/s without an external sample and hold circuit. The single chip is fully parallel, TTL compatible, and utilizes 1k closely matched bipolar components.

It finds application where high speed, small size, and low cost are important but high resolution is not. Among these applications are video data conversion, radar data conversion, high speed multiplexed data acquisition, image processing, and facsimile systems.

The circuit comprises 15 sampling comparators, combining logic, and an output buffer register. A single convert signal controls the unit operation. Additional capabilities include the option of binary or 2's complement output, two power sources (5 V and −6 V), 250-mW power dissipation, and an operating temperature range from −60 to 150 °C. Linearity is $\pm\frac{1}{8}$ LSB, and aperture jitter is 30 ps. The package is a 16-pin ceramic DIP that measures 0.3 x 0.8 x 0.17″ (0.76 x 2.0 x 0.43 cm).

Circle 358 on Inquiry Card

4k Static RAM Offers Access Time Options From 150 to 450 ns

A 4096-bit static random access memory, the EA2114L, is available in five models offering access time options ranging from 150 to 450 ns. Produced by Electronic Arrays Inc, 550 E Middlefield Rd, Mountain View, CA 94043, and organized as 1024 x 4, the NMOS RAM is designed for memory applications where realtime I/O access, large storage, easy interface, and high performance are important, such as in microcomputers, video terminals, communication equipment, and computer peripherals.

Other characteristics include TTL compatibility, a single 5-V power supply, $\pm$10% voltage supply margins, and 80 °C/W package thermal resistance. The memory offers economy through the elimination of dynamic clocks, strobes, and refresh circuits, as well as a compact density of 0.5M bits/ft^2 (5.4M bits/m^2) of printed circuit board. It is system compatible with other static ROMS and EPROM elements.

Circle 359 on Inquiry Card

Low Cost 64-Word FIFO Guarantees >5-MHz Shift In/Shift Out Rate

A first in, first out (FIFO) bipolar serial memory is designed to fill the gap between very slow (1-MHz) MOS and very fast (10-MHz) memories. Having a storage capacity of 64 4-bit words and a shift in, shift out rate of 5 MHz (guaranteed), 8 MHz (typ), the single-chip memory is available at $13.80 in hundreds.

The S67401 from Monolithic Memories Inc, 1165 E Arques Ave, Sunnyvale, CA 94086, is intended to provide a less expensive alternative to high speed FIFOs in temporary data storage and data rate matching applications that do not require a maximum transfer rate. Its high density and medium I/O speed increase the options available to the designer of such devices as communication buffers, disc controllers, and Winchester type disc drives.

Additional characteristics include TTL inputs and outputs, asynchronous or synchronous operation capability, and packaging in a 16-lead, 0.3″ (0.8-cm) wide DIP. It is readily expandable in bit dimensions, although not cascadable in a word direction.

Circle 360 on Inquiry Card

Grab the Competitive Edge in data acquisition systems, free.

Today's advanced microprocessors and digital processing systems require high performance components to interface the digital/analog world. Harris Semiconductor has assembled a design file which presents a family of performance-proven data acquisition circuits and applications which will stimulate your design imagination. This designer's file could be the key to solving some of your most perplexing data acquisition problems.

Harris has a complete line of data acquisition components. All of which provide the high speed, high accuracy and high throughput you need for processing fast signals in all types of applications—military, aerospace/avionics, instrumentation, industrial process control, EDP, and others.

For top performance in your data acquisition systems, get "Your Competitive Edge". Use the file to collect information on data acquisition techniques and to store information on new, innovative Harris circuits that will be introduced in the coming months. For a free designer's file, write on your company letterhead to: **Harris Semiconductor Products Division, Box 883, Melbourne, Florida 32901.**

HARRIS HOT LINE!
1-800-528-6050, Ext. 455
In Arizona: 1-800-352-0458, Ext. 455
Call toll-free (except Hawaii & Alaska) for phone number of your nearby Harris sales office, authorized distributor or expedited literature service. Or check your IC MASTER for complete product listing and specifications.

Harris Technology ... Your Competitive Edge

HARRIS
SEMICONDUCTOR
PRODUCTS DIVISION
A DIVISION OF HARRIS CORPORATION

Monolithic Device Contains Complete PWM Power Control Circuitry

Each device in a family of ICs from Signetics, 811 E Arques Ave, Sunnyvale, CA 94086, contains all the control circuits for a power supply inverter or switching regulator integrated on a single chip. The devices feature complete pulse width modulation control circuits, single-ended or push-pull outputs, and line and load regulation of 0.2%. Total supply current is less than 10 mA with an operating frequency beyond 100 kHz.

The SG1524, offered as a second source to Silicon General's part having the same designation, can be used for switching regulators of either polarity, transformer coupled dc-dc converters, transformerless voltage doublers, and polarity converters, as well as in other power control applications. It maximizes the efficiencies in any of the three basic types of switched-mode power supply circuits: forward converters, flyback converters, and push-pull converters. The device is specified for operation over the full military temperature range of −55 to 125 °C.

Specific circuits contained in the 16-pin dual-inline package are a voltage reference, oscillator, error amplifier, current-limiting circuits, pulse width modulator, and pulse steering flipflop. A commercial version, the SG73524, is available, specified over the 0 to 70 °C range. There is also an intermediate version, the SG2524, which shares the tighter electrical specifications of the top of the line model, while having the temperature characteristics of the commercial version.

Circle 361 on Inquiry Card

Ramp Oscillator, Logic, And Motor Logic ICs Control Stepping Motor

Three integrated circuits may be used in a variety of ways to provide low power signals for the control or actuation of stepping motor drive systems. The MSI devices provide alternatives to extensive software or numerous discrete components.

This chip set from Sigma Instruments Inc, 170 Pearl St, Braintree, MA 02184, consists of the 29G01 CMOS ramp control logic circuit (RCL), the 29G21 linear bipolar ramp control oscillator (RCO), and the 29G41 digital motor logic circuit (DML). The RCL is normally used in conjunction with the RCO. Together, the two circuits form a buffered ramper, able to accept a constant high frequency pulse train to deliver a variable frequency output with preset acceleration and deceleration profiles. The output of these chips can drive the DML motor logic IC or almost any other stepping motor drive. Used alone, the RCO can be employed in a number of ways to generate fixed or variable frequency pulse trains, including ramped frequency trains for speed control applications.

Intended to be the key element in a motor driver, the DML accepts a pulse train input and decodes it into a selectable, parallel output stepping motor phase excitation format. It has sufficient flexibility to fit most data input and output formats. Input can be either dual pulse trains, CW or CCW, or a pulse line and a direction line. The phase outputs can be 2-, 3-, or 4-phase in either full-step or half-step sequences, and can be selectively disabled for either standby power reduction or damping. In addition, the outputs can be in wave or overlapping sequences. There are separate connections for a reverse pulse damping input and an initial reset input.

The chips operate from 8- to 15-V power supplies, on typical logic level inputs, with most outputs open-drain active circuits for maximum noise immunity. RCL dimensions are 0.600 x 1.310″ (1.524 x 3.327 cm); maximum dimensions for RCO and DML chips are 0.250 x 0.870″ (0.635 x 2.21 cm).

Circle 362 on Inquiry Card

Bus Compatible Binary Up Counter Can Reach 10 MHz

An LSI 32-bit binary up counter with 32 latches, multiplexer, and eight 3-state outputs is capable of counting up to 10 MHz. The LS7060, produced by LSI Computer Systems Inc, 1235 Walt Whitman Rd, Melville, NY 11747, presents its information in 8-bit binary bytes, least significant byte first, to the 3-state outputs at clock rates up to 1 MHz. Successive data bytes are enabled to the outputs on each positive transition of the scan pulses.

A special cascading feature allows any number of the devices to be attached to the same bus. Information from the counters can then be read out in successive bytes in sequence within the cascaded string. Each successive scan pulse enables the next data byte and, when each counter finishes presenting its information, it enables the next counter.

The device is an N-channel MOS silicon gate chip in a high density 18-pin package with 0.3″ (7.6-mm) row spacing. Inputs are TTL, CMOS, and NMOS compatible, and outputs are TTL compatible.

Circle 363 on Inquiry Card

CRT Timer-Controller Display, Monitor Formats Are User Programmable

A cathode ray tube video timer-controller is implemented in N-channel MOS as an LSI device. All frame formatting, horizontal, vertical, or composite sync, characters per data row, data rows per frame, and raster scans are completely user programmable. The data row counter has been designed to facilitate scrolling.

Programming is effected by loading seven 8-bit internal registers from a bidirectional data bus. Four register address lines plus a CS line provide complete microprocessor program controlled setup. The device may be self loaded via an external P/ROM tied to the data bus. Formatting also may be programmed by a single mask option.

This timer-controller from Solid State Scientific, Montgomeryville, PA 18936, contains the logic functions required to generate timing signals for presentation and formatting of interlaced and noninterlaced video data on a standard or nonstandard CRT monitor. In addition to the control registers, the device has storage registers which hold the cursor character and data row addresses used to generate the cursor video signal. The contents of these registers also may be read out onto the data bus for update by the program.

Two versions of the chip are available. The SND5037 can be programmed for an odd or even number of scan lines per data row in both interlaced and noninterlaced modes. Programming it for an odd number of scan lines per data row eliminates character distortion caused by the uneven beam current normally associated with odd field/even field interlacing of alphanumeric displays. The SND5027 provides noninterlaced operation with an even or odd number of scan lines per data row, or interlaced operation with an even number of scan lines per data row.

Circle 364 on Inquiry Card □

ROLM's Mil-Spec ECLIPSE® Data System... a new power in military computers

Military operations on the move make tough demands on data processing systems.

The computers must be compact, rugged, and reliable. The data base and operating system must be transaction-oriented for fast real-time, interactive processing.

That's why ROLM developed the Mil-Spec ECLIPSE Data System. It's tough and has all the proven advantages of Data General's ECLIPSE® architecture and software. The key is a sophisticated multiprogramming Advanced Operating System (AOS), which controls real-time, multi-user, and batch operations... all while effectively managing up to 2 Megabytes of main memory.

And with ROLM's Model 3353/3354 Mil-Spec Storage Module System, AOS manages up to 540 Megabytes of on-line disk storage. Language support is impressive: FORTRAN 5, PL/1, DG/L™, COBOL, and the INFOS® file manager.

For shipboard systems, this flexible computing power is fully compatible with Naval Tactical Data Systems when joined with ROLM's new 3400 Series Interfaces. These compact MIL-STD-1397 modules come in SLOW, FAST, ANEW, and SERIAL types with 8, 16, and 32-bit configurations. They are interchangeable and feature software transparency. Designers can configure a system to match the data requirements of any ship... without restriction on future expansion.

ROLM's Mil-Spec ECLIPSE System lets you move out with power never before available in a military computer system. Designed to meet MIL-E-5400, MIL-E-4158, and MIL-E-16400 specifications, it gives you extensive software, full peripheral support, and ROLM reliability and service.

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 19, D-6450, Hanau, Germany, 6181 15011, TWX 4-184-170.

ECLIPSE and INFOS are registered trademarks of Data General Corporation.

CIRCLE 99 ON INQUIRY CARD

A full range of high resolution color and monochrome monitors with

OFF-THE-SHELF AVAILABILITY

Priced as low as $1375

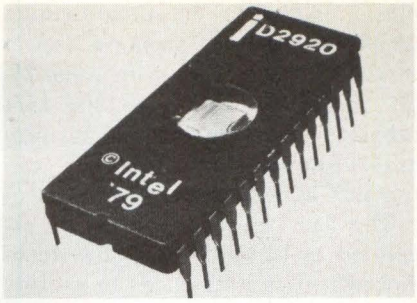
Aydin Controls has a complete family of RGB raster scan color video monitors available from inventory. These high performance color monitors are specifically designed for the display of computer generated text, graphics and image data. All Aydin displays come with a one year warranty and feature: high and ultra-high resolution shadow mask CRT's, high video bandwidth, long term convergence stability, modular construction, rack mountability, convenient control accessibility and simplified maintenance. A comprehensive list of options to meet any requirement is available.

AYDIN CONTROLS

414 Commerce Drive • Fort Washington, PA 19034
(215) 542-7800 • TWX 510 661 0518

CIRCLE 100 ON INQUIRY CARD

PRODUCT FEATURE



2920 signal processor

Single-Chip Analog Microcomputer Processes Complex Signals in Real Time

Multiple component and multicircuit analog subsystems required for real-time signal processing applications can now be replaced by a single-chip programmable analog/digital microcomputer. Claimed by its developer, Intel Corp, to be the first such analog input/output microcomputer, the 2920 signal processor provides capabilities equivalent to those of a microcomputer 10 times as powerful as the 8086 (or 100 times those of the standard 8080). For instance, the 8080 can operate as a signal processor at frequencies up to only a few hundred Hertz, while the digital processor on the 2920 executes its program at typically 13k times/s when used with a 10-MHz clock rate.

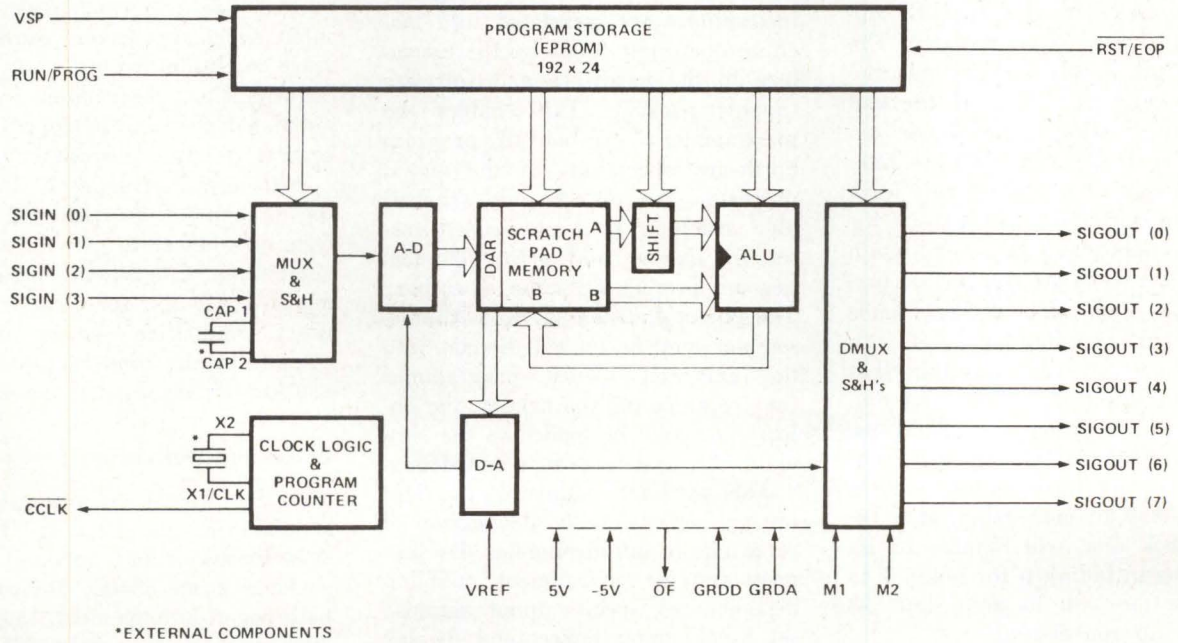
In operation, the signal processor converts analog input signals to digital information, manipulates that information in its onchip high speed, digital processor, and produces analog outputs in a realtime mode. Its frequency range covers those common in telecommunications, instrumentation, control, guidance, medical, and other electronic systems.

An SP20 hardware and software support package, introduced for use with the 2920, includes assembler, software simulator, erasable programmable read only memory (EPROM) programming personality board, and documentation. Both assembler and software simulator run on the Intellec® microcomputer development system; the personality card allows EPROM on the 2920 to be programmed on an Intellec universal P/ROM programmer.

Signal Processor

Digital circuitry on the 2920 single-chip signal processor includes EPROM program storage, scratchpad random access memory (RAM), clock and timing logic, binary shifter, and arithmetic logic unit (ALU). Analog circuits include four inputs, input multiplexer, input sample and hold (S/H), analog to digital (A-D) and digital to analog (D-A) converters, output demultiplexer, eight outputs, and buffered output S/Hs. To achieve the efficiency and speed necessary for realtime operation, analog circuits operate simultaneously with digital ones.

EPROM consists of 192 24-bit words, with each word made up of six instruction fields that control individual subsystems (see functional



*EXTERNAL COMPONENTS

Functional block diagram of signal processor (run mode)

block diagram). In programming mode, EPROM is arranged as a 1152 x 4-bit memory with each 24-bit instruction loaded as six 4-bit nibbles. Once the EPROM is programmed, the signal processor can function as an analog subsystem.

The RAM read/write array is organized as 40 words of 25 bits each. Address space is extended to provide constants and access to a register (DAR) for interfacing the memory ALU with the analog conversion section. Both RAM and the ALU represent data in 2's complement format. All operations are performed in 2's complement arithmetic.

An external clock can be used or the signal processor can generate its own clock with an external crystal. The program counter is incremented one instruction count for every four master clock cycles and continues to increment until it reaches a count of 191 or is reset. Instructions are executed sequentially and no program jumps are provided. Sample rate is determined by the number of instructions in the program and the instruction cycle time.

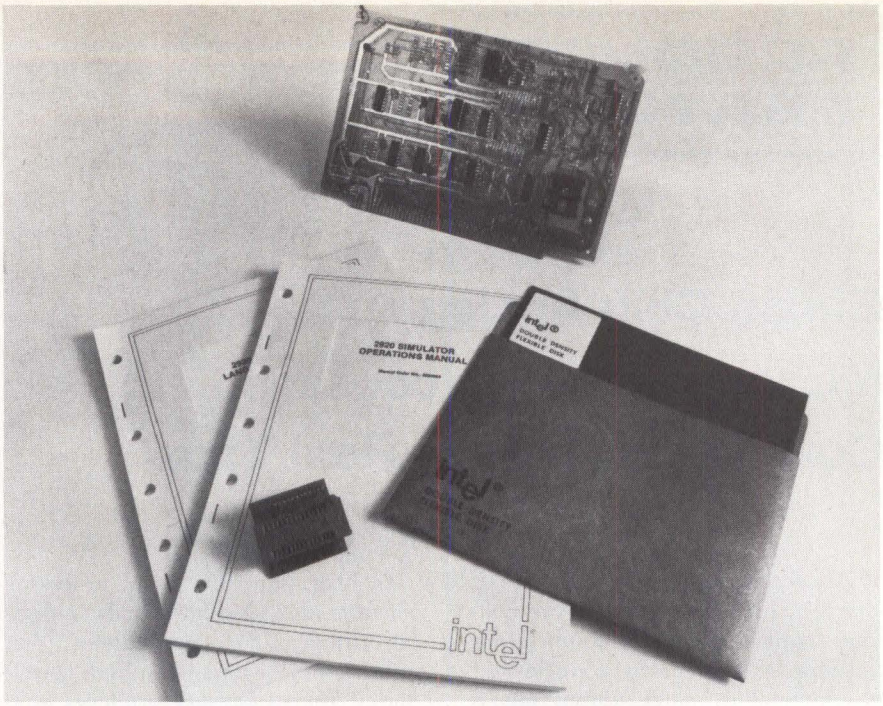
A binary shifter between the memory "A" port output and the ALU "A" operand input allows the "A" operand to be scaled by any magnitude between 2^2 and 2^{-13} (left shift 2 to right shift 13). When a number is shifted right, vacated bit positions are filled with the sign bit.

The ALU calculates a 25-bit result based on an operation performed on the scaled "A" and the "B" operands delivered from memory. The 25-bit result is written back into the "B" memory location near the end of the instruction cycle. Logic accommodates the left shift scaling. For arithmetic operations, this logic is used to calculate a 25-bit result for normal operations and to maintain the sign bit when an overflow occurs.

Analog input channels are made up of four sampling switches with a common external capacitor that yields an offset of $<-\frac{1}{2}$ LSB and an acquisition time of <2400 ns. Successive approximation A-D conversion is performed under program control. A 9-bit conversion, at a 10-MHz clock rate, will require 25 instructions including 6 for input, 1 to initialize the DAR to zero, and 18 for the A-D conversion.

Eight analog output channels include one S/H circuit/channel demultiplexed from a common, buffered D-A converter output. Signal output (SIGOUT) pins can be selected to be either analog out or TTL compatible.

The internal D-A converter requires a single, user supplied 1- or 2-V reference to establish its range. The resulting input and output signal voltage range is ±VREF.



SP20 hardware and software support package

Support Package

Symbolic 2920 assembly language instructions are translated into machine operation codes by the assembler in the hardware and software support package. This enables the programmer to symbolically program hardware operations of the signal processor. An object code (executable machine code), complete assembly listing, and error diagnostics are produced by the assembler. The object code output from the assembler may be loaded directly into the universal P/ROM programmer for programming the EPROM; the object code may be loaded to the simulator for system design and debug.

The software simulator provides testing and symbolic debugging of programs in microcomputer development systems environment, enabling designers to specify input signals; set breakpoints; collect and display input, output, and system variables; and display and alter contents of memory location during simulation. Hex format object files produced by the assembler are accepted by the simulator. Output values and internal trace data may be saved on ISIS-II disc files for further analysis.

Simulation of signal processor machine instructions is performed in software. All internal registers, memory, input values, output values, and other system variables can be examined and modified. Speed of on-chip signal processing simulation varies with the complexity of the input signal, breakpoint setting, and trace condition. Exclusive of I/O time requirements, instructions will be simulated at a rate of approximately several hundred instructions/s.

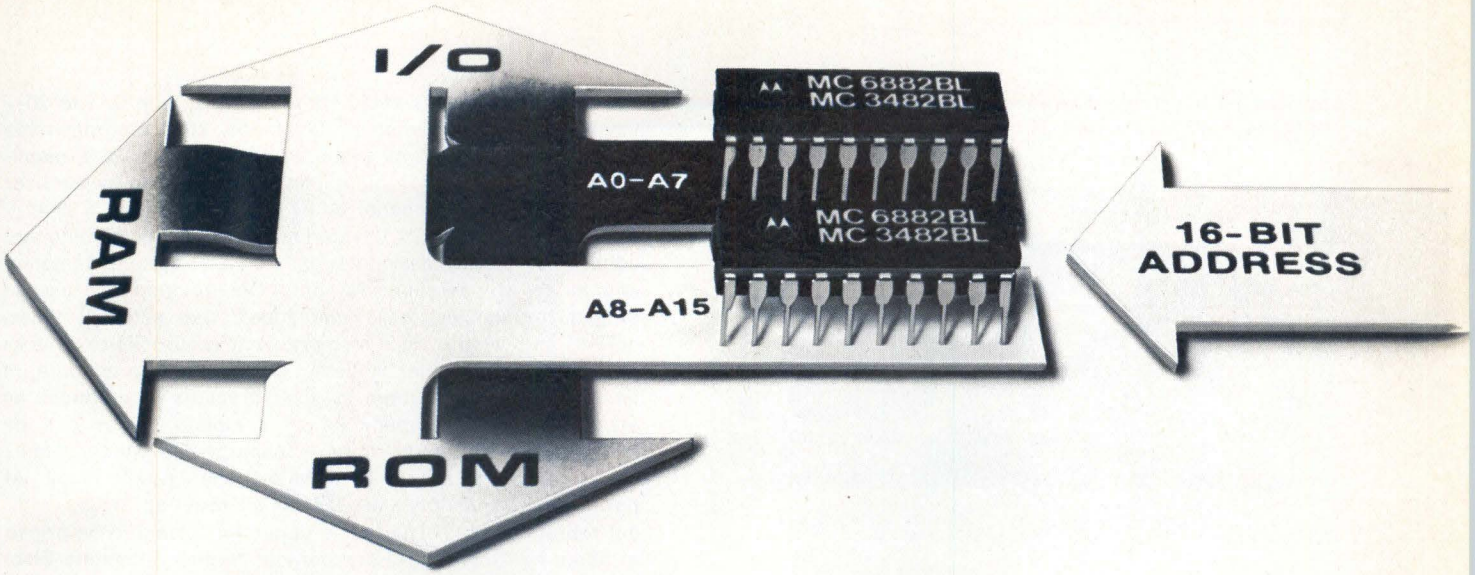
After each instruction is simulated, the breakpoint is evaluated to determine whether to stop or continue simulation. Conditional breakpoints are also provided for debugging purposes. Simulation can be manually stopped at any time by pressing the ESC key on the Intellec console.

Price and Delivery

The 2920 signal processor is priced at $250 in quantities of 100; the SP20 hardware and software support package costs $3400. Deliveries of both began in September. Intel Corp, 3065 Bowers Ave, Santa Clara, CA 95051. Tel: 408/987-8080.

Circle 199 on Inquiry Card

Technological leadership.



Double your drive, tune out noise with Motorola's 3-state, octal buffer latch.

Despite being around for a while from multiple sources using known LS technology, quantities of octal buffer latches are usually gone by the time you get to the ordering stage. Even if you've been lucky enough to find any lately for MPU memory address bus buffering, chances are they haven't lived up to every performance parameter you could wish for.

Until now.

Now Motorola can supply a steady stream of these impossible-to-get parts with some new wrinkles that make the MC6882/3482 linear interface family an absolutely great find for enhancing system production and performance.

More margin, more boards, less noise.

The units furnish a full, 48 mA I_{OL} drive capability—twice what LS373 types offer. That means you've got much more margin to drive more memories and more boards without any increase in parts count. And this top performer drives a full 500 pF load. You can't do better than that anywhere.

Built-in hysteresis provides noise immunity. The output switches only when you want it to. And the part can be latched to further protect your system from noise.

Mux, demux, buffer and latch.

Together or separately. Inverting or non-inverting. You can use it on latched bus structures such as the '6801 or on unlatched structures like the '6800 where buffers are latched to provide noise immunity.

When multiplexing with a pair, each drives 8 bits alternately from a three-state output.

It offers fast, 8 ns typ Schottky prop delay, single 5 V power supply requirements and high impedance PNP inputs to ensure minimum bus loading.

Last, not least, it's pin-for-pin, spec-for-spec compatible with LS373 types, so all you do is drop it into those designs and watch it take over. With more drive . . . and at nearly equal cost.

Device	Suffix	Inverting/Non-Inverting	Price (100–up)
MC6882A/ MC3482A	L (ceramic)	Inverting	$2.80
MC6882B/ MC3482B	L(ceramic)	Non-inverting	2.90

Contact your authorized Motorola distributor or write Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, AZ 85036 for complete data and turnaround on the MC6882/3482.

Together with our M6800 family of MPUs, MCUs and peripherals, you'll have your next complete generation of

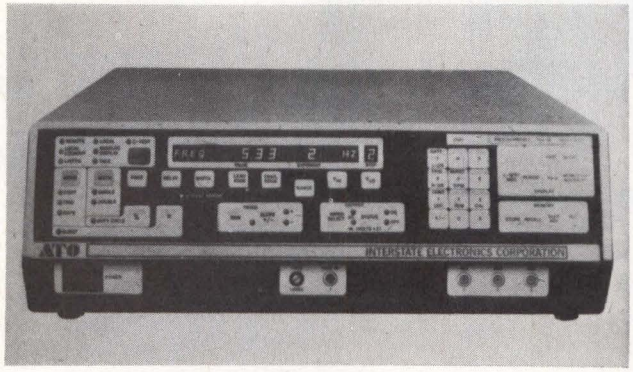
Innovative systems through silicon.

MOTOROLA INC.

CIRCLE 101 ON INQUIRY CARD

PRODUCTS

Low Cost Programmable Pulse Generator Features Fast Response Time



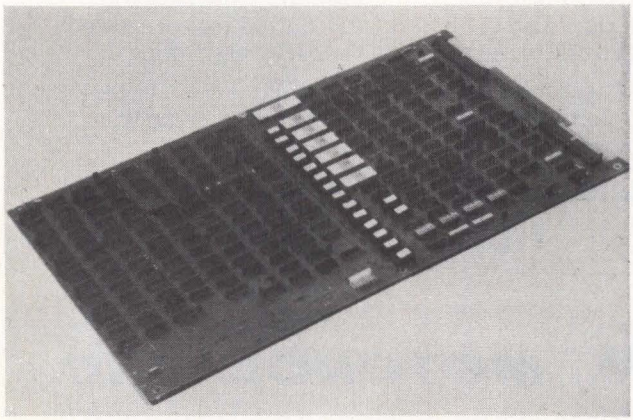
Circle 200 on Inquiry Card

Repetition rate pulses of 10 Hz to 50 MHz, with 0.1- to 20-V amplitudes, are produced by the model 2021 programmable pulse generator in 7 ns (variable to 10 ms at 20-V amplitude). A 20-V amplitude pulse can be established by the user from either the front panel or by program control in a 40-V window from −20 to 20 V, referenced to ground. Annunciator lights and alphanumeric displays identify pulse parameters and mode of operation. An Auto Cal function, for use at critical frequencies, calls amplitudes, use and fall times, delays, and widths from memory. A microprocessor checks parameters and either initiates a correction procedure, if needed, that adjusts them to desired values or produces an errror message. As many as 10 complete setups can be stored in the internal memory. A rechargeable battery retains the memory unit for up to 4 weeks when power is off. At power-up the memory unit recalls all required setups without reprogramming. This pulse generator is said to be priced at about half the cost of comparable models. **Interstate Electronics Corp,** PO Box 3117, Anaheim, CA 92803.

V.27 Compatible 4800-Bit/s Data Modem Fits Wide Range of Applications

Conformation to CCITT Recommendations V.27 bis and V.27 ter, MOS circuitry, and a complete range of system monitoring and fault isolation, including V.54 remote loopback and low speed V.23 secondary channel, enable the LSI/48/V.27 high speed data modem to meet a variety of user requirements. The device operates at 4800 bits/s over 2- or 4-wire leased lines or 2-wire dial networks, with fallback to 2400 bits/s, and uses 8-phase DPSK or QAM for primary signaling in the transmitter and receiver. Narrow band modulation and fully automatic adaptive equalizer (with other V.27 bis modems) assure low error rates under all conditions. Choice of switch or strap selectable operating modes allow system operation over degraded circuits. Point to point operation is over M580 or equivalent lines; a type M1020 line is recommended for optimum performance in multipoint applications. Other features include low frequency 75- or 150-bit/s secondary channel, EIA RS-232-C or CCITT V.24 compatible interface, and automatic or manual answer. **Codex Corp,** 20 Cabot Blvd, Mansfield, MA 02048.
Circle 201 on Inquiry Card

Signature Analysis Provides Diagnostic Capability for Single-Board Tape Formatter



A bipolar bit slice microprocessor in the model 9X00F dual-density magnetic tape formatter provides a signature analysis capability that allows a technician to locate malfunctions by comparing microprocessor-generated patterns with those based in ROM. Presence of the microprocessor also improves control and reduces the number of needed ICs; the resultant reduced board size permits installation of the 13 x 8.5" (33 x 21.6-cm) single-board formatter in the chassis of the company's model 9000, 9100, 9300, 9700, or 9800 9-track read-after-write tape transports. As many as 4 daisy chained transports with 2 different speeds can be handled by 1 formatter. All logic required for reading and writing both 1600-char/in (630/cm) PE and 800-char/in (315/cm) NRZI formats for ANSI and IBM compatible tape is in ROM. Speeds from 12.5 to 125 in/s (31.7 to 317 cm/s) are selectable by onboard DIP switches. Switches also control status and address designations. **Kennedy Co**, 1600 S Shamrock Ave, Monrovia, CA 91016.
Circle 202 on Inquiry Card

PROVEN RELIABILITY

THE RADIANT FEATURE IN MEMORY

MODEL 4016 MEMORY

***28,000 HRS. MTBF**
DEMONSTRATED AND IMPROVING
37.9 MEGABITS
8.5 MILLI SEC. AVE. ACCESS
.035 CENTS PER BIT O. E. M.

*ASK FOR A COPY OF OUR MTBF STUDY

Vermont Research
CORPORATION

Precision Park
North Springfield, Vermont 05150

TEL. (802) 886-2256 TWX: 710-363-6533 FAX (802) 886-2682

CIRCLE 102 ON INQUIRY CARD

MAGSTRIPE™ Card Readers

BY AMERICAN MAGNETICS

Proven, World-Wide Performance

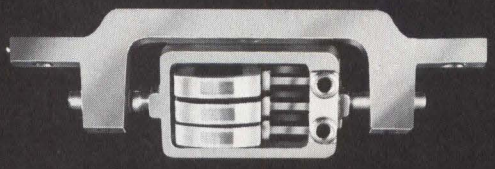
Field proven, economical means for collecting data from magnetic stripe cards or badges.

Standard models read ANSI X 4.16 - 1976, any combination of tracks 1, 2, or 3 (75 and 210 BPI); special models available for any track density up to 400 BPI.

Self-contained spatial decoding electronics provide TTL (data and strobe) outputs. Card velocity range 3 to 120 inches/second; completely acceleration independent. Less than one error per 10^8 bits.

UNIQUE MAGSTRIPE™ HEADS

INDEPENDENTLY-SUSPENDED, GIMBAL-MOUNTED



Reliability in reading warped and soiled cards is achieved by means of a patented read head assembly — each head individually suspended on parallelogram springs in a gimbal mount. Low contact force guarantees lowest head and card wear.

Rugged construction permits outside installation and exposure to the elements. Virtually maintenance free.

Many major system manufacturers, after extensive testing, have chosen our readers which out-perform all others in reading "real world" cards. Our MAGSTRIPE™ Readers are used world-wide in a variety of applications including:

- Airline Ticketing Terminals
- Bank Terminals
- Building Access Systems
- Bulk Fuel Dispensing Terminals
- Data Input for CRT Terminals
- Computer Access Devices
- Fare Collection Systems
- Identification & Badges
- POS Terminals
- Self-Service Gas Stations

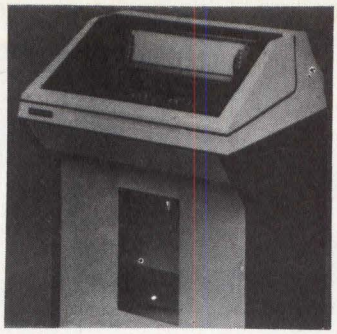
AMERICAN MAGNETICS CORPORATION

For more information and technical data, contact:

American Magnetics Corporation

2424 Carson St., Torrance, Calif. 90501
(213) 775-8651, TWX 910-349-6956

DUAL-SPEED STEEL BAND LINE PRINTERS



Enhanced print capabilities on both 300- and 600-line/min band printers enable line speed to be reduced to 170 and 350 lines/min respectively, in approx 4 s. Std high quality printout at 300 or 600 lines/min is suitable for day to day printing requirements or drafts, and quality obtained at 170 or 350 lines/min fills needs for special reports or final copies. Dual print speed is accomplished through the microprocessor architecture of the printers. The print band speed can be switched under program control. Printers are designed for 30 to 40% duty cycles, and feature a 3000-h MTBF. Tabletop, pedestal, and quiet cabinet models are available. **NEC Information Systems, Inc,** 5 Militia Dr, Lexington, MA 02173.

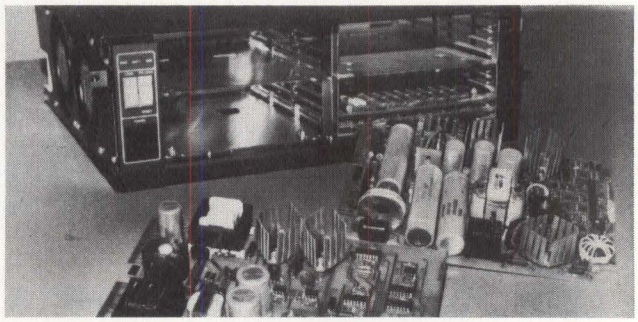
Circle 203 on Inquiry Card

HIGH CAPACITY FIXED MEDIA DISC DRIVE

4700 series drives based on 3350 technology yield high capacity, fast access, rapid data transfer, and high reliability. Device incorporates a mechanical package design that is small in size for easy installation and requires only 7" (17.8 cm) of vertical rack space. 112M- and 158M-byte configurations are achieved by use of either 3 or 4 disc platters, respectively. Performance characteristics are 30-ms avg access time (6-ms track to track), 9.40-MHz data transfer rate with a projected module life of 35k hours. Storage density is 6427 bits/in (2530/cm). Total per surface capacity is 22.6M bytes. Soft error rate is 1 bit/10^{10}; hard error rate is 1 bit/10^{13}. **Microdata Corp,** 17481 Red Hill Ave, Irvine, CA 92714.

Circle 204 on Inquiry Card

MICROCOMPUTER POWER SYSTEM OPTIONS



Permitting the microNova™ MP/100 and /200 to operate during temporary power failure, the optional model 4315 battery backup is contained on a single PC board. With the addition of either the optional model 4316 battery pack or 2 ordinary car batteries, users can keep computers plus main memory operating when main ac power fails. All voltages are maintained and fans are kept operating. Battery pack consists of two 12-V batteries connected in series and includes mounting hardware and cable that plugs into backplane. The 2.5-Ah pack supplies power for 16 min to a 64k-byte MP/100 system, and for 7 min to a 64k-byte MP/200. **Data General Corp,** Rt 9, Westboro, MA 01581.

Circle 205 on Inquiry Card

AED ANNOUNCES ITS NEW PDP-11 LINE-UP.

Single card RM-02 ® emulation

The fullback for the PDP-11 team is AED's new STORM-02, a hex-card controller/formatter for storage module drives.

We tried out a lot of fullbacks for the team but STORM-02 was the only player that could offer everything! Single hex-card electronics; RH-11, RM-02 and RM-03 emulation; the ability to plug right into the SPC slot on your PDP-11; plus the ability to get along with the media. That's the kind of compatibility we like!

A standard single board STORM-02 handles 4 SMDs. With an optional second hex-card, the STORM-02 can accommodate four more drives for a total capacity of over 500 megabytes.

Our big surprise was the bottom line on the contract. The OEM price for the STORM-02 is just $2370 for the hex-card electronics — far less than any fullback in the league. The complete system with one 80-megabyte storage module drive, in quantities of one, is $13,500 . . . about half the price of a comparable DEC fullback.

For the complete statistics and quick delivery, call or write Bob Deisher, Rigid Disk Products Manager.

Big disk RP-04 ® emulator

The noseguard for the PDP-11 team is the field proven AED8000. He anchors the line with his ability to tackle 4 CPUs at one time. The 8000 also provides microprogrammable data control and intermediate buffering between your PDP-11s and up to 8 mass storage drives — including Winchester — in any combination simultaneously. That means over 2200 megabytes of data storage on the gridiron.

This versatile player emulates the DEC RP Series controllers, thus saving management big bucks by always having software transparency with successive DEC operating system releases. And the 8000 will run DEC's disk system diagnostics as well!

Check this list of accomplishments:

- RP-03, RP-04 and RP-06® emulation
- Microprogrammable 24-bit power
- Handles any combination of Ampex, Calcomp, CDC, ISS and Memorex drives
- 56-bit Fire Code Error Correction
- 256 x 16-bit data buffer

For complete statistics on economical OEM prices and fast delivery, call or write Bob Deisher, Rigid Disk Products Manager.

Full color graphics system

The coach of PDP-11's team is our new AED512 graphics generating system that makes the blackboard obsolete. Now, when he plots the plays, the FIVE TWELVE's compact video terminal will display all the action in high-resolution detail using up to 256 simultaneous colors and 16.8 million different hue/intensity combinations on a 512 x 480 pixel screen. The AED512 is microprocessor controlled, and has the largest refresh memory of any system in the league.

Other features that make the new PDP-11 'coach' a cost/performance leader include:

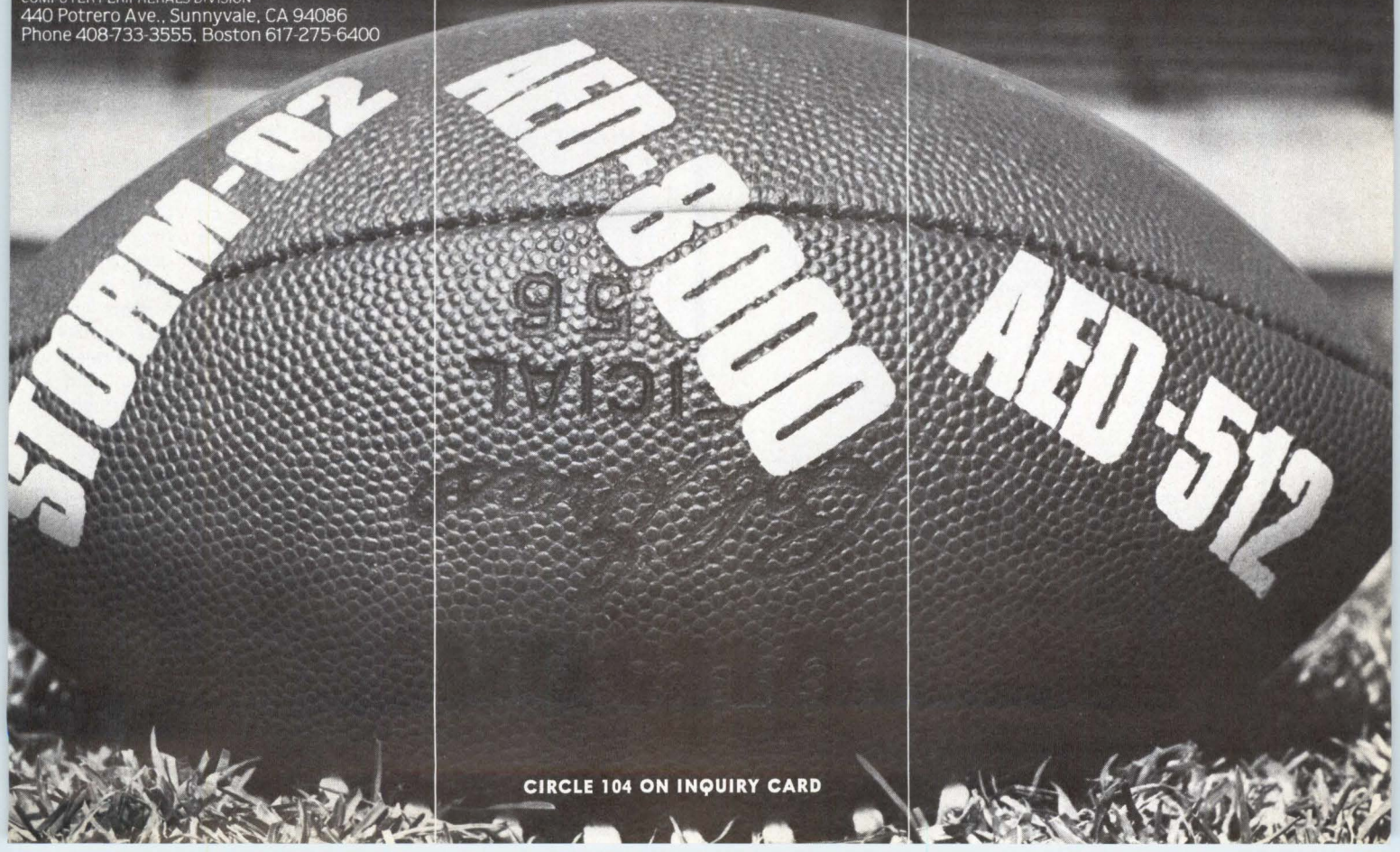
- DMA interfaces (Q-BUS® or UNIBUS®) available.
- 2:1, 3:1 . . . 16:1 zooming. Panning via integral joystick.
- Vector and circle generation. Curve fill. Single-point addressability.
- Crosshair cursor with programmable color.
- SUPEROAM panning over 1024 x 2048 contiguous pixels.
- Programmable character fonts and 8 programmable special function keys.
- $6,875 with two colors only, excluding monitor and DMA.

For delivery information, write or talk to Jerry Kennedy, VP Marketing.

® Registered trademark of Digital Equipment Corp.

ADVANCED ELECTRONICS DESIGN, INC.

COMPUTER PERIPHERALS DIVISION
440 Potrero Ave., Sunnyvale, CA 94086
Phone 408-733-3555, Boston 617-275-6400



CIRCLE 104 ON INQUIRY CARD

COMDEX'79

December 3-5, 1979
MGM Grand Hotel, Las Vegas

If you are a distributor, dealer, commercial OEM, systems house, turnkey vendor, manufacturers representative, value adder, software packager or any other kind of independent "third party" seller, you should plan now to attend this stimulating three day conference and exposition.

Over 30 sessions will focus on the challenges and opportunities facing you as a dealer . . . for more profitable selling and a higher degree of professionalism.

You will also have ample opportunity to visit more than 100 exhibitors -- manufacturers whose focus is on you the dealer.

For registration information on COMDEX '79, call (800) 225-4620 (In Mass. (617) 879-4502).

If you are a manufacturer, COMDEX '79 gives you a unique opportunity to display new and existing products to attract the third-party seller.

Unlike broad-based computer expositions, COMDEX '79 focuses on the needs of manufacturers to be adequately represented. COMDEX '79 gives you the right environment to develop sales representation or reinforce existing relationships. Because the conference is designed to appeal to third-party sellers you are guaranteed the audience you want.

We'll be glad to discuss with you available exhibit space and any other aspect of the exposition. **Call Milton Berns at 800-225-4620 (In Mass. 879-4502).**

COMDEX'79
The National Conference & Exposition for Dealers, Distributors and Reps

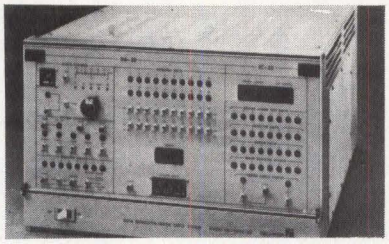
Another Conference and Exposition from
The INTERFACE Group

Producers of:
Data Communications INTERFACE, INTERFACE WEST, FEDERAL DP EXPO, COMDEX

160 Speen Street, Framingham, MA 01701

PROGRAMMABLE WORD GENERATOR AND ERROR CHECK SYSTEM

DG-20/EC-20 provides both data generation and error check capabilities in a single benchtop or rackmount unit. It contains a variable clock source, 256-word x 20-bit data generator, and 8-bit error comparator. Internal clock oscillator provides variable operation from 2.5k to 20M bits/s. Programmable word generator section provides 20 parallel outputs at ECL levels, suitable for driving 50-Ω coaxial line. Word length is integer variable up to 256 words. Error check section provides for error check comparisons on up to 8 input channels. Individual inputs may be masked out to inhibit error checking of those channels. Operational controls allow unit to continuously check input data or to stop on first error condition. **Tau-Tron, Inc,** 27 Industrial Ave, Chelmsford, MA 01824.



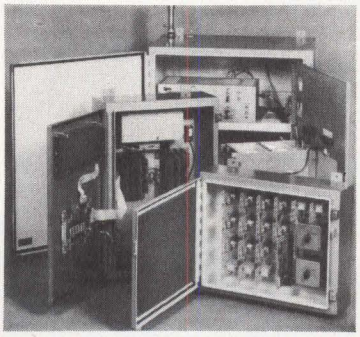
Circle 206 on Inquiry Card

ECLIPSE/NOVA 3 ADD-IN MEMORIES

Designed for use with Data General Eclipse and Nova 3, the in1560 has full software compatibility with the Nova 3, and incorporates onboard parity control. It has very low power dissipation, and high circuit density to reduce system cost. Battery backup operation can be supported. An onboard memory management and protection unit provides full 128k addressing and detection of 5 software violations. 32k and 128k configurations occupy a 15" (38-cm) board. For use with Eclipse computers, the in5150 is compatible with both core and semiconductor memories. It has onboard error logging facilities and can support 2-, 4-, or 8-way interleaving. An onboard cache memory gives a 200-ns access time. Capacity is 64k. **Sintrom Electronics Ltd,** Arkwright Rd, Reading, Berks RG2 0LS, England.

Circle 207 on Inquiry Card

ANALOG AND DIGITAL I/O MULTIPLEXERS



Series 2300 provide I/O for industrial data gathering and control systems. Analog and digital inputs and outputs are transmitted and received via a serial communication link with either RS-422 or RS-232 interface at data rates up to 9600 baud. Std interfaces include dry contact inputs for supervised or unsupervised lines, 110-Vac digital inputs, 10- and 12-bit analog inputs, 8- and 10-bit analog outputs (4 to 20 mA), and 3- and 10-A start/stop relay outputs. Each unit consists of NEMA 12 enclosure backpanel with connectors, I/O interfaces, and controller board containing microprocessor and communications interfaces. DGC 2331 handles digital inputs. 2333 accepts 4 analog inputs and generates 1 analog output; digital I/O can be either 16 inputs and 8 outputs, or 8 inputs and 16 outputs. 2320 has up to 16 I/O slots. **Logicon Process Systems Div,** 10398 Democracy Lane, Fairfax, VA 22030.

Circle 208 on Inquiry Card

AED ANNOUNCES ITS NEW LSI-11 LINE-UP.

Low priced RX-02® emulator

The quarterback for the LSI-11 team is the new FLEX-02, a dual-width floppy disk controller/interface card. The FLEX-02 earned its starting role by proving its ability to completely emulate DEC's RX-02 while offering RX-02 users double-headed drive capabilities — a feature no other league quarterback has right now.

Best of all, in OEM quantities the single bluechip FLEX-02 dual-width PC board costs just $700, including the bootstrap loader. (Try getting a 'quarterback' with this kind of talent elsewhere at the same price).

In full gear, a two-drive double-headed disk system with an AED power supply in a 5¼" DEC look-alike cabinet is only $3940 for quantity one. The complete double-drive, single-headed system is just $3440 in a quantity of one.

Whether you have RSX-11/M, RT-11V3A/B, I.A.S., RSTS-3, CTS-500 or CTS-310 operating systems centering the ball, the versatile FLEX-02 can now complete the line-up and lead your DEC data to the end zone.

For complete statistics and quick delivery, call or write Steve Loring, Diskette Products Manager.

RL-01® compatible Winchester

The linebacker for our LSI-11 team, the WINC-01, is surprisingly small for a pro. He consists of just two PCBs — one a microprocessor-based formatter/controller mounted with a SA-4008 drive, and the second, a dual-width Q-BUS interface card that inserts directly into the CPU backplane.

However, when WINC-01 proved he could deliver Winchester technology to DEC LSI-11, -11/2, -11/23 users, we signed him up immediately. He amazed us by playing with up to three SA-4008 Winchester drives and tackling up to a total of 60 megabytes of data. Additionally, he has the capacity to include a plug-in floppy disk drive.

Best of all, he bunked with the DEC RL-01 driver software and we can report they are very compatible up to 20 megabytes.

In contract talks, the WINC-01 demanded considerably less than the DEC hardware: his two boards sell together for under $1150 in OEM quantities. The complete system, including the two PCBs, an AED power supply, one SA-4008 drive and a DEC look-alike cabinet sell for $6700 in quantities of one.

For WINC-01 technical information and quick delivery, contact Bob Deisher, Rigid Disk Products Manager.

Full color graphics system

The coach of LSI-11's team is our new AED512 graphics generating system that makes the blackboard obsolete. Now, when he plots the plays, the FIVE TWELVE's compact video terminal will display all the action in high-resolution detail using up to 256 simultaneous colors and 16.8 million different hue/intensity combinations on a 512 x 480 pixel screen. The AED512 is microprocessor controlled, and has the largest refresh memory of any system in the league.

Other features that make the new LSI-11 coach' a cost/performance leader include:

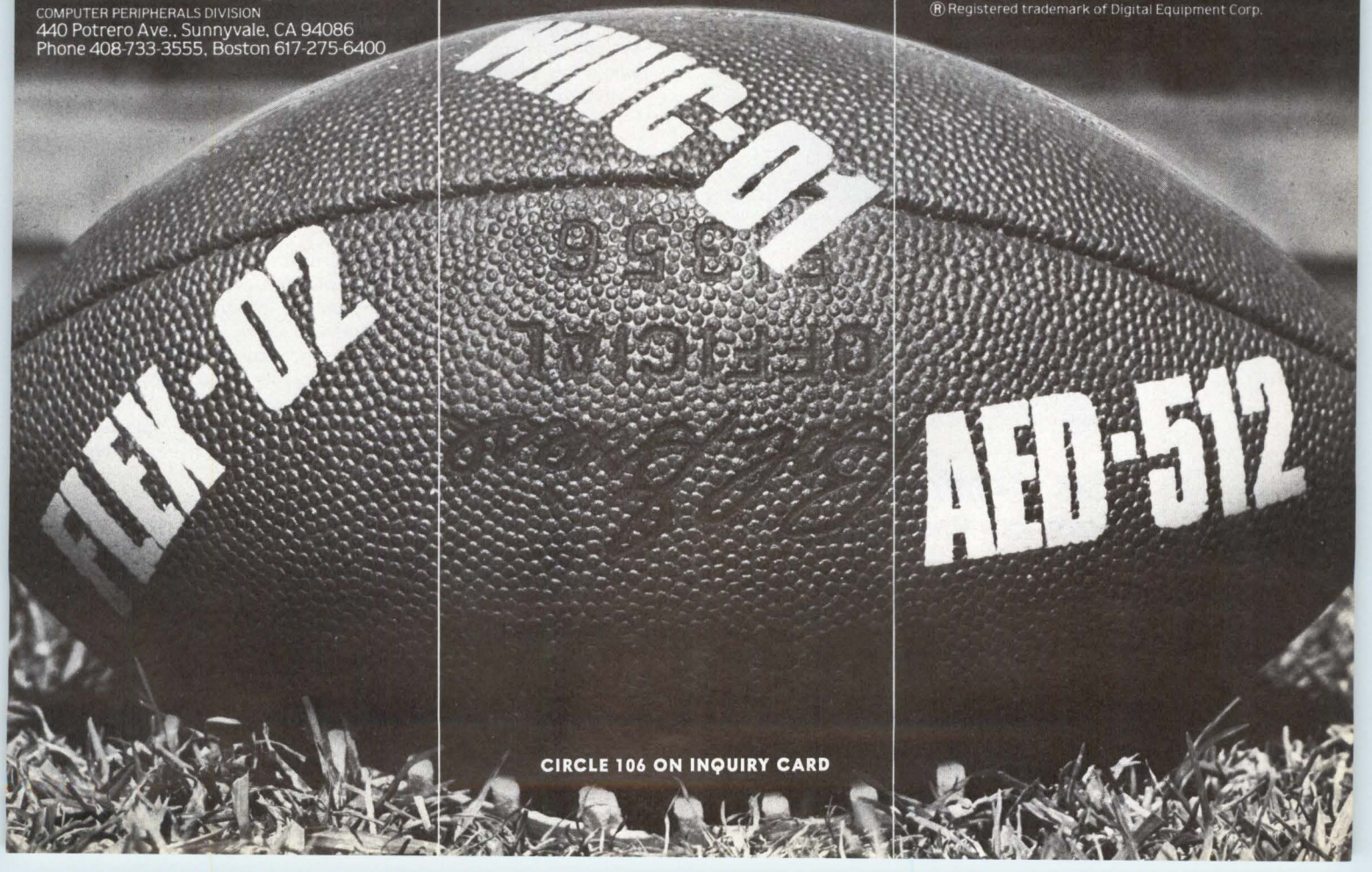
- DMA interfaces (Q-BUS® or UNIBUS®) available.
- 2:1, 3:1 . . . 16:1 zooming. Panning via integral joystick.
- Vector and circle generation. Curve fill. Single-point addressability.
- Crosshair cursor with programmable color.
- SUPEROAM panning over 1024 x 2048 contiguous pixels.
- Programmable character fonts and 8 programmable special function keys.
- $6,875 with two colors only, excluding monitor and DMA.

For delivery information, write or talk to Jerry Kennedy, VP Marketing.

® Registered trademark of Digital Equipment Corp.

ADVANCED ELECTRONICS DESIGN, INC.

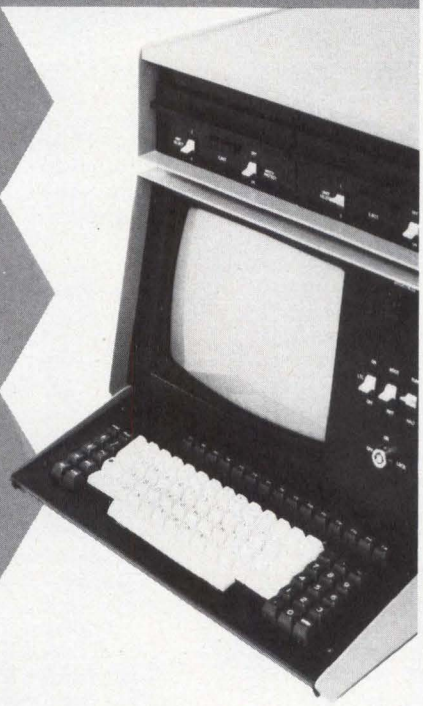
COMPUTER PERIPHERALS DIVISION
440 Potrero Ave., Sunnyvale, CA 94086
Phone 408-733-3555, Boston 617-275-6400



CIRCLE 106 ON INQUIRY CARD

MULTIBUS*

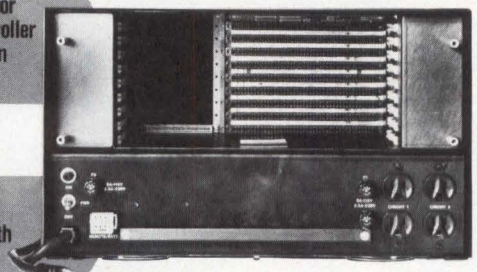
Development/Target System



Floppy Disk Subsystem
Single/Double Density

80 X 24 Display
7 X 9 Dot Matrix
Key Lock Control

ASCII Keyboard
15 Function Keys
Numeric Key Pad



9 Multibus Slots for
CPU Display Controller
Memory & System
Expansion

30 Amp +5V
Power Supply with
Switched AC

12" Integrated Computer System
64K Bytes RAM
Dual Floppy Disk Subsystem
8085 CPU **Price: $8,935**

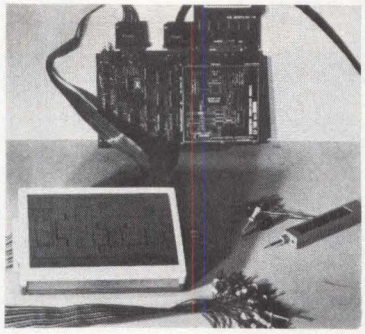
ISIS ** • CP/M •
Fortran • Basic • Pascal •
Macro Assembler

*Multibus and ISIS are Trademarks of Intel Corporation
**Configured to run all Intel supplied software

COMARK CORPORATION
257 CRESCENT ST., WALTHAM, MASSACHUSETTS 02154
(617) 894-7000 • TWX: 710-367-4318 **The BusMasters**

EXPANDABLE SIGNATURE ANALYSIS DATA MULTIPLEXER MODULE

Signature data multiplexer operates under software control in conjunction with the LS 100 series bus plug-in peripheral signature analyzer. Inputs to the LS MUX 32 multiplexer can be individual inputs to quick disconnect connectors, 40-pin DIP clips for microprocessor and LSI component connection, and bus terminator/card edge connectors for computer card interface. By cascading analyzers and multiplexers in a microcomputer bus, a limitless number of signature data lines can be input. Multiplexer is totally controllable from the analyzer and user computer system. Associated status and control words allow full software control. Software is available for Z80, 8080, 6800, and 6502 processors. **Phoenix Digital Corp,** 3027 N 33rd Dr, Phoenix, AZ 85017.



Circle 209 on Inquiry Card

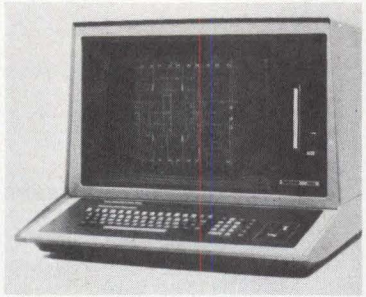
MULTIUSER PROGRAMMING STATION FOR IN-CIRCUIT TEST SYSTEMS

Designed to complement the 2270 test system, the 2290 offline programming station allows simultaneous program generation by up to 4 users. By performing program generation offline, the unit increases productivity of the test system by eliminating machine time conflicts between programmers and production personnel. The station is equipped with a DEC PDP-11 based computer and 128k bytes of memory. It has a single CDC Hawk 10M-byte fixed head disc drive and controller. Two disc cartridges provided with the unit contain 2270 program preparation software, 2 have RSX-11M binary system software, and 2 are blank. The unit is housed in a single low profile vertical rack. **GenRad Inc,** 300 Baker Ave, Concord, MA 01742.

Circle 210 on Inquiry Card

GRAPHIC COMPUTING SYSTEM WITH DYNAMIC OPTION

Dynamic Graphics option provides users of the 4054 Graphic Computing System with the power to work directly with graphic elements of a design problem, in addition to points and lines. Simple BASIC commands allow users to create and manipulate graphics objects as simple as line or word, or as complex as a 1000-vector object or user definable key menu. After being created, an object is saved in dynamic memory for later recall. With 13M addressable points, the 19" (48-cm) direct view storage tube offers high resolution graphics. Option 30 is a field installable circuit board containing microprocessor and 32k bytes of memory dedicated to creation and display of refresh objects, completely independent of the 4054's processor. **Tektronix, Inc,** PO Box 500, Beaverton, OR 97077.



Circle 211 on Inquiry Card

In Data Display. . .

TV means performance with economy

BALL TV Series general purpose displays have advanced features

BALL TV Series general purpose display

- 5, 7, 9, 12-inch sizes
- TTL-compatible sync interface
- 100% silicon circuitry
- Variety of frame styles

The TV Series is the standard of the industry for general purpose data display. TV Series users get many of the advanced features found on BALL high-performance models. Features such as strong and light weight wire frame design, simple sub-assembly construction, TTL-compatible sync interface circuits for direct drive, and electronic linearity control.

As with all BALL display products, the TV Series can be modified to suit your exact needs. You aren't hampered by lack of choice in mechanical or electronic specifications.

Even with the proven level of TV Series dependability, you'll be glad to know that BALL maintains fully staffed regional service centers, ready to deal quickly with any problems.

You can't buy a more dependable and low life-cost display than a BALL TV Series unit. Take a close look at life cycle costs, and you'll have a BALL every time.

In data display, BALL means experience, quality and service.

Ball Electronic Display Division

P.O. Box 43376 St. Paul, MN 55164 (612) 786-8900. TWX: 910-563-3552

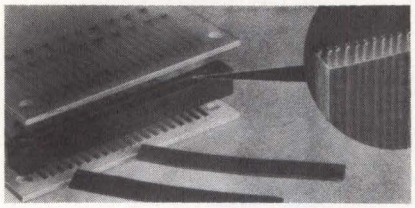
Sales Offices:

Downers Grove, IL (312) 960-4434
Ocean, NJ (201) 922-2800
Lewisville, TX (214) 436-2383
Santa Clara, CA (408) 244-1474
Upland, CA (714) 985-7110
Burlington, MA (617) 273-0608

CIRCLE 108 ON INQUIRY CARD

PRODUCTS

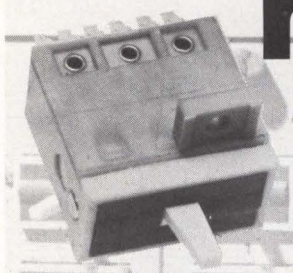
PRINTED CIRCUIT BOARD STACKING CONNECTORS



CONMET provides electrical connection between PC boards mounted in mother-daughter fashion. Connector element is comprised of 0.003″ (0.076-mm) dia wire, vertically oriented and equally spaced in 1 row and surrounded by solid silicone rubber except for contacting tips. High density of wires in element enables interconnection of any contact arrangement having at least 0.025″ (0.635-mm) wide pads and 0.010″ (0.254-mm) spaces. **Technical Wire Products, Inc,** 129 Dermody St, Cranford, NJ 07016.
Circle 217 on Inquiry Card

A new T-bar® miniature

Full Size.



6PDT Toggle Switch

2 million cycles

for computers, minicomputer and main frame formating, data communications equipment, medical, industrial instrumentation, and stop-start test switching

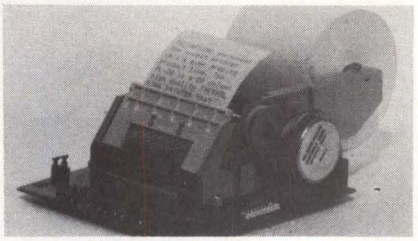
T-BAR Series 202 6PDT Mini-Paddle Lever Switches are designed for "must operate" applications. T-BAR Edge-to-Dome™ bifurcated contacts provide the SitStill™ reliability that protects the integrity and stability of millions of circuits during continuous use or even long periods of inoperation. The 202 retains its initial characteristics through 2-million operations. Call for application help.

T-bar® INCORPORATED

SWITCHING COMPONENTS DIVISION

141 Danbury Road Wilton, CT 06897 Telephone: 203/762-8351 TWX: 710/479-3215

MICROPROCESSOR CONTROLLED THERMAL PRINTER ASSEMBLY



Capable of printing 2½ 20-char lines/s, the PL-20E thermal line printer uses a 5 x 8 dot matrix to form u/lc ASCII characters with descenders. The controller provides an invert mode for mounting this assembly in any position, a self-test mode, automatic carriage return and line feed for lines longer than 20 char, and std 8-bit parallel interface. Power requirements are 5 Vdc at 150 mA and 20 Vdc at 500 mA. **Telpar, Inc,** 4132 Billy Mitchell Rd, Addison, TX 75001.
Circle 218 on Inquiry Card

FIXED DISC EMULATING SUBSYSTEM

Interfacing with all Data General and DG emulating CPUs, the DMAA is a self-contained modular random access disc emulating controller which gives bulk memory addressing capability beyond 64k and speeds data transfers in existing operating systems. The unit is contained on a 15 x 15″ (38 x 38-cm) PC board and occupies one card position in the computer chassis. The controller is compatible with existing RDOS, IRIS, and BLIS operating systems. **Mini Mag, Inc,** 5611 Kendall Court, Suite 104, Arvada, CO 80002.
Circle 219 on Inquiry Card

IBM COMPATIBLE LOOP MODEMS

Designed to operate in conjunction with IBM 3600 financial communication loop systems, 12 and 24 LMS modems provide 1200- and 2400-bit/s operation as direct replacements for IBM 3603 terminal access unit. Features include automatic central site notification of network problems, fault isolation at unattended remote sites, and restoration of failed network components when used with the company's 185 network diagnostic controller or 200 network management center. Dial backup capabilities are provided. **Racal-Milgo, Inc,** 8600 NW 41st St, Miami, FL 33166.
Circle 220 on Inquiry Card

PRODUCTS

DIGITAL CAPACITANCE MEASUREMENT PROBE

C-Probe II attaches directly to the input of any std frequency counter and causes the counter to directly display the value of capacitors from 0.1 pF to 10,000 μF with a picofarad range accuracy of 0.25% to 200,000 pF and accuracy of 0.5% in the microfarad range to 10,000 μF. Measurement cycle times are 0.1 s to 30 μF, 1 s to 3000 μF, and 10 s above 3000 μF. Controls include range selection, resolution (X1 or X10), user selectable gate times (0.1, 1, or 10 s), output signal attenuation (X1, X10, or X100), 10-turn calibration potentiometer for pico and microfarad ranges, and 10-turn potentiometer for stray or lead capacitance cancellation to 50 pF. **International Instrumentation Inc,** Box 3751, Thousand Oaks, CA 91359.

Circle 212 on Inquiry Card

LARGE CAPACITY HIGH SPEED MEMORY BOARDS

Dynamic random access memory boards BLC-032, -048, and -064 provide 32k, 48k, and 64k bytes, respectively. Each includes all refresh, timing, control, and buffering circuitry, and 20-bit address decode which allows use in a 1M-byte memory. All boards have access time of 430 ns and full read or write cycle of 660 ns. BLC-064 has a max power requirement of 20.7 W. The boards operate as either 8- or 16-bit memories, and allow for 1-board expansion of 16-bit systems. Used in either advanced or delayed write mode, they have logic circuitry for battery backup and memory protection, for user installed byte parity, and onboard refresh logic. **National Semiconductor Corp,** 2900 Semiconductor Dr, Santa Clara, CA 95051.

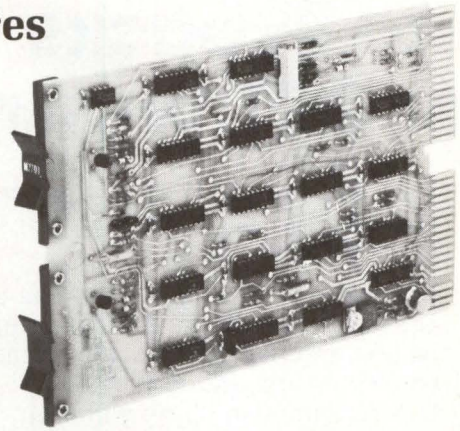
HIGH RESOLUTION PARALLEL AND SERIAL INTERFACE PRINTERS

IPS-7048 and -7049 parallel interface printers and -7248 and -7249 serial Teletype compatible printers feature a 9-wire printhead and a 7 x 9 dot matrix instead of the 7 x 7 matrix provided by earlier parallel and serial models. All models print a 96 ASCII char set in a 7 x 9 matrix at 200 char/s. -7048 and -7248 feature a 500-char circular buffer; -7049 and -7249 offer a 3500-char buffer. Other features include programmable vertical format, control which allows operator selectable printing of either 6 or 8 lines/in (2.3 or 3.1/cm); audible alarm to alert operators to problems; self-test switch to aid in fault diagnosis; and full lower case descenders that offer clean printing with true descenders. **Dataroyal, Inc,** Main Dunstable Rd, Nashua, NH 03061.

Circle 213 on Inquiry Card

Stocking genuine DEC computer spares

. . .



call Radgo. Radgo is stocked and staffed to help you with your requirements for most general purpose K&M series and many computer spare modules manufactured by Digital Equipment Corporation — at factory prices. We also stock a large assortment of COMPUTER SUPPLIES.
Call today:
(513) 752-6880.
Outside Ohio:
(800) 543-1986

radgo

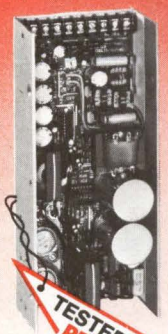
3988 McMann
Cincinnati, Ohio 45245

CIRCLE 110 ON INQUIRY CARD

Extra

high quality switchers

Deltron offers switchers that are both high quality and versatile. These 100 to 300 watt singles, duals, triples and quads feature efficiencies to 82%, with brown out protection and 20 msec. loss of line hold-up. This is Deltron's unique answer to meet your design challenges of today at competitive prices.



- Built-in differential and common mode RFI suppression.
- Input surge and OV protection.
- UL 478 recognized.
- Split primary.
- Open and closed frame units.

Write for more information on Deltron's high performance switchers.

TESTED AND PROVEN

Deltron inc.

Wissahickon Avenue • North Wales, PA 19454
Tel: 215/699-9261 Twx: 510/661-8061

AC 31

CIRCLE 111 ON INQUIRY CARD

NEW! Standard yokes and flybacks for CRT terminals

The need to specify special order yokes and flybacks for your CRT video display has ended.

The same Triad-Utrad which has been answering the needs of mini-computer design engineers for 10 years, can end your high-cost and long-wait frustrations with its new line of standard deflection yokes and flybacks for CRT terminals. Now off-the-shelf yokes and flybacks for CRT video display are available from the stock of your local Triad-Utrad distributor.

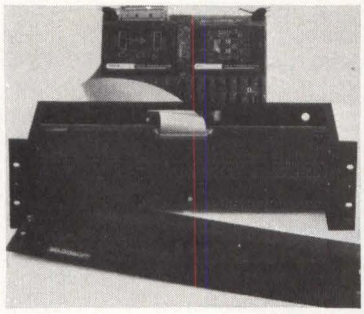
Call now, and specify our standard deflection yokes and flybacks (900 series) for your CRT.

Litton TRIAD-UTRAD Distributor Services

305 North Briant Street
Huntington, Indiana 46750

UNIVERSAL SIGNAL CONDITIONING PANEL

Equipped with screw terminals for easy connection of analog signals, the DT701 provides a convenient junction and access point for up to 50 analog input signals. Signals may be generated by remote transducers having low level outputs, or by any of the company's microcomputer analog interface boards. The panel, a heavy duty PC board, has a std conductive-etch matrix pattern connected to analog inputs by 2 onboard screw type barrier strips; either 1 or 2 onboard 3M ribbon connectors mate via appropriate cable to computer. Pattern of conductive etch allows user to install signal conditioning functions in up to 50 individual channels. 19 x 5″ (48 x 12.7-cm) panel screws directly to std RETMA rack; for recessed mounting, the -MA option provides a RETMA std 19″ mounting bracket. **Data Translation, Inc,** 4 Strathmore Rd, Natick, MA 01760.



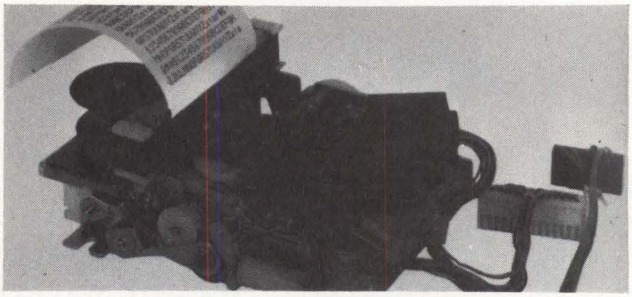
Circle 214 on Inquiry Card

LOW COST ENTRY LEVEL COMPUTER SYSTEM

A fully integrated, multiuser system, the 5000/ES offers 10M bytes of hard disc storage, 10M-byte capacity magnetic tape cartridge drive for software backup and recovery, and 4 user ports in its basic configuration. The system includes MULTUS multi-user timesharing executive. Disc storage expands in increments of 10M, 29M, or 58M to 184M bytes. Up to 4 tape cartridge drives may be installed in the basic tape module. Transfers between disc and tape cartridge may be performed programmatically, allowing up to 40M bytes of programs and data files to be transferred without physical handling of tape in a 4-drive configuration. **BTI Computer Systems,** 870 W Maude Ave, Sunnyvale, CA 94086.

Circle 215 on Inquiry Card

MINIATURE IMPACT DOT MATRIX PRINTER ASSEMBLY



Model DP-822 provides 21-col hardcopy printing at a speed of 2.5 lines/s. Its disposable 7-wire, 5-dot matrix printing head can be used with std adding machine tapes. Printhead has life expectancy of 15M char. Printer uses just one 12-Vdc motor to control head, paper feed, and ribbon mechanism. Miniature solenoids activate the 7 wires in the head. The unit weighs 650 g and measures 52.5 x 106 x 145 mm. The 5 x 7 matrix yields a printed character measuring up to 1.8 mm wide x 2.9 mm high. Line spacing is 4.24 mm. The mechanism is equipped with 2 pairs of connectors. One plugs into the controller or printer driving circuit, the other into the customer's software. **Star Micronics, Inc,** Pan Am Bldg, Suite 2308, 200 Park Ave. New York, NY 10017.

Circle 216 on Inquiry Card

Check 'em out! New Burroughs OEM print mechanisms and heads.

You'll find every feature you've been looking for: speed, performance, price and reliability.

That's right. For the first time ever, Burroughs offers to OEM's our line of dependable, low-cost, dot matrix print heads and printer mechanisms. The print head options include 90, 120 or 180 cps operation with 7 or 9 pin configuration. Print mechanisms available with 132 print positions and print speeds to 90 cps.

You can add Burroughs dependability to your product for as little as $80 (PH 119-90 print head) or $270 (PM 100 Series print mechanism) in 100 quantity. They're worth looking into. Call or write for low evaluation unit prices and detailed specifications.

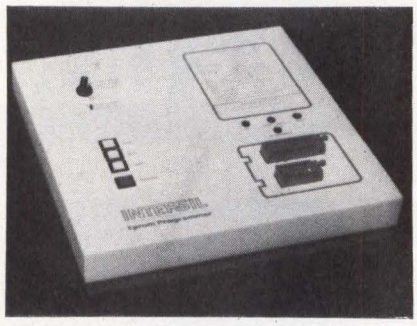
Burroughs OEM Marketing Corporation, P.O. Box 1226, Plainfield, NJ 07061, (201) 757-5000. In Europe, High Street, Rickmansworth Hertfordshire, England. Telephone 70545.

Burroughs

Circle 113 For General Information

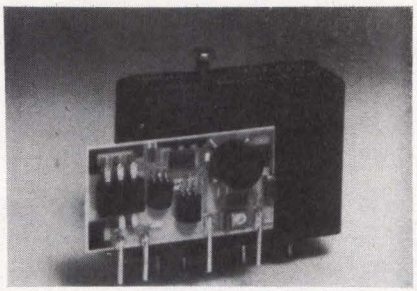
Circle 114 For Detailed Specifications

MICROPROCESSOR CONTROLLED CMOS EPROM PROGRAMMER



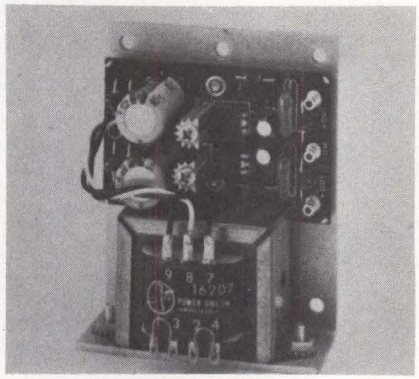
Designed for use with IM87C48/C41 single-chip microcomputers and with IM6653 1k x 4 and IM6654 512 x 8 CMOS EPROMs, the 6920 operates with terminal, as standalone unit, or as peripheral to computer, and features built-in RS-232-C and 20-mA current loop interfaces. Firmware contains 16 editing, loading, listing, and programming commands. Data may be loaded or dumped in ASCII, hex, or BNPF formats, or displayed in any of 15 bases. **Intersil Inc,** 10710 N Tantau Ave, Cupertino, CA 95014.
Circle 221 on Inquiry Card

HYBRID THICK FILM I/O MODULES



Hybrid modules feature components that are laser trimmed to within 0.3%, are resistant to severe vibration and physical and thermal shock, and have 600-V blocking and VDE specs. 8-, 16-, and 24-position boards have plug compatible logic contacts; 4-position version has screw terminal logic connections. All have a barrier strip with screw terminals for load connections, circuitry for pullup resistors, 5-A field replaceable fuses, LED status indicators, and color coded position indicators. **Gordos Arkansas, Inc,** 1000 N Second St, Rogers, AR 72756.
Circle 222 on Inquiry Card

DUAL-OUTPUT DC POWER SUPPLIES



Models HAD12 and 15 provide ±12 V and ±15 V at 0.25 A for PMOS, NMOS, CMOS, and linear devices. Std features include 115/230-Vac ±10% ac input capabilities, ±0.10% line and load regulation, and full short circuit and thermal overload protection. Max output ripple is 10 mV pk-pk. Both supplies meet MIL-STD-810B for shock and vibration. Size is 3.75 x 3.0 x 1.4" (9.5 x 7.6 x 3.6 cm); weight is 1 lb (0.45 kg). **Power-One Inc,** Power One Dr, Camarillo, CA 93010.
Circle 223 on Inquiry Card

Improve Readability and Contrast

CUT GLARE WITH THERMOFORMED VIDEO FILTERS®

• eliminate glare from ambient light • enhance contrast, improve sharpness • exceptional angular viewing • interchangeable selection of colors or neutral grays for all JEDEC sizes • graticules available • scratch and solvent resistant • low cost.

See for yourself...call or write for **FREE** *sample.*

PANELGRAPHIC CORPORATION
10 Henderson Drive • West Caldwell, New Jersey 07006
Phone (201) 227-1500; TWX: 710-734-4367

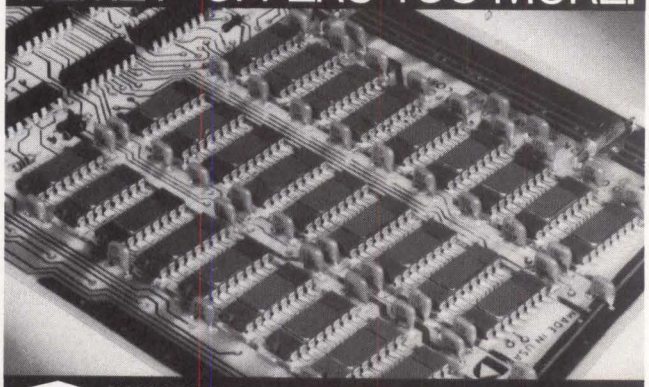
CIRCLE 115 ON INQUIRY CARD

"BLUE MAX" DID IT!

Datapoint Corp. of San Antonio, Tex. needed a capacitor of miniature size, with maximum CV ratings, of consistent quality, and at a competitive price. They chose the KEMET "Blue Max" dipped monolithic ceramic capacitor. It comes in three dielectrics, six case sizes, with more than 350 CV ratings, in capacitance values from 2.2 pF to 4.7 μF, in 50, 100 and 200V ranges. For more information, write: Components Dept., Union Carbide Corporation, P.O. Box 5928, Greenville, SC 29606. Phone: (803) 963-6300. **Or see your local KEMET Capacitors Distributor.**

Datapoint 5500
Advanced Business Processor

KEMET® OFFERS YOU MORE.



UNION CARBIDE ELECTRONICS DIVISION COMPONENTS DEPARTMENT

In Europe: Union Carbide Europe, S.A. 5, Rue Pedro Meylan, Geneva 17, Switzerland. Phone: 022 47 4411. Telex: 845-22253

KEMET and Blue Max are trademarks of Union Carbide Corporation

CIRCLE 116 ON INQUIRY CARD

Imagine a low cost tape drive and formatter that combines 3 densities and any of 3 speeds into a single OEM subsystem...

Telex's new 6253 Tri-Density tape drive and 6850 Tri-Density formatter-controller does just that. It's priced below $15,000.00* and offers OEMs a single subsystem that combines 800 BPI (NRZI), 1600 BPI (PE) and 6250 BPI (GCR) formatting with tape speeds of 45, 75 or 125 IPS. Any of the three formats can be selected manually or automatically under program control.

The 6850 formatter can handle up to four 6253 drives. With an expansion option, it can be expanded to eight drives. An address select switch is also available as an option. In addition, the 6253 features automatic tape loading and Telex's Supr-Lite™ Capstan with the lowest inertia available.

Call Telex or send your business card with this ad to our offices. You'll discover how imagination is taking OEM tape drive technology further.

*Price applies to OEM quantities and is subject to change without notice.

TELEX® COMPUTER PRODUCTS, INC.

Imagination to take technology further.

6422 EAST 41ST/TULSA, OKLAHOMA 74135/(918) 627-1111
332 CONSUMERS ROAD / WILLOWDALE, ONTARIO M2J1P8 / (416) 494-4444

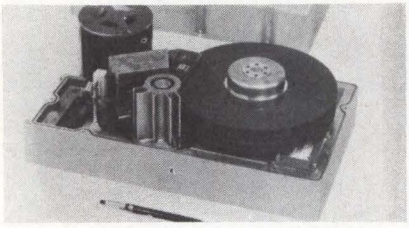
CIRCLE 186 ON INQUIRY CARD

PRODUCTS

TRI-DENSITY TAPE DRIVE AND FORMATTER CONTROLLER

OEM oriented tri-density model 6253 mag tape drive and model 6850 formatter-controller combine 800-bit/in (315/cm) NRZI, 1600-bit/in (630/cm) PE, and 6250-bit/in (2460/cm) GCR formats in a single system. Any format can be selected manually, or automatically under program control, with specified tape speeds of 45, 75, or 125 in/s (115, 190, 320 cm/s). An optional dual-speed capability allows selection of two different operating densities. **Telex Computer Products,** 6422 E 41st St, Tulsa, OK 74135.
Circle 224 on Inquiry Card

8-IN DISC SUBASSEMBLY



Incorporating a rotary actuator, deck plate with an integral spindle, recirculating air filtration system, plus cover, the Mini Fox 8″ (20-cm) disc subassembly can mount up to four 200- or 210-mm discs for up to 51.2M bytes of unformatted storage. Operating conditions of the 8.75 x 14.75 x 5.0″ (22.2 x 37.5 x 12.7 cm) unit specify 15 to 48 °C temperature and 10 to 80% relative humidity (noncondensing). **SLI Industries,** 21040 Victory Blvd, Woodland Hills, CA 91367.
Circle 225 on Inquiry Card

ASYNCHRONOUS SHORT HAUL MODEMS

Extended range, limited distance ALD-XR modem provides a 50% increase in operating range over the std ALD, enabling 1200-bit/s transmission for up to 21 mi (33 km) and 9600-bit/s transmission for up to 6 mi (9.6 km) over the same type of cable. ALD-LP features board mounted varistors that protect its receive circuitry from high voltage surges; ALD-LP/XR is an extended range version of this unit. All provide half- or full-duplex data transmission over 2- or 4-wire facilities. **Prentice Corp,** 795 San Antonio Rd, Palo Alto, CA 94303.
Circle 226 on Inquiry Card

REMOTE DATA ENTRY KEYPAD SYSTEM

With 34 data keys and a shift key arranged in a 5 x 7 matrix, system generates 2 codes for each data key depending on status of shift key. Keytop layout is user definable; a software lookup routine will convert to any desired code. Output conforms to RS-423, which is RS-232 compatible but allows transmission up to 2500′ (750 m) on 24-gauge twisted pair wire with an RS-232 receiver. Std baud rate is 75; 300-baud is optional. **Gimix Inc,** 1337 W 37th Pl, Chicago, IL 60609.
Circle 227 on Inquiry Card

DOUBLE-SIDED 8″ DISKETTES

The single-density 742 is compatible with IBM 5110 systems. 7430 diskettes, for double-density applications, are available unformatted or in 256, 512, and 1024 formats for IBM System/34, 5110, and compatible systems. 743-2 versions are compatible with Shugart 850 drives. All have long wearing formulation of oxides and polymers. Low abrasivity protects read/write heads, promoting longer head life. **3M Co, Data Recording Products Div,** PO Box 33600, St Paul, MN 55133.
Circle 228 on Inquiry Card

SOFTWARE/FIRMWARE HARDWARE ENGINEERS

Free Employment Service

Positions Nationally

- **Scientific and commercial applications**
- **Software development and systems programming**
- **Telecommunications**
- **Control systems**
- **Computer engineering**
- **Computer marketing and support**

Call or send resume or rough notes of objectives, salary, location restrictions, education and experience (including computers, models, operating systems and languages) to either one of our locations. Or check the reader service card for a free sample resume. We will answer all correspondence from U.S. citizens and permanent residents and will guarantee our best efforts in a professional and ethical manner to all qualified applicants that we think we can help. Our client companies pay all of our fees.

RSVP

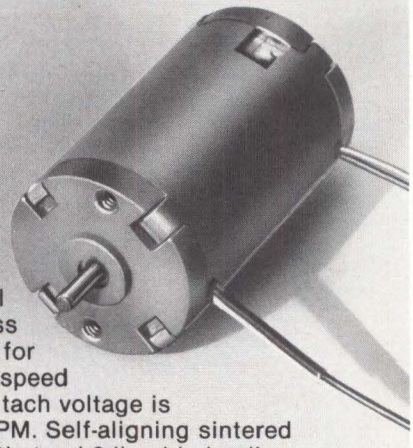
RSVP SERVICES, Dept. CD
Suite 700, One Cherry Hill Mall
Cherry Hill, New Jersey 08002
(609) 667-4488

RSVP SERVICES, Dept. CD
Suite 300, Dublin Hall
1777 Walton Road
Blue Bell, Penna. 19422
(215) 629-0595

RSVP SERVICES

Employment Agency for Computer Professionals

d-c servo motor...



D-C PM motor features integral 16-pole brushless A-C tachometer for precise voltage/speed control. Typical tach voltage is 2V RMS/1000 RPM. Self-aligning sintered bearings will withstand 2 lb. side loading. This lightweight, compact (1-1/4 in. dia. x 2 in.) motor is ideal for driving tape decks, digital cassettes, floppy disks, printers, X-Y plotters, copiers, business machines, etc.

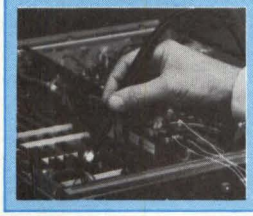
BARBER COLMAN COMPANY

Barber-Colman Company
MOTOR DIVISION
Dept. V, 14048 Rock St., Rockford, Illinois 61101

Set your COURSE for the 80's

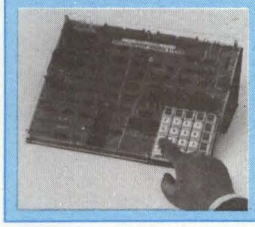
Through Advanced Technical Education from
INTEGRATED COMPUTER SYSTEMS, INC.

Course 142—Five Days
Troubleshooting Microprocessor-Based Systems



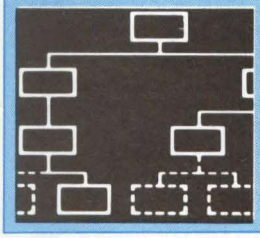
PHOENIX January 21-25
WASHINGTON, DC January 28-February 1
DALLAS February 4-8
DENVER February 11-15
SAN FRANCISCO February 25-29
SEATTLE March 3-7
LOS ANGELES March 10-14
BOSTON March 24-28
SAN DIEGO April 14-18

Course 160—Four Days
Microprocessors & Microcomputers



ATLANTA January 15-18
DENVER January 22-25
LOS ANGELES January 29-February 1
WASHINGTON, DC February 12-15
SAN DIEGO February 19-22
HOUSTON February 26-29
BOSTON March 4-7
SAN FRANCISCO March 25-28
DALLAS April 15-18

Course 320—Four Days
Structured Programming



ATLANTA January 15-18
SAN FRANCISCO January 22-25
WASHINGTON, DC February 5-8
SAN DIEGO February 12-15
HOUSTON March 4-7
SEATTLE March 25-28
LOS ANGELES April 15-18
BOSTON April 22-25
WASHINGTON, DC April 29-May 2

Course 330—Four Days
PASCAL: The Structured Language

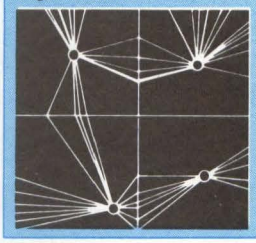
```
10: FUNCTION RFIB(N,LEVEL
11: VAR RF:INTEGER;
12: BEGIN
13:   DOTS(LEVEL);  WRITE
14:   IF N>1 THEN
15:     RF:=RFIB(N-1,LE
16:   ELSE
17:     IF N=1 THEN RF:
18:       ELSE RF:=0;
19:   RFIB:=RF;
20:   DOTS(LEVEL);
21:   WRITELN('LEAVE, N='
22: END(*RFACT*);
```

DALLAS January 22-25
SAN FRANCISCO February 12-15
WASHINGTON, DC March 4-7
LOS ANGELES March 11-14
ATLANTA March 18-21
HOUSTON April 15-18
BOSTON April 29-May 2
SAN DIEGO May 6-9

Course 340—Four Days
Engineering Project Mgmt.

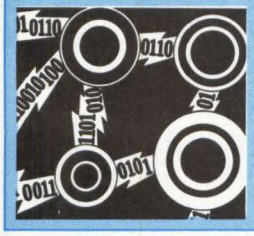
SAN FRANCISCO January 29-February 1
WASHINGTON, DC February 12-15
HOUSTON February 19-22 NEW
ATLANTA February 26-29
SAN DIEGO March 11-14
BOSTON April 15-18
WASHINGTON, DC April 22-25
LOS ANGELES April 29-May 2
SEATTLE May 6-9

Course 350—Four Days
Distributed Processing Systems



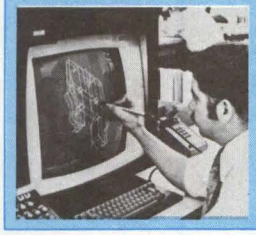
SAN DIEGO January 22-25
WASHINGTON, DC February 12-15
ATLANTA March 18-21
WASHINGTON, DC April 29-May 2

Course 355—Four Days
Computer Communication Networks NEW



SAN FRANCISCO January 15-18
WASHINGTON, DC February 26-29
DENVER March 4-7
LOS ANGELES March 25-28
ATLANTA April 15-18
BOSTON April 22-25
MINNEAPOLIS May 6-9

Course 365—Four Days
Computer Graphics

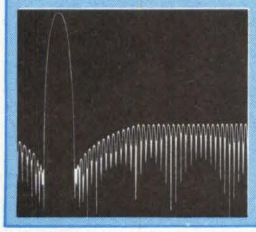


LOS ANGELES January 15-18
HOUSTON January 22-25
PHOENIX January 29-February 1
ATLANTA February 5-8
WASHINGTON, DC February 12-15
SAN DIEGO March 18-21
NEW YORK April 15-18
SAN FRANCISCO April 22-25
BOSTON April 29-May 2

Course 370—Four Days
CAD/CAM NEW

LOS ANGELES January 14-17
WASHINGTON, DC January 21-24
SEATTLE February 25-28
DALLAS March 3-6
SAN FRANCISCO March 17-20
NEW YORK March 24-27
BOSTON April 14-17
CINCINNATI April 21-24

Course 412—Five Days
Digital Signal Processing



HOUSTON January 21-25
WASHINGTON, DC January 28-February 1
PHOENIX February 4-8
SAN FRANCISCO February 11-15
ATLANTA February 25-29
DENVER March 10-14
LOS ANGELES March 17-21
BOSTON April 14-18
WASHINGTON, DC April 21-25

Self-Study Microcomputer Training

Course 525A Microcomputer Software/ Hardware

Course 536A Microcomputer Interfacing Techniques

Course 565 Developing Microcomputer Software

EUROPEAN COURSE LOCATIONS

These courses, and other advanced technology courses, are also offered throughout the year in Paris, London, Copenhagen, Munich, and other European cities. For details, contact:

Course Enrollment Secretary
ICSP—U.K.
Pebblecoombe, Tadworth
Surrey KT20 7PA, England
Telephone: Leatherhead (03723) 79211
Telex: 926842

For Free Detailed Brochures:

Please contact your nearest ICS enrollment office:

Integrated Computer Systems, Inc.
3304 Pico Blvd./P.O. Box 5339
Santa Monica, CA 90405
(213) 450-2060
(LOS ANGELES)

OR

Integrated Computer Systems, Inc.
300 N. Washington St./Suite 103
Alexandria, VA 22314
(703) 548-1333
(WASHINGTON, D.C.)

TRAIN YOUR TEAM FOR THE 80'S

If you have a requirement:
- For training 20 or more engineers/managers
- In state-of-the-art technology

Then consider:
- A special on-site course presentation
- At your facility
- At reduced tuition cost
- Customized to your organization's needs

To discuss your company's specific requirements, please contact:

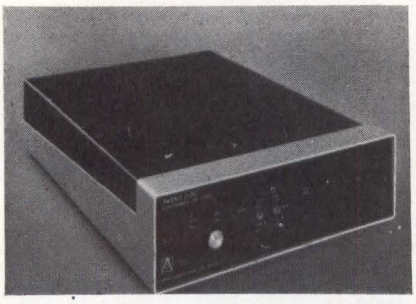
Michael B. Sanson/V.P.—Sales
Integrated Computer Systems, Inc.
3304 Pico Blvd./P.O. Box 5339
Santa Monica, CA 90405

Telephone: (213) 450-2060
TWX: 910-343-6965

CIRCLE 187 ON INQUIRY CARD

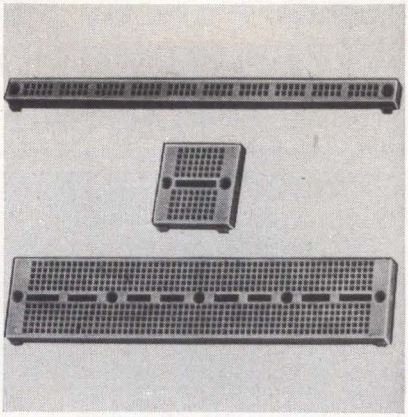
PRODUCTS

SYNCHRONOUS LINE DRIVER



Designed for cost effective inhouse or limited distance data transmission, the 2100 operates over unloaded lines, twisted pairs, or coaxial cables, at distances up to 10 mi (16 km). Output levels and spectrum conform to Bell Pub 43401. Std operating speeds are switch selectable at 2.4k, 4.8k, 9.6k, and 19.2k bits/s. Speeds of 40.8k, 50k, 56k, 224k, and 230.4k bits/s are available with Bell type 301/303 or CCITT V.35 interface. **Avanti Communications Corp,** Box 205, Broadway Station, Newport, RI 02840.
Circle 229 on Inquiry Card

CIRCUIT MOUNT BOARDS



Boards feature solderless insertion type sockets on 0.100″ (0.254-cm) centers. Each row has 5 common points. Larger boards also have 40-point bus lines; a separate bus strip model is available. All can accept std component leads including DIPs, while interconnections are easily made using std 22 AWG solid wire. Prototype boards range from small modules holding a single IC up to 1020-point panel mounted boards complete with binding posts. All modules are interlocking. **OK Machine and Tool Corp,** 3455 Conner St, Bronx, NY 10475.
Circle 230 on Inquiry Card

INTELLIGENT TAPE CODE CONVERTER READER

Model 5030 is a compact unit designed using the Facit 4031 reader mechanism to read perforated tape in any 5-, 6-, 7-, or 8-level code and output in any 5-, 6-, 7-, or 8-level code via its RS-232-C serial interface. Baud rates and operating modes are switch selectable. The microprocessor controller is normally programmed to convert 5-level Baudot (US or CCITT) to 8-level ASCII. Other codes are available on request. An 80-char data buffer is included. **Data Science,** 1189 Oddstad Dr, Redwood City, CA 94063.
Circle 231 on Inquiry Card

LINEAR HALL EFFECT SENSOR

Linear output Hall effect transducers (LOHET) are operated by the magnetic field from a permanent magnet or electromagnet, providing linear feedback for analog control systems. A 0.050″ (0.127-cm) sq silicon chip mounted on a ceramic base holds Hall effect circuitry and amplifier. 2 models are rated through the −40 to 150 °C range; the third operates from 0 to 85 °C. Ratiometric, semiratiometric, and regulated outputs are available. **Micro Switch, a Honeywell Div,** 11 W Spring St, Freeport, IL 61032.
Circle 232 on Inquiry Card

Tarbell Double Density Floppy Disk Interface

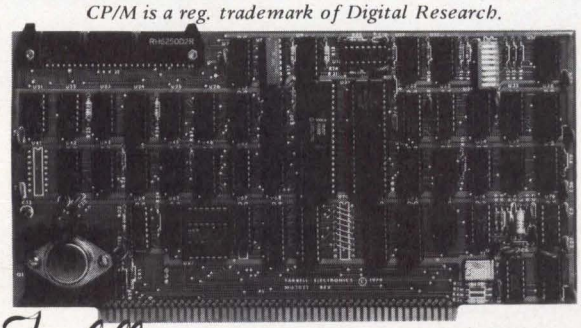
FOR 8" DISK DRIVES

Under Tarbell Double-Density CP/M, single and double density disks may be intermixed. The system automatically determines whether single or double density is in place.

- Software select single or double density.
- Phase-locked-loop and write precompensation for reliable data recovery and storage.
- On-board phantom bootstrap PROM is disabled after bootstrap operation so all 64K memory address space is available to user.
- DMA in single or double density permits multi-user operation.
- Extended addressing provides 8 extra address bits, permitting direct transfer anywhere in a 16 megabyte address range.
- Select up to 4 drives, single or double sided.
- New BIOS for CP/M included on single-density diskette.

Assembled and Tested $425

CP/M is a reg. trademark of Digital Research.



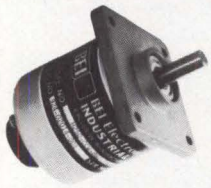
Tarbell Electronics 950 Dovlen Place, Suite B,Carson, Ca. 90746
(213) 538-4251 (213) 538-2254

CIRCLE 119 ON INQUIRY CARD

ANNOUNCING

A HEAVY DUTY OPTICAL INDUSTRIAL ABSOLUTE POSITION ENCODER

The H25 Series



- Resolutions thru 2^8
- Heavy Duty Bearings - 35 Lb. Maximum Dynamic Radial Loading
- Gray Code or Natural Binary Outputs
- TTL, CMOS, High Voltage Open Collector, or Line Driver Output Options
- Optional Shaft Seal and Many Other Features

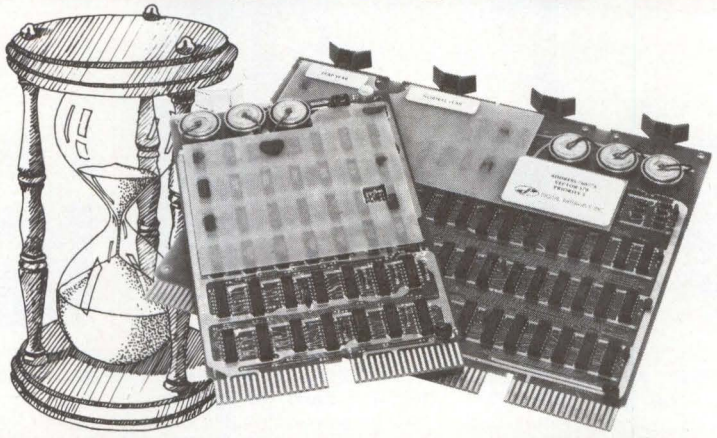
BEI Electronics, Inc.

Digital Products Division Little Rock, Arkansas — BEI — Industrial Encoder Divison Goleta, California

Exclusive manufacturers of the BALDWIN® encoder
7230 Hollister Ave. Goleta, CA 93017
TEL: (805) 968-0782

CIRCLE 120 ON INQUIRY CARD

TIME after TIME



BATTERY SUPPORTED CALENDAR CLOCKS

PDP-11*

TCU-100 • $495

- Provides month, day, hour, minute and second.
- Can interrupt on date/time, or periodic intervals.

TCU-150 • $430

- Provides year, month, day, hour, minute and second.
- Automatic leap year.
- Patches for RSX-11M, RT-11 FB/SJ VO2, VO3 and UNIX.

LSI-11/2*

TCU-50D • $295

- Provides month, day, hour, minute and second.
- Dual size board.
- Patches for RT-11 SJ/FB VO2, VO3B.

Lockheed SUE

TCU-200 • $550

- Provides year, month, day, hour, minute, second and milli-second.
- Interval interrupts between 1/1024 seconds and 64 seconds.

Computer Automation (Naked Mini)

TCU-310 • $385

- Provides year, month, day, hour, minute and second.

Multi-Bus**

TCU-410 • $325

- Provides year, month, day, hour, minute and second.
- SBC/BLC compatible.

HP 2100

TCU-2100 • $395

- Correct time restored after power failure.
- Compatible with the HP TBG card.

Serial Clock (RS 232 or 20 mA)

SLC-1 • $575

- Connects between any terminal and host computer.
- Provides date, time and more!

All Digital Pathways TCUs have on board NICAD batteries to maintain time and date during power down. Timing is provided by a crystal controlled oscillator. Prices are U.S. domestic single piece. Quantity discounts available.

For more information on these products, contact:
Digital Pathways Inc.
4151 Middlefield Road
Palo Alto, CA 94306
Phone: (415) 493-5544

*Trademark of Digital Equipment Corporation

**Trademark of Intel Corporation

DIGITAL PATHWAYS

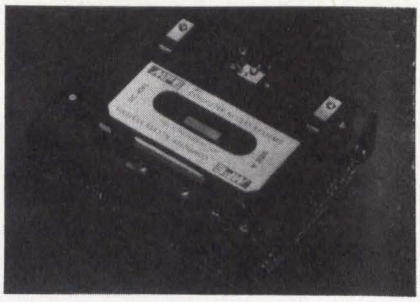
CIRCLE 121 ON INQUIRY CARD

CRT TERMINAL WITH 4-PAGE DISPLAY MEMORY

Microprocessor based display terminal has an 80-char by 24-line screen, and provides forms control, u/lc, up to 19 user programmable function keys, line drawing graphics, and shared printing capabilities. Standard on the Concept 104 are 4 pages of display memory, windowing (multiple subscreen), and networking between up to 3 communications lines. Other features include tiltable nonglare screen, detached keyboard, and audible key touch. **Human Designed Systems, Inc,** 3700 Markey St, Philadelphia, PA 19104.

Circle 233 on Inquiry Card

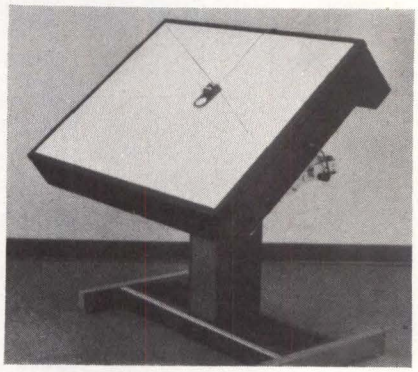
DUAL-TRACE CASSETTE TAPE TRANSPORT



ANSI/ECMA compatible model 452B features a 2-track read-after-write head that permits remote track selection, and eliminates need for operator intervention. After conventionally writing track 1, it rewinds in 30 s, electronically switches tracks, and writes track 2. Either recorded track can be accessed at will. With data transfer rate of 32k bits/s, the unit stores up to 720k formatted char. Offering 15k-h MTBF and 30-min MTTR, transport measures 4.5 x 5.5 x 4″ (11.4 x 13.9 x 10.2 cm). **MFE Corp, Digital Products Group,** Keewaydin Dr, Salem, NH 03079.

Circle 234 on Inquiry Card

HIGH INTENSITY BACK-LIT DIGITIZER



Consisting of digitizing surface, interchangeable crosshair or pen cursor, and controller, backlit digitizers and tablets are available in 8 sizes from 11 x 11″ (27.9 x 27.9 cm) to 42 x 60″ (106 to 152 cm) with resolutions of 0.001 or 0.01″ (0.025 or 0.254 mm). Adjustable high intensity light source provides even light distribution over digitizing surface with invisible grid lines. Std fluorescent bulbs, cooling fans, and simple bulb replacement procedure minimize downtime because of bulb failure. **GTCO Corp,** 1055 First St, Rockville, MD 20850.

Circle 235 on Inquiry Card

TERMINALS
FROM TRANSNET

PURCHASE FULL OWNERSHIP AND LEASE PLANS

DESCRIPTION	PURCHASE PRICE	PER MONTH 12 MOS.	24 MOS.	36 MOS.
LA36 DECwriter II	$1,595	$ 152	$ 83	$ 56
LA34 DECwriter IV	1,295	124	67	45
LA120 DECwriter III, KSR	2,295	219	120	80
LA180 DECprinter I, RO	2,095	200	109	74
VT100 CRT DECscope	1,895	181	99	66
VT132 CRT DECscope	2,295	220	119	80
DT80-1 CRT Terminal	1,795	172	93	63
TI745 Portable Terminal	1,875	179	98	66
TI765 Bubble Memory Term.	2,795	267	145	98
TI810 RO Printer	1,895	181	99	66
TI820 KSR Printer	2,395	229	125	84
ADM3A CRT Terminal	875	84	46	31
QUME Letter Quality KSR	3,195	306	166	112
QUME Letter Quality RO	2,795	268	145	98
HAZELTINE 1410 CRT	895	86	47	32
HAZELTINE 1500 CRT	1,195	115	62	42
HAZELTINE 1552 CRT	1,495	143	78	52
DataProducts 2230	7,900	755	410	277
DATAMATE Mini Floppy	1,750	167	91	61

FULL OWNERSHIP AFTER 12 OR 24 MONTHS
10% PURCHASE OPTION AFTER 36 MONTHS

ACCESSORIES AND PERIPHERAL EQUIPMENT
ACOUSTIC COUPLERS • MODEMS • THERMAL PAPER RIBBONS • INTERFACE MODULES • FLOPPY DISK UNITS
PROMPT DELIVERY • EFFICIENT SERVICE

TRANSNET CORPORATION
2005 ROUTE 22, UNION, N.J. 07083
201-688-7800
TWX 710-985-5485

On August 3, 1492, Christopher Columbus set sail from Spain, seeking honor and wealth by establishing new trade routes with India. Since he had miscalculated the circumference of the earth by 6,331 miles, he was destined to spend years in a vain search for the mainland of Asia. In 1502 he died poor and forgotten.

If you want to reach spice merchants, pick the right continent.

Success is always easier to grasp if you're in the right place, talking to the right people. BPA-audited (Business Publication Audit of Circulation, Inc.) magazines let you know exactly where your ads are going. BPA audits the job title and description of people who receive our magazines, so you know to whom you're talking.

BPA We count, so your ads will.

This BPA-audited magazine donated the space for this ad, with creative and production costs contributed by BPA agency and advertiser members.

CIRCLE 122 ON INQUIRY CARD

CIRCLE 123 ON INQUIRY CARD

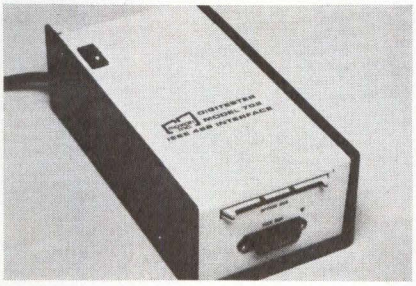
PRODUCTS

FCC REGISTERED PROGRAMMABLE DATA COUPLER

PC-1001F is an interface unit designed to provide both the data access arrangement and the network control signaling. Prewired in either fixed loss loop (−4 dBm), permissive (−9 dBm), or programmable (−12 to 0 dBm) modes, it isolates customer equipment for protection of telephone plant and personnel from hazardous voltages, and detects incoming ringing signals to permit operation in unattended answering mode. **Precision Components, Inc,** 1110 W National Ave, Addison, IL 60101.

Circle 236 on Inquiry Card

IEEE 488 DATA GENERATOR INTERFACE



Model 702 IEEE 488 interface allows model 725 data generator to operate as talker or listener in test system controlled by IEEE 488 GPIB compatible computer or calculator. Each symbol on data generator keyboard has been assigned an ASCII character; functions are accessed remotely by sending the appropriate character on the bus. **Moxon Inc,** 2222 Michelson Dr, Irvine, CA 92715.

Circle 237 on Inquiry Card

5-V MOS MEMORY PROTECTORS

GMP-5 series TransZorb® transient voltage suppressors have max surge rating of 215 A for 50 μs and 70 A for 1 ms. Protectors feature 6.9 V at 10 A max clamping level for impulse waveform of 10 x 1000 μs. With theoretical response time of 1 x 11^{-12} s and low series resistance, devices protect VMOS, HMOS, NMOS, and CMOS circuits from unwanted transients while maintaining the circuit voltage level for continuous system operation. **General Semiconductor Industries, Inc,** 2001 W 10th Place, Tempe, AZ 85281.

Circle 238 on Inquiry Card

RS-232-C AND IEEE 488 BUS CARTRIDGE RECORDERS

Single- or dual-drive digital cartridge recorders provide 2.4M bytes of storage/cartridge using 1600-bit/in (630/cm) PE recording on 0.25" (6.35-mm) mag tape in ANSI/ECMA format. Features include full read-after-write, automatic error handling, 2048-byte buffer and programmable formatting, and search and edit functions. Either RS-232-C or IEEE 488 GPIB interface is available. **Tandberg Data Inc,** 4060 Morena Blvd, San Diego, CA 92117.

Circle 239 on Inquiry Card

For IBM mainframe and major mini-computer users, Adage 4000 Series systems now offer the same superior performance that has made us, for years, the recognized leader in interactive graphics. All systems feature host channel speed interfaces, host computer off-loading, image buffer, local hard copy output, and high-speed interactive displays.

For IBM System Users

The 4250 — our higher-performance, plug-compatible replacement for the IBM 3250. With 12 displays, the 4250 offers the most economical price/display ratio available today.

The 4370 — our full 3D graphics terminal designed to interface directly to an IBM/370 compatible channel.

THE ADAGE ADVANTAGE

Interactive Graphics for IBM and Mini-Computer Users

The 4380 — our innovative combination of all 4250 and 4370 functions in one terminal.

For Mini-Computer Users

The 4100 Series — includes 2D (4115 and 4125) and 3D (4135 and 4145) models with state-of-the-art graphics capabilities and direct interfaces to popular mini-computers.

The Adage Advantage

For over a decade Adage systems have been helping customers in industries including aerospace, automotive, heavy machinery and petroleum, solve their most complex graphics problems. These include applications such as CAD/CAM, command and control, simulation, and data analysis.

To learn how Adage can help you, call (617) 783-1100.

ADAGE
INTERACTIVE COMPUTER GRAPHICS WORLDWIDE

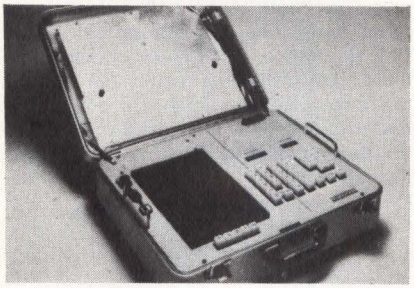
U.S.: 1079 Commonwealth Ave. • Boston, MA 02215
(617) 783-1100 • TWX 710-330-0141

Europe: Markstrasse 9, 3308 Koenigslutter am Elm, West Germany
Phone: 05353/1089, Telex 095528

CIRCLE 124 ON INQUIRY CARD

PRODUCTS

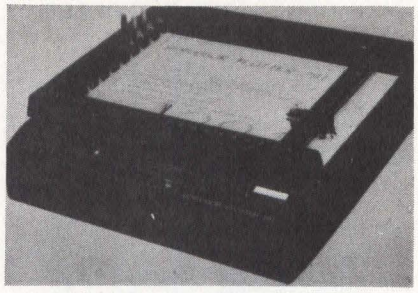
PORTABLE CONTROLLER PROGRAM DIAGNOSTIC UNIT



Reprogramming the MaxiMiser programmable controller in <1.5 min, diagnostic unit uses simple ladder diagram language to program or make changes in existing programs. The portable device can load a complete program into nonvolatile EAROM of the controller with optional cassette memory loader. Error and status indicator allows programming of diagnostics and digital display of system failures. **Cincinnati Milacron, Electronic Systems Div,** Mason Rd & Rt 48, Lebanon, OH 45036.

Circle 240 on Inquiry Card

MICROPROCESSOR CONTROLLED MULTI-PEN PLOTTER



A Z-80 microprocessor controls the automatic pen changing, off-scale data handling, and coordinate transformation for model 281 digital plotter. 8 separate pens may be colored fiber tips or isograph drafting pens. Firmware provides circle interpolation, character plotting in 5 fonts, generation of axes and grids, window plotting, and point digitizing. Plotter uses DIN-A3 std graph paper and interfaces via RS-232-C/V.24, 20-mA, or IEEE-488 bus. **Soltec Corp,** 11684 Pendleton St, Sun Valley, CA 91352.

Circle 241 on Inquiry Card

256k-BYTE SEMICONDUCTOR ADD-IN MEMORY SYSTEMS

DR-123S and DR-125S provide Data General Nova 3 and Eclipse minicomputers, respectively, with 256k bytes of add-in storage. —123S offers 500-ns cycle time, 325-ns access time, parity, and 8-position DIP to select starting address. Single-bit error correction is standard with the -125S that also features 500-ns read cycle, 700-ns write cycle, 350-ns access time, and 8-position DIP to set starting address. **Dataram Corp,** Princeton-Hightstown Rd, Cranbury, NJ 08512.

Circle 242 on Inquiry Card

HIGH RESOLUTION RASTER GRAPHICS SYSTEM

With noninterlaced refreshing of the full 1024 scan lines 60 times/s, the GMDS-4000 monitor provides a clear stable display. It offers 1024, 864, or 768 pixels on each of the 1024 lines, with any 2 of these formats selectable under program control. Optional multiple memory planes can provide up to 16 levels of gray, support for 4 monitors, and display of constant background with variable data overlays on multiple monitors. **Image Automation, Inc,** 3350 Scott Blvd, Bldg 22, Santa Clara, CA 95051.

Circle 243 on Inquiry Card

Who's Who in Technology Today

Nuclear Magnetic Resonance • Lasers • Coal Gasification • Polymers
Oceanography • Hydraulics • Superconductors • Pollution Control
Microcomputers • Architecture • Solar Energy • Bubble Memories
Ceramics • Amorphous Materials • Fusion • Advanced Automation
Acoustics • Mechanical • Optical Communication • Environmental
Computer Science • Advanced Medicine • Holography • Chemical
Biomedical • Spectroscopy • Nuclear • Civil • Electronics • Optical
Metallurgical and over 400 other technologies

Keep pace with today's technology... Locate leading experts, find companies for joint ventures and mergers, make associations with technical universities.

Now you can tap a vast pool of over 7,500 of the nation's leading technologists involved in more than 400 areas of modern technology at over 2,500 U.S. companies and universities. And for less than $46.00 a month!

This new service begins with a 6-volume, information packed directory entitled "Who's Who in Technology Today" which is technically arranged for fast and accurate information retrieval. You'll also receive bimonthly "updates" with your subscription and a monthly "toll-free" call to keep you abreast of the latest developments in today's technology.

Charter subscription: $550.00

Write or call today to start this exclusive new service!

Technology Recognition Corporation
1382 Old Freeport Road • Pittsburgh, PA 15238

Call toll-free 1-800-245-2958

CENTRALIZED AND DISTRIBUTED DATA ENTRY PRODUCTS MARKET

Frost & Sullivan has completed a 370-page in-depth report on the "Centralized and Distributed Data Entry Products Market." An analysis and 10-year sales forecast in numbers of units, unit price and dollar sales are furnished for various product types in these data entry product categories: keypunch, keyboard-to-tape, keyboard-to-disc, intelligent terminals, non-intelligent terminals, A/N display terminals, optical bar code readers, hand-held readers, optical character readers, optical mark readers, mixed media systems, pushbutton telephones, portable data recorders, industrial data collection, voice data entry, direct hand entry, magnetic character readers. An analysis is furnished on data entry system concepts ranging from the keypunch and teletypewriter to the keypunch replacement systems, the advent of source data automation, distributed data entry, and distributed data processing. A state of the art description is provided for the various data entry products.

Price: $800. Send your check or we will bill you. For free descriptive literature, plus a detailed Table of Contents, contact:

FROST & SULLIVAN
106 Fulton Street
New York, New York 10038
(212) 233-1080

OUR COMPETITIVE EDGE

Precision, extra-long life character elements for high-speed printers, point of sale equipment, teleprinters and similar printing and stamping equipment.

By what criteria do you design the character transfer elements of your printing and stamping equipment? Are they engineered to give the performance you require throughout the product life?

Mark Stamp Steel, a division of Mohawk Data Sciences Corp., engineers and manufactures quality print drums, print wheels, type slugs and similar character elements for some of the largest printer and teleprinter manufacturers in the world.

Quality design and engineering insure that your specifications are exactly met. Availability of high-technology processes, including powdered metal, cold rolling, and precision engraving, insure that your character elements are manufactured using the best possible process. The result, optimum uniformity throughout product life.

Choose from a library of over 5000 characters, including OCR, MICR, IBM, CDC, and numerous special and foreign fonts. Or, let us design a font to your specifications.

Mohawk Data Sciences is one of the leading suppliers of distributed data processing, key-to-disk and peripheral systems, with a customer base of over 7000 worldwide. Mark Stamp Steel has played a major role in the success of MDS products and their reputation for exceptional performance and reliability.

To receive additional information, or a price/performance quotation on your application, fill out and return the attached coupon. We'll tell you how our competitive edge can improve the price and performance of your product.

I'd like to learn more about your products and services:

- ☐ Please send literature.
- ☐ Please send quotation (My specifications and requirements are attached).
- ☐ Please have a design specialist call.

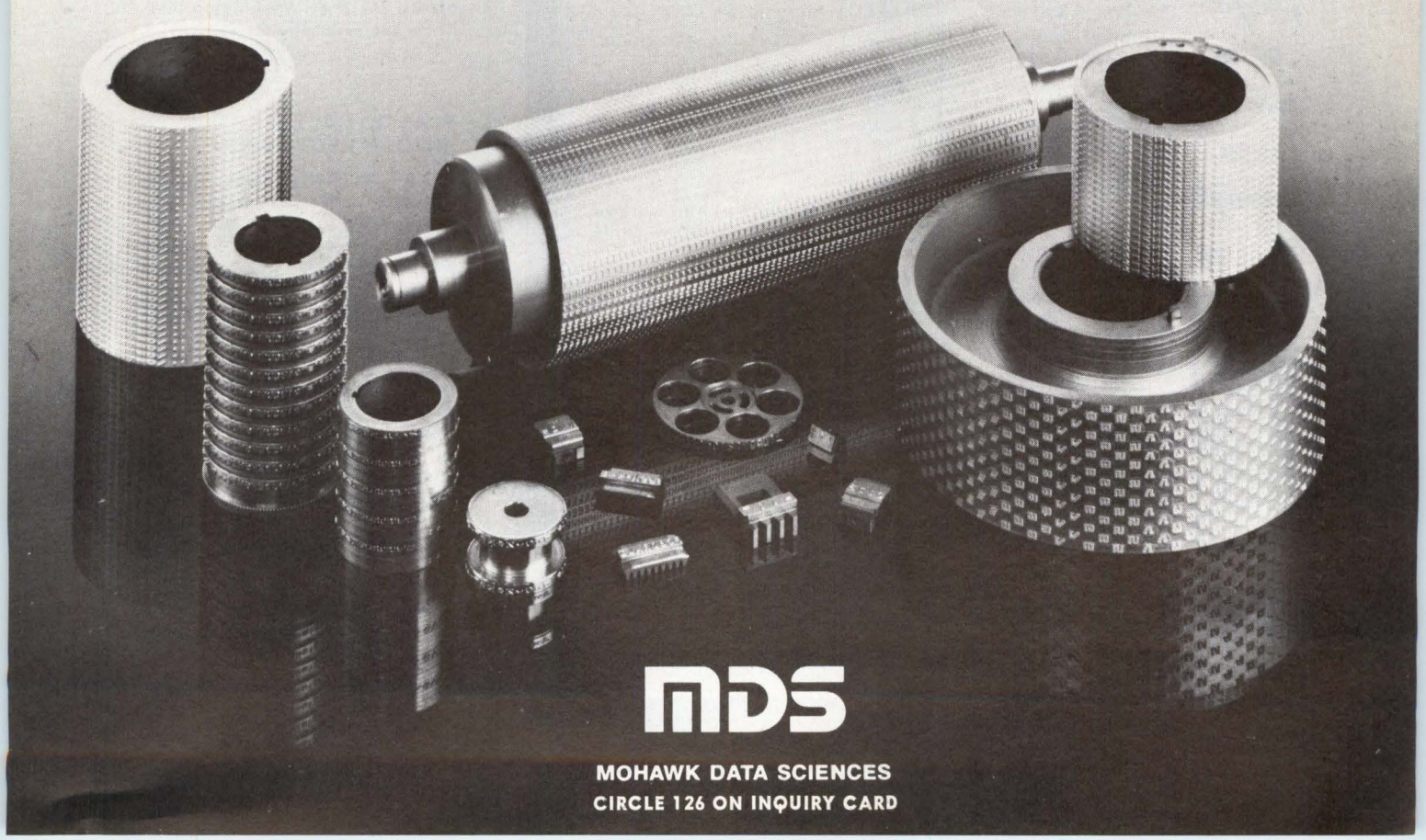
Name _____ Title _____

Company _____

Street _____ City _____

State _____ Zip _____ Phone (___) _____

Mark Stamp Steel, a division of Mohawk Data Sciences Corp.,
Palisade Street, Herkimer, N.Y. 13350
Telephone: (315) 866-5300 (Ext. 5406). CD1079



MDS

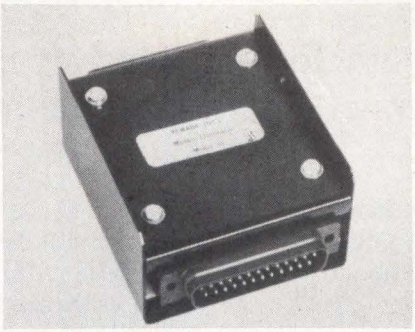
MOHAWK DATA SCIENCES

CIRCLE 126 ON INQUIRY CARD

ERROR FREE DATA CARTRIDGE

Certified 100% error free at shipment, model 98200 data cartridge offers reliable data storage for series 9800 desktop computers and 264X series display terminals. Up to 5.4M bits of unformatted data can be stored on the 140′ (42 m) of 0.150″ (0.38-cm) wide tape with a 1600-bit/in (629/cm) recording density on 2 tracks. Speeds up to 90 in (228 cm)/s are possible. Acceleration rates of up to 2000 in (5080 cm)/s² keep start/stop distances minimum. **Hewlett-Packard Co,** 1507 Page Mill Rd, Palo Alto, CA 94304.
Circle 244 on Inquiry Card

MODEM ELIMINATOR



Model 30 permits direct connection between terminals and computers, eliminating need for short haul modems or acoustic couplers where limited distance is involved. The static device requires no ac or dc voltage. It transposes transmit data and received data and request to send and data carrier detect. Packaged in an aluminum housing measuring 3 x 2.5 x 1.5″ (7.6 x 6.4 x 3.8 cm), input/output connections are provided by std 25-pin EIA RS-232-C connectors. **Remark International,** 4 Sycamore Dr, Woodbury, NY 11797.
Circle 245 on Inquiry Card

engineering

PRODUCT DESIGN/ SYSTEMS

NORTHROP

If You Share Our Commitment to Excellence...

...consider a career with Northrop Defense Systems Division, the renowned leader in the research, development and manufacture of sophisticated electronic countermeasures. If you're trained and experienced in one of the following areas, investigate the potential at Northrop:

PRODUCT DESIGN

- 5—10 years experience in electronics and electromechanical high density packaging of military support equipment. Knowledge of investment casting and metal fabrication method processes.
- RF design and analysis. Octave bandwidth MIC and stripline components. ECM TWT and equipment experience, plus familiarity with MIL-STD-38510 and 5400E requirements.
- Project Engineer with background in power supplies, modulators and high power TWT's required. Will be responsible for design and development of ECM transmitters.
- Project Engineer with analog/digital circuits and microwave components experience.
- Digital—Experience in design engineering for digital/analog controlled hardware necessary. Understanding of high voltage design and microwave circuitry desirable.

SYSTEMS

SENIOR ENGINEERS

MSEE and a minimum of 3 years experience in hardware or systems design and good written communications skills required. Microwave background necessary.

PROJECT ENGINEERS

A minimum of 5 years experience in EW hardware, software, systems design and analysis (active and/or passive), necessary. Microwave experience required.

ENGINEERS

Experience in active and passive electronic warfare systems and strong software and/or hardware background necessary.

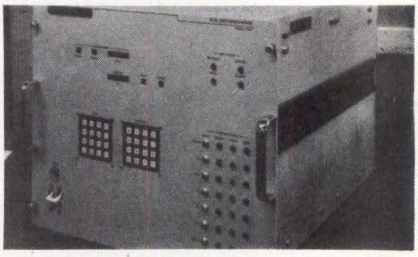
We offer outstanding compensation packages including complete benefits, unlimited growth potential and the opportunity to combine the career of a lifetime with off-hours enjoyment in Chicago, one of the most exciting and liveable areas in the nation. For further information, please forward your resume including salary history and requirements, in confidence, to:

Employment Manager

NORTHROP CORPORATION
Defense Systems Division
600 Hicks Road • Rolling Meadows, IL 60008

equal opportunity employer m/f

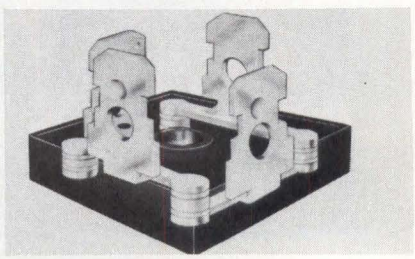
STORED PROGRAM FORMAT SYNCHRONIZER



Model 1126B is a microprocessor based unit featuring both formatting and data preprocessing capability. Data format features include data rates to 5M bits/s, conventional and adaptive sequential ratio probability synchronization strategy, up to 5 independent subframe synchronizers, multiport output, and programmable RAM. Online data processing functions include data compression capabilities and computation. **Aydin Monitor Systems,** 401 Commerce Dr, Fort Washington, PA 19034.
Circle 246 on Inquiry Card

PLASTIC CASE SILICON RECTIFIERS

Silicon rectifier bridges feature miniature size, quick connect terminals, and epoxy filled plastic cases rather than larger, more expensive metal cases. The single-phase, full wave bridge measures 0.8″ (2.0 cm) sq x 0.3″ (0.76 cm) high. Terminals are 0.250″ (0.635-cm) quick connect for heat sink and chassis mounting. Ratings are 8 A at 50, 100, 200, 400, 600, and 800 V. Surge is 150 A as a result of large size junctions. **Electronic Devices, Inc,** 21 Gray Oaks Ave, Yonkers, NY 10710.



Circle 247 on Inquiry Card

THE ULTIMATE INTERFACE

BELDEN EIA RS-232-C CABLE ASSEMBLIES

It's fast. Simple. Reliable. Accurate. In fact, it's the ultimate interface for your data terminal and communications equipment employing serial binary data exchange.

Belden's new 25 conductor molded cable assemblies are designed and built to meet EIA standard RS-232-C and types A through M standard interfaces.

These are cables you can count on. Belden's rugged 8459 cable (UL style number 2576) is used in these assemblies. This cable also passes the FR-1 vertical flame test and is the preferred cable for critical interfaces. And positive pin-to-pin mating using subminiature "D" type plug connectors means no mix-up.

Complete cable assemblies are now in stock in four standard lengths of up to 70′ (21m). Bulk cable is available in put-ups of up to 1000′. Custom designed assemblies are also available on special request. Belden Corporation, Electronic Division, P.O. Box 1327, Richmond, IN 47374; 319-966-6661. Out West contact our Regional Sales Office in Irvine, CA 714-833-7700.

NOW IN STOCK

© 1979 Belden Corporation

BELDEN

Coming through...

with new ideas for moving electrical energy

CIRCLE 128 ON INQUIRY CARD

8-15-9

DC TO AC STATIC POWER INVERTERS

With capacities from 700 to 10k VA, inverters deliver ac power to sensitive loads. The devices operate from an input of 48 or 125 Vdc and produce a clean 120-V sinewave output at 60 Hz (50 Hz available). Output voltage regulation is held within ±3% of nom for full load and line change, and output frequency to within ±0.5%. Output is fully protected against overloads and short circuit conditions. **Deltec Corp,** 980 Buenos Ave, San Diego, CA 92110.

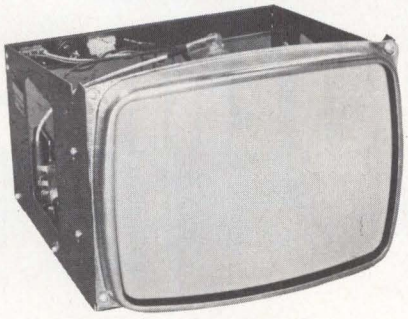
Circle 248 on Inquiry Card

REMOTE CLUSTERED CRT TERMINAL SYSTEM

Series 300 Interactive Display System utilizes Softprint microprocessor controlled display terminals which support std 24-line by 80-col formats and expanded 27-line by 132-col format. The system will emulate an IBM 3270 Information Display System and can be attached to a host computer by a BSC link. It will support user operational activities in cluster configurations of up to 32 devices. **Lee Data Corp,** 5700 Green Circle Dr, Minnetonka, MN 55343.

Circle 249 on Inquiry Card

Announcing a new source for CRT data displays.



BHD-1200

An all-new line of data display monitors is now being manufactured by Bell & Howell for OEM applications.

Available in 5-, 7-, 9-, and 12-inch screen sizes, these units can be mechanically and electrically fitted to standard display terminals without modification, but can also be manufactured to meet custom specifications.

Wide range of options—hundreds of possible configurations

- 15.75 KHz, 16.2 KHz, 18.6 KHz or other scan rates
- Dynamic focus — standard
- EIA P4, P31, P39, or P42 phosphors
- Kits and metal chassis available for all screen sizes

For more information about these new data display monitors, contact Bell & Howell Display Devices, 4000 Birch Street, Newport Beach, CA 92660, (714) 752-7602.

DISPLAY DEVICES

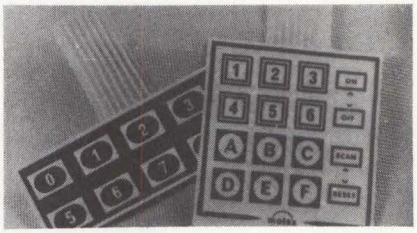
BELL & HOWELL

ANTI-ALIASING FILTER WITH IEEE 488/1978 INTERFACE

Incorporating the IEEE Std 488/1978 interface, 1-Hz to 100-kHz dual low pass filter provides AH1 (acceptor handshake), L1 (basic listener with listen only), and DT1 (device trigger) functions. Each channel provides a roll-off rate of better than 115 dB/octave; in cascade the 2 channels offer better than 230 dB/octave. Other specs are ±0.25-dB ripple and >80-dB stopband attenuation. Cutoff frequency range of the filter is adjustable from 1 Hz to 110 kHz. **Rockland Systems Corp,** Rockleigh Industrial Pk, Rockleigh, NJ 07647.

Circle 250 on Inquiry Card

MEMBRANE SWITCH SYSTEM



Construction of the 10900 membrane switch is based on deposition of conductive polymer ink to provide silver contacts and interconnections on 2 sections of thin, flexible polyester substrate. A spacer layer sandwiched between the sections before sealing has openings to create the contact gap, which decreases at actuation until contact surfaces meet to close circuit. Switches are custom designed to meet exact needs for contact spacing, aesthetics, mounting, and termination. **Molex Inc,** 2222 Wellington Ct, Lisle, IL 60532.

Circle 251 on Inquiry Card

FIBER OPTIC COMMUNICATIONS LED

Microlensed LED is supplied in std hermetically sealed TO-46 package and is designed to couple to single fiber or fiber bundle through use of std connectors. IRE-161 has typ output of 2.0 mW into a 0.5 numerical aperture (30° half angle) when driven at 100 mA dc; at 70 °C output is typ 1.5 mW. Second harmonic distortion is <40 dB. Typ rise and fall time is 10 ns. Wavelengths from 790 to 880 nm are available. **Laser Diode Laboratories, Inc,** 1130 Somerset St, New Brunswick, NJ 08901.

Circle 252 on Inquiry Card

The Power Paradox:

The AC power your computer needs in order to operate is also a major cause of computer error, malfunction and damage.

The computers that control your operations (and therefore your profits) are designed to operate from a clean, steady supply of ac power.

This ac power *must* be kept within manufacturer-specified tolerances in order for the computers to operate properly and safely.

In fact, the U.S. Department of Commerce states that "if a computer's voltage exceeds 120% [of the rated voltage] for a duration as short as 1 to 10 milliseconds, the computer will make errors."[1] Unfortunately, interruptions and disturbances of this nature are commonplace occurrences within most computer facilities.

A comprehensive study of power line disturbances which affect sensitive computerized equipment was conducted by two IBM researchers. They concluded that such disturbances occur on an average of 128 times each month.[2] For users of computer-based equipment, power disturbances can and do create a variety of costly problems.

Effects upon data processing computers.

When these power disturbances occur in your data processing center they can cause entry errors, program changes or loss, head crash, data loss, the generation of false or garbled data, the need to rerun programs, and computer downtime.

Effects upon computerized process control equipment.

Process control equipment is also vulnerable to power disturbances. Common problems created by these disturbances include improper batch termination and even program changes. The program changes can result in the repetition of process errors and in downtime while equipment is being reprogrammed.

Effects upon energy management systems.

Most energy management systems use small computers to make energy-saving decisions, but their effectiveness can be offset by these same disturbances. Program changes and errors may prevent useful operation of these systems as energy savers.

Thus, the computers your company depends on to reduce operating costs actually may be increasing them.

Topaz power peripherals can protect all of your computers.

Topaz can provide the power peripherals specifically designed to keep your company's data processing, process control and energy management computers from making costly power-related errors.

And if you manufacture computers or computerized equipment, Topaz peripherals can make your product more reliable as well as reduce the requirements for needless service calls.

Immediate delivery and guaranteed solutions to power problems have made Topaz the leading computer power peripheral company in the world.

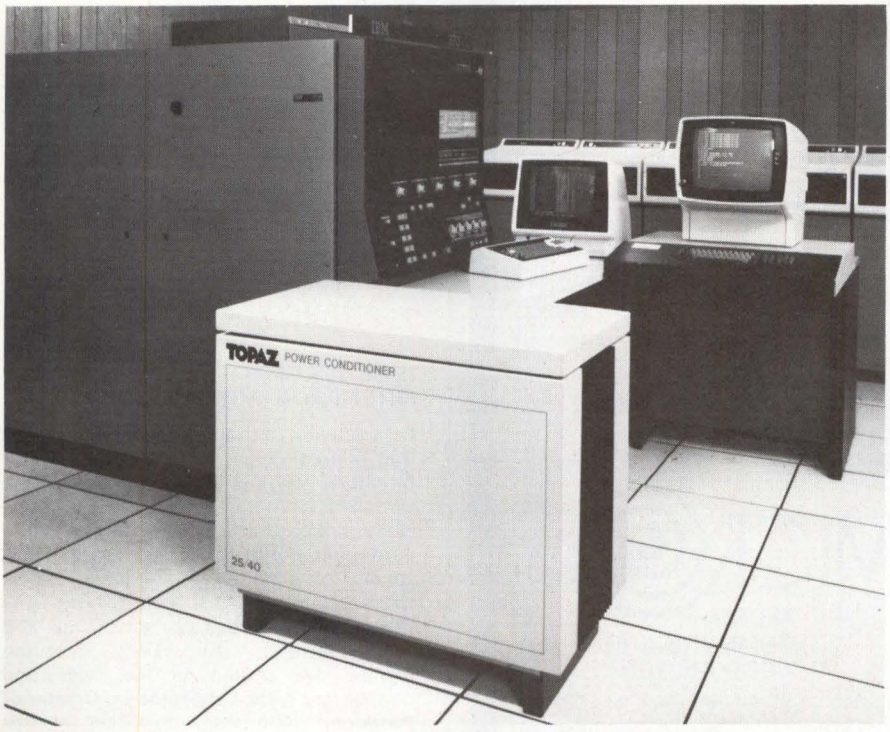
For more information about Topaz and its products:

1. Tear out this ad and mail it to us along with your business card; or

2. Call us:

References:

1. *U.S. Department of Commerce, "The Effects of Electrical Power Variation Upon Computers: an Overview."*
2. *George W. Allen and Donald Segall, IBM Systems Development Div., "Monitoring of Computer Installations for Power Line Disturbances," presented to the IEEE Power Engineering Society.*



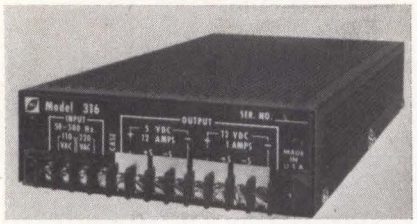
Topaz peripherals solve the power paradox by conditioning normal ac power for your computer and computer-based equipment.

TOPAZ
ELECTRONICS

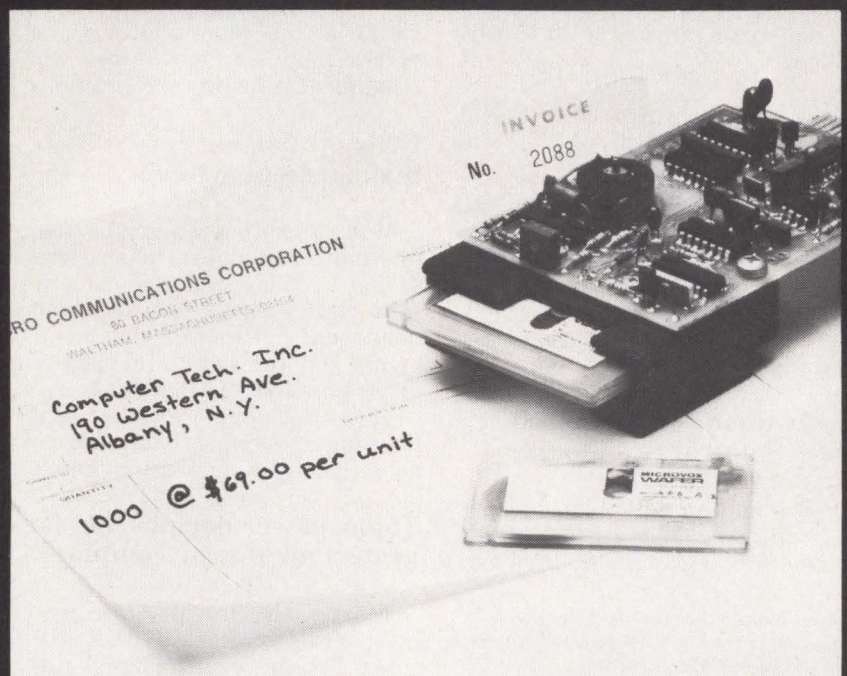
3855 Ruffin Road, San Diego, CA 92123
(714) 279-0831 — TWX (910) 335-1526

CIRCLE 130 ON INQUIRY CARD

DUAL SWITCHING POWER SUPPLIES



Model 314 produces 5 V at 10 A and 12 V at 2 A; model 315 is rated at 5 V, 8 A and 12 V, 3 A. Model 316 outputs 5 V, 12 A and 12 V, 1 A. All come in a low profile package measuring 1.75 x 5.28 x 10.75″ (4.45 x 13.4 x 27.3 cm), and have short circuit and current limiting protection. Overvoltage protection is std on all 5-V outputs. **RO Associates, Inc,** 246 Caspian Dr, Sunnyvale, CA 94086.
Circle 253 on Inquiry Card



A digital tape transport system for the price of an audio system

For just $69.00 (in O.E.M. quantities) Micro's Read/Write Tape Transport System gives you size and performance features an audio system can't match.

You get higher read/write speeds—3 ips vs. audio speeds of 1.87 ips; higher tape densities—3200 fci vs. audio densities of 400 fci; and electronically, rather than mechanically, controlled starts and stops.

Just 6″ in length, weighing less than 6 ounces, and housed in die cast aluminum, the Read/Write System can be conveniently designed into any microprocessor.

Ideal for program loading and data logging, the system features a 4800 baud transfer rate, up to 120K bytes of storage, TTL and CMOS compatibility, and a start/stop time of 30/40 milliseconds.

RELIABILITY? The system's only moving part is the capstan motor. No springs. No clutches. No gears to wear out. That's why our performance rivals systems 3 times our cost.

Micro's Read/Write System . . . Digital Performance at Audio Prices.

MICRO
MICRO COMMUNICATIONS CORPORATION
80 Bacon Street, Waltham, Ma.02154
(617) 899-8111 • TWX 710-324-7600
CIRCLE 131 ON INQUIRY CARD
A BUCKEYE INTERNATIONAL COMPANY

SMALL UNINTERRUPTIBLE POWER SYSTEM

Model UPS-102-1B, a 1-kVA rated UPS, consists of rectifier/charger, solid state inverter, and optional static or electromechanical bypass switch. Line power is rectified to dc, power is provided to a pulse width modulated transistor inverter, full charge is maintained on a nom 72-Vdc external battery, and the inverter reconverts the dc to 120 Vac 60 Hz. The unit is packaged in a 7″ (17.8-cm) high rack-mounted chassis and weighs 70 lb (32 kg). Op temp range is 0 to 40 °C. **Elgar Corp,** 8225 Mercury Ct, San Diego, CA 92111.
Circle 254 on Inquiry Card

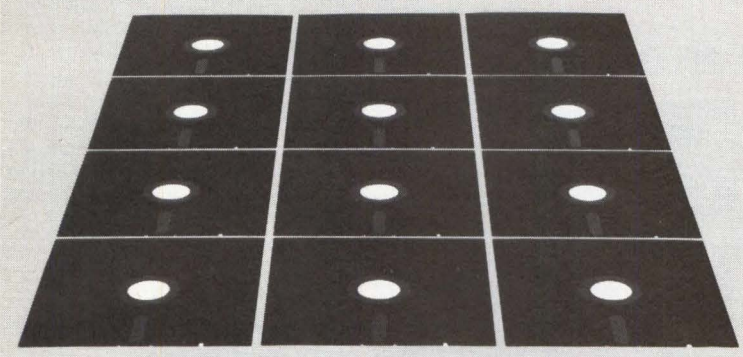
COMMUNICATIONS PROTOCOL CONVERSION PROCESSOR

Connecting asynchronous or bisync equipment to mainframes or peripherals using Burroughs Poll/Select protocol, CA12-SIU/BPS also permits IBM or other mainframe users to use Burroughs equipment with minimal software modification. Operating transparent to the user, unit performs protocol conversion, data conversion, and function transformation, and provides up to 30 ports and up to 32k of buffer memory in the 16.7 x 16.9 x 5.25″ (42.4 x 42.9 x 13.33-cm) package. **Industrial Computer Controls, Inc,** 196 Broadway, Cambridge, MA 02139.
Circle 255 on Inquiry Card

IEEE-488 GPIB INTERFACE MODULE

A software programmable I/O card that implements talker and listener functions of the IEEE-488 GPIB, the uP GPI-1 features selectable interrupts, onboard address recognition, and automatic handling of handshake protocol to simplify implementation of those functions in control systems where another device serves as the bus controller. All GPIB interface signals are routed to the card-edge connector. **Wyle Laboratories/Computer Products,** 3200 Magruder Blvd, Hampton, VA 23666.
Circle 256 on Inquiry Card

OLD. NEW.



Meet the Mini Wini.™ The new 8" fixed disk drive that stores 20 megabytes.

It's the lowest-cost way of getting 20 megabytes in an 8" floppy slot. And with Winchester-type technology, to boot.

So you can expand the on-line capacity of your present desk-top system without having to redesign one bit of your present chassis.

Interfacing?
It's a snap. The Mini-Wini (alias the PCC D8000 fixed disk) has a microprocessor-controlled interface, featuring a bidirectional command/status bus and serial data transfer. It's easier and simpler to design the CPU interface.

And maybe best of all, it's made by Pertec Computer Corporation. At PCC, we don't just innovate. We have the production capacity to supply those innovative products when we say we will. Which is reassuring.

The PCC Mini-Wini. Small size. Big capacity. Call us for details.

PCC PERIPHERALS
PERTEC COMPUTER CORPORATION

They won't let you down.

For further information, call toll-free 800-528-6050, Ext. 1323.

CIRCLE 132 ON INQUIRY CARD

NEW

7 MIL*

"SIL-PADS 400": THE SUPERB SOLID STATE HEAT SINK INSULATORS . . . TEST 'EM!

7 MIL

(FOR MAX. HEAT DISSIPATION) REDUCES THERMAL RESISTANCE BY 35%

Since 1973, Bergquist has helped overcome heat-sink problems with "SIL-PADS". Eliminate messy grease and fragile mica or plastic film by using this exclusive development.

"SIL-PADS 400" are thin, tough layers of thermally-conductive silicone-rubber and fiberglass (laminated). Cut-through, tearing, breaking problems are gone. Assembly time is reduced; no solder bath contamination; consistent heat transfer.

Perhaps you've tested or are using 9 mil. NOW . . . test both 7 and 9 mil, and you decide!

"SIL-PADS 400" are successfully used in thousands of applications. Many standard configurations, plus custom capability.

FREE SAMPLES, TECHNICAL DATA, and LITERATURE!

BERGQUIST

5300 Edina Industrial Blvd.
Minneapolis, MN 55435
Phone (612) 835-2322
TWX 910-576-2423

PRODUCTS

DATA ACQUISITION SYSTEM FOR MINICOMPUTERS

Interfacing with series V77 minicomputers, F2963 consists of 1 master chassis and up to 7 daisy-chained expansion chassis, each accommodating up to 16 plug-in modules for a total of 512 analog channels/chassis. In an 8-chassis system, up to 128 modules of any combination may be used to provide 4000 separate input channels of data. Available analog/digital components include simultaneous sample/hold, signal processors, D-A and A-D converters, and various multiplexers. **Sperry Univac,** PO Box 500, Blue Bell, PA 19424.

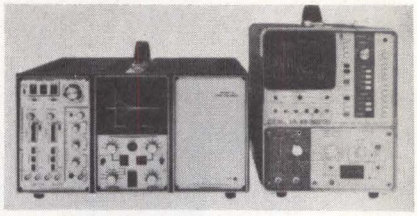
Circle 257 on Inquiry Card

LOGIC ANALYSIS SYSTEM

Logic state, logic timing, and waveform recording functions of the System 5000 operate interactively as a total data system, or as independent analysis units. Interactive or linked triggering between analysis elements, and interfaces for RS-232, IEEE-488, and floppy discs are provided. Keyboard of portable system folds up to protect 9″ (23-cm) CRT during transport and features positive action keys. Menu keys guide user through operation. **Paratronics, Inc,** 122 Charcot Ave, San Jose, CA 95131.

Circle 258 on Inquiry Card

HIGH SPEED FREQUENCY ANALYSIS SYSTEMS



Models 4402A and 4404A combine a 2090 digital oscilloscope with the 446 Mini-Ubiquitous^{R} FFT computing spectrum analyzer. 1- or 2-channel systems provide sampling rates to 20 MHz. The oscilloscope digitizes and stores up to 4096 input time samples; any 1024-sample block can be transferred to the spectrum analyzer. Input sensitivity of the scope is variable from ±100 mV to ±40 V. Sweep time for 1024 samples is variable from 51.2 μs to 341 min. Amplitude accuracy is ±0.5% of full scale. **Nicolet Scientific Corp,** 245 Livingston St, Northvale, NJ 07647.

Circle 259 on Inquiry Card

ENCAPSULATED MERCURY FILM RELAY

W1728 features bounce free performance and long reliability, and operates in any mounting position. Pins are arranged on std 1 x 0.2″ (2.5 x 0.5-cm) centers. Self-healing contacts provide reliability. At loads ranging from 2 to 1 x 10^{-12} A, reliability exceeding 2G MCBF may be expected at a 90% confidence level. Contact resistance over the life of the relay varies by no more than 0.02 Ω. **Fifth Dimension, Inc,** 707 Alexander Rd, Princeton, NJ 08540.

Circle 260 on Inquiry Card

Monstrous IDC problems solved.

See page 59

BEEHIVE INTERNATIONAL

MICRO B

custom designed

Micro B, Model DM1S
EMULATION
VT52*, PRISM*, DASHER*, Beehive B150

Micro B, Model DM2S
EDITING
Editing Capability, Expanded Keyboard with 16 Function Keys, Block Send

Micro B, Model DM3S
ADDITIONAL MEMORY
8K RAM Multi-Page Capability, Parallel Printer Interface, Beehive B300 Emulator

Beehive International. Custom designed. They go together! Beehive now offers three 'family planned' microprocessor based terminals which can be Beehive or customer software designed as the user requires. Give our sales office nearest you a call today . . . or use our toll free number below.

We think you will be surprised how inexpensive quality can be!

TOLL FREE USA **(800) 453-9454**

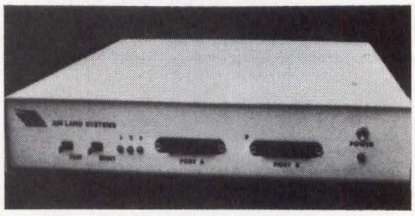
**These names may be subject to trademark claims.*

CALIFORNIA Costa Mesa *(714) 540-8404 TWX 910-595-2572* • Sunnyvale *(408) 738-1560*
FLORIDA Altamonte Springs *(305) 830-4666* **ILLINOIS** Arlington Heights *(312) 593-1565*
MASSACHUSETTS Woburn *(617) 933-0202* **NEW YORK** New York *(212) 682-2760* **OHIO** Centerville *(513) 435-7073*
PENNSYLVANIA Plymouth Meeting *(215) 825-0243* **UTAH** Salt Lake City *(801) 355-6000*
VIRGINIA Falls Church *(703) 356-5133*
EUROPE Amsterdam, The Netherlands *Phone 020-451522*

BEEHIVE INTERNATIONAL

Box 25668 • 4910 Amelia Earhart Drive • Salt Lake City, Utah 84125

PROTOCOL CONVERTER



The 8085 based PCU effects data conversion between 2 different communications protocols. With 2 serial I/O ports, the converter allows most RS-232 compatible devices to be put on-line. Each port under program control functions either synchronously or asynchronously at program selected baud rates. The converter features up to 8k of buffer storage and up to 8k of program storage. **Air Land Systems,** 2820 Dorr Ave, Fairfax, VA 22031.
Circle 261 on Inpuiry Card

SUPER BRIGHT LED AND MOUNTING SOCKET

LED interchangeability and low profile packages are offered by packaging together model 180 screw-in super bright red, amber, or green LEDs, with clear or diffused lenses, and PS 200 series mounting sockets. This provides a lower profile than common T-1¾ LEDs plus a socket with built-in resistor for selection of operating voltage. The LED protrudes about 0.100″ (2.54 mm) from the front of the mounting panel and the assembly fits into a 0.250″ (6.35-mm) panel cutout. **Data Display Products,** 303 N Oak St, Inglewood, CA 90301.
Circle 262 on Inquiry Card

RECEIVE ONLY LINE PRINTER

Capable of operating at speeds of 300 to 1500 lines/min, the Mark V RO 3780 printer simulates IBM 3780 line discipline. Std features are logic for determining type of text, space decompression, multiple record capability, horizontal tabs, and vertical forms control including overprint. Double-hinged yoke assembly with monorail font guidance provides accurate print alignment. **Hetra,** 1151 S Eddie Allen Rd, Melbourne, FL 32901.
Circle 263 on Inquiry Card

MINICOMPUTER SYSTEM AC POWER CONDITIONERS

W-model Voltector® series 5 remove electrical disturbances from power line to protect sensitive electronic equipment from noisy and unstable ac power. Reducing high voltage surges to safe levels and removing low voltage transients and various noise spectra, units handle up to 120 J of transient energy. They are effective in both common mode and transverse, or differential mode forms of interference. Models are rated 1, 2, 3, 5, 10, 15, and 20 A. **Pilgrim Electric Co,** 29 Cain Dr, Plainview, NY 11803.
Circle 264 on Inquiry Card

6-FT WIDE DRUM PLOTTER

Continuous roll drum paper provides 6′ (1.83-m) wide plotting capability with max drawing speed of 30 in (76 cm)/s. Model 1065 has resolution of 0.0005″ (0.0127 mm) and linear pen actuation, and uses translucent, rag, vellum, or mylar papers, and pressurized ballpoint, liquid ink, nylon tip, and liquid ball type pens. Other features include Y-axis limit switches, paper supply monitor, plot time meter and speed control, return to last plotted position, and self-test diagnostics. **California Computer Products, Inc,** 2411 W La Palma Ave, Anaheim, CA 92801.
Circle 265 on Inquiry Card

DATA COMMUNICATIONS LINE SWITCH

CLS-2VF connects both digital and VF sides of 2 modems to a single telephone line, and allows interfaces to be switched between the line and terminal or CPU. Switching of 4 isolated lines is provided between 2 separate and 1 common 6-position modular female jack. 20 commonly used EIA interface signals are also switched between Line A and Line B connectors. The device employs status indicator buttons to give a clear indication of which line is selected. **Electrodata, Inc,** PO Box 46130, Bedford, OH 44146.

Circle 266 on Inquiry Card

Veteran tough guy meets his match.
See page 15

WINCHESTER DISC SYSTEM FOR DEC MICROCOMPUTERS

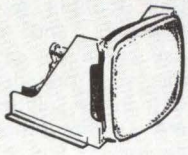
Winchester technology for the DEC LSI-11 series is available with the WINC-01 disc system. Two PCBs comprise the system: a microprocessor based formatter/controller mounted with a Shugart SA-4008 Winchester drive and a dual-width Q-Bus interface card that inserts directly into the CPU backplane. The system can accommodate up to three 20M-byte 14″ (36-cm) Winchester drives, for a total sealed media capacity of 60M bytes. **Advanced Electronics Design, Inc,** 440 Potrero Ave, Sunnyvale, CA 94086.
Circle 267 on Inquiry Card

NEW! LOW COST CRT DISPLAY MODULE

MOST-REQUESTED FEATURES

Motorola's new 12-inch CRT display module offers low unit cost while maintaining the features most-requested in volume OEM applications. Features such as 800-line resolution, excellent linearity and geometry, video response to 15 MHz—features that contribute to the module's capability of providing sharp, clean characters in a full 80 x 24 format. TTL-compatible direct drive operation and single 12V dc input requirement further simplify your design considerations.

CHASSIS OR KIT



The new module is available with sheet metal chassis as Model M3570, or without the chassis in "kit" form as Model M3970, pictured below. Model M3970 offers superior economy—and has no metal boundaries to inhibit your own layout.

PRICED TO HELP HOLD DOWN YOUR PRODUCT COSTS

In addition to the already low unit price, maximum cost savings can be achieved by ordering either model packaged in bulk (subject to minimum purchase volume and shipping restrictions). These cost savings at the component level can have a noticeable impact on the price of your final product. Without compromising performance!

CALL TODAY

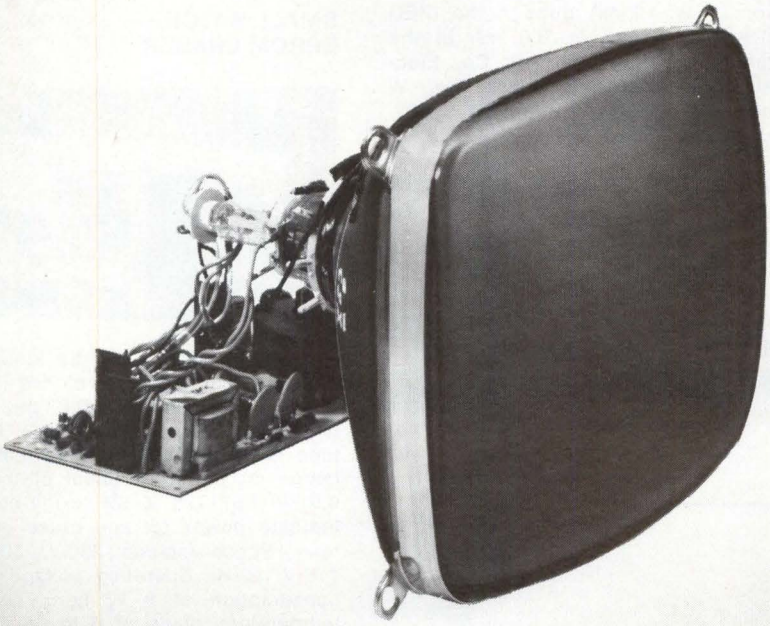
Call today for more information about the new, low-cost display from Motorola ■ Santa Clara, CA (408) 988-3422 ■ Tustin, CA (714) 838-5621 ■ West Chicago, IL (312) 231-4400 ■ Richardson, TX (214) 231-9901 ■ Windham, NH (603) 898-5921 ■ Shrewsbury, NJ (201) 544-9541 ■ Baltimore, MD (301) 821-0062 ■ Overseas and Canada call West Chicago, IL (312) 231-4400 ■ TWX: 910-230-3117

MOTOROLA INC.

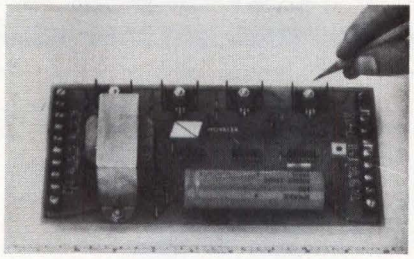
Display Systems

1155 Harvester Rd.
West Chicago, IL 60185

CIRCLE 134 ON INQUIRY CARD



LOW SPEED STEPPER MOTOR CONTROLLER

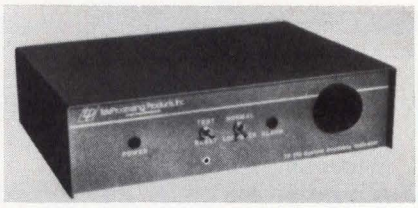


Eliminating heat generating resistors with an onboard 5-V power supply, compact controller for 5-V motors integrates power supply, oscillator, and translator in a single glass epoxy PC board. Screw terminal connections, integral standoffs, and external wiring schematic are provided. Compatible with 5-V, 4-phase steppers up to 1.6 A/phase and 200 steps/s, the 4.5 x 9 (11.4 x 22.9-cm) unit provides TTL or switch closure inputs that permit direct connection to computer or non-computer outputs. **Novatek, Inc,** 79 R Terrace Hall Ave, Burlington, MA 01803.
Circle 268 on Inquiry Card

DISC EMULATOR

Microprocessor based single-board controller, the PM-DC1100, emulates DEC[R] RP11 and provides compatibility with system software for RP11 and RP02/03 subsystems. One controller can handle two 80M- or 300M-byte storage modules, or with the addition of a multidrive interface chassis, up to 8 storage modules. Features include 3-sector data buffering, consecutive sector transfers, and transfers across track boundaries. **Plessey Peripheral Systems,** 17466 Daimler, Irvine, CA 92714.
Circle 269 on Inquiry Card

COMMUNICATIONS SYSTEM AVAILABLE INDICATOR



TP-210 provides both visual and audible indication of a communications failure between remote data terminal equipment and host system. The unit monitors the RS-232-C interface at the data terminal, and responds to either a failure to raise "request to send" or to loss of data carrier. Alarm condition activates audible signal, lights LED on front panel, and switches ac power to 115-Vac outlet on rear of unit. Indicator operates in either synchronous or asynchronous applications. **TeleProcessing Products, Inc,** 4565 E Industrial St, Bldg 7K, Simi Valley, CA 93063.
Circle 270 on Inquiry Card

LOGIC TO POWER OPTO-ISOLATOR INTERFACE

H11G, a liquid epitaxial GaAs IRED optically coupled to a Darlington connected phototransistor, an extension of the MT2L line, operates in the −55 to 100 °C temp range. BV_{CEO} is up to 100 V with 2500-V rms isolation capability. Other features include high current transfer ratio and low degradation LEDs. 10 mA through the IRED will switch a load of 100 mA in the Darlington. **General Electric Co, Electronic Components Business Div,** W Genesee St, Box 14, Auburn, NY 13021.
Circle 271 on Inquiry Card

QUAD-LED LOGIC STATUS INDICATORS

Mounting GaAsP red LEDs in a 4-element array provides easier PCB mounting and wave soldering. Advantages include positive seating and spacing of light source to the PCB surface. Polarity is identified to assure error-free installation. Model 555-4001 has no integral current limiting resistor, -4003 is a current limited 5-V/6-mA unit, and -4007 is a current limited 5-V/3-mA unit. All can be driven directly from TTL. **Dialight, a North American Philips Co,** 203 Harrison Pl, Brooklyn, NY 11237.
Circle 272 on Inquiry Card

ACOUSTIC DATA COUPLER/MODEM

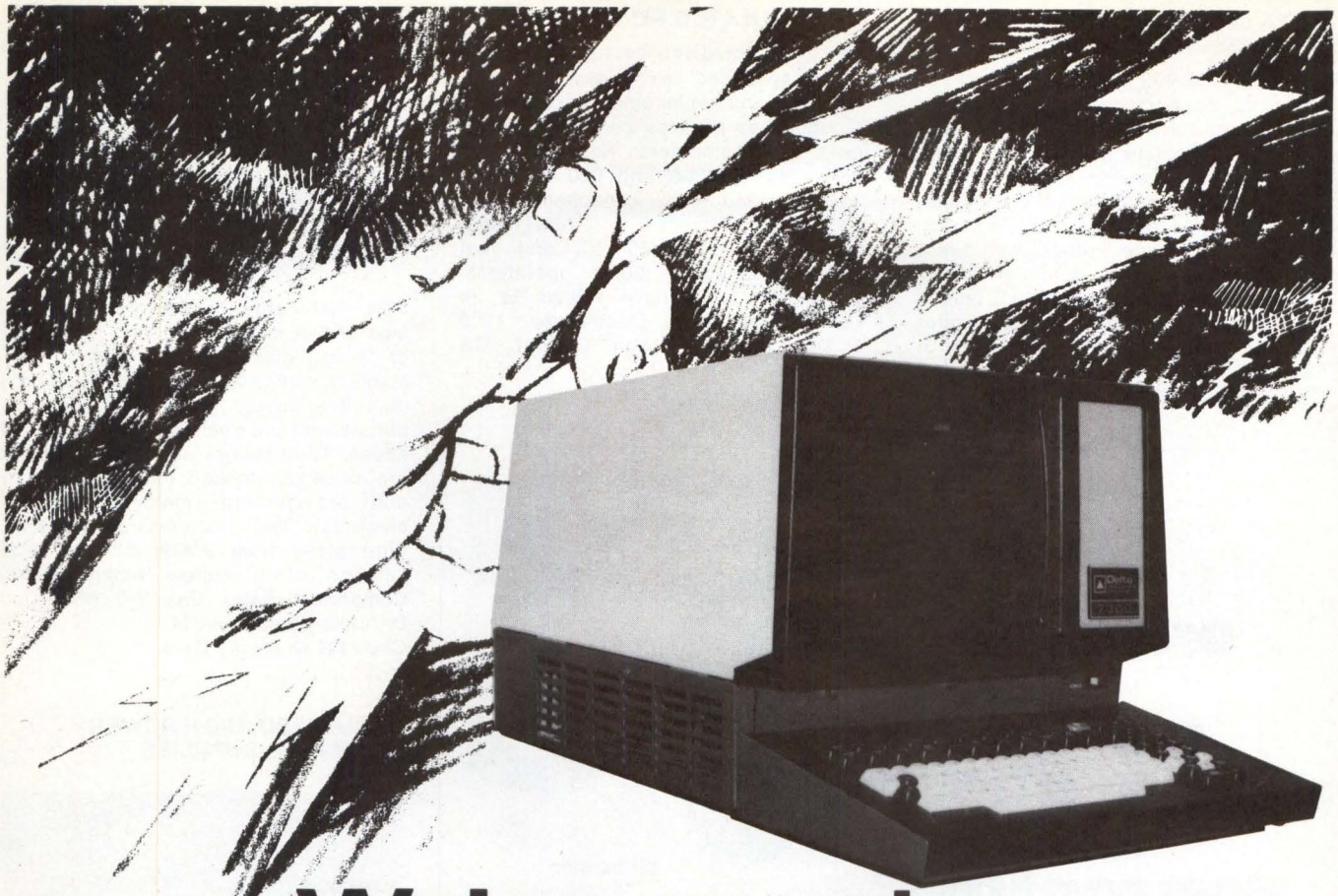
Model 247 is FCC approved for direct connection via modular jack or DAA, and may be used as acoustic coupler. All types of line connections are switch selectable and require no internal modifications. Compatible with Bell 103/113 type modems, the unit transmits and receives full duplex asynchronous data at speeds to 450 bits/s. It provides a dual-terminal interface for either EIA RS-232 or 20-mA current loop terminals. **Anderson Jacobson, Inc,** 521 Charcot Ave, San Jose, CA 95131.
Circle 273 on Inquiry Card

SMALL BATCH EPROM ERASER

Up to 15 EPROMs can be loaded into the front sliding tray of the SE 15. Safety interlock disables the lamps when the tray is removed. Erasure time is presettable up to 40 min. Neon lamps on the front panel of the 11 x 9.5 x 4.5″ (28 x 24 x 11-cm) unit indicate power on and erase in progress. Specs include 230-V, 50-Hz or 115-V, 60-Hz operating voltage, power consumption of 8 W nom, operating temperature range of 0 to 65 °C, and UV source wavelength 253 to 257 nm. **Stag Systems,** 2465 E Bayshore Rd, Suite 329, Palo Alto, CA 94303.
Circle 274 on Inquiry Card

Man's best friend is his____.

(See page 114 for the answer.)



We've got the POWER

for OEM's and large systems users

The new DELTA 7000 Series 16-bit microcomputer display terminals...More power to you for data preparation, text editing and distributed processing applications

The DELTA 7000 Series of multifunctional terminals is a unique combination of hardware and software designed to meet sophisticated applications in large computer systems. This combination offers you a choice of display terminals with truly outstanding performance features, including:

- 16-BIT MICROCOMPUTER for superior programmability and wide applications flexibility
- MULTIPLE SPLIT SCREEN allows you to divide the screen into independent display areas
- MULTI-CHARACTER FUNCTION KEYS permit one key to display or send a string of multiple characters or codes
- DYNAMIC FONT GENERATION enables you to design special symbols, or modify existing characters from the keyboard and have them immediately available
- EXTENDED CHARACTER SETS provide display of up to four 248-character sets which can be PROM resident or RAM loaded
- LARGE TEXT MEMORY from 6K up to 36K characters adds applications flexibility and terminal power to meet your needs

Put the power at your fingertips with a DELTA 7000 Series video display terminal. Zing us a line, or call for more information, literature or applications assistance.

See us at Comdex '79, Booth 924

Delta Data Systems Corporation

U.K. Subsidiary:
DELTA DATA SYSTEMS LTD.
Welwyn Garden (07073) 33833

Woodhaven Industrial Park
Cornwells Heights, PA 19020
(215) 639-9400

Service in over 150 locations in the U.S., and 14 European countries and Canada.

CIRCLE 135 ON INQUIRY CARD

DATA COMMUNICATIONS INTERCONNECT ADAPTER

Black Box RS-499 adapter performs all necessary adjustments for interconnection between RS-499 and -232. It includes 37-pin male and 25-pin female connector and provides 2 side access holes to facilitate optional connection of additional external cabling. Installation is made either by direct mounting on rear of terminal or by cable connection. 2 male and 2 female screwlocks are provided. **Expandor Inc,** 400 Sainte Claire Plaza, Upper St Clair, PA 15241.

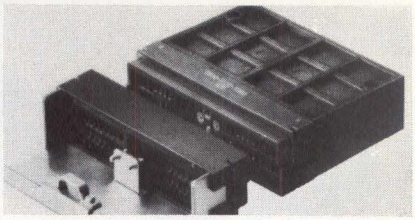
Circle 275 on Inquiry Card

ENCAPSULATED RC NETWORKS

Quick connect/disconnect pins on a line of encapsulated RC networks ease assembly and replacement in such applications as process control, machine tools, and computers. Networks have std ratings of 200 and 600 Vdc and 125 and 250 Vac, capacitance and resistance tolerances to ±10%, temp range of −40 to 85 °C, and min life expectancy of 200M operations. Heavy duty units have ratings to 2k Vdc and 480 Vac. **Electrocube,** 1710 S Del Mar Ave, San Gabriel, CA 91776.

Circle 276 on Inquiry Card

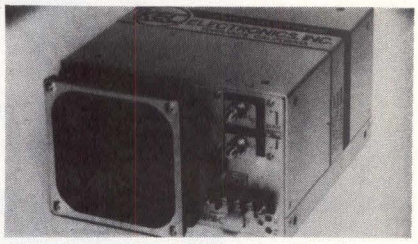
MULTI-CABLE CONNECTORS



FCN 120 cable connectors have ratings of 6 A max and contact resistance of 10 mΩ max. Housings are of heat stable, fire resistant, and self-extinguishing UL-approved glass filled polycarbonate and are resistive to mechanical abuse. Gold-over-nickel finish contacts are positively locked into the housing and provide firm mating with max electrical and mechanical integrity. Wire sizes from AWG #24 to #32 can be used. **Fujitsu America, Inc, Component Sales Div,** 910 Sherwood Dr, Lake Bluff, IL 60044.

Circle 277 on Inquiry Card

REGULATED, HIGH POWER SWITCHING SUPPLIES



Tight line (0.1% max) and load (0.15% max) regulation are features of the 750-W SE series. Requiring 115- and 230-Vac inputs, units have brownout protection ranges of 97 to 127 and 194 to 254 Vac—15 to 10% of center voltages. Overvoltage and overload protection and integral thermal cutoff are included. 7.75 x 4.93 x 9.70″ (19.67 x 12.52 x 24.64-cm) units provide 5 Vdc at 150 A, 12 Vdc at 64 A, and 240 Vdc at 32 A outputs. Efficiencies are 80% at 5 V to 85% at 24 V. **KEC Electronics, Inc,** 21535 Hawthorne Blvd, Torrance, CA 90503.

Circle 278 on Inquiry Card

LINE PRINTER CONTROLLER

Controller handles any printer up to 500k bytes/s. The half-board plugs directly into any available I/O slot in either 16- or 32-bit Perkin-Elmer/Interdata computers. The module is fully software compatible with both OS/16 and OS/32, and host-supplied diagnostics. Pin compatible Interdata cables are provided which allow the host supplied Centronics or Data Printer interface to be directly replaced by the controller module. Switches are used to select attributes. **Macrolink,** 1740-E South Anaheim Blvd, Anaheim, CA 92805.

Circle 279 on Inquiry Card

CIQ Series

9"and 12" CRT DISPLAY MONITORS with a Horizontal Rate of 15.72 KHz

Compatible with TV120 or TV90

Priced Below the Competition

Built-in Quality, Performance, Dependability

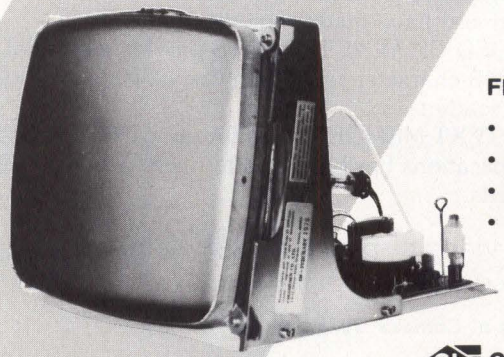
Kit Version

The low-cost CIQ-9 and CIQ-12 CRT Display Monitors with a horizontal rate of 15.72 KHz provide data equipment manufacturers with sharp, highly reliable image presentation.

Separate horizontal drive, vertical drive, and video signal inputs mean elimination of composite sync and video signal processing and simple output circuitry.

The completely new design of the compact integrated PCB utilizes the latest semiconductor and other components, providing a dependable performance level never before possible.

Delivered with P4 phosphor as standard. Available options are P31 and P39 phosphors, sturdy zinc chromate plated chassis and a power supply module which is compatible with practically any power supply standard in the world.



Chassis Version

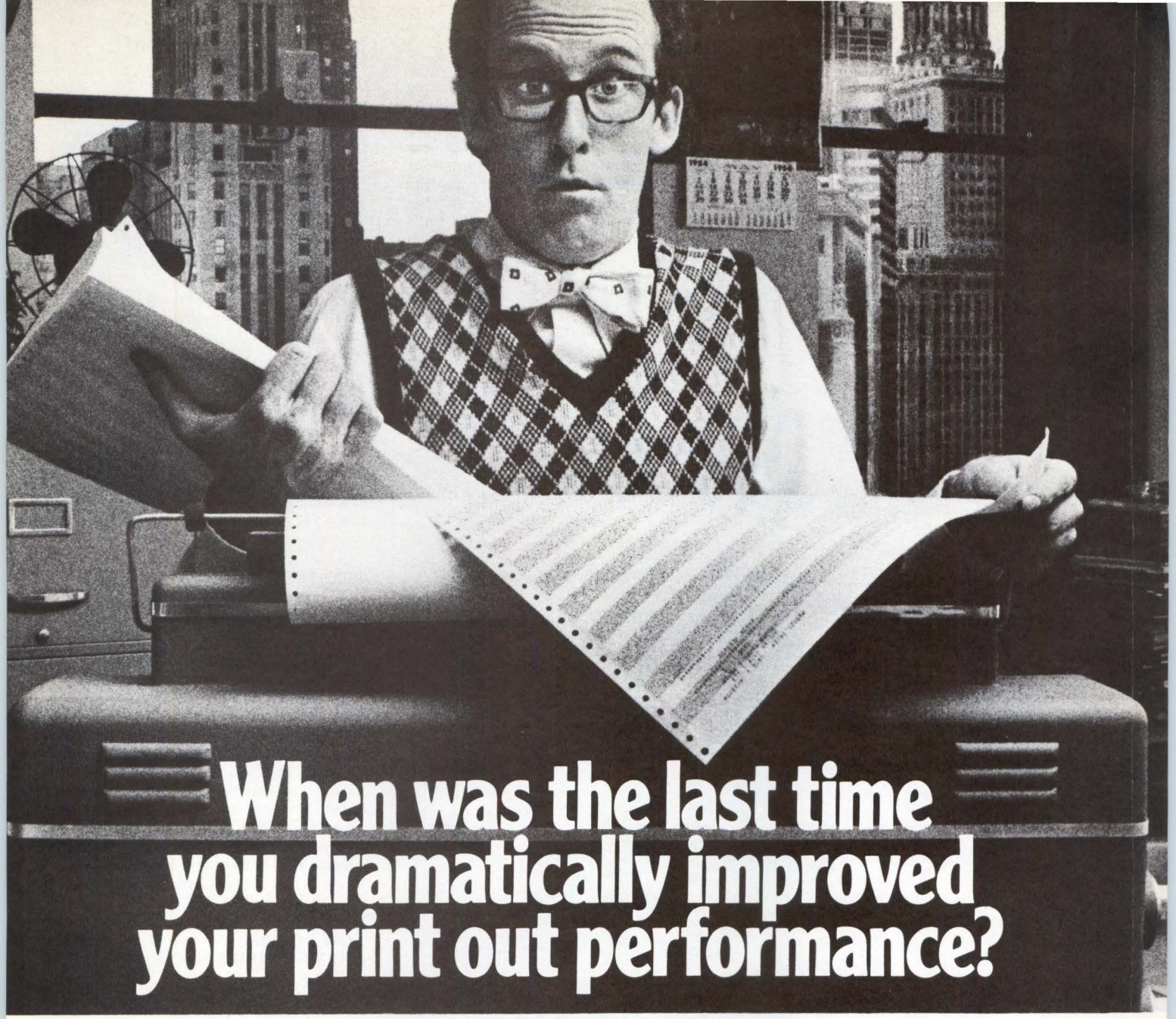
FEATURES

- Uniform High Resolution
- Integrated PC Board
- Dependable Construction
- Squareness of Picture

C. ITOH ELECTRONICS, INC.

5301 Beethoven Street Los Angeles, Calif. 90066
Telephone: (213) 390-7778 Telex: (WU) 65-2451

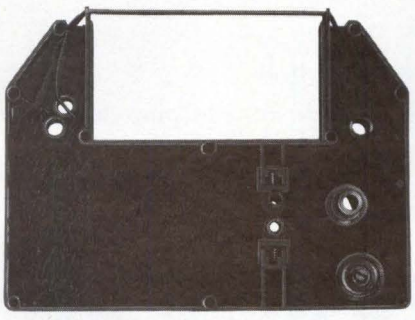
280 Park Avenue, New York, NY 10017
Telephone: (212) 682-0420 Telex (WU) 12-5059



When was the last time you dramatically improved your print out performance?

Today's measure of a printer's performance goes beyond line speed and purchase price. A revolutionary Porelon reinking system now adds a new dimension to print out performance. It will dramatically increase the printing life of the ribbon in your impact printer and substantially reduce character cost.

Porelon's unique ribbon reinking system automatically begins to reink the impact printer's ribbon only after reinking becomes necessary. This is made possible through a patented delayed engagement device. The printing life of the ribbon is maximized and printouts continue to be crisp and clean for a longer period of time.



Find out how simple it is to add this performance feature to your impact printers. Your competition may already be considering it. Call (615) 432-4134. Or write Porelon, Inc., Cookeville, Tennessee, 38501, for further information.

PORELON

YOUR LAST IMPRESSION IS WHERE WE BEGIN

© 1979 by Porelon, Inc. A subsidiary of Johnson Wax. **CIRCLE 137 ON INQUIRY CARD**

Porelon is a trademark.

MIL-STD-1553A DATA BUS INTERFACE

Model 3760 aircraft multiplex data bus interface for AN/UYK-19 and Eclipse computers operates in the 3 information modes specified in MIL-STD-1553A: system controller to remote terminal (RT), RT to system controller, and RT to RT. The unit consists of 2 printed wiring assemblies that interface any Rolm CPU to a pair of MIL-STD-1553A data buses through the CPU's I/O bus. **ROLM Corp,** 4900 Old Ironsides Dr, Santa Clara, CA 95050.

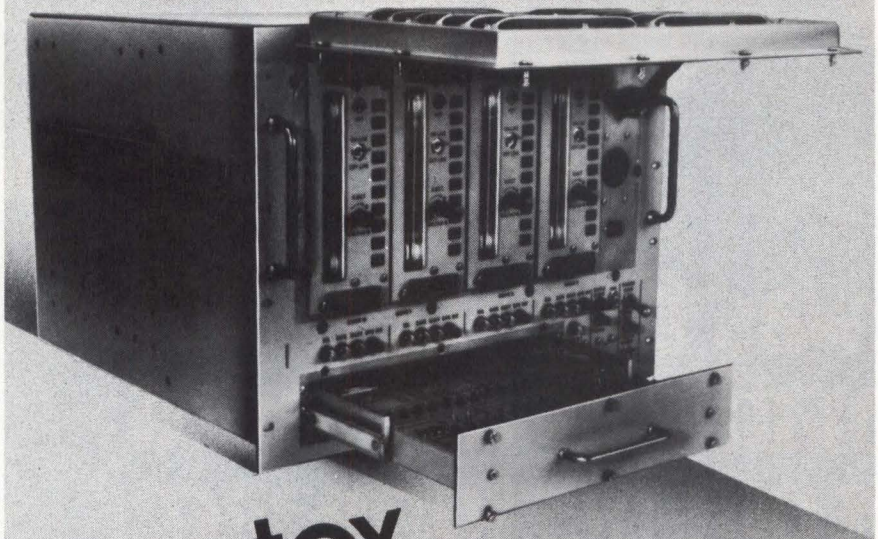
Circle 280 on Inquiry Card

DUAL-PRINTER CONTROLLER

The dual format of the S1403/dual controller maximizes use of an IBM 1403 printer by alternately interfacing the printer to any 2 IBM or non-IBM computers, and providing the interface, control, and power functions necessary to interface with nonIBM computers. A memory in the controller stores the universal char set for each type train or chain to be used, making the printer software compatible with both computers. **Spur Products Corp,** 1904 Centinela Ave, Los Angeles, CA 90025.

Circle 281 on Inquiry Card

MIL SPEC Qualified!



Qantex the only qualified 3M Cartridge Tape Storage System!

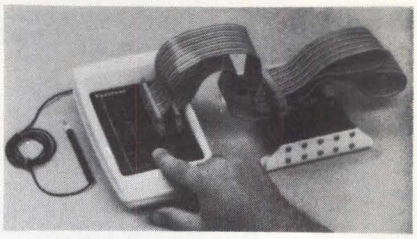
- Tested to MIL-E-16400
- U.S. Navy Standard AN/USH-26(V)
- All NTDS Interfaces
- From 1 to 4 Tape Drives per Unit
- Provides Multiplex Operation from 2 Computers
- ANSI Compatible Format

For information on our spectrum of Militarized Recorders, call Leon Malmed, Sales Manager

Qantex DIVISION
NORTH ATLANTIC INDUSTRIES, INC.
60 PLANT AVE., HAUPPAUGE, NEW YORK 11787 • 516-582-6060 • TWX: 510-227-9660

See us at INTERFASE WEST Booth 446

CONTINUITY TESTER FOR FLAT CABLE ASSEMBLY



Interface module and adapters of F-500 portable continuity tester enable quick testing of flat cable assemblies, with LED displays identifying shorts or opens. Unit tests 14- and 16-pin DIP, D series, and 20- to 50-contact PC edge connectors, plus 10- to 50-contact sockets. Probe allows testing of connectors of other than flat cable. Portable unit operates on 9-V battery. **Fasttest,** 921 Loraine Ave, Los Altos, CA 94022.

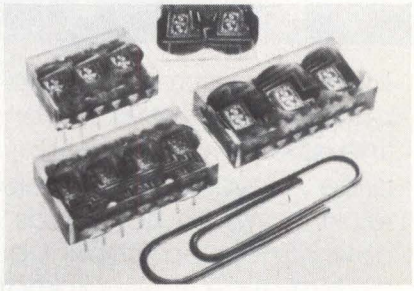
Circle 282 on Inquiry Card

6800 TEST PACKAGE OPTION

Fully programmable test package option allows MX-17 test system users to test and evaluate device operating modes and instruction sequences of all 6800 devices in less time than required by other systems. The 6800 test package includes a device programming unit, manual device board, and a test program for the device to be tested. Although written to MC68B00 specs, easily implemented software changes allow the test program to accommodate MC6800, MC68A00, and other specs. **Adar Associates, Inc,** 154 Middlesex Tpk, Burlington, MA 01803.

Circle 283 on Inquiry Card

LOW POWER, BRIGHT LED DISPLAYS



Intended as alternatives to LCDs for self-illuminating use, DL-440M, -430M, -330M, and -340M LED digit displays draw <1.0 mW/segment. Displays with 0.150″ (3.81-mm) high digits are available in 2- and 3-digit end stackable models; 0.110″ (2.794-mm) high models have 3 and 4 digits. Displays are encapsulated and hermetically sealed in plastic packages with high impact plastic lenses. Typ luminance for all 4 models is 1.5 mcd at 5 mA/segment. **Litronix,** 19000 Homestead Rd, Cupertino, CA 95014.

Circle 284 on Inquiry Card

There's a bright new face in 12" data monitors.

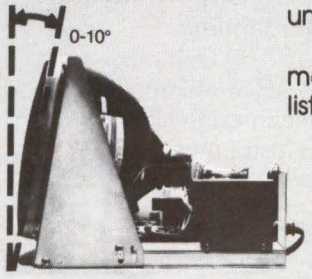
If you've got a need for a 12" CRT monitor, Sanyo has a model that will fill it.

For cost-sensitive applications, choose the 5000 series. You get your choice of AC or DC power, P4 or P31 phosphors, and separate or composite video and sync inputs. 15 MHz bandwidth and standard 15.75 kHz scan rate provide excellent resolution and easy application.

For extra-demanding jobs, pick the 6000 series. You get 1,000 line resolution and 22 MHz bandwidth for ultra-sharp graphics and crisp, high definition 80-character lines. TTL-compatible sync inputs make interfacing a snap.

With either series, you get a compact, rugged steel chassis with adjustable CRT tiltback to fit virtually any enclosure design. You also get adjustable scan size, plus remote brightness control capability. Single-PCB construction and one-connector hookup save time in assembly, testing, and maintenance. And Sanyo's many years of manufacturing field-proven CCTV monitors, and our unparalleled QC assure long, trouble-free service.

For all the facts on these exciting new open-chassis monitors, contact your local Sanyo sales representative listed below.



SANYO

Communications Products Division
1200 W. Artesia Blvd., Compton, CA 90220 (213) 537-5830

Contact your nearest Sanyo rep:

AKRON: Avcom, Inc. (216) 777-2060 **ATLANTA:** Len Elliott Company (404) 875-9701 **ATLANTIC CITY:** Austin Associates (609) 871-9290 **BALTIMORE:** David H. Brothers, Inc. (301) 764-7189 **BOSTON:** Piper Associates (617) 449-1144 **CHICAGO:** George Petit Company, Inc. (312) 261-0342 **DALLAS:** The Crockett Sales Co. (214) 748-8209 **DENVER:** Mile-High Marketing (303) 457-2058 **DETROIT:** Burcaw Co. & Associates (313) 533-7700 **INDIANAPOLIS:** Midwest Rep. & Assoc., Inc. (317) 844-4555 **KANSAS CITY:** Pacer Sales Corporation (816) 358-6638 **LOS ANGELES:** Marketing Specialists (213) 341-1471 **MIAMI:** L. Haas Company (305) 945-6544 **PORTLAND:** Earl & Brown Co., Inc. (503) 245-2283 **SAN FRANCISCO:** Tech-Rep Associates (415) 785-4531 **SEATTLE:** Earl & Brown Co., Inc. (206) 284-1121 **ST. PAUL:** Skor, Inc. (612) 645-6461 **WHITE PLAINS:** Irving Langbaum Assoc., Inc. (914) 634-1141

© 1979 Sanyo Electric Inc., Compton, CA 90220

CIRCLE 139 ON INQUIRY CARD

LITERATURE

Successive Approximation ADCs

Data sheet gives block and timing diagrams, detailed specs, a sample circuit, and applications comments for 400- and 1000-ns monolithic ADCs. **TRW LSI Products,** Redondo Beach, Calif.
Circle 300 on Inquiry Card

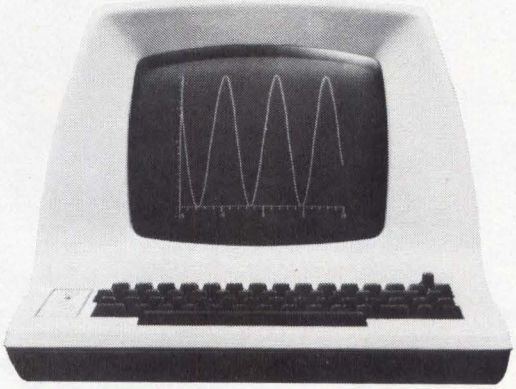
PC Mountable Switches

Featuring tiny toggle switches, slides, pushbuttons, and rotary switches for PCB mounting, catalog furnishes dimensional drawings and specs. **Alco Electronic Products, Inc,** North Andover, Mass.
Circle 301 on Inquiry Card

Apple Computer Software

More than 100 business, demonstration, game, education, language, and utility programs for the Apple microcomputer are described in catalog along with hardware and accessories. **Rainbow Computing Inc,** Northridge, Calif.
Circle 302 on Inquiry Card

Smart move

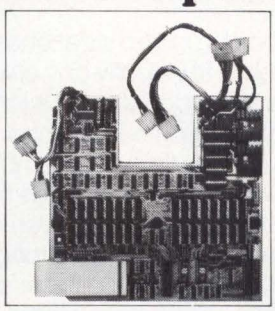


for a dumb terminal.

Retro-Graphics™

Retro-Graphics transforms the ordinary Dumb Terminal into a sophisticated graphics terminal. Check these features:

Packaging: Mounts inside the Lear Siegler ADM-3A. Installation requires no cutting or soldering.



Performance: Microprocessor based. Generates graphs and pictures on a 512 by 250 plotting grid.

Compatibility: Tektronix Plot 10 software compatible. Replaces Tektronix 4006's, 4010's and 4025's in many applications.

Affordability: $1150.00 Domestic single unit price. Retro-Graphics is now available through US and European distributors. Call or write today for details.

DIGITAL ENGINEERING
INCORPORATED
1787-K TRIBUTE RD. • SACRAMENTO, CA 95815 • (916) 920-5600

Lear Siegler and Dumb Terminal are registered trademarks of Lear Siegler Inc.
Tektronix, 4006, 4010, 4025 and Plot 10 are registered trademarks of Tektronix Inc.

Bridge Rectifiers

Selection chart lists specs including avg rectifier current, op temp, peak current surge, and voltage ratings for 1.5- to 30-A rectifiers; flip side provides dimensional drawings. **Electronic Devices, Inc,** Yonkers, NY.
Circle 303 on Inquiry Card

Small Business System Evaluation

Brochure provides checklist of questions and discussion of considerations in evaluating vendor, software, hardware, total system, and financial aspects of a small business system. **Data General Corp,** Westboro, Mass.
Circle 304 on Inquiry Card

Enhanced BASIC

COBOL, APL, and FORTRAN features of HP Enhanced BASIC including multicharacter identifiers, array operations, and function subprograms are outlined in brochure. **Hewlett-Packard Co,** Palo Alto, Calif.
Circle 305 on Inquiry Card

Alternatives for Speed And Direction Control

Application notes present alternatives to standard speed, direction, and braking control for permanent magnet and shunt wound drive systems. **Bodine Electric Co,** Chicago, Ill.
Circle 306 on Inquiry Card

2400-Bit/s Modem

Photos of front panels with explanations of indicators and switches illustrate capabilities of MX 2400 modem line in brochure which also details options, models, and features of the line. **Codex Corp,** Mansfield, Mass.
Circle 307 on Inquiry Card

The Hughes Microprocessor Development System... an important addition to the 1800 CMOS microprocessor family

Hughes again brings its high-technology leadership and high reliability performance to the microprocessor users with a powerful development system for 1802 Microprocessor Products.

The **Hughes Microprocessor Development System** (HMDS) solves the problem of developing software and hardware for 1802 Microprocessor based designs. The HMDS contains an easy-to-use assembler plus editor and monitor software and in-circuit-debug for real time hardware development. High-level languages, PROM programmers and support of additional industry standard Microprocessors are just some of the available options.

THE 1800 MICROPROCESSOR FAMILY

(Available Now)

Number	Function
HCMP 1802	CPU
HCMP 1822	256 X 4 RAM
HCMP 1824	32 X 8 RAM
HCMP 1831/2	512 X 8 ROM
HCMP 1833/4	1024 X 8 ROM
HCMP 1852	I/O Adapter
HCMP 1853	3 to 8 Decoder
HCMP 1854	UART
HCMP 1856/7	Bus Buffer/ Separator
HCMP 1858/9	Memory Latch/ Decoder
HCMP 1861	TV Interface

Hughes offers a complete line of Microprocessor related devices including Hughes new Liquid Crystal Display Drivers (HLCD 0437 and HLCD 0438) along with those listed in the table.

Other advanced products will be announced soon. For further information on the growing Hughes product line call or write: Gary Des Rochers, Hughes Semiconductor Products, 500 Superior Avenue, Newport Beach, CA 92663, (714) 759-2907 (800) 854-3515. In Europe: Hughes Microelectronics Ltd., Clive House, 12-18 Queens Road, Weybridge, Surrey KT13 9XD, England. Telephone 932-47262.

HUGHES

HUGHES AIRCRAFT COMPANY
SOLID STATE PRODUCTS DIVISION

CIRCLE 141 ON INQUIRY CARD

Linear Circuit Tester

Hardware and software components and test options for the Series Five linear IC tester are outlined in catalog, complete with block and circuit diagrams, photos, and sample programs. **Lorlin Industries, Inc,** Danbury, Conn.
Circle 308 on Inquiry Card

Portable Cable Assembly Tester

Brochure details features and operating modes of AutoScan high speed portable fault finder that visually identifies fault as short, miswire, or open and provides pin number of defective wire. **Muirhead-Addison,** Mountainside, NJ.
Circle 309 on Inquiry Card

General Purpose Switches

Catalogs present specs and dimensions for basic, diecast limit, and thumbwheel switches, and also proximity switches. **Omron Electronics, Inc,** Schaumburg, Ill.
Circle 310 on Inquiry Card

LED Assemblies

Curves in application brief plot typical forward current vs forward voltage for LED assemblies to aid in selection of LED within required voltage and current ranges. **Data Display Products,** Inglewood, Calif.
Circle 311 on Inquiry Card

Variable Reluctance Stepping Motors

Electrical specs, diagrams, and photos are included in catalog for commercial permanent magnet and variable reluctance stepping motors. **Clifton Precision, Litton Systems, Inc,** Clifton Heights, Pa.
Circle 312 on Inquiry Card

Static RAM Family

Organization, speed, power consumption and power supply requirements, and package and pinout information for 2k, 4k, and 8k static RAMs are presented in data sheet. **EMM/SEMI, Inc,** Tempe, Ariz.
Circle 313 on Inquiry Card

Statistical Multiplexer

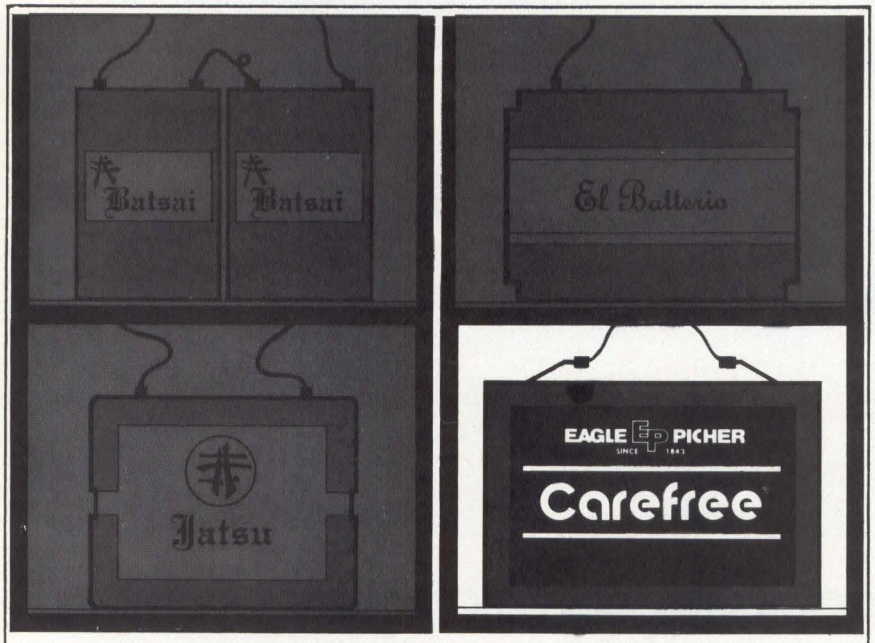
Features of 200% efficient statistical time division multiplexer including peak loading tolerance, error protection, and flow control are detailed in data sheet. **General DataComm Industries, Inc,** Danbury, Conn.
Circle 314 on Inquiry Card

Electronics Enclosures

Constructed of ABS material with internal mounting bosses, rails, and vertical card guides, enclosures illustrated in catalog are offered as both kits and production models. **PacTec Div of LaFrance Corp,** Philadelphia, Pa.
Circle 315 on Inquiry Card

POWER BASIC

Product Reference Guide for POWER BASIC exemplifies statements, commands, and functions, and describes evaluation, development, and configurable versions of the language. **Texas Instruments, Inc,** Houston, Tex.
Circle 316 on Inquiry Card



A battery is just a battery — until it has to perform.

At that critical moment, you'll appreciate CAREFREE's guaranteed delivery of 100% capacity on first cycle, unlike gels — with none of the memory problems of nickel cadmium. That's why the CAREFREE immobilized electrolyte technology is becoming the standard of the industry. Test it for yourself.

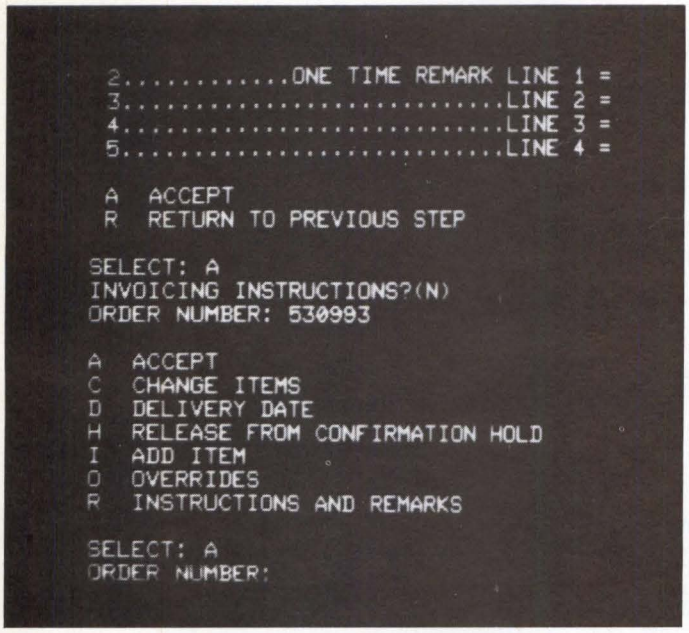
Choose from the world's largest line of maintenance-free rechargeables — ½ amp to 33 amp, 2 volt to 24 volt.

If you want to get technical, give us a call 417 776-2258

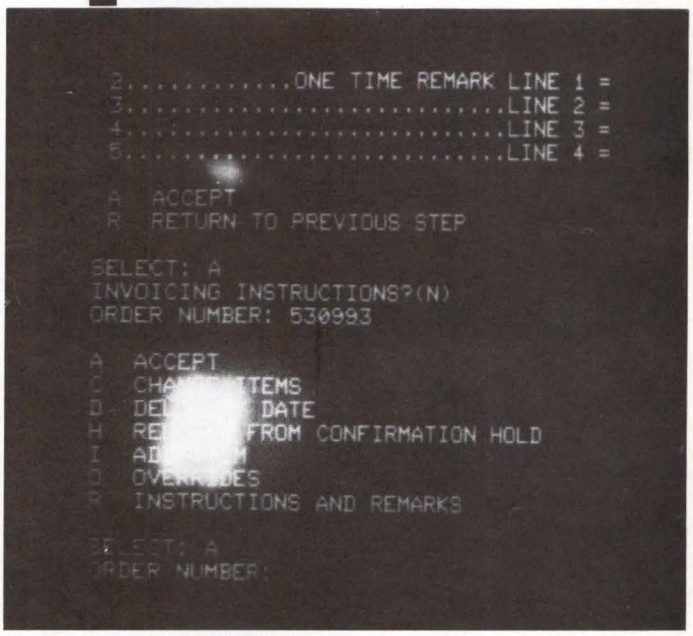
Carefree®

EAGLE PICHER SINCE 1843 Eagle-Picher Industries, Inc. • Commercial Products Department
P.O. Box 130, Seneca, Missouri 64865 • TWX 910 774-4533

To see or not to see? That is the question.



Display in ambient light with polarizer.



Display without polarizer.

And Polaroid has the answer: circular polarizer contrast-enhancement filters let you see your display under a variety of lighting conditions.

Circular polarizers kill reflections from CRT's by acting as a light trap. Ambient light can go through the circular polarizer, but after it is reflected from the tube face, it can't get out again. And circular polarizers can suppress up to 99% of reflected room light. They are far more effective than absorption-type filters for improving contrast.

Polaroid invented the circular polarizer and can satisfy your needs better than anybody else.

We offer the widest selection of *off-the-shelf* contrast-enhancement filters. Or—we'll make up precisely the filter you need: Choose glass or plastic filters with polished or nonglare surfaces. They can be flat or shaped to your specifications. They can have antireflective, RFI or abrasion-resistant coatings. Colors can be computer-matched to your display to provide maximum visibility.

We sell circular polarizers and offer technical assistance worldwide. For a free sample, just fill out and mail the coupon below. Or call Dick Adams *collect* at 617-577-3315. He'll recommend the contrast-enhancing filter that best meets your needs.

And makes everything perfectly clear.

Polaroid Corporation, Technical Polarizer Division, Dept. A 415, 20 Ames St., Cambridge, Mass. 02139

☐ Please send me a free sample circular polarizer and literature.

☐ Have your Application Specialist call me for an appointment.

Name_____

Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Phone Number_____

Application_____

Polaroid

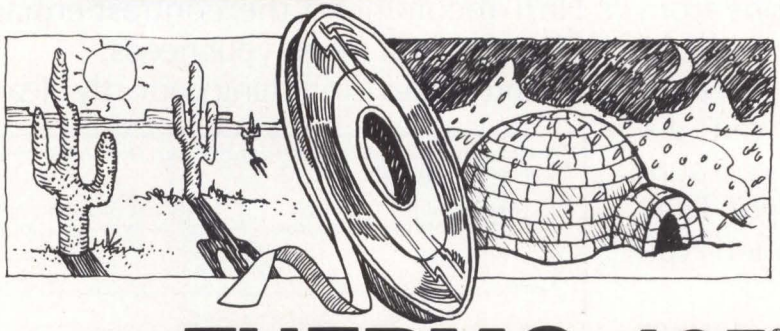
Polarizing film. We made it first. We make it best.

©1979 Polaroid Corporation

CIRCLE 188 ON INQUIRY CARD

GUIDE TO PRODUCT INFORMATION

The real world is a tough place for conventional magnetic tape



Rely on THERMO-465®

superior digital/audio tape for severe environments — proven to retain data at **+400°F** and **−65°F**

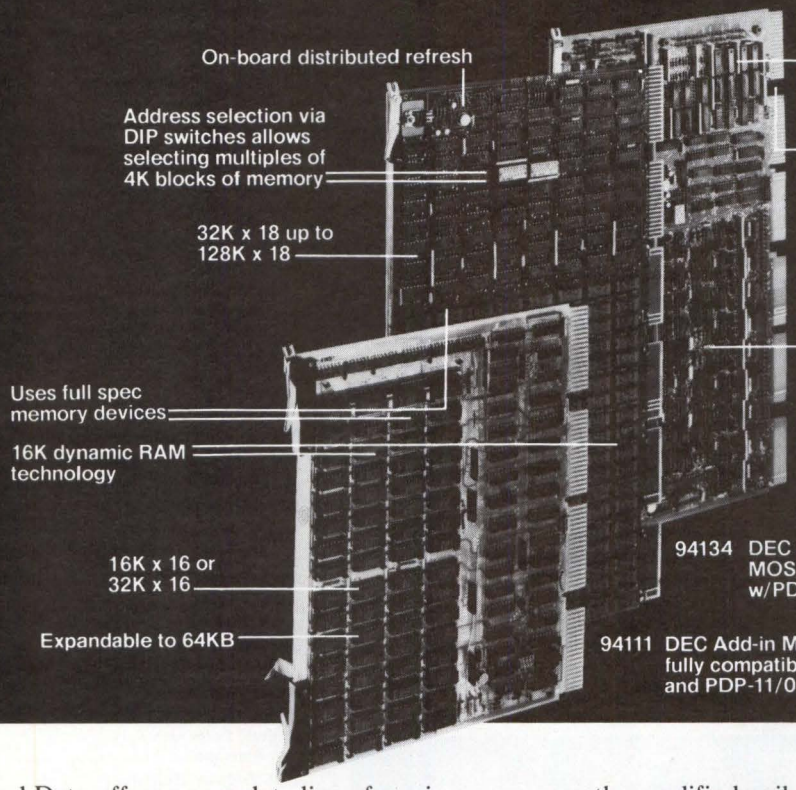
Applications: • Military data systems • Commercial aircraft, ships • Remote or field recording • Metal-tape replacement • Safe wide-temperature data storage

For further information contact
Raymond Engineering Inc.
217 Smith Street, Middletown, CT 06457
Telephone: (203) 632-1000 • Telex: 9-9394

A subsidiary of Raymond Industries Inc.

THERMO-465® is a registered trademark of Graham Magnetics Incorporated and is distributed exclusively in the U.S.A. by Raymond Engineering Inc.

Add-on quality, Add-in quality with OEM memory from Control Data.



Control Data offers a complete line of semiconductor and core memory that's fully compatible with today's processors. Enclosures, too. And all are built with the same concern for quality that goes into every product we manufacture.

You see, Control Data believes in improving upon basic design when we make memory for mini-computer processors. All chips in our semiconductor memory are "full-goods." So you get all the quality and density you pay for. We use IC sockets instead of hardwiring our chips, so servicing is easier.

When your *PDP-11 needs more memory...

Add-in our 94234 Core Memory Module. It's fully compatible, of course, but you also get the inherent reliability and non-volatility of core memory technology.


94270

Our *Add-on* core is fully compatible too, and fits into your PDP-11/70 rack. It gives you up to 512 Kbytes in a 10½ inch enclosure housing two power supplies, one back plane, one controller circuit board, two to eight memory modules (in pairs), four interconnect cables and four terminator circuit boards.

And when you need better semiconductor memory...

Our 94134 MOS RAM module is fully compatible with your PDP-11/34 and uses either the standard or the modified unibus connector. Maximum configuration is 128K x 18, but smaller densities are also available. Refresh is automatic.

Our 94111 MOS RAM has block address selection via switches for the standard configuration of 16K or 32K x 16. It is pin-to-pin, voltage, signal, hardware and software compatible with *LSI-11 and PDP-11/03 systems.

Put quality behind your nameplate. Call us at 612/830-6018 or send us the coupon below.

*DEC, LSI and PDP are registered trademarks of Digital Equipment Corporation.

Jack Middlestaedt, Product Sales Manager CD-109
Control Data Corporation, Computer Memory Division
8001 East Bloomington Freeway, Bloomington, MN 55420

Please tell me more about memory for my _____ processor.

Name _____ Phone _____

Company _____ Title _____

Address _____

City _____ State _____ Zip _____

CONTROL DATA CORPORATION

More than a computer company

CIRCLE 145 ON INQUIRY CARD

CUSTOM MOS

Solitron will design, process, assemble and test Hi Rel or commercial grade MOS devices. Our CMOS is manufactured utilizing an industry compatible silicon and metal gate, low or high threshhold process, with operation voltage ranges from 1-1/2 to 18 volts.

The time is right now! There is design time available and our new wafer fab equipment is on stream. We have wafer capacity for 3,000 additional 3" wafers per month over present production. We will second source custom designs and ship parts in wafer form, die form or packaged parts.

Let us work with your design team.

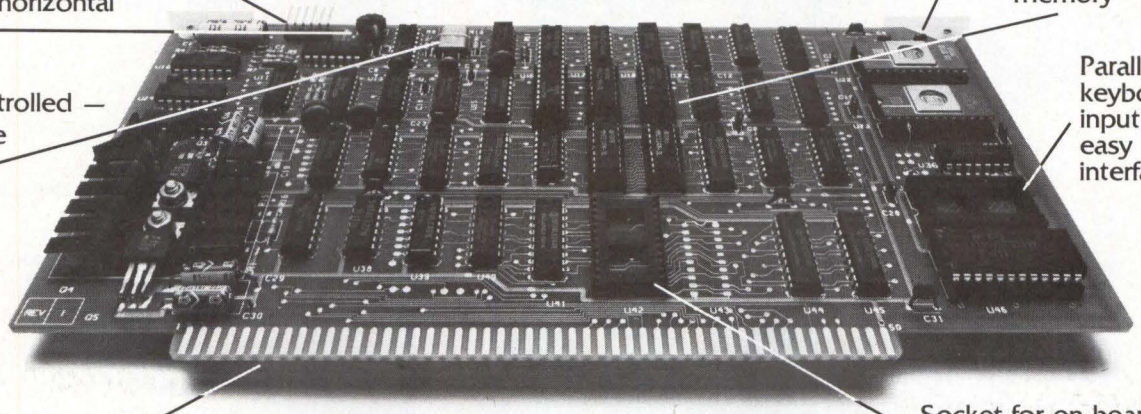
Call Randy Chapman or Jim Everett for details. (800) 854-2021.

LARGE OR SMALL VOLUME CMOS, PMOS AND NMOS LSI

Solitron DEVICES, INC.

8808 Balboa Ave., San Diego, CA 92123, Ph.(714) 278-8780

EyewitnessNews
EyewitnessNews
EyewitnessNews
EyewitnessNews
EyewitnessNews



RS 170 composite video and separate TTL video and sync

Adjustable horizontal position

Crystal controlled — for extreme stability

S-100 bus interface — memory mapped screen 80 characters by 24 lines

Character font programmable — up to 256 characters can be generated

2K on board refresh memory

Parallel keyboard input — for easy interface

Socket for on board monitor/video driver prom

Flashwriter II. Good news in video boards from Vector Graphic.

If you haven't seen any good computer graphics lately you may be surprised to discover how revealing a Flashwriter II video board can be.

Go ahead, compare Vector Graphic's Flashwriter II video board with anyone else's and see what you've been missing.

It's everything a video board should be. And more. Call (213) 991-5740 for your nearest dealer.

VECTOR GRAPHIC INC.

31364 Via Colinas, Westlake Village, CA 91361

CIRCLE 147 ON INQUIRY CARD

COMPUTERS AND COMPUTER SYSTEMS

DATA COMMUNICATIONS EQUIPMENT

Now, a 10 megabyte hard disk subsystem designed for micros.

And iCOM® has it.

It's here. The 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 4511R hard disk subsystem rounds out PCC's iCOM family. From our compact little 2411 Microfloppy™ to our dual- density, dual flexible disk drive 3812 system, iCOM is the first name to look for in Microperipherals.®

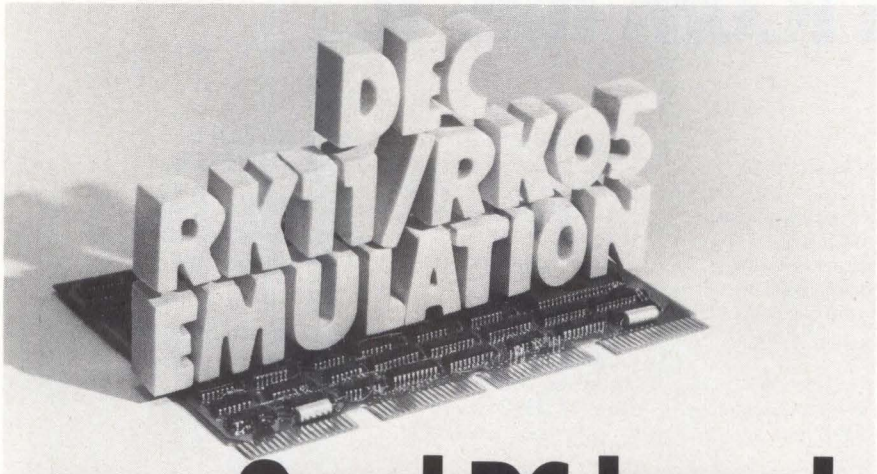
PCC SYSTEMS
PERTEC COMPUTER CORPORATION

For further information, call this toll-free number: 800-331-1000. (In Oklahoma, call 918-664-8300 collect.)

iCOM and Microperipherals are registered trademarks of Pertec Computer Corporation. Microfloppy is a trademark of Pertec Computer Corporation. CP/M is a trademark of Digital Research, Inc.

DATA ACQUISITION AND CONTROL EQUIPMENT

TEST AND MEASUREMENT EQUIPMENT; INSTRUMENTATION



on a Quad PC board

When you build the new Xylogics Model 610 Disk Controller into your DEC Unibus® CPU, you get more than just RK11/RK05 emulation.

With the Model 610 Disk Controller, you can accommodate up to four cartridge drives by CDC, EM&M, Pertec, Western Dynex and others providing storage capacity to 80MB of unformatted data. Media compatibility is obtained with any of the front load 5MB drives. The Model 610 is fully software compatible too.

Best of all, you get all this on one quad single printed circuit board. For RK11/RK05 emulation, go with Xylogics Model 610 Disk Controllers. And get *real* performance!

*Trademark of Digital Equipment Corporation.

Xylogics

Call Toll Free 800-225-3317

Xylogics, Inc., 42 Third Avenue, Burlington, Massachusetts 01803 (617) 272-8140

International Subsidiary: Xylogics International Ltd., Lynton House, Mill Lane, Gerrards Cross, SL9 8AY, United Kingdom Tel: (02813) -88287

We did it with . . . innovation/imagination/integrity

OTHER PRODUCTS; SERVICES

OEM America Meets

at the Invitational Computer Conferences

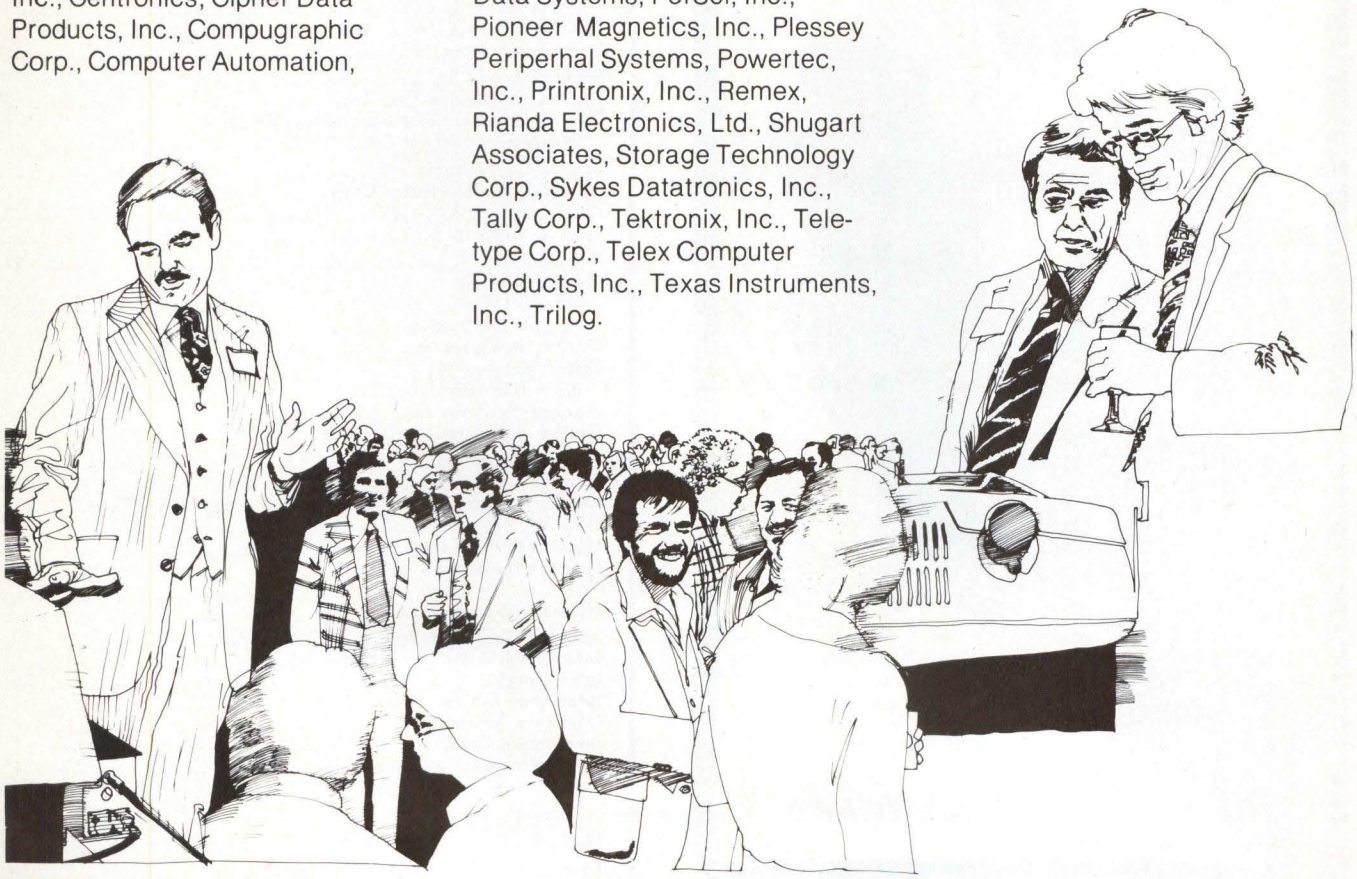
In Boston... in Ft. Lauderdale... in Palo Alto and seven other cities, OEM decision-makers meet the country's top computer and peripheral manufacturers at the Invitational Computer Conferences — the only seminar/displays designed specifically for the unique requirements of the quantity user.

In one day, at each 1979/80 ICC, guests will receive a concentrated, up-close view of the newest equipment and technology shaping our industry. Some of the companies which participated in the 1978/79 ICC Series were: CalComp, Cambridge Memories, Inc., Centronics, Cipher Data Products, Inc., Compugraphic Corp., Computer Automation, Inc., Computer Design, Computerworld, Control Data Corp., Data 100 Corp., Datamation, Datamedia Corp., Dataproducts Corp., Dataram Corp., Data Systems Design, Inc., Datum, Inc., Diablo Systems, Inc., Digital Design, Electronic Engineering Times, Honeywell Information Systems, Houston Instrument, ISS/Sperry Univac, Kennedy Company, Lear Siegler, Inc., MDB Systems, Inc., Microdata Corp., Mini-Micro Systems, Monolithic Systems Corp., National Semiconductor, NEC Information Systems, PCC/Pertec Division, Perkin-Elmer Data Systems, PerSci, Inc., Pioneer Magnetics, Inc., Plessey Periperhal Systems, Powertec, Inc., Printronix, Inc., Remex, Rianda Electronics, Ltd., Shugart Associates, Storage Technology Corp., Sykes Datatronics, Inc., Tally Corp., Tektronix, Inc., Teletype Corp., Telex Computer Products, Inc., Texas Instruments, Inc., Trilog.

The schedule for the 1979/80 Series is:

Sept. 6, 1979	Palo Alto, CA
Sept. 27, 1979	Minneapolis, MN
Oct. 10, 1979	Newton, MA
Nov. 1, 1979	Cherry Hill, NJ
Nov. 15, 1979	Southfield, MI
Jan. 15, 1980	Orange County, CA
Feb. 6, 1980	Ft. Lauderdale, FL
Mar. 25, 1980	Dallas, TX
Mar. 27, 1980	Houston, TX
April 28, 1980	Atlanta, GA

Invitational Computer Conferences



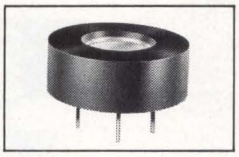
Invitations are available from participating companies or the ICC sponsor. For further information contact: B.J. Johnson & Associates, 2503 Eastbluff Drive, No. 203, Newport Beach, CA 92660. (714) 644-6037

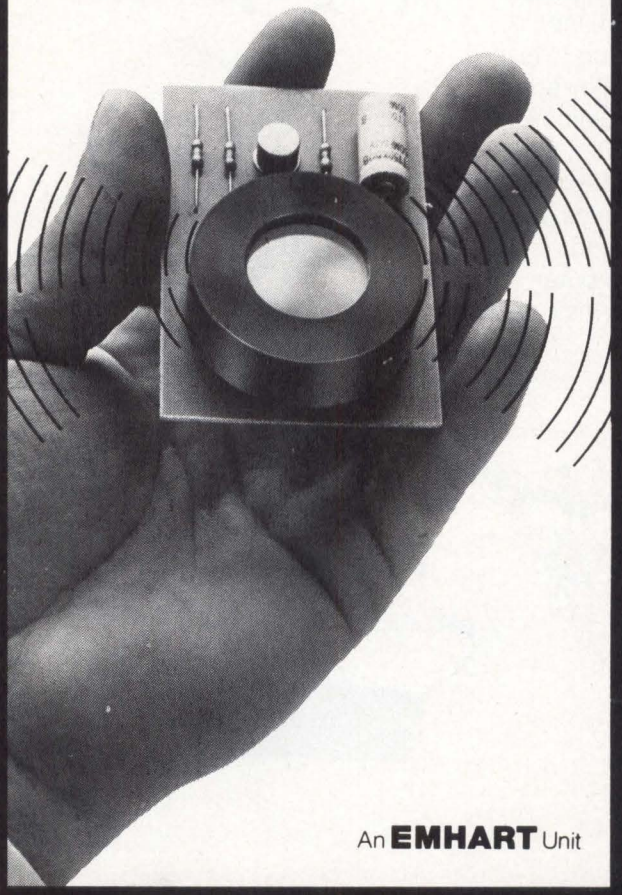
Now you can sound off right from your printed circuit boards.

The Mallory Sonalert® Signal.

This new Sonalert design gives you a choice of three medium loud sounds—continuous, fast pulse, or slow pulse at 2900 Hz. It will even give you pulsing or continuous sound in the same package. You can spec it into just about anything in which you need sound. And its pin mounting makes it easy to insert and solder into printed circuit boards. Units may be hand or wave soldered.

Mallory Sonalert Electronic Signals are available direct, or through authorized Mallory distributors in U.S., Canada and overseas. Give us a hearing. Write or call. Mallory Capacitor Co., a division of Mallory Components Group, Emhart Industries, Inc., P.O. Box 372, Indianapolis, Indiana 46206. (317) 636-5353.





An **EMHART** Unit

MALLORY

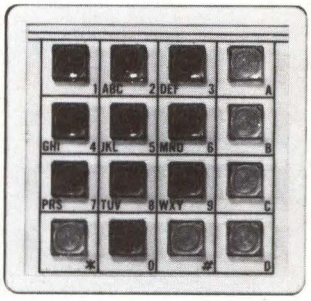
CIRCLE 151 ON INQUIRY CARD

ADVERTISERS' INDEX

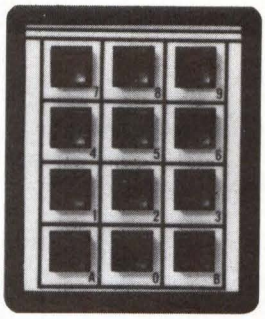
*Appearing only in issues delivered outside of U.S. and Canada

Low Profile...

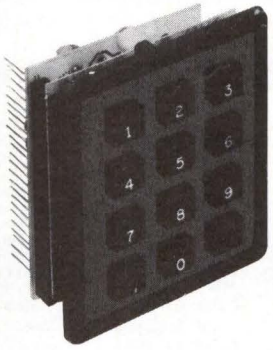
LED lighted keys give visual indication of status function. Or choose unlighted keyboard.



10, 12, or 16 station. Square or round keys. Attractive color selection. Clear, sharp key top or decal marking.



BCD and hexi-decimal encoding available as optional plug-on "Adder-Boards". Easy front panel mounting.

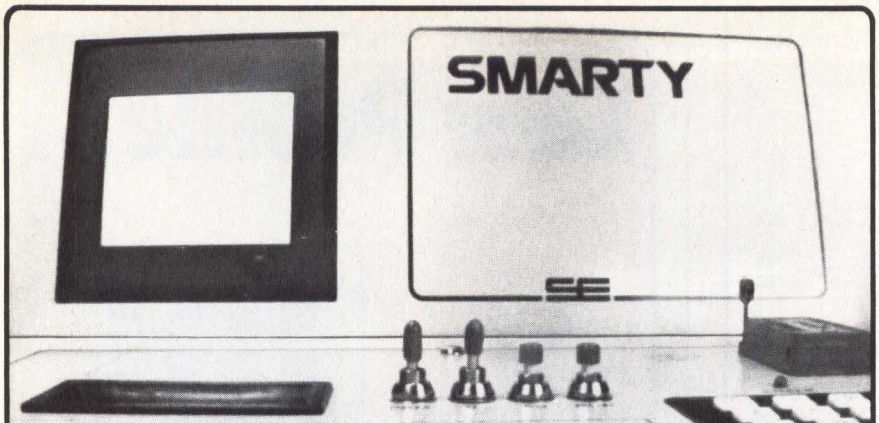


Design your own keyboard. Single station modules mount on PC or prepunched boards with .100 center holes.

STACOSWITCH
a STACO, INC. company
1139 BAKER STREET, COSTA MESA, CALIF. 92626
(714) 549-3041 TWX: 910/595-1507

Other STACO Company products: Custom Transformers, STACO ENERGY PRODUCTS, Richmond, Indiana; Variable Transformers, STACO ENERGY PRODUCTS, Dayton, Ohio.

CIRCLE 152 ON INQUIRY CARD



THE SMART APPROACH TO PROM PROGRAMMING

The unique, universal PROM programming system with a smart approach to:

PROGRAMMING — Smarty programs all types of PROMs, FPLA's PALs and FPGAs. Gang programs up to 240 Fuseable Link PROMs and EPROMs.

SIMPLICITY — No interchangeable personality modules are required.

SIMULATION — Smarty comes with a built-in PROM simulator as a standard feature.

EDITING — Smarty gives you 14 editing commands. Other systems offer only three or four.

DATA STORAGE — You can order an optional, built-in Micro Cassette Data Storage unit.

INTERFACE — Smarty is equipped with built-in PPTR interface, parallel bus, RS232C, and current loop with 14 switch-selectable baud rates.

And Smarty costs less than any other universal PROM programming system.

SUNRISE ELECTRONICS
307-H South Vermont Ave., Glendora, CA 91740 (213) 963-8775 • (213) 914-1926

CIRCLE 153 ON INQUIRY CARD

We supply the S-100 revival.

Why S-100? Because S-100 machines are not consumer toys — but flexible, pro-level systems that are easy to upgrade, modify, and adapt to specific applications. Over the years the S-100 buss has proven to be the ideal choice for commercial, industrial, and scientific applications.

We're expanding the options for S-100 systems by using the experience we've acquired in the past, mixing in the best technology offered by the present, and building products for the future... products that meet, and often exceed, the demands of the new wave of S-100 professional users. When you move up to S-100, move up to the **CompuPro™** line from **Godbout Electronics.**

NEW! HIGH-PERFORMANCE S-100 MOTHERBOARDS

19 slot: $174 unkit, $214 assm
12 slot: $129 unkit, $169 assm
6 slot: $89 unkit, $129 assm

(Unkits have edge connectors and termination resistors pre-soldered in place for easy assembly.)

These 3rd generation motherboards are shielded, terminated, and designed to work with the latest 5 and 10 MHz CPUs coming on line. Fits in Godbout, Vector, IMSAI, TEI, and similar enclosures. These high quality products are a welcome addition to any system — or the start of a great one.

NEW! The Godbout Box!

At last — a high quality, industrial grade home for your computer. Includes power supply. Use for either desk or rack mount. Check your local computer store for details, or write us direct... this is a product that has been needed for a long time, and we're filling that need in style.

Send for our free catalog today.

2S "Interfacer" S-100 I/O board $189 unkit, $249 assm, $324 CSC*

Dual serial port with 2 full duplex parallel ports for RS-232 handshake. Crystal timebase, Baud rates to 19.2 KBaud selectable for each port, much more. This no-excuses serial board does things the others only dream about.

NEW! 3P + S "Interfacer II" S-100 I/O board $189 unkit, $249 assm, $324 CSC*

Incorporates 1 channel of serial I/O (with **all** the features of a port from the 2S "Interfacer"), along with 3 full duplex parallel ports with attention/enable/strobe bits for each parallel port and individual interrupts. The versatility of each port contributes to a very versatile, and extremely flexible, I/O board.

NEW! Memory Management $59 kit, $85 assm, $100 CSC*

Add bank select and extended addressing to older S-100 machines — boost memory capacity beyond 64K, up to ½ megabyte! Use our new extended addressing memories, or retrofit existing memories that have phantom or extra qualifier lines.

...AND DON'T FORGET OUR MEMORIES!

All our memory boards are fully static, are zip along with 5 MHz systems, include a 1 year warranty, and are available in 3 different configurations. Here are just some selections from our roster of 14 **Econorams****...

Name	Buss & notes	Unkit	Assm	CSC*
8K Econoram II	S-100	**$149**	**$179**	**$239**
32K Econoram X	S-100	**$529**	**$649**	**$789**
24K Econoram XII	S-100 (1)	**$329**	**$419**	**$519**
16K Econoram XIV	S-100 (2)	**$289**	**$349**	**$448**
16K Econoram XV-16	Heath H8 (3)	**$329**	**$395**	n/a
32K Econoram XV-32	Heath H8 (3)	**$599**	**$729**	n/a

Notes
(1) Bank select board — 2 independent banks addressable on 8K boundaries.
(2) Extended addressing (24 address lines).
(3) Bank select option for implementing memory systems greater than 64K.
* CSC boards are qualified under our high-reliability Certified System component program (200 hour burn-in, replacement in event of failure within 1 year of invoice date)
** **Econoram** is a trademark of **Godbout Electronics.**

GODBOUT ELECTRONICS
Bldg. 725, Oakland Airport, CA 94614

TERMS: Cal res add tax. Allow 5% for shipping, excess refunded. VISA®/Mastercharge® call our 24 hour order desk at **(415) 562-0636.** COD OK with street address for UPS. Prices good through cover month of magazine.

CIRCLE 154 ON INQUIRY CARD

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., R.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
(800) 241-9461

MIDWESTERN STATES

Berry Conner, Jr.
88 West Schiller St.
Suite 2208
Chicago, IL 60610
(312) 266-0008

WESTERN STATES AND TEXAS

BUCKLEY/BORIS ASSOC., INC.
Terry Buckley
Tom Boris
John Sabo
22136 Clarendon St.
Woodland Hills, CA 91367
(213) 999-5721
(714) 957-2552

The New CPS Digital Plotting Systems

The plotter size & speed you need, complete with microprocessor based controller

The CPS Digital Plotting System allows you to select the plotter size and speed most suited for your specific application and combine it with a microprocessor based plotter controller for optimum digital plotting - whether online or remote.

Speeds for the plotters on the CPS Systems range from 300 to 2000 steps/second and plotting surfaces are available from 11" to 42" wide.

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 simplifies host computer software. The controller can either operate from a host computer or serve as a sophisticated computer interface - whichever fits your specific application.

High or low speed, high or low resolution, wide or narrow plotting surface ... whatever your plotting needs may be, there's a CPS System tailored to meet them, at a price to fit your budget.

For complete information on the new CPS Digital Plotting Systems, call or write Houston Instrument, One Houston Square, Austin, Texas 78753. (512) 837-2820. 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.

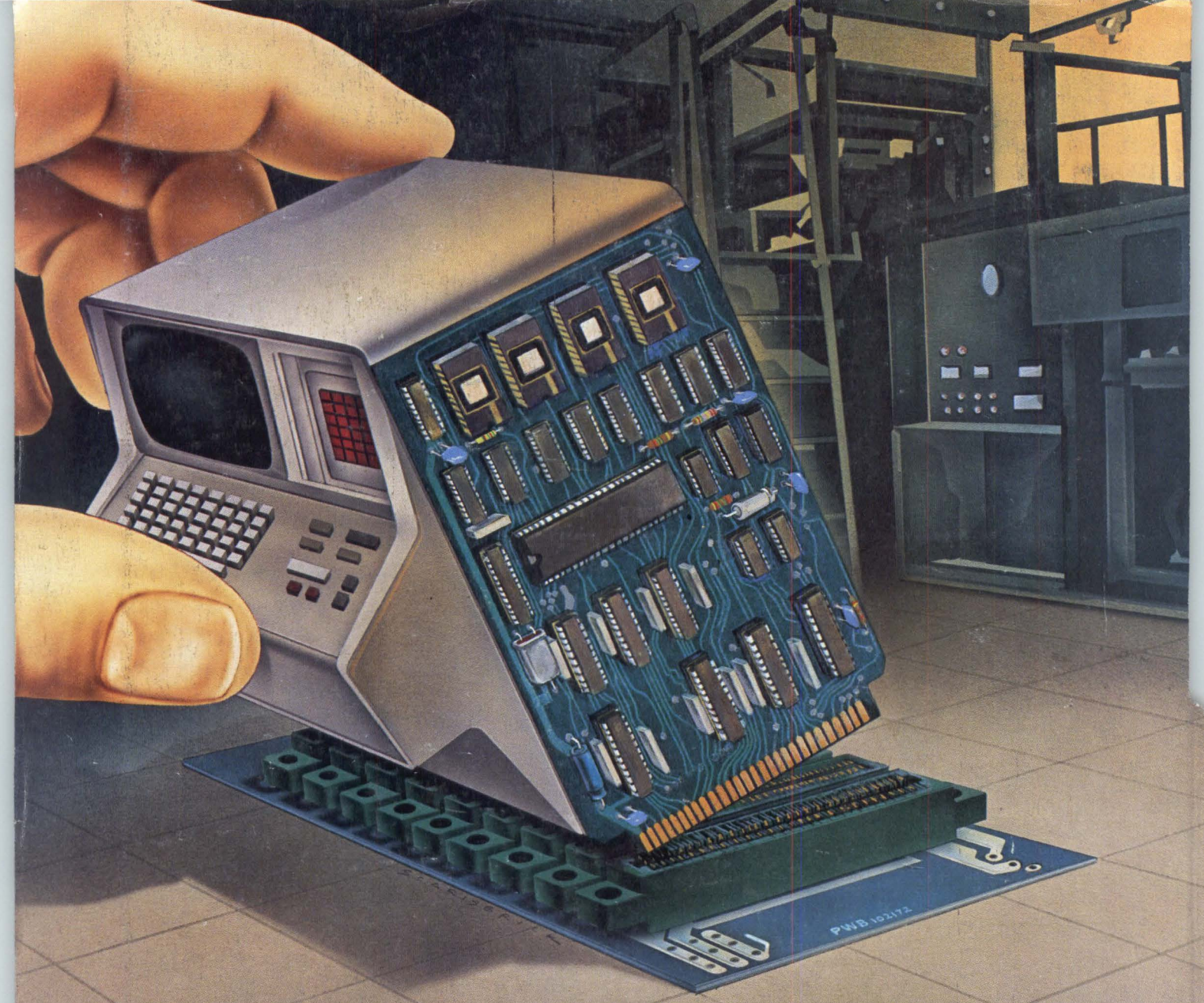
Circle #155 for literature.
Circle #156 to have a representative call.

*U.S. Domestic Price Only

houston instrument | DIVISION OF **BAUSCH & LOMB**

Visit us at ISA Booth 138

"the graphics - recorder company"



Microprocessor design can be simple.

With our new Series 7000 cards. Designed, manufactured, and tested for rugged industrial use.

Our modular Series 7000 cards can handle anything from data processing to instrumentation or industrial control. Take your choice of Z-80, 6800 and 8085 CPU cards. We also have a variety of other cards including memory, input/output, industrial control (like TRIAC outputs and AC/DC opto-isolated inputs), and communications interfaces (such as RS-232 and TTY). We also have card racks and compatible power supplies. Because our Series 7000 cards conform to the STD BUS, all of our cards work together. Just plug them into our standard bused motherboard. No messy, inconvenient backplane wiring.

Second-source designed in at every level.

We use all second-sourced parts, parts which have been proven through years of use. Buy 250 of any one card, and we give you free nonexclusive manufacturing rights, photo-ready artwork, a parts list and assembly prints. So you can build your own cards relying on us as your second-source.

Reliability backed by a 1-year parts and labor warranty.

We test every card before and after power-on burn-in. If something does go wrong, our modular, plug-in concept means easy service. Just swap cards.

Visit our booth #426-428 at MIDCON

Our courses and literature show you how easy microprocessor design can be.

Write for a copy of our STD BUS Technical Manual, our Microprocessor User's Guide, and for a schedule of our free half-day microprocessor economics seminars and our microprocessor design courses. Pro-Log Corporation, 2411 Garden Road, Monterey, CA 93940, phone (408) 372-4593.

PRO-LOG CORPORATION

CIRCLE 157 ON INQUIRY CARD