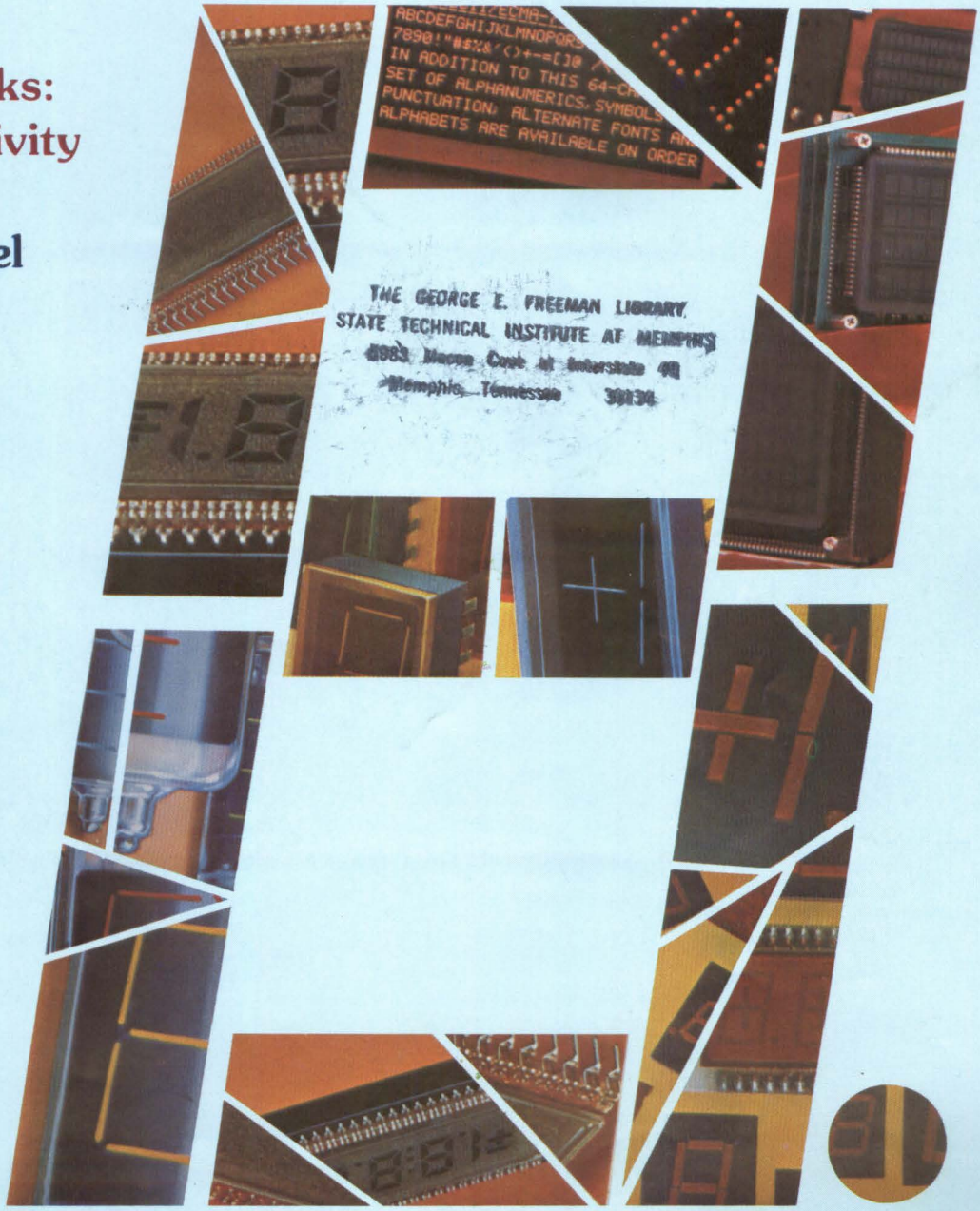
JULY 1977

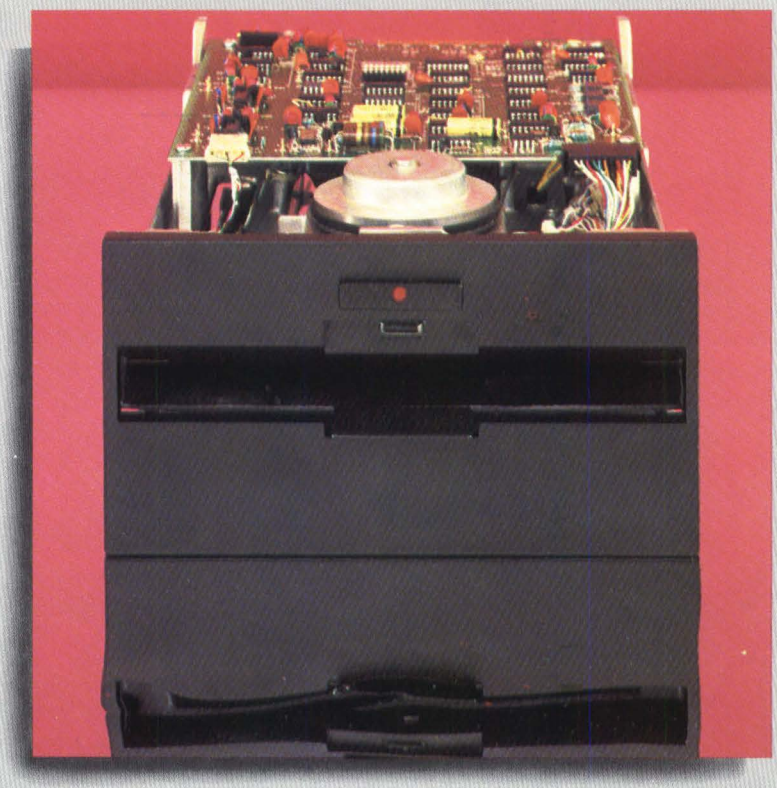
digital design
the magazine of digital systems

Graphic Display Systems:
Adding Dimension To Computer I/O

Floppy Disks: Patent Activity

Digital Panel Meters





Go with the winner-GSI-FDD 200.
Double-sided, double-track density, flexible disk drive.

The winner in high quality, delivery and price. GSI's FDD 200 disk drive accommodates up to 25.6M bits using MFM or M²FM encoding techniques. Downward compatible with GSI's FDD 110 and available in the same package design, it is available for upgrading with minor system modifications. It is fully IBM compatible and will read and write IBM 3740 formatted diskettes. You also can daisy chain up to 4 drives.

Important features include: parallel ready lines plus unit select, separation of clock and data, Track "00" photo sensing, automatic diskette ejection and fail-safe interlock latch mechanism.

Go with the thousands of happy GSI winners. What have you got to lose?

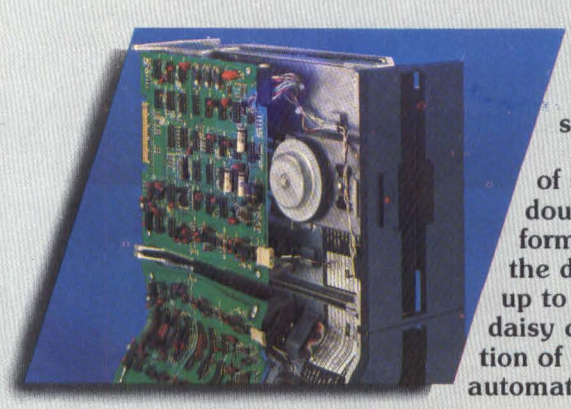
uter peripherals-second to none.

CIRCLE 1

GSI THE WINNER

GENERAL SYSTEMS INTERNATIONAL, INCORPORATED

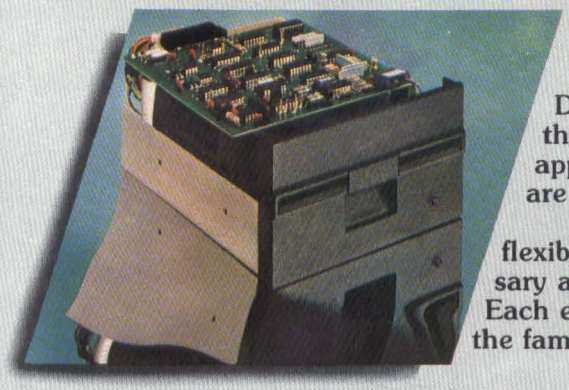
1440 Allec Street, Anaheim, CA 92805, (714) 956-7183, Telex 69-2488



Flexible Disk Drive GSI-FDD 110

A compact, random access, flexible disk drive for single or double density data storage.

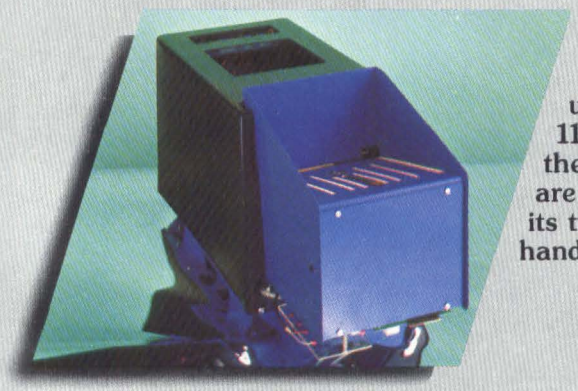
It will accommodate up to 6.4M bits of data on one side of standard media using MFM or M²FM encoding techniques for double density applications. Single density storage in variable formats provides up to 3.2M bits of data. Fully IBM compatible the disk drive will read and write IBM 3740 formatted diskettes up to 1.9M bits. The high performance unit offers up to 4 drive daisy chain operation, parallel ready lines plus unit select, separation of clock and data and Track "00" photo sensing. It also has automatic diskette ejection and a fail safe interlock.



Flexible Mini-Disk Drive GSI-MDD 050

The GSI family of highly reliable small Mini-Disk Drives: MDD 050, 100K bytes; MDD 051, 200K bytes and the MDD 052, 465K bytes are designed to fit into many applications where conventional disk drives (GSI-FDD 110) are physically inappropriate and space is at a premium.

Low in cost, the MDD 050 Mini-Disk Drive utilizes a small flexible disk permanently housed in an envelope with the necessary apertures for drive spindle, head and sector hole access. Each envelope is 5¼" by 5¼" but otherwise is conceptually like the familiar IBM diskette.



Horizontal Autoloader GSI-H155

The Horizontal Autoloader automatically loads and unloads open or closed flap diskettes to and from a GSI-FDD 110 Flexible Disk Drive. Diskettes are loaded sequentially from the hopper. After processing in the diskette drive, the diskettes are electronically selected and stacked horizontally in either of its two bins. The bins are removable and suitable for general handling of diskettes.

Flexible Disk Drive Sub-Systems GSI-FDD 2100

Packaged horizontally into a 19" Retma rack mount chassis, the GSI-FDD 2100 series sub-systems provide single and dual drive capability. Included in the sub-system is the necessary power to drive two flexible disk drives and a customer supplied formatter. Input AC power is supplied from the host computer controller via a relay system included in the GSI-FDD 2100.

GSI-World leadership in compu

The 8080 "Ice Breaker"

Portable for Development - Production Test - Field Service

BREAKTHROUGH QUESTIONS	muPro-80E	INTEL® MDS + ICE*
Low cost In-Circuit Emulator?	YES, (no terminal req'd) $3,250.	NO, $5,400. plus terminal cost
Real time execution from emulator or users system memory?	YES, phase locked to user clock; rate up to 2.86 mHz	NO, emulator resident programs execute slower than real time
Memory available to user in 16K emulator system?	ALL 16K	LESS THAN 4K (12K+used by ICE-80 driver)
Totally transparent control/display functions?	YES	NO, imposes memory, I/O and interrupt restrictions
High-level relocatable language supported by 16K paper tape or 32K disk system?	YES, BSAL-80	NO, PL/M® requires 64K disk system
Assembly language efficiency with high level language?	YES, BSAL-80	NO, PL/M® burdened with typical compiler inefficiences
Multi-user/Multi-task disk operating system?	YES, plus concurrent batch capability	NO, single user/single task
Portable for development, test, and field service?	YES, 4.6" x 6.6" x 15" 18 lbs.	NO, 8.5" x 19" x 17" 65 lbs. Plus terminal

*INTEL and PL/M are registered trademarks of INTEL CORP.
*from published specifications

Consider Your Field Service and Production Requirements.

µPro

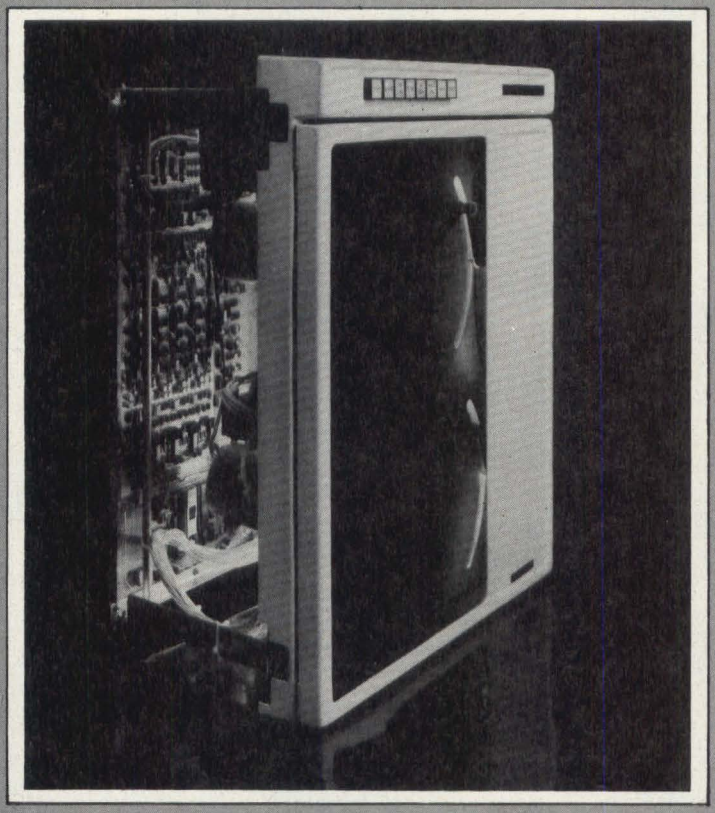
Manufacturers of Innovative OEM and End User Microcomputer Systems

muPro Inc. ▪ 424 Oakmead Pkwy ▪ Sunnyvale, CA 94086 ▪ (408) 737-0500

Circle 4 for Demonstration Circle 5 for Literature

Tandberg Data introduces a tape drive

SO WHAT ELSE IS NEW?



Performance. On an absolutely new level.

With the name Tandberg you expect top performance. And innovation. And being a little ahead of the competition in certain fresh and subtle ways. Ditto our new TDI 1050 Synchronous Tape Transport.

When you're a Johnny-Come-Lately with a product line you *better* try harder.

We did!

Your benefit? Greater reliability, maintainability, and programability as a result of our micro processor-based control logic. With its optional *internal* formatter, the 10½-inch-reel TDI 1050 makes your interfacing task a whole lot easier, giving unprecedented flexibility and performance when controlling the reading and writing of data.

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

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

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

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

Tandberg Data Inc.
4060 Morena Blvd.
San Diego, CA 92117
(714) 270-3990

TANDBERG

CIRCLE 5

altair™ floppy disk system

Disk capabilities can transform an ordinary microcomputer system into one of infinite magnitude. By introducing one Altair Floppy Disk System (88-DCDD), your 8800 series system acquires a mass storage capacity of 310,000 bytes per diskette.

The 88-DCDD includes a disk drive, controller, power supply, interconnect cable and case. Featuring a Pertec FD-400, the disk drive unit has direct drive dc motor operation which is insensitive to disrupting line frequency variations.

Up to 16 disk drives may be interfaced with the Altair Disk Controller. Consisting of two PC cards that plug into the Altair 8800 bus, the Disk Controller regulates all mechanical operations and disk status.

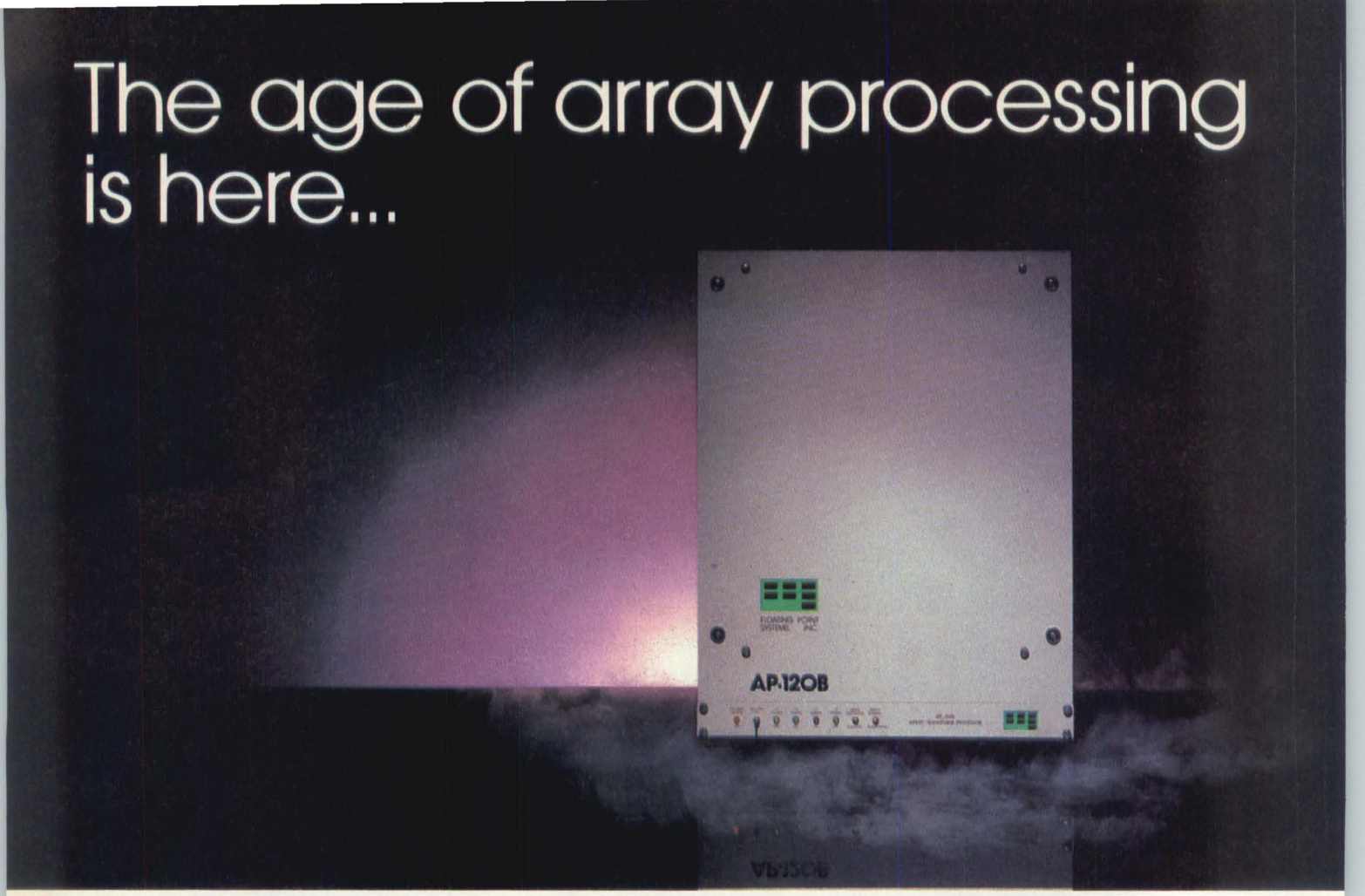
Two software systems are available for the Altair Floppy Disk. Altair Disk BASIC offers the many features of Altair Extended BASIC plus increased program and data file load/save facilities. Our new DOS provides comprehensive tools for assembly language program development and disk file maintenance.

See the Altair Floppy Disk System along with the complete Altair product line at your local Altair Computer Center, or contact the factory for further information.

mits

2450 Alamo SE Albuquerque, N.M. 87106

The age of array processing is here...



THE AP-120B
FLOATING-POINT ARRAY PROCESSOR

This high-speed, programmable array processor is interfaced to most popular computer systems providing small to medium sized systems with the computational speed and power to process scientific/analysis algorithms with the enhanced throughput comparable only to large dedicated mainframes.

- SIMULATION
- IMAGE PROCESSING
- GRAPHIC RESEARCH
- METEOROLOGY
- SIGNAL PROCESSING
- ...and MORE

FAST: 167 nanosecond multiply/add...2.7 millisecond 1024 FFT. Throughput 100 to 200 times greater than most computers.

EASY PROGRAMMING: Over 95 routines callable from FORTRAN. Its symbolic cross-assembler and simulator/debugger helps you create new routines.

COMPATIBLE: Interfaced to all popular computers and their operating systems. A flexible format converter translates data to and from the host CPU. And a high speed DMA port is available to use with other peripherals.

CAPACITY: 167 or 333 nanosecond 38-bit memories from 8K to 1 megaword.

PRECISION: 38-bit floating-point arithmetic, **normalized and convergently rounded,** produces eight decimal digit accuracy, not just six.

RELIABLE: Goes where your CPU goes—computer room, lab, or in the field. More than two years of operation logged.

ECONOMY: A complete system less than $40K. That's a small fraction of what you must spend for comparable computing power.

Discover how the AP-120B has brought **The Age of Array Processing.** Hundreds are in use. Send for our data pack and find out what the AP-120B can do for you.

The Age of Array Processing Is Here.

FLOATING POINT SYSTEMS, INC.

CALL TOLL FREE 800·547·1445

P.O. Box 23489 Portland, OR 97223 11000 S.W. 11th, Beaverton, OR 97005
(503) 641-3151, TLX: 360470 FLOATPOINT PTL

Please send me additional information

Name_____ Title_____

Company_____ Phone_____

Address_____

City_____ State_____ Zip_____

My Computer System is _____ My application is _____

See us at IFIP Congress '77

digital design

Volume 7 Number 8 July 1977

Features

Departments

This month's cover, "Graphic Display Systems: Adding Dimension to Computer I/O," was designed by Denise Piscitello, Art Director for Industrial Electronic Engineers, Inc. in Van Nuys, California.

Published monthly by Benwill Publishing Corp., 167 Corey Rd., Brookline, MA 02146. Controlled Circulation postage paid at Long Prairie, MN.

digital design

PUBLISHER	Yuri Spiro
EDITORIAL DIRECTOR	Harold G. Buchbinder
EDITORIAL BOARD	Dave Bandel Martin Himmelfarb Israel Katz Kirtland Olson
EDITOR	George King
ASSOCIATE EDITOR	William Belt
ASSISTANT EDITORS	Jeffry Beeler Sharon Pellerin Jeff Spirer
ART DIRECTOR	J Porter
STAFF ARTISTS	Mike Barisano Jane Higgins Mary Ann Parker Irene Stawicki
PRODUCTION	E. Storm Merrie Buchbinder Joe Gillis Joe T. Ingram
COMPOSITION	Nancy Aldrich Jonna Yager
CIRCULATION	Samuel Freedenberg Regina Harrington
GENERAL ADMINISTRATION	Sarah Binder Marion Pearlman Charles Vigilante Joy Wallens

subscription policy

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

Circulation Director
DIGITAL DESIGN
167 Corey Road
Brookline, MA 02146

Subscription rates: Domestic subscriptions for non-qualified subscribers, groups, libraries or companies, $25.00 per year. Foreign subscriptions, $35.00 per year.

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

BPA CIRCULATION OVER 42,000.

Published monthly by Benwill Publishing Corporation, Harold G. Buchbinder, Chairman of the Board; George Palken, President; Esther Shershow, Treasurer. Executive, Editorial and Subscription Offices, 167 Corey Rd., Brookline, MA 02146. Telephone (617) 232-5470.

◀ CIRCLE 7 CIRCLE 8 ▶

/ability.

It Comes Naturally With The Altair™ 8800b

The Altair 8800b from MITS: the second generation design of the microcomputer that started it all. The mainframe that has the abilities everyone is demanding from microcomputers today:

Expand-ability:

The Altair 8800b power supply and one-piece, 18-slot motherboard allow efficient and easy expandability for memory and I/O options. All Altair PC boards are designed to give you maximum capability/lowest power usage possible per board. This means that for each slot used you get more features and require less power, than with any of the "off-brand" Altair-bus-compatible boards.

Whether you buy an entire system up front or choose to expand gradually, it's easy to get the configuration you need with the complete family of Altair peripheral equipment, including floppy disk, line printer, audio cassette record interface, A/D converter, PROM programmer, serial and parallel I/O boards, choice of four different memory boards and many others.

Reli-ability:

The unique design features of the Altair 8800b, which have set the standard for the microcomputer industry, make it the most reliable unit of its kind. The Altair 100-pin bus, the now-standard design used by many imitators, has been "standard" all along at MITS. The unique Front Panel Interface Board on the Altair 8800b isolates and filters front panel noise before it can be transmitted to the bus. The all-new CPU board utilizes the 8080A microprocessor, Intel 8224 clock generator and 8216 bus drivers.

Flex-ability:

Meeting the diversified demands of an ever-increasing microprocessor market requires flexibility: not just hardware flexibility but software flexibility as well. MITS software, including the innovative Altair BASIC language, allows the full potential of the Altair 8800b computer to be realized.

8K ALTAIR BASIC has facilities for variable length strings with LEFT$, RIGHT$, and MID$ functions, a concatenation operator, and VAL AND STR$ functions to convert between strings and numbers.

Extended ALTAIR BASIC allows integer, single and double precision variables, automatic line numbering and renumbering, user-defined string functions, PRINT USING for formatted output and a powerful EDIT command for editing program files during or after entry. Extended statements and commands include IF . . THEN . . ELSE, LIST and DELETE program lines, SWAP variables and Trace On and Off for debugging.

Disk ALTAIR BASIC has all the features of Extended BASIC with the additional capability to maintain sequential and random access disk files. Utilities are provided for formatting disks and printing directories.

In all versions of ALTAIR BASIC you get the ease and efficiency of BASIC for the solution of real world problems.

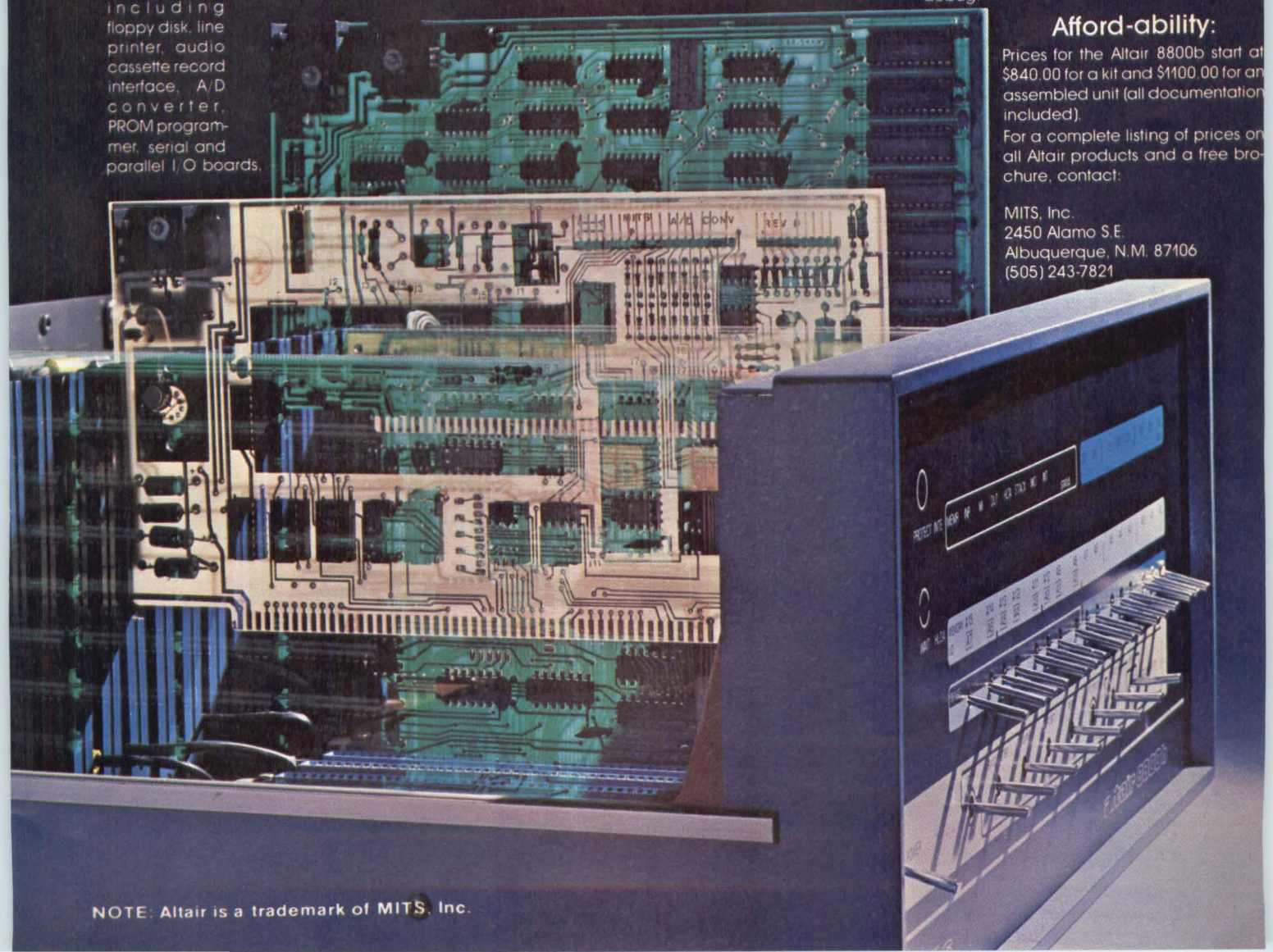
Package II, an assembly language development system for the Altair 8800b, includes system monitor, text editor, assembler and debug.

Afford-ability:

Prices for the Altair 8800b start at $840.00 for a kit and $1100.00 for an assembled unit (all documentation included).

For a complete listing of prices on all Altair products and a free brochure, contact:

MITS, Inc.
2450 Alamo S.E.
Albuquerque, N.M. 87106
(505) 243-7821



NOTE: Altair is a trademark of MITS, Inc.

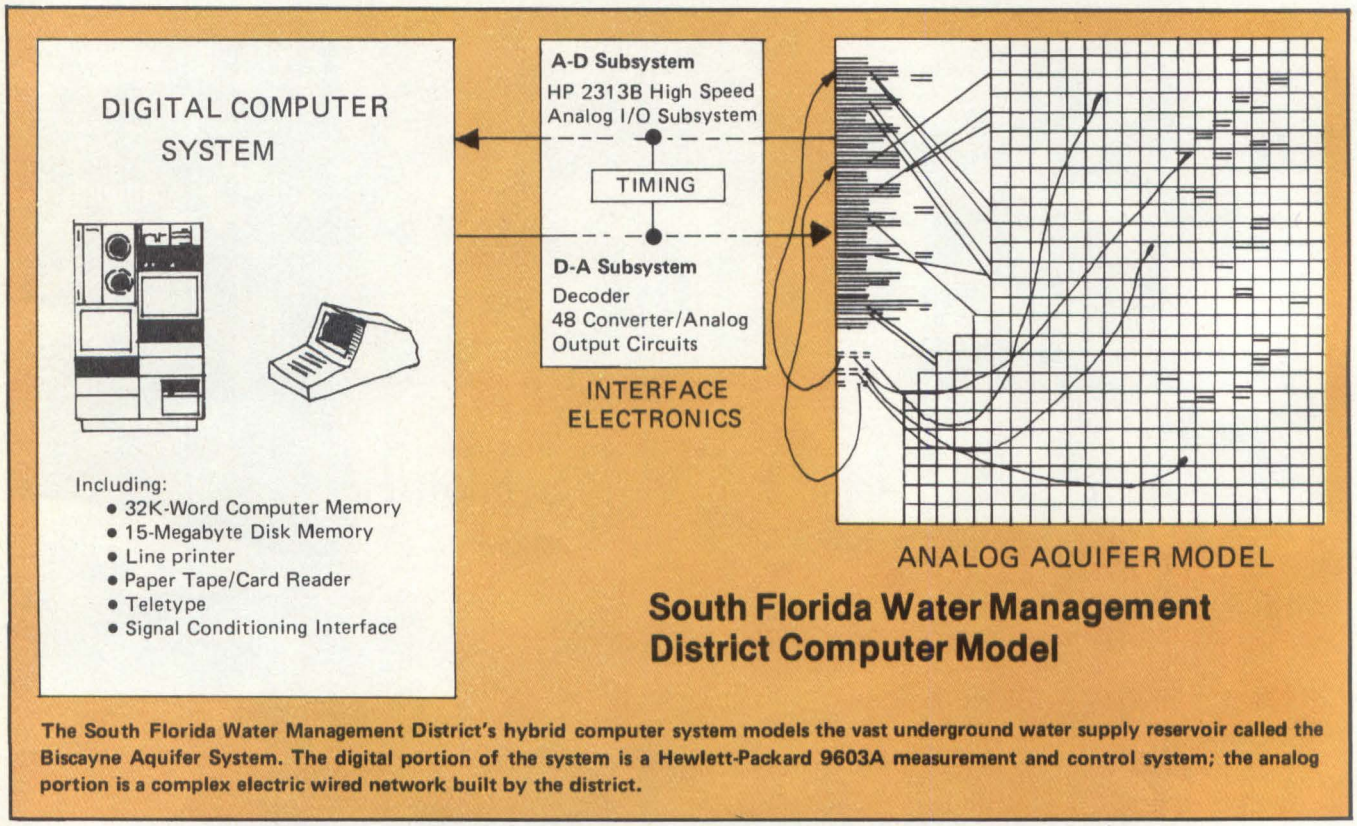
Hybrid computer predicts Florida's future water supply

By using computer techniques that compress 10 years into a single day and the lower half of Florida onto three small circuit boards, planners in West Palm Beach, FL predict the future of their water supply. A hybrid, analog-digital computer which includes a Hewlett-Packard 9603A measurement and control computer system models the vast underground water supply reservoir called the Biscayne Aquifer System.

the rest of the aquifer. Long-range population shifts can be better planned for, and the system is helping in the development of water policy alternatives without the loss of time and the irreversibility of working on the real world.

This planning and research is being carried out by the South Florida Water Management District headquartered in West Palm Beach. The overall goals of the agency include developing water

printed with the map of a South Florida county. The three counties represented are Dade, Broward and Palm Beach. A wired network using resistors and capacitors mounts in the wooden board-map. This network simulates the nature of the aquifer. Parameters such as water movements, the porousness of the ground, the discharges into canals and other hydrologic data are simulated. Currently, the resolution of the modeling boards is one square inch to



The South Florida Water Management District's hybrid computer system models the vast underground water supply reservoir called the Biscayne Aquifer System. The digital portion of the system is a Hewlett-Packard 9603A measurement and control system; the analog portion is a complex electric wired network built by the district.

Given historical and current data on water levels, depth of the aquifer and other factors, planners program the model to simulate the effects of increased or decreased rainfall, more pumping, new well-fields, or other changes in land use or the water picture that will affect the future water supply of South Florida.

For example, the dynamic model can determine the impact of a new large water user, such as a housing development or an industrial park, on

use and supply plans, preventing flood damage, and protecting the quantity and quality of fresh water resources.

The model resembles another model used by the U.S. Geological Survey (USGS) in Reston, Va. That model was designed and built as part of a cooperative program involving the USGS and the South Florida Water Management District, along with several other agencies.

The analog portion of the model is constructed on three boards, each im-

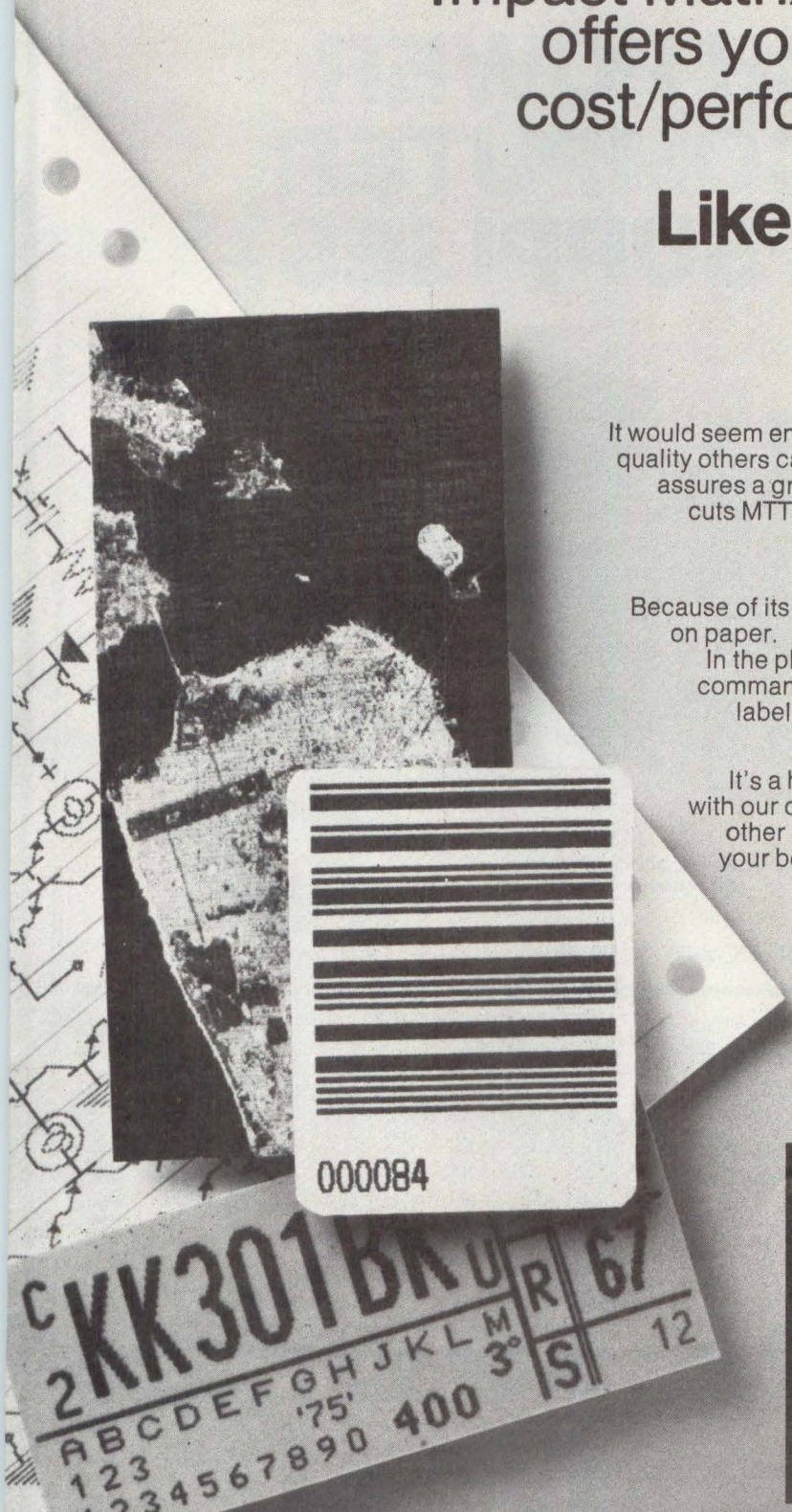
one square mile although additional boards with greater resolution can be made.

The resistors in the board model the transmissivity of the aquifer at that point. Transmissivity is a measure of the water's ability to flow. The capacitors represent electrically the storage capacity of the aquifer, and the voltage at any point on the board is proportional to the height of the water table there.

The elevation of the ground water

The concept and design of the Printronix 300 Impact Matrix Line Printer/Plotter offers you several remarkable cost/performance advantages.

Like plotting capability ...at no extra cost.



It would seem enough to find a 132 column, 300 lpm printer with print quality others can't match, with an elegantly simple mechanism that assures a greater MTBF, and a modular design that dramatically cuts MTTR. The Printronix 300 offers all of these advantages. But it also offers plotting capability. At no extra cost.

Because of its unique mechanism, it can put a single dot anywhere on paper. It forms characters a dot row at a time when printing. In the plot mode, it can form any pattern a dot at a time upon command. Drawings. Graphs. Bar codes. Large character labels. You name it and you can do it on a Printronix 300.

It's a handy capability to have around, and it comes to you with our compliments . . . at no extra charge . . . along with the other remarkable advantages that make the Printronix 300 your best buy. Send for our brochure. You'll discover why the Printronix 300 prints better, will last longer, and require far less maintenance. That's why it's been sold with a one-year warranty from the beginning.

Printronix Inc., 17421 Derian Ave., Irvine, California 92714. (714) 549-8272.

PRINTRONIX 300

It's your best buy!

CIRCLE 9

If you really compare design, specs, component quality, construction, price, delivery and guarantees, these are the power supplies you'll buy!

ADTECH POWER MICROCOMPUTER POWER SUPPLIES

Universal application: 115/230 VAC ±10% 47-440 Hz (no derating for operation on 50 Hz).

Over 50,000 hours MTBF.

Hermetically sealed transistors and IC's

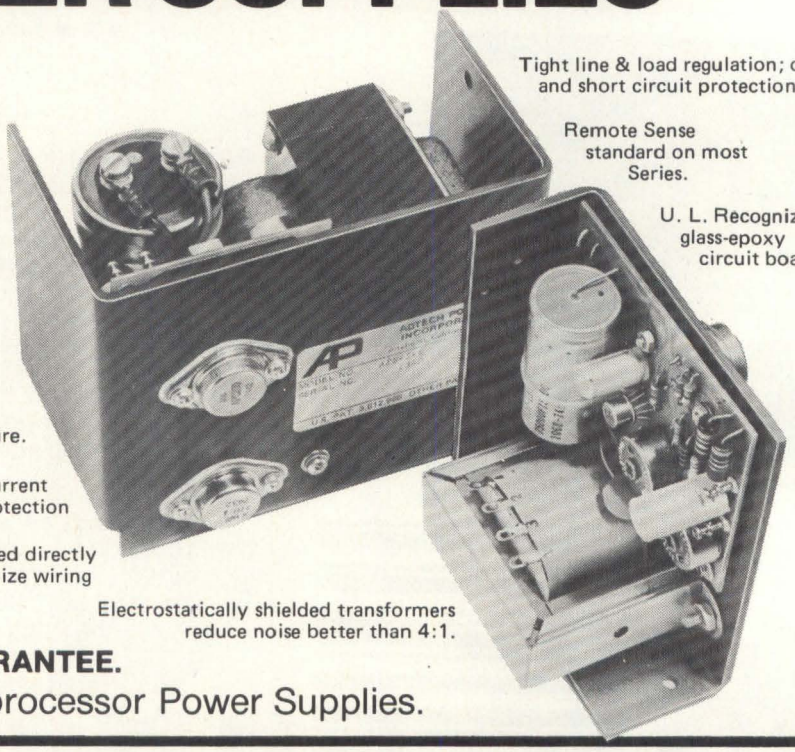
IC-zener protected against overvoltage.

Integrated circuit regulation and integrated Darlington TO–3 output stage provide much simpler circuitry, higher reliability

No overshoot on turn-on turn-off, or power failure.

Automatic foldback current limiting overload and short circuit protection

TO–3 can is mounted directly to frame to minimize wiring



Tight line & load regulation; overload and short circuit protection.

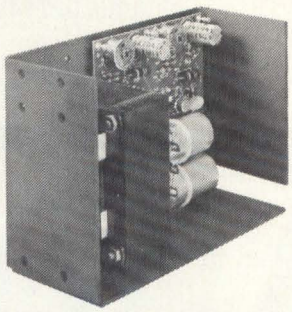
Remote Sense standard on most Series.

U. L. Recognized glass-epoxy circuit board.

Electrostatically shielded transformers reduce noise better than 4:1.

3 DAY DELIVERY...6 YEAR GUARANTEE.

New Multiple Output Microprocessor Power Supplies.



DUAL OUTPUT MICROPROCESSOR SERIES

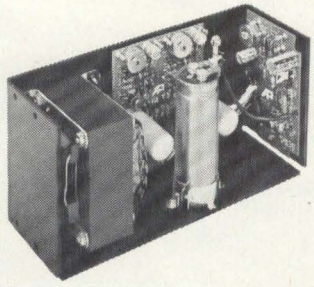
U. L. Recognized. (File No. E58512)

MODEL NUMBER	RATING		QUANTITY PRICES						
	Vdc	Amps	1-4	5-9	10-24	25-49	50-99	100-249	250-499
DAPS 5.8	±5	0.8	43.00	41.95	40.70	39.80	38.00	36.80	33.00
DAPS 9-12.5	±9 to 12	0.5	43.00	41.95	40.70	39.80	38.00	35.80	33.00
DAPS 12-.75	±12	0.75	43.00	41.95	40.70	39.80	38.00	35.80	33.00
DAPS 15-.60	±15	0.60	43.00	41.95	40.70	39.80	38.00	35.80	33.00
DAPS 5112.5	+5	1.0	43.00	41.95	40.70	39.80	38.00	35.80	33.00
	−12	0.5							
DAPS 12-1.5	±12	1.5	59.00	57.60	55.90	53.30	50.65	47.60	43.80
DAPS 15-1.3	±15	1.3	59.00	57.60	55.90	53.30	50.65	47.60	43.80
DAPS 53121.5	+5	3.0	59.00	57.60	55.90	53.30	50.65	47.60	43.80
	−12	1.5							

REGULATION: ±0.05% Line, ±0.1% Load. RIPPLE (PK/PK) 3mV.

DIMENSIONS: (Small unit) 4"x2.75"x4.87" (Large Unit) 7"x3.40"x4.87"

REQUEST BULLETIN DAPS - 976



TRIPLE OUTPUT "TAPS" MICROPROCESSOR/GENERAL PURPOSE SERIES

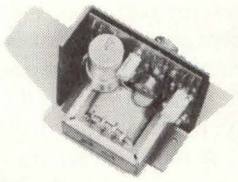
MODEL NUMBER	RATING		QUANTITY PRICES						
	Vdc	Amps	1-4	5-9	10-24	25-49	50-99	100-249	250-499
TAPS 1	5V	4.0	94.15	91.85	89.20	85.05	80.85	75.90	71.00
	±9-12*	0.5							
TAPS 2	5V	6.0	107.00	104.60	101.60	96.85	92.10	89.00	87.50
	±9-12*	1.0							
TAPS 3	5V	9.0	137.00	134.00	129.80	127.80	125.00	123.75	113.85
	±9-12*	1.5							
TAPS 4	5V	12.0	163.00	159.00	154.45	151.50	149.00	148.00	147.00
	±9-12*	3.0							

* Also available with ±12-15V output. Specify if desired.

REGULATION: ±0.1% Line, ±0.1% Load. RIPPLE (PK/PK): 5mV

DIMENSIONS: 8.62"x3.65"x4.87" to 15"x4.5"x4.87". REQUEST BULLETIN TAPS - 377

Single Output Microcomputer Power Supplies.

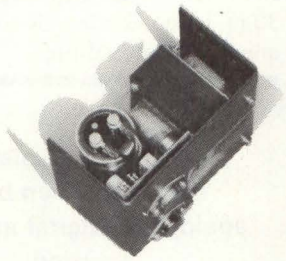


15 TO 24 WATT "RED BARON" SERIES. SINGLE OUTPUT

* U. L. Recognized (File No. E58512)

MODEL NUMBER	RATING		REGULATION		RIPPLE (PK/PK)	OVP MODEL SUFFIX	PRICES-ALL MODELS		
	Vdc	Amps	Line	Load			QTY	POWER SUPPLY	OVP UNIT
APS 5-3*	5	3	±0.05%	±0.1%	3mV	OV1-53	1-4	34.00	7.00
APS 6-2.5	6	2.5	±0.05%	±0.1%	3mV	OV1-63	5-9	33.15	6.90
APS 12-1.6*	12	1.6	±0.05%	±0.1%	3mV	OV1-122	10-24	32.20	6.70
APS 15-1.5*	15	1.5	±0.05%	±0.1%	3mV	OV1-152	25-49	30.70	6.40
APS 20-1	20	1.0	±0.05%	±0.1%	5mV	OV1-201	50-99	29.20	6.05
APS 24-1*	24	1.0	±0.05%	±0.1%	5mV	OV1-241	100-249	27.00	5.70
APS 28-0.8*	28	0.8	±0.05%	±0.1%	5mV	OV1-281	250-499	25.20	5.25

DIMENSIONS: 4" x 2.75" x 4.87 REQUEST BULLETIN APS-277



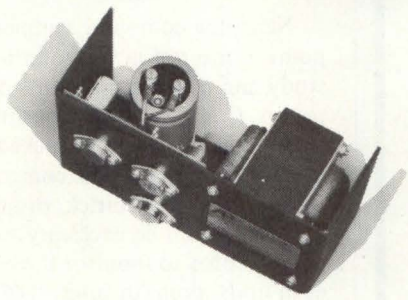
30 TO 60 WATT "GREEN HORNET" SERIES. SINGLE OUTPUT

† U. L. Recognized (File No. E58512)

MODEL NUMBER	RATING		REGULATION		OVP MODEL SUFFIX	POWER SUPPLY PRICES			OVP PRICES
	Vdc	Amps	Line	Load		QTY	APS 48-1	ALL OTHERS	
APS 5-6†	5	6.0	±0.05%	±0.1%	OV2-56	1-4	68.00	55.00	15.00
APS 6-5	6	5.0	±0.05%	±0.1%	OV2-65	5-9	66.70	53.65	14.85
APS 12-4†	12	4.0	±0.05%	±0.1%	OV2-124	10-24	64.75	52.10	14.40
APS 15-3†	15	3.0	±0.05%	±0.1%	OV2-153	25-49	61.75	49.65	13.75
APS 20-2.4*	20	2.4	±0.05%	±0.1%	OV2-203	50-99	58.75	47.25	13.05
APS 24-2.2*†	24	2.2	±0.05%	±0.1%	OV2-245	100-249	55.15	44.35	12.25
APS 28-2 *†	28	2.0	±0.05%	±0.1%	OV2-284	250-499	50.75	42.00	11.30
APS 48-1 *	48	1.0	±0.05%	±0.1%	OV2-481	500-999	49.60	40.00	11.05

* RIPPLE: (PK/PK) 5mV. All others 3mV.

DIMENSIONS: 5.62"x3.40"x4.87" REQUEST BULLETIN APS-277



50 TO 120 WATT "BLACK BEAUTY" SERIES. SINGLE OUTPUT

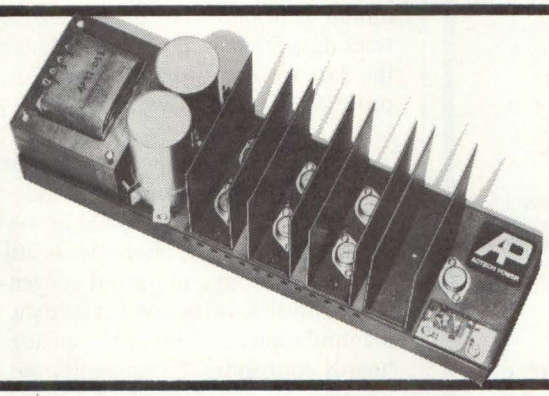
5 Vdc @ 9 Amps to 28 Vdc @ 4 Amps. U. L. Recognized. (File No. E58512) *

MODEL NUMBER	RATING		OVP MODEL SUFFIX	POWER SUPPLY PRICES					OVP PRICES
	Vdc	Amps		QTY.	APS 5-9	APS 5-12	APS 5-18	ALL OTHERS	
APS 5-9	5	9	OV2-510	1-4	71.00	85.00	108.00	75.20	15.00
APS 5-10*	5	10	OV2-510	5-9	68.75	82.95	104.50	73.40	14.85
APS 5-12	5	12	OV2-512	10-24	66.74	80.55	101.45	71.30	14.40
APS 5-18	5	18	OV2-518	25-49	63.90	76.80	96.70	67.95	13.75
APS 12-7*	12	7	OV2-127	50-99	61.05	73.00	91.95	64.60	13.05
APS 15-6*	15	6	OV2-156	100-249	57.30	68.55	86.35	60.65	12.25
APS 24-5*	24	5	OV2-245	250-499	52.75	65.00	79.45	55.80	11.30
APS 28-4*	28	4	OV2-284	500-999	51.60	57.90	77.70	54.60	11.05

REGULATION: Line ±0.05% Load ±0.1%. RIPPLE (PK/PK): 3mV on 5, 12, 15V models. 5mV on 24, 28V.

DIMENSIONS: 9"x3.65"x4.87"

APS 5-18 DIMENSIONS: 14"x3.65"x4.87" REQUEST BULLETIN APS-277



125 TO 250 WATT "BLUE MAX" SERIES. SINGLE OUTPUT

5 Vdc @ 25 Amps to 28 Vdc @ 9 Amps.

MODEL NUMBER	RATING		REGULATION		OVP MODEL SUFFIX	POWER SUPPLY PRICES			OVP PRICES
	Vdc	Amps	Line	Load		QTY	APS 5-30	ALL OTHERS	
APS 5-25	5	25	±0.05%	±0.0.1%	OV3-525	1-4	163.00	158.00	25.00
APS 5-30	5	30	±0.05%	±0.0.1%	OV3-530	5-9	159.25	154.40	24.50
APS 6-22	6	22	±0.05%	±0.0.1%	OV3-622	10-24	154.65	149.95	24.25
APS 12-17	12	17	±0.05%	±0.0.1%	OV3-1217	25-49	147.45	142.95	23.15
APS 15-15	15	15	±0.05%	±0.0.1%	OV3-1515	50-99	140.20	135.90	22.00
APS 20-11	20	11	±0.05%	±0.0.1%	OV3-2011	100-249	131.65	127.60	20.65
APS 24-10	24	10	±0.05%	±0.0.1%	OV3-2410	250-499	121.10	117.40	19.00
APS 28-9	28	9	±0.05%	±0.0.1%	OV3-289	500-999	118.50	114.85	18.60

RIPPLE (PK/PK): 3mV on 5,6,12,15V models. 5mV on 20,24,28V models.

DIMENSIONS: 16.72"x4.87"x6.60" Max. APS 5-30 only. All others 16. 72"x4.87"x5.75".

REQUEST BULLETIN APS-277

CALL OUR ENGINEERING SALES OFFICE IN YOUR AREA FOR APPLICATION ENGINEERING ASSISTANCE

ADTECH POWER

Alabama, Huntsville (205) 536-1941
Arizona, Phoenix (602) 946-9860
California, Long Beach (213) 426-7375
San Francisco (408) 247-9891
Colorado, Denver (303) 773-2830
Connecticut, Meriden (203) 237-9232
Florida, Satellite Beach (305) 773-4700
Ft. Lauderdale (305) 581-6611
St. Petersburg/Tampa (813) 360-1484
Georgia, Atlanta (404) 252-5360
Hawaii, Honolulu (808) 941-1574
Illinois, Chicago (312) 298-4830
Indiana, Indianapolis (317) 251-2757
Iowa, Cedar Rapids (319) 362-9177
Kansas, Kansas City (913) 381-0004
Wichita (316) 264-2662
Massachusetts, Boston (617) 245-0250
Michigan, Detroit (313) 576-4705
Minnesota, Minneapolis (612) 854-4270
Missouri, St. Louis (314) 569-1220
New Mexico, Albuquerque (505) 294-8408
Las Cruces (505) 524-0126
New York, Albany (518) 456-6667
Buffalo (716) 632-7880
New York, New York (516) 487-3966
Rochester (716) 482-3000
Syracuse (315) 637-9383
North Carolina, Winston-Salem (919) 725-6196
Ohio, Dayton (513) 434-8808
Pennsylvania, Philadelphia (215) 825-9515
Pittsburgh (412) 961-0414
Texas, Dallas (214) 387-2489
Houston (713) 665-0991
Washington D.C., (202) 363-9417
Wisconsin, Milwaukee (414) 421-2300

Canada: Montreal (514) 363-5120, Ottawa (613) 745-0541, Toronto (416) 787-0991, Winnipeg (204) 338-5050, Vancouver (614) 748-2392

ADTECH POWER Inc., 1621 South Sinclair Street, Anaheim, California 92806 (714) 634-9211

CIRCLE 10

table is a crucial parameter in water planning; not only as a measure of the aquifer, but also because if the aquifer is overpumped in one area, there may develop an undesirable flow. For example, increases in storage in the western portion of Florida can lead to seepage into the east coast's municipal well fields in dry periods. Or, going in the other direction, there is a possibility of salt-water intrusion.

A Hewlett-Packard HP 21MX digital computer inputs the initial voltages to the resistor-capacitor network, sets the test in action and loads the voltage changes over the scaled time period in timed release fashion. The computer can perform 400 time steps. Usually, 30 millisecond intervals correspond to one month of real time.

Water resource planning improves when both analog and digital methods are used.

Next, the computer samples each point of interest in the counties under study and collects and prints out the results. Contour maps connecting more than 1500 points are produced.

"Without a real time computer system," says Bob Hamrick, project manager, "it would be necessary to use oscilloscopes to monitor the changes at each nodal point of interest in the network. Then we would have to take hundreds of photos of the screens, extract data from each photo, keypunch the data for entry to a computer for processing. All of this would take several man-days."

"A hybrid computer combines the best features of the analog and digital types," adds George Shih, systems engineer. "The computer is utilized for its input and output convenience and flexibility and for its data manipulation capability. The analog boards contribute the capability of handling many independent events simultaneously with continuous instead of digital functions."

This model is more sophisticated than others of its type because it not only converts analog output data to digital for analysis by the computer, but it also inputs the starting conditions and steps the model through a program by converting digital computer signals to analog ones that the board can understand. Thus the sys-

tem completes the loop of communications between its analog and digital parts.

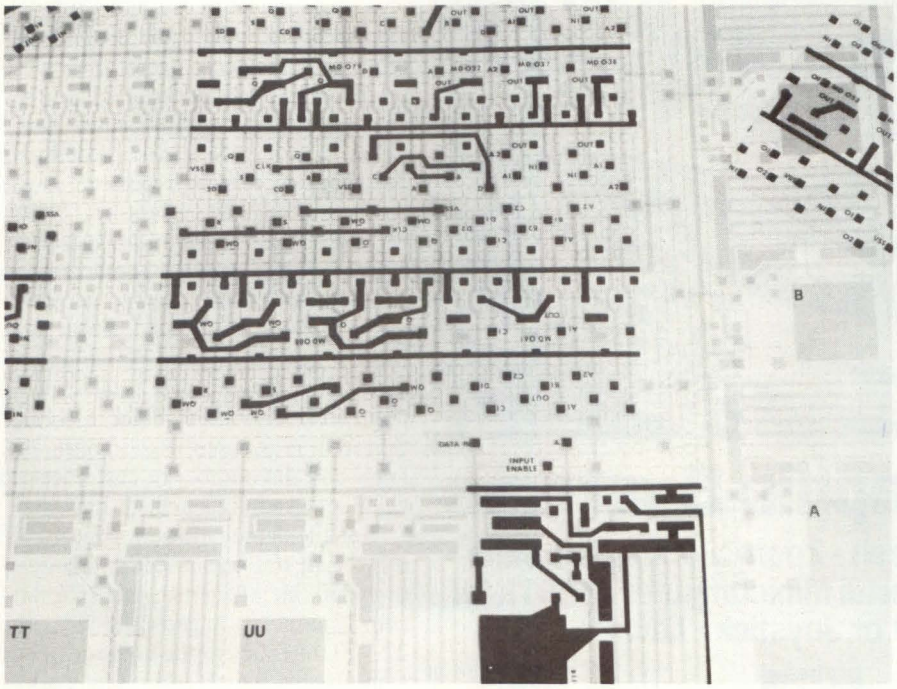
In a typical use of the model, the appropriate county's analog board is prepared by checking the resistors and capacitors to be sure they represent the physical conditions of the real world. The size of the resistors must correspond to the transmissivity and the capacitance must correspond to the water-bearing capacity of the aquifer.

A particular time period for the study is selected, such as one year. Up to 30 years can be simulated. The key data for the test is input to the HP computer using punched computer cards. Rainfall rates, pumpages from water well fields and water inputs that might be released from storage are input. Once the simulated situation is set, the computer steps through time in one month intervals and makes the programmed changes.

At desired intervals, the system monitors changes in voltage at each point of interest and stores the data. The input program continues to drive the model system. After the year is complete, the system has stored the history of each point which can then be used to develop the contour maps of the elevation of the water table. These contours connect all points with the elevation at the same level.

Monochip brings breadboard to LSI

A new device, the Monochip, is destined to become a major factor in the choice of custom versus standard integrated circuits. Developed by Interdesign, Inc., Sunnyvale, CA, the 138 x 138 mil chip converts into an LSI custom circuit with a few days of engineering effort. The chip contains the equivalent of 262 gates and replaces 10 to 20 MSI packages. It uses an n-channel, silicon-gate, isoplanar process.



Monochip's function is defined by overlaying transparent patterns that convert the cells into specific logic functions.

Fairchild Semiconductor participated in the development. The tie-in between the two companies was established last year with an agreement covering MOS custom integrated circuits. Robert Townley, senior vice president and chief operating officer of Interdesign, stated that "the agreement and subsequent development of a digital Monochip will triple our business. Interdesign pioneered the Monochip concept and is the largest supplier of it now, even though we have been exclusively a linear house. With digital IC's outweighing linear by a factor of four, we are gearing up to rapid expansion in the next year."

Derek Bray, VP for engineering, said that "the digital Monochip represents a two-year effort to develop a radically different chip layout which allows any electronic engineer, regardless of specification, to design a custom IC in a few days without expensive computer

graphics. We did this by re-thinking the configuration of the basic cell so that it connects into any logic function."

"With this cell as a building block, the designer pieces together logic functions with simple geometric patterns. For example, to implement a flip-flop, a transparency of the function is pulled out of the library and overlaid on the basic chip pattern. Then the function blocks are interconnected with pencil."

"We chose the Fairchild isoplanar process over the I^2L process because even though I^2L can produce 50% higher gate density, it uses twice as many gates for the same function. Further, working with wired-or logic is cumbersome. In Monochip, each cell connects into nand or nor logic and the levels are directly TTL and CMOS compatible."

The tooling charge for Monochips is a constant $2,800, and the first 50 prototypes require four weeks. Townley describes this as "the lowest tooling charge in the industry and the fastest turn-around time." Other suppliers who offer semicustom approaches charge between $3,000 and $10,000 for this phase and take 8 to 13 weeks. Dedicated custom integrated circuits cost $30,000 to $75,000 and take about a year to reach production.

This chip is the first of a series, Townley says. "Like the chip size range for our linear Monochips, we will blanket the digital applications range, going up to at least 1,000 gates. With closely staggered sizes, we can offer close-to-optimum chips. We now produce several hundred thousand Monochips per year while remaining price competitive with full custom integrated circuits."

Satellite speeds news distribution

Satellite technology now makes possible low cost distribution of press service, radio network and specialty programming to large numbers of magazines, newspapers and radio stations equipped with small dish antennas. This satellite receiving capability eliminates the need for terrestrial communications lines currently used for audio and wire service network distribution.

The Associated Press and United Press International simultaneously demonstrated a wide range of their wire services and news picture facsimile services, all fed by satellite transmission, at the American Newspaper Publishers Association's Research Institute at the Anaheim Convention Center.

Wire service distribution costs are currently subject to telephone company interexchange rates, charged per mile and calculated to include the distance to each receiving newspaper or magazine, point-to-point. The alternative is point to multipoint satellite distribution with rates insensitive to both distance and the number of customer-provided receive only earth stations.

For the demonstration, a receive only earth station six feet in diameter provided line of sight to the RCA Satcom I spacecraft in geostationary orbit 22,300 miles above the equator. Fourteen original signals from New York were transmitted to RCA Americom's Vernon Valley, NJ, earth station, then to the satellite and back down to the six-foot antenna.

Satellite wire services demonstrated by AP included LaserPhoto, a news-picture facsimile distribution service; DataStream, a 1,200 baud newswire;

and six teletype services. UPI demonstrated its Unifax·II newsphoto transmission system. The satellite also provided transmission services for UPI's 1200 CPS DataNews and four teletype wires.

Satellite technology has no switches, amplifiers and other ground equipment that cause errors in data transmission. Further, satellites don't care about distance and beam down uniform signals, delivering pictures, sound or teletype copy to small receive only stations. Economical small antennas, like the six-foot dish used in the demo, install easily on the ground or rooftops in cities or remote areas.

The satellite system provides eight 8kHz channels yielding consistent signal to noise ratios of 67dB, meeting broadcast distribution quality standards. More channels can be provided when the user's requirements call for a narrower bandwidth (3,4, or 5kHz, for example) or a lower signal to noise standard.

Each channel can be multiplexed to carry up to 30 separate wire services or other teletype material. Multi-channel service can be designed so that receiving newspapers may select any number of news and photo services desired. News service input can originate at any location with terrestrial links to one of RCA Americom's operations centers in these cities: New York, San Francisco, Los Angeles, Chicago, Camden and Houston.

Satellite technology minimizes transmission costs, maintenance down-time and data errors in news distribution networks.

The six-foot antenna used in the demonstration is made by Prodelin of Hightstown, NJ, but has not yet been approved by the FCC for general use. Related ground equipment components of the small earth station are a low noise amplifier, made by Scientific Communications, Inc., Smithtown, NY, and the receive modem made by Coastcom, Concord, CA. Coastcom also designed and built a special transmit modem for RCA's proposed press/audio network services.

News, audio and picture services provided by AP and UPI normally are transmitted via landlines to thousands of newspapers and broadcast stations.

Is your computer smart enough

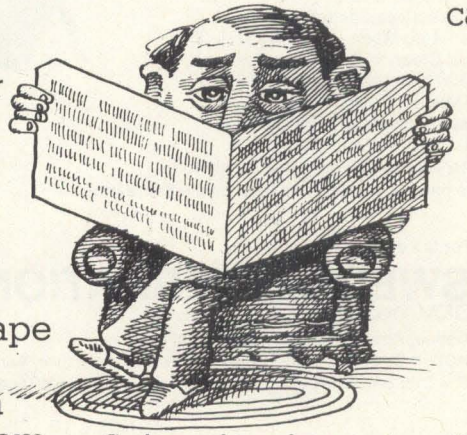
A 3M peripheral drive which uses 3M data cartridges is better than any drive which uses punched cards or paper tape.

And, if you'd take the time to ask it, your computer would probably tell you so.

It's simple logic.

Cartridges are faster than cards.

Cards and paper tape are slow. It takes hundreds of cards for a single computer program.



Cards must be read one at a time.

Or hundreds of feet of paper tape.

And each program must be punched, verified and read one card at a time.

With our drive system, on the other hand, programs are stored on a single tape cartridge.

Cartridges offer much faster data storage, program loading, data transfer and faster access to the computer.

So you save time and money.

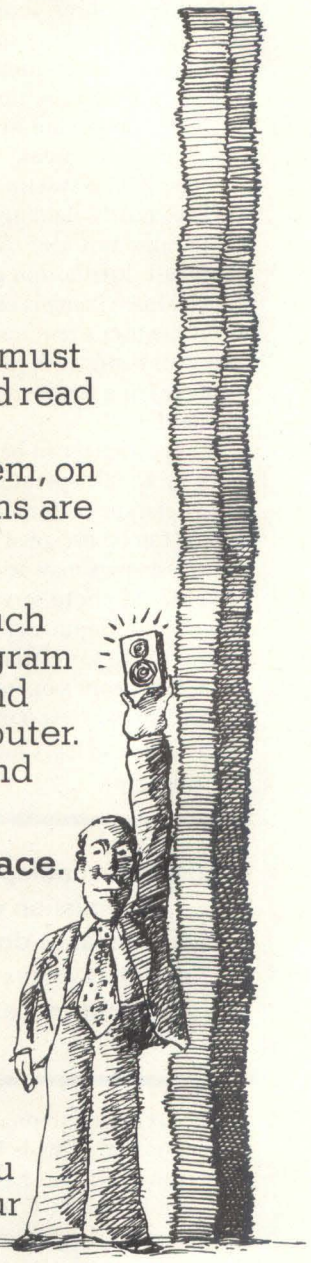
Cartridges take less space.

It would take a stack of cards almost sixteen feet high to store all the information you can store on a single 3M DC-300A data cartridge.

With cartridges, you can store all of your programs in a fraction of the space you'd need for cards or paper tape.

Your filing system is simplified and overhead is greatly reduced.

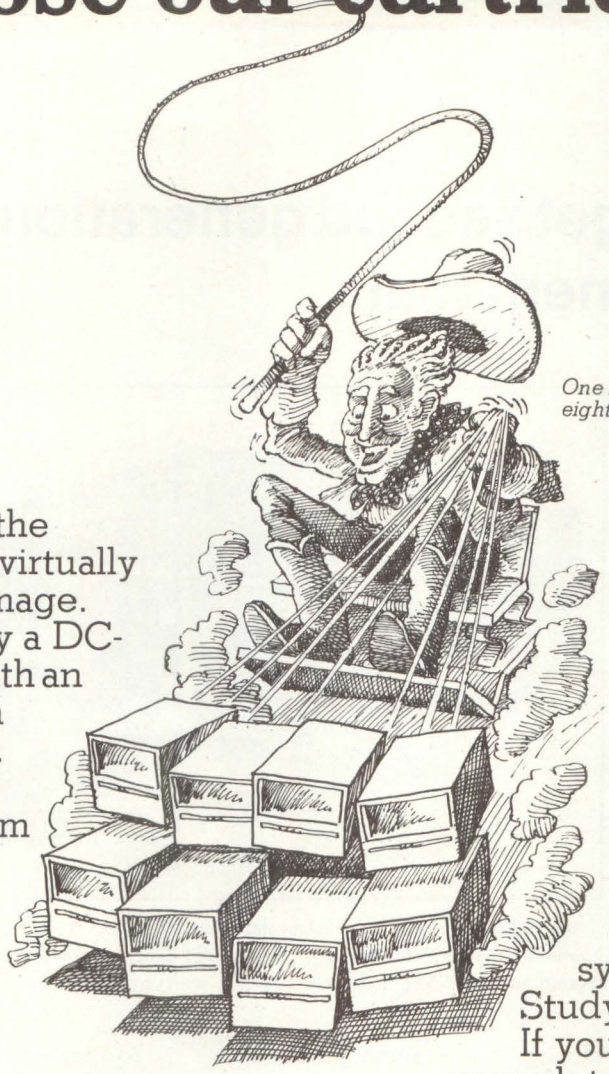
One DC-300A cartridge equals almost 16 feet of cards.



Cartridges won't fold, spindle or mutilate.

Unlike paper cards, you need never touch the media. It's well

to choose our cartridge drive?



One formatter can control eight drives at once.

protected inside the cartridges, so it's virtually impossible to damage.

You can carry a DC-100A cartridge with an entire program in your shirt pocket.

Even if you drop it, the program will survive unscathed.

Remember that the next time you drop a stack of cards.

Don't take our word for it. Ask your computer.

If you'll send us the coupon, we'll send you the specifications for all three of our drive systems.

Ask your computer to compare them with any other type of drive system.

We'll bet your computer will prefer ours.

Maybe it'll choose our famous DCD-3 drive. It's people-proof, jam-proof and wear-resistant.

Or maybe your computer will decide upon our DCS-3000 series, an ANSI-formatted system that allows one formatter to control up to eight drives.

The DCS-3000 is extremely easy to integrate into your system. Only one cable to the user's logic is required.

But if you require compact size, your computer will probably choose our unique DCD-1. It offers many of the features of our bigger systems, yet it will fit inside a five-inch cube.

The cartridge alone measures just 2.4 x 3.2 x .5 inches.

See for yourself.

Send us the coupon. There's much more we can tell you about our drive systems.

Study the information carefully. If your computer isn't smart enough to choose our drive systems, we'll bet you will be.

Send me more information.

Name _____ Title _____

Firm _____ Address _____

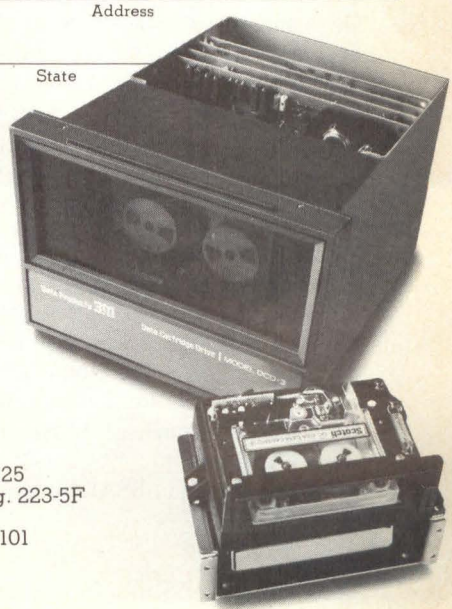
City _____ State _____

Zip _____

Phone _____

3M COMPANY

Mail to: 3M Company
Data Products, Dept. 125
Mincom Division, Bldg. 223-5F
3M Center
St. Paul, Minnesota 55101



CIRCLE 16

micro notes

8080 designers get second generation system development tools

Over the last two years, 8080-based equipment has propagated like rabbits. With each new product, designers learn new methods to control and decrease development time. MuPro, a small Sunnyvale, CA company in the 8080 support business, has built its product line with these lessons in mind.

Microprocessor development systems must include more than hardware. MuPro has addressed this fact by mixing hardware, software and modularity. The firm's product line consists of a hardware emulator, a block-structured assembly language and a multi-user, multi-task disk operating system.

MuPro's in-circuit emulator, MuPro-80E, emulates an 8080-based system under development. It does this in real time, independent of the mode of operation. With emulators that ignore real time operation, the designer faces the risk of software failure in the final system.

In other development systems, one CPU runs the monitor programs and the other performs emulation. However, both CPUs access the same memory unit. In MuPro's emulator, a transparent control panel provides all the necessary debug functions but without degrading speed. In addition, the control panel functions do not consume memory space. In other systems, the emulator reserves memory space for I/O device codes or interrupt vectors.

The firm has also developed for the 8080 an Algol-like programming language called BSAL-80 or Block Structured Assembly Language. BSAL-80 fills the void between assembly language and languages like PL/M — Intel's high level programming language for the 8080, says Jim Moon, VP for engineering at MuPro. Easier to write than assembly language, BSAL-80 generates the same amount of code.

MuPro-80 Microprocessor Development System: This system supports real time emulation of 8080 programs. The control panel on the right hand unit permits the programmer to debug his code without worrying about final system timing problems.

Programming in BSAL-80 is not as efficient as programming in PL/M, Moon explains: PL/M permits developing programs five times faster than assembly language. Nonetheless, MuPro's customers say that programming in BSAL-80 is three times faster than programming in assembly language. Further, BSAL-80 does not impose a penalty of excess code which can affect memory requirements and execution time.

BSAL-80 lets the programmer access the machine level instructions of the 8080. Variable name references eliminate the need for mnemonics. For example, a program statement to increment the H-L register pair is HL = HL + 1. For program loops the familiar IF condition THEN BEGIN ... END ELSE BEGIN ... END construction is available.

Other BSAL-80 features include macro capability, literals representation, four variable declarations, a linking loader, diagnostic messages, symbol cross-reference table and a text editor.

Another significant part of MuPro's software development capability is a multi-user, multi-task disk operating system. Unlike some operating systems that can handle only file transfers to and from disk, this operating system performs task scheduling and queuing. It works much like Digital Equipment's RSX-11, Moon explains. The file structures and data management techniques resemble those used on HP 3000 systems.

Perhaps the most valuable feature of this operating system is its ability to support multiple users on one system. Running under the MuPro operating system, a single 8080 system can concurrently support three edit terminals and a batch assembly.

With 64 priority levels, the batch assembly job can be assigned a low priority, insuring programmers a reasonable response time on the edit terminals. During system development, program listings usually consume the most time, Moon notes. The ability to run other tasks with the system printing greatly increases throughput while cutting development time.

BSAL-80 OP-CODE SUMMARY

Type	Statement	Mnemonic	Instruction Code Byte 1								Byte 2	Byte 3	# Of States	Flags Sign	Zero	H/C	P	C	SP
	D = S;	MOV D,S	0	1	D	D	D	S	S	S			5[1]	·	·	·	·	·	·
	NOP;	NOP	0	0	0	0	0	0	0	0			4	·	·	·	·	·	·
Single	R = R + 1;	INR R	0	0	D	D	D	1	0	0			5	↑↓	↑↓	↑↓	↑↓	·	·
Register	R = R − 1;	DCR R	0	0	D	D	D	1	0	1			5	↑↓	↑↓	↑↓		·	·
	R = K;	MVI R,K	0	0	R	R	R	1	1	0	K		7[1]	·	·	·	·	·	·
	A = A + R;	ADD R	1	0	0	0	0	S	S	S			4[1]	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A = A + R + CARRY;	ADC R	1	0	0	0	1	S	S	S			4[1]	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A = A − R;	SUB R	1	0	0	1	0	S	S	S			4[1]	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A = A − R − CARRY;	SBB R	1	0	0	1	1	S	S	S			4[1]	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A = A + K;	ADI K	1	1	0	0	0	1	1	0	K		7	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A = A + K + CARRY;	ACI K	1	1	0	0	1	1	1	0	K		7	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A = A − K;	SUI K	1	1	0	1	0	1	1	0	K		7	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A = A − K − CARRY;	SBI K	1	1	0	1	1	1	1	0	K		7	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A = NOT A;	CMA	0	0	1	0	1	1	1	1			4	↑↓	↑↓	·	·	·	·
	A = A AND R;	ANA R	1	0	1	0	0	S	S	S			4[1]	↑↓	↑↓	0	↑↓	0	·
	A = A XOR R;	XRA R	1	0	1	0	1	S	S	S			4[1]	↑↓	↑↓	0	↑↓	·	·
Logical	A = A IOR R;	ORA R	1	0	1	1	0	S	S	S			4[1]	↑↓	↑↓	0	↑↓	0	·
	A = A AND K;	ANI K	1	1	1	0	0	1	1	0	K		7	↑↓	↑↓	0	↑↓	0	·
	A = A XOR K;	XRI K	1	1	1	0	1	1	1	0	K		7	↑↓	↑↓	0	↑↓	0	·
	A = A IOR K;	ORI K	1	1	1	1	0	1	1	0	K		7	↑↓	↑↓	0	↑↓	0	·
	RLC; 	RLC	0	0	0	0	0	1	1	1			4	·	·	·	·	·	·
	RRC; 	RRC	0	0	0	0	1	1	1	1			4	·	·	·	·	↑↓	·
Rotate	RAL; 	RAL	0	0	0	1	0	1	1	1			4	·	·	·	·	↑↓	·
	RAR; 	RAR	0	0	0	1	1	1	1	1			4	·	·	·	·	↑↓	·
Compare	A − R;	CMP R	1	0	1	1	1	S	S	S			4[1]	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A − K;	CPI K	1	1	1	1	1	1	1	0	K		7	↑↓	↑↓	↑↓	↑↓	↑↓	·
Decimal Adjust	DAA;	DAA	0	0	1	0	0	1	1	1			4	↑↓	↑↓	↑↓	↑↓	↑↓	·
	A = INPUT (K);	IN K	1	1	0	1	1	0	1	1	K		10	·	·	·	·	·	·
	OUTPUT (K) = A;	OUT K	1	1	0	1	0	0	1	1	K		10	·	·	·	·	·	·
Output	ENABLE INTERRUPT;	EI	1	1	1	1	1	0	1	1			4	·	·	·	·	·	·
	DISABLE INTERRUPT;	DI	1	1	1	1	0	0	1	1			4	·	·	·	·	·	·
	CARRY = 1;	STC	0	0	1	1	0	1	1	1			4	·	·	·	·	1	·
Carry	CARRY = NOT CARRY;	CMC	0	0	1	1	1	1	1	1			4	·	·	·	·	$\bar{c}$	·
Halt	HALT;	HLT	0	1	1	1	0	1	1	0			7	·	·	·	·	·	·
	HL = HL + RP;	DAD R	0	0	Y	Y	1	0	0	1			10	·	·	·	·	·	·
	RP = RP + 1;	INX R	0	0	Y	Y	0	0	1	1			5	·	·	·	·	·	[2]
Register	RP = RP − 1;	DCX R	0	0	Y	Y	1	0	1	1			5	·	·	·	·	·	[3]
Pair	HL<==>DE;	XCHG	1	1	1	0	1	0	1	1			4	·	·	·	·	·	·
	HL<==>TOS;	XTHL	1	1	1	0	0	0	1	1			18	·	·	·	·	·	·
	SP = HL;	SPHL	1	1	1	1	1	0	0	1			5	·	·	·	·	·	HL
	RP = constant; or RP = @ identifier;	LXI R,K	0	0	Y	Y	0	0	0	1	LSK	MSK	10	·	·	·	·	·	[5]
	MEM(RP) = A;	STAX R	0	0	0	X	0	0	1	0			7	·	·	·	·	·	·
	A = MEM(RP);	LDAX R	0	0	0	X	1	0	1	0			7	·	·	·	·	·	·
Memory	identifier = A;	STA adr	0	0	1	1	0	0	1	0	LSA	MSA	13	·	·	·	·	·	·
Reference	A = identifier;	LDA adr	0	0	1	1	1	0	1	0	LSA	MSA	13	·	·	·	·	·	·
	identifier = HL;	SHLD adr	0	0	1	0	0	0	1	0	LSA	MSA	16	·	·	·	·	·	·
	HL = identifier;	LHLD adr	0	0	1	0	1	0	1	0	LSA	MSA	16	·	·	·	·	·	·
Stack	PUSH RP;	PUSH R	1	1	Y	Y	0	1	0	1			11	·	·	·	·	·	−2
	POP RP;	POP R	1	1	Y	Y	0	0	0	1			10	↑↓	↑↓	↑↓	↑↓	↑↓	+2
	GO TO LABEL;	JMP adr	1	1	0	0	0	0	1	1	LSA	MSA	10	·	·	·	·	·	·
	PC = HL;	PCHL	1	1	1	0	1	0	0	1			5	·	·	·	·	·	·
	IF condition THEN GO TO LABEL;	Jmn adr	1	1	V	V	V	0	1	0	LSA	MSA	10	·	·	·	·	·	·
Transfer	CALL SUB;	CALL SUB	1	1	0	0	1	1	0	1	LSA	MSA	17	·	·	·	·	·	−2
of Control	IF condition THEN CALL SUB;	Cmn adr	1	1	V	V	V	1	0	0	LSA	MSA	11/17	·	·	·	·	·	·/−2[4]
	RETURN;	RET	1	1	0	0	1	0	0	1			10	·	·	·	·	·	+2
	IF condition THEN RETURN;	Rmm	1	1	V	V	V	0	0	0			5/11	·	·	·	·	·	·/+2[4]
	RESTART K[5]	RST k	1	1	K	K	K	1	1	1			11	·	·	·	·	·	−2

· No Change.
↑↓ Change depends upon the result of the operation which is performed.
$\bar{c}$ Carry bit is complemented.
+n An increase in value by n.
−n A decrease in value by n.
K 1-byte constant.
LSA Least significant byte of the 16-bit memory address of an identifier.
MSA Most significant byte of the 16-bit memory address of an identifier.
LSK Least significant byte of a 16-bit constant.
MSK Most significant byte of a 16-bit constant.
SUB Subroutine Entry identifier
R Register
D Destination Register
S Source Register

RP Register Pair
SP Stack Pointer
TOS The upper 2 bytes of the Stack
PC Program Counter
C Carry
H/C Half/Carry
P Parity

DDD or SSS	REGISTER
000	B
001	C
010	D
011	E
100	H
101	L
110	MEM(HL)
111	A

X	REGISTER PAIR
0	BC
1	DE

YY	REGISTER PAIR
00	BC
01	DE
10	HL
11	SP (or AFLAGS)

VVV	Condition	Mnemonic
000	NONZERO	NZ
001	ZERO	Z
010	CARRY = 0	NC
011	CARRY = 1	C
100	PARITY = 0	PO
101	PARITY = 1	PE
110	POSITIVE	P
111	NEGATIVE	M

MuPro's BASL-80 programming language lets 8080 coders write programs in an algebraic format. Programs written in this language require the same amount of memory as programs written in 8080 assembly language.

Eliminating decoders: addressing components in a 6800 Microcomputer

Each component in a microcomputer system (RAMs, ROMs, PIAs*) has a set of addresses pertaining only to itself. Manufacturers put chip select (CS) pins on their memory and PIA ICs for unique addressing. When a microcomputer system contains many memory ICs, external decoders are often used to select a particular memory chip from signals on the address bus. Unfortunately, decoders require the introduction of extra hardware into the system. In the technique described here, Professor Joseph D. Greenfield of the Rochester Institute of Technology relates how to make optimum use of CS pins on memories to minimize and generally eliminate using external decoders.

As an example, consider the 6810, a 128 byte memory commonly used in 6800 systems. This RAM comes in a 24-pin DIP package with two positive CS inputs (CS0, pin 10 and CS3, pin 13) and four negative inputs ($\overline{CS}1$, $\overline{CS}2$, $\overline{CS}4$ and $\overline{CS}5$, on pins 11, 12, 14 and 15, respectively). These CS pins typically connect to the address bus. A 6810 does not respond unless both of its positive CS pins connect to 0's.

A 6810 requires 7 address bits (A_0 - A_6) to select 1 of its 128 bytes. Nine address lines remain for chip selection. Filling the entire memory with 6810s permits it to accept 512 ICs. This technique requires external decoding, leaving no room for ROMs, PIAs and other components. Generally, each system requires only a few RAMs; proper use of address lines eliminates external decoders.

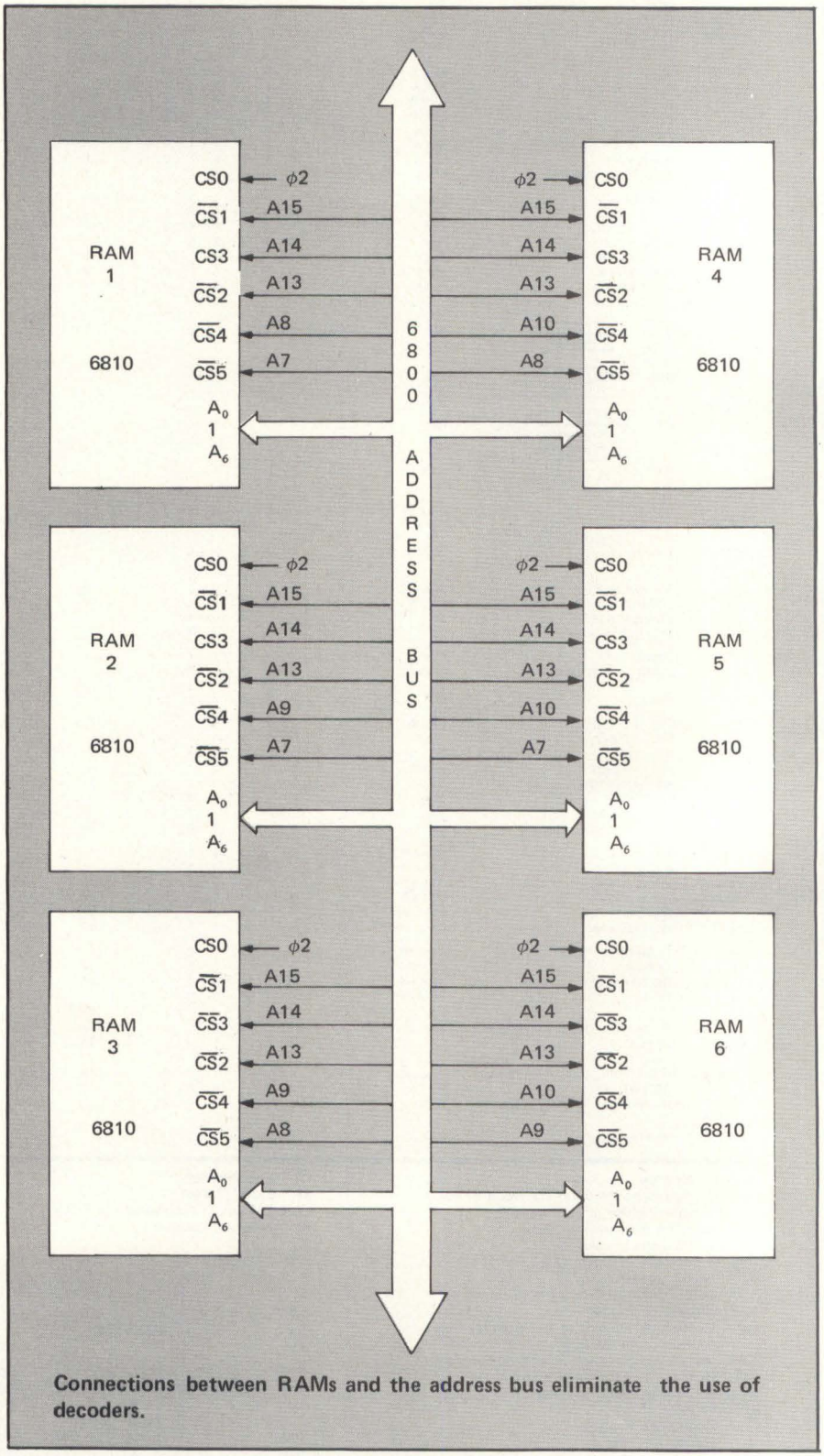
Selecting a group of RAMs requires dividing the 16 bit address bus into four fields:

- *The unconnected field* consists of lines on the address bus not connected to any of the RAMs.
- *The RAM identification field* consists of address bits connected to the RAMs to enable or disable them. This field distinguishes RAMs from other components in the system.
- *The word selection field* determines which word on the selected RAM is accessed.
- *The RAM selection field* determines which of several RAMs in the system is selected.

Reserving a number of negative CS pins for RAM selection optimizes decoding. A RAM selection field n bits long should consist of m O's and (n-m) 1's, where m is the number of negative CS inputs reserved on each IC. The field can be arranged in n!/m!(n-m)! ways. This number of RAMs can be selected without decoding.

For example, suppose the system addresses a RAM whenever A15 = 0 and A14 = 1. These lines become the RAM identification field; in all 6810s

*Peripheral Interface Adapter



Connections between RAMs and the address bus eliminate the use of decoders.

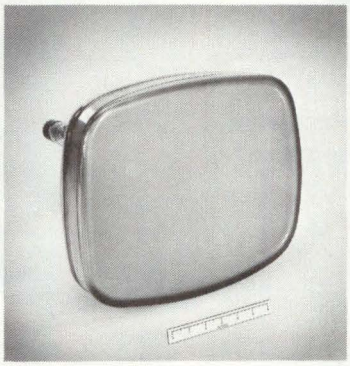
Finally! A display that won't go out of focus when you turn up the brightness!

It sounds fantastic! And, it is!

Using our new, state-of-the-art Laminarflo® electron-gun CRT's, your computer terminal display is guaranteed not to "bloom" at high-brightness levels.

Why? Because the Laminarflo's high-density electron beam can provide increased brightness up to double your present peak-line brightness —without producing a corresponding reduction in resolution!

In fact, our tubes have operated in high resolution CRT terminals at 60 Ft.-Lamberts without blooming. This means the information displayed on your screen can be easily viewed; even in direct sunlight!



Laminarflo CRT's are direct replacements for the traditional crossover-gun CRT's your present displays are probably using. So, no special or unusual voltages are required.

And, they're available in sizes up to 25-inch rectangular.

So, if you're tired of squinting at dim displays, give us a call.

Contact the Watkins-Johnson Field Sales Office in your area or phone CRT Applications Engineering in Santa Cruz, Calif. at (408) 438-2100, ext. 308.

Our CRT's are a real sight for sore eyes!

A crisper, well-defined, brighter display with W-J Laminarflo CRT's.

WATKINS-JOHNSON

Watkins-Johnson—U.S.A.: 3333 Hillview Ave., Palo Alto, CA 94304 • (415) 493-4141 • TWX: 910-373-1253 • Telex: 34-8415 • Cable: WJPLA • 700 Quince Orchard Rd., Gaithersburg, MD 20760 • (301) 948-7550 • TWX: 710-828-0546 • Telex: 89-8402 • Cable: WJCEI • **United Kingdom:** Shirley Ave., Windsor, Berkshire SL4 5JU. England • Tel: Windsor 69241 • Cable: WJUKW-WINDSOR • Telex: 847578 • **West Germany:** Muenchenerstr. 17, 8033 Planegg • Tel: (089) 859-9441 • Cable: WJDBM-Muenchen • Telex: 529401 • **Italy:** Piazza G. Marconi, 25 00144 Roma-EUR • Tel: 59 45 54 • Cable: WJROM-ROMA • Telex: 60117

CIRCLE 17

a negative CS input connects to A14.

The word selection field consists of addresses A0 through A7 and the RAM selection field consists of 4 bits (A10, A9, A8 and A7). Inputs $\overline{CS4}$ and $\overline{CS5}$ are the $\overline{CS}$ inputs associated with RAM selection, leaving one positive and one negative CS input available for additional timing and decoding. Bits A13, A12 and A11 serve as the unconnected field. For simplicity, assume that these bits are 0's.

By the above procedure, the RAM selection field consists of two 1's and two 0's; this procedure allows us to connect 4!/2!2! = 6 RAMs. The address connections for the RAMs appear in the table. The table goes together as follows:

- CS4 and CS5 on each RAM
- All 6 combinations of two 1's and two 0's appear in the field column.
- $\overline{CS4}$ and $\overline{CS5}$ on each RAM connect to address bits corresponding to the 0's in the field.
- The 16-bit memory addresses result from the 5 MSBs (01000), the RAM selection field and the 7 LSBs for memory address.
- For RAM 4, for example, the field is 0101; the address is 01000 0010 1000 0000 or $(4280)_{16}$; the maximum is 0100 0010 1111 1111 or $(42FF)_{16}$. The accompanying figure shows the address bus connections for this problem with CS0 connected to 02 and $\overline{CS2}$ connected to A13.

To provide more than 6 RAMs, the RAM selection field expands by reducing the unconnected field; RAM selection requires adding $\overline{CS2}$ to the negative CS pins. In general a longer field allows use of more RAMs. A 6-bit field with two CS inputs addresses 15 RAMs. This method can also select 6830 ROMs and other components with several CS inputs.

RAM Address Connection example

Field					Address Bits		Memory Addresses	
RAM	A_{10}	A_9	A_8	A_7	$\overline{CS4}$	$\overline{CS5}$		
1	1	1	0	0	8	7	010001100XXXXXXX	4600 467F
2	1	0	1	0	9	7	010001010XXXXXXX	4500 457F
3	1	0	0	1	9	8	010001001XXXXXXX	4480 44FF
4	0	1	0	1	10	8	010000101XXXXXXX	4280 42FF
5	0	1	1	0	10	7	010000110XXXXXXX	4300 437F
6	0	0	1	1	10	9	010000011XXXXXXX	4180 41FF

This address connection chart demonstrates the method outlined by Prof. Greenfield to address a RAM. External decodes are eliminated by using chip select (CS) pins.

CIRCLE 19 ▶

OUR TRIDENTS ARE SO WELL MADE THEY'LL COME APART IN 10 MINUTES.

We've made it very easy for you to get to all the parts and components of every Trident disk drive.

You can remove all subassemblies without using a soldering iron. They all either slide right out, or fold out on hinges.

You can connect an exerciser to troubleshoot without removing any system cables.

The degate switch on every Trident lets you take out one drive for repairs without interrupting the others.

And since all critical subassemblies are enclosed to prevent contamination, they stay clean when the skins are off.

MAINTENANCE

All this means that when you need to maintain a Trident, you don't have to pamper it.

You can take it apart fast. Get the work done simply. And get it back together fast.

But design excellence is only part of the Trident story. Capacities range from 27 to 312 megabytes, and each Trident model is fully compatible with every other Trident model.

Each gives you track-following servo technology—plus one of the lowest cost-per-byte ratios in the industry.

In addition, Tridents now come with two interfaces: The standard. And the new differential.

TRIDENT FORMATTER

Our 1150A Formatter is also easy to maintain. It offers micro/minicomputer systems designers important features previously available only in large disk controller subsystems. Features like ECC, RPS, and overlapped seek.

It can control and format any mix of up to eight Trident drives—for a total storage capacity of up to 2.4 billion bytes online. And it can be attached to virtually any micro/minicomputer.

STATE OF THE ART

If features like these are important to your growing systems business, you'll want more data on the state-of-the-art Trident family. Just call us at (714) 821-2011, or fill out the coupon. We'll do the rest.

DD-M7-77

To: California Computer Products, Inc. MS3
2411 West La Palma Avenue
Anaheim, California 92801

Please tell me all about your Trident Disk Drives.
☐ I am interested. ☐ I am serious.

Name

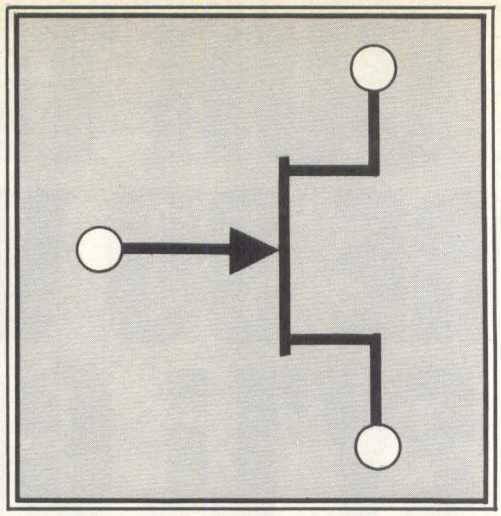
Company Title

Address Phone

City State Zip

CALCOMP

How to Use the On/Off Relay Action of Junction Field-Effect Transistors



by James E. Buchanon

Many designers overlook the characteristics of junction field-effect transistors (JFETs) that can greatly simplify the implementation of many clamping, limiting and initiating circuits. JFETs are unique among solid state devices in that they are normally ON and in their most conductive state with no potential across them or applied to their gates; whereas, all other devices, typically represented by bipolar transistors, require a base current or drive voltage to turn them ON. Since the JFET essentially functions as a normally closed relay, it simplifies the ensuing digital and analog circuits and can improve circuits in many other applications.

Even though n-channel and p-channel, normally-ON JFETs (Fig 1) are available, n-channel devices are more commonly available, but as we shall see, though they possess more desirable parametric characteristics, many applications call for using a p-channel FET. N-channel JFETs cost less for a given ON-impedance and pinch-off level, the two most important parameters in applications requiring the normally-ON characteristic. (The potential applied to the gate with respect to the source or drain is the pinch-off voltage that turns the FET OFF.) Ideally, the ON-impedance should be zero, but never is. Available n-channel devices come with ON impedance as low as 5 Ω; the much higher impedances p-channel FETS range from 50-100 Ω and higher.

Most applications require as low as possible pinch-off voltages. Here again, n-channel devices provide low pinch-offs in addition to low impedance. In an n-channel, a negative voltage with respect to the drain or source pinches the device off; in a p-channel, a positive voltage. Note that the devices are symmetrical and the drain and source are interchangeable without affecting circuit operation. Clipping and clamping applications often use this characteristic.

digital applications

A normally-ON JFET can serve as the key component in initiate, clear or inhibit circuits in digital system applications. These applications may require a circuit to provide a signal for:

- Initiating the system in the proper state when the power goes ON;
- Preventing random outputs wherever transients force system power ON or OFF;
- Protecting data in memory by preventing false data from entering into the store during power turn-ON or -OFF.

In general, during power turn-ON, the clear or initiate signal should be ON initially and remain ON for some time to give the system time to stabilize. And during system power turn-OFF or the appearance of a transient signal, the clear or inhibit circuit should turn ON almost instantaneously to prevent false or random conditions from occurring. Initiating or shutting down a digital system requires setting or resetting registers and counters, and inhibiting certain inputs or outputs until the system power supplies have stabilized at ON or OFF.

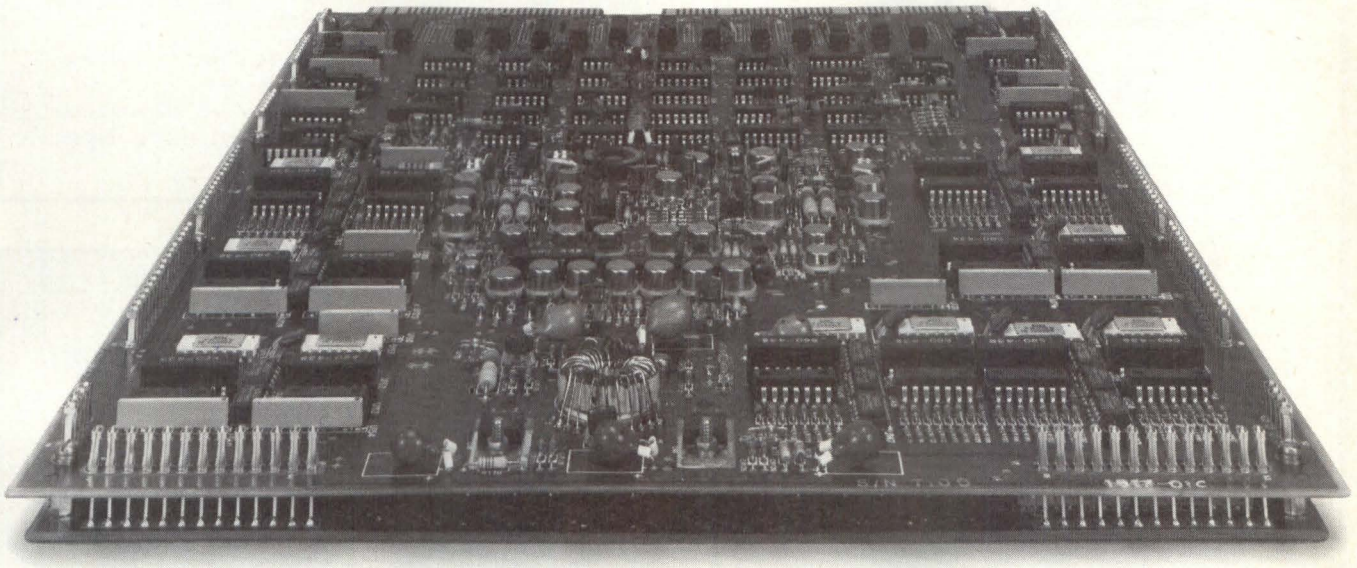
A low input on the master, or a dc set or reset (clear) input, sets or resets the more common TTL flip-flop, register or counter. Also, a low input on any input line inhibits the standard TTL gate. (The output state is fixed regardless of the state of the inputs.) In all cases, since the driver or circuit that provides the low signal must sink current. Initiating or inhibiting TTL circuits requires a normally closed device or circuit that must be driven open and that can be tied between gate inputs, flip-flop set or reset lines and the low-power supply line (ground).

A normally closed switch, capable of turning ON, closing or shorting out without system power or before system power is fully established or lost, can solve this problem. You could use a normally closed electromechanical relay to provide the function, but a relay is slow and its contacts bounce. A normally-OFF device such as the bipolar transistor requires base current (system power) and is not applicable. However, a normally-ON JFET can provide the proper functions without system power or before power is fully established.

Fig 2 illustrates the basic clear or inhibit circuit that uses a JFET. Gate g of the FET switch Q1 is connected to an RC network that is tied to the system basic dc voltage. The voltage level indicates the primary power status. Ideally, the voltage sensed by Q1 should be just large enough to exceed the JFET pinch-off potential. Pinch-off forces the JFET to act as a simple initially-ON switch that turns OFF after power is applied after an interval of time determined by the RC network. The clear or inhibit current sinking path exists until Q1 turns OFF. However, Q1 does not have to be turned OFF completely for the circuit to function. If the sensed voltage level is lower than the pinch-off value, pull-up resistors R3 can be sized from FET drain current vs. drain voltage curves to produce the logic level after stabilization.

The sensed voltage must indicate the exact status of

The Solid State Memory



That Works

Here's a new solid state memory that works wherever a reliable, non-volatile, high capacity, fast access digital memory is needed.

Ampex 3220 Series core memories are modular. Individual modules store 32K words of up to 20 bits each, and you can combine as many as 16 modules for a total memory capacity of 512,000 words.

New 3220 Series memories are fast, too. Data access within 275 nanoseconds and full cycle in 650 nanoseconds. And power supply options offer a choice of +5/+15 volts or +5/+15/−15 volts.

Size is no problem. Ampex 3220 Series memory modules measure *less* than 1 by 12 by 16 inches. And you can get a complete system from Ampex, too, complete with cage space for 4, 8 or 16 modules plus power supply, blowers and logic interface.

Versatility is another advantage of Ampex 3220 Series memories. They're physically and electrically compatible with Ampex 1600 Series and with Micro 3000 Series products. And you'll get far wider operating margins, thanks to temperature independent core formulation.

Solid design. Solid performance. Solid reliability. Solid value. Ampex Core. The solid state memory that works.

AMPEX

Ampex Memory Products Division
200 N. Nash Street, El Segundo, California 90245
(213) 640-0150

CIRCLE 20

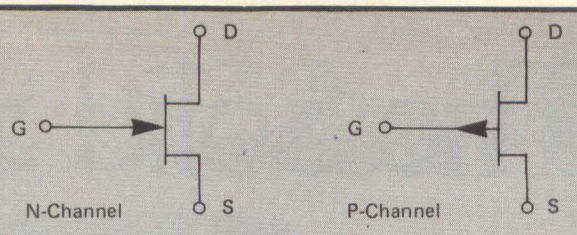


Fig 1 In these normally-ON JFETs, a negative voltage on the gate with respect to the source and drain turns the n-channel device OFF; a positive voltage turns the p-channel device OFF. Most JFETs are symmetrical, since source and drain can be interchanged.

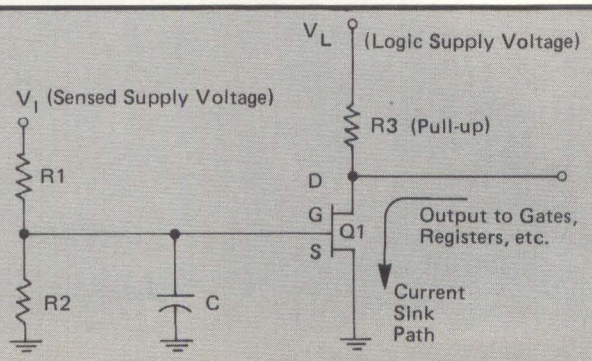


Fig 2 In this basic clear or inhibit circuit, FET switch Q1 turns OFF and ON to provide the required functions.

the power supply voltage to logic circuits. Even though the most obvious and best voltage to be sensed is the logic supply voltage, several limitations restrict logic supply sensing. In applications that must sense a positive voltage, the more common p-channel JFETs have high pinch-off voltage levels and relatively high ON resistance. Sensing unregulated dc to the logic supply regulator, if possible, can overcome high pinch-off requirements, as well as anticipate the future status of the supply voltage (perhaps most important when shutting down). In applications that must sense a negative potential, the n-channel JFET with the negative pinch-off turns it ON and OFF at the same time as the logic supply.

In either of the two circuits shown in Fig 3, with system power OFF and no voltage on the JFET gate, switch Q1 is ON and provides a clear or inhibit signal to the circuit. Q1 remains ON until the gate voltage reaches the threshold or pinch-off level of the FET. By selecting the JFET, the divider network and capacitor value, you can set the voltage level and time delay to FET cut-off for most systems.

The pinch-off voltage for JFETs varies widely – from 2-10 V. However, FETs with a 2 to 3-V pinch-off spread are available, as well as devices with a maximum pinch-off of under 2 V. Of course, you could use a potentiometer for one of the resistances of divider R1, R2 to set the trigger point. Since the JFET requires no gate current to turn ON or OFF, you can use large ohmic values for R1 and R2 (No IR drop occurs, except due to gate current leakage across the resistors) with small values of capacitance to produce long delays with physically small components.

The FET must offer a low enough ON-resistance so that the IR drop across the FET drain to source due to current provided by the inhibiting of various logic gates and by the setting or resetting of registers does not exceed the maximum low logic level. If the circuit contains a common type of TTL gate with low-input current sinking of about 2 mA, a single 30-Ω FET can easily inhibit 6 gates without exceeding the normal 400-mV max-

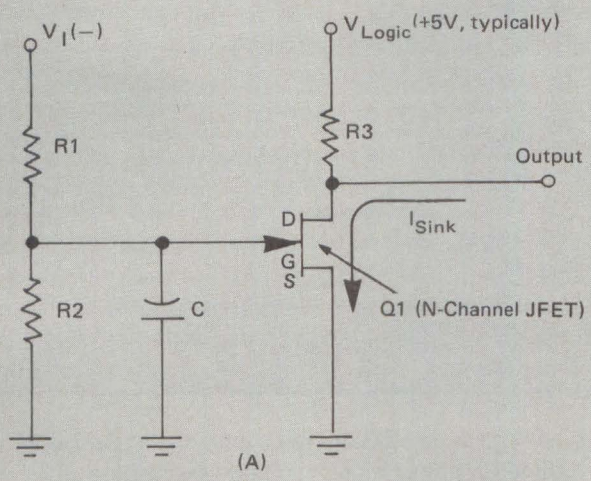


Fig 3 (A) Depicts an n-channel JFET circuit.

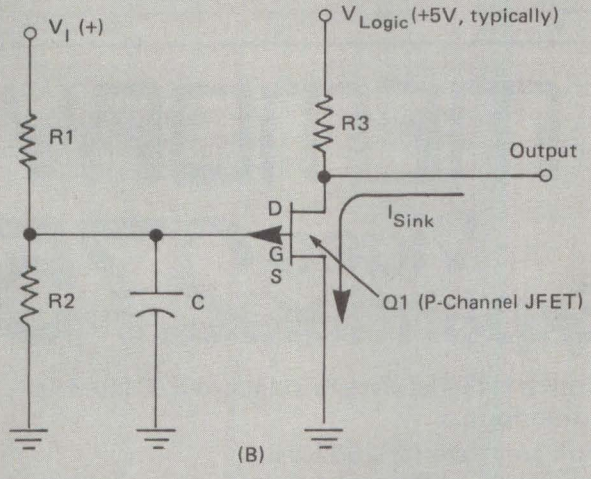


Fig 3 (B) A p-channel circuit. Both use +5 and ground potential logic power.

imum low TTL level (6 x 2 x 30 = 360 mV). For applications that need lower ON-resistance, you can parallel a number of FETs with a common divider. Or you can use available n-channel JFETs with an ON-resistance under 5 Ω. However, most common applications do not supply a negative voltage for sensing.

In most applications, the more desirable solution usually involves sensing the actual logic supply voltage with a p-type FET (Fig 3B), since other voltages may not be available to produce a level for pinching off the FET. However, a circuit with no R2 can function as required, for after the gate voltage exceeds the pinch-off level, the circuit can be considered to behave like a voltage follower. The final output level of

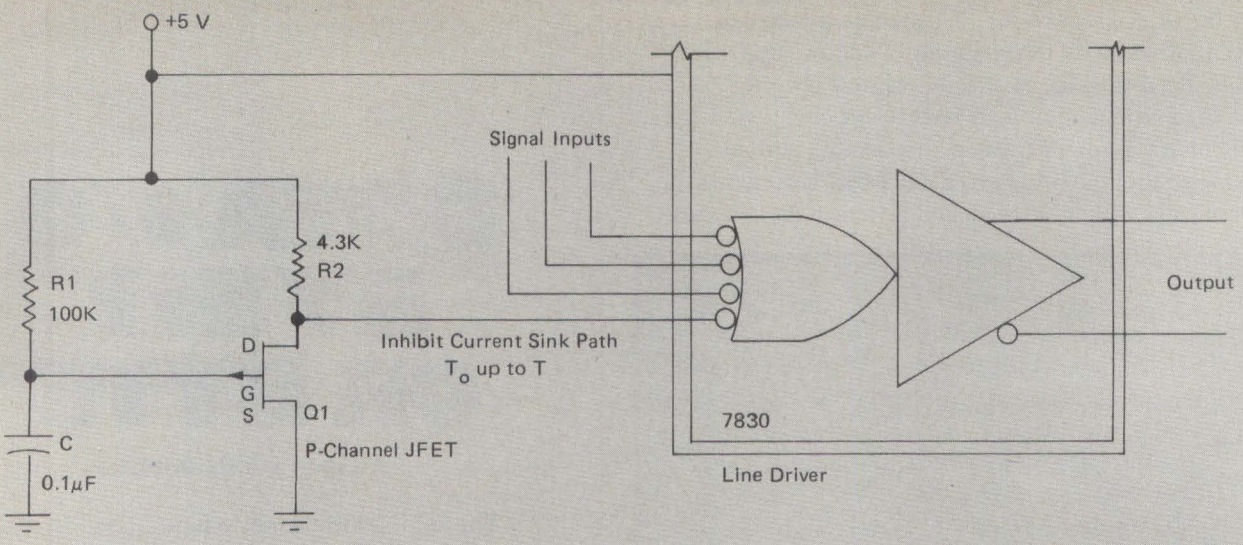


Fig 4 In this line driver inhibit circuit, R1 and C1 determine the duration of the inhibit signal and R2 serves as the pull-up when Q1 begins to cut off.

the circuit containing a properly selected R3 will reach approximately one pinch-off level less than the supply voltage. In a circuit with a 5-V supply, a one- to two-V pinch-off device will produce a 3-V, or more, output – an adequately high logic level for removing the set or reset, or inhibiting a TTL gate or register.

The simple basic circuit shown in Fig 3 suffers from several disadvantages. It does not supply the hysteresis normally required for power supply, voltage-level sensing under transient conditions. It also permits a delay to exist before the clear or inhibit signal is applied during power shut down, a condition that an appropriately placed diode can remedy. Although these disadvantages mean that some applications need additional circuitry to meet shut-down, transient-clear

or inhibit requirements, it is difficult to conceive a more positive initialization circuit for systems that must have a signal at the very onset of power-ON.

Fig 4 shows a normally-ON JFET circuit that can inhibit digital line driver outputs during the start-up of a system. The circuit in Fig 5 can clear and preset a pair of TTL registers. In parallel with the open collector 5407 device, a p-channel JFET (Fig 6) secures the output low for some time after the power is turned ON and eliminates the possible existence of false high outputs during the transition between

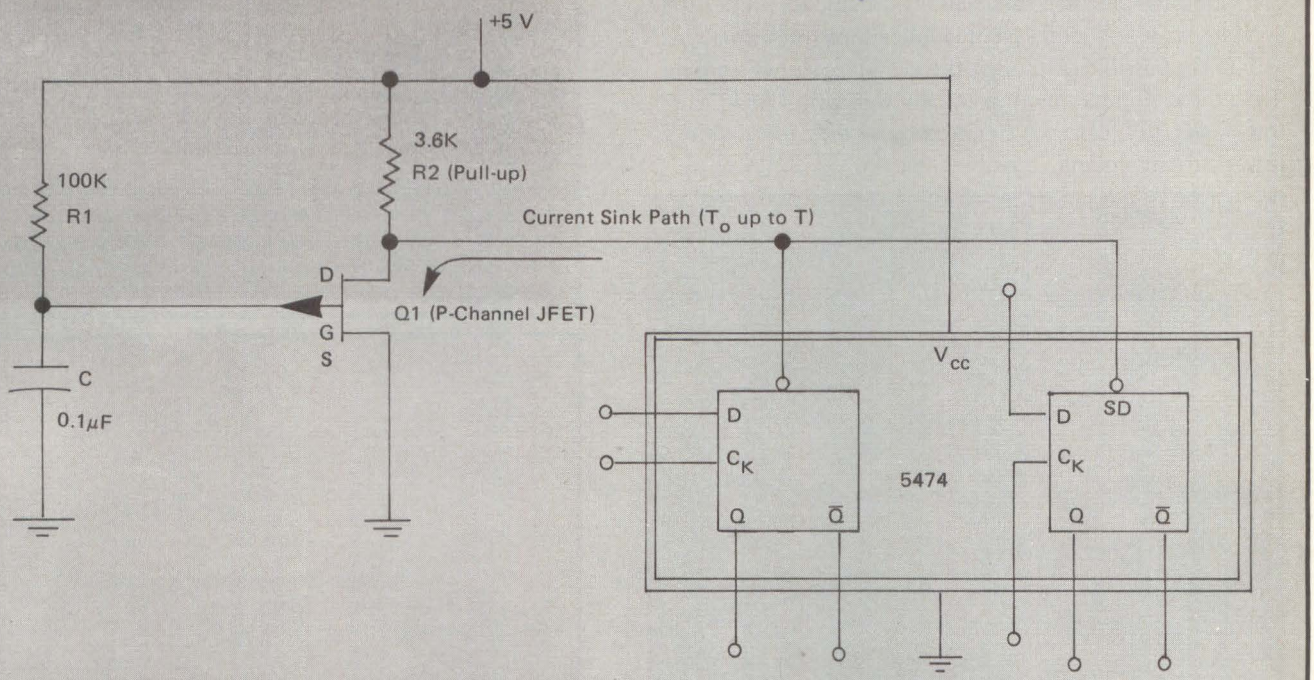


Fig 5 A current-sinking, normally-ON JFET sets, resets or clears this TTL flip-flop counter or register.

OFF and ON. Such a circuit could generate a power-enable signal to a remote point in the system. In a similar use of the JFET (Fig 7), the normally-ON device is in parallel with the open collector output of an IC comparator, such as the LM111. The FET keeps the output low long enough for the comparator to become stable and to assume its proper state.

Many similar digital system applications for normally-ON JFETs are possible. Although the examples shown contain TTL, these circuits function equally well with CMOS and low-power TTL device systems, because they too require lower current sinking.

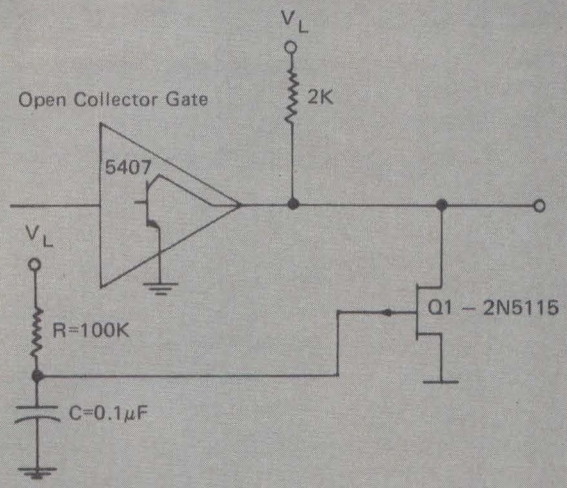


Fig 6 A normally-ON JFET, in parallel with open collector gates or drivers, guarantees a known, low-level start-up state.

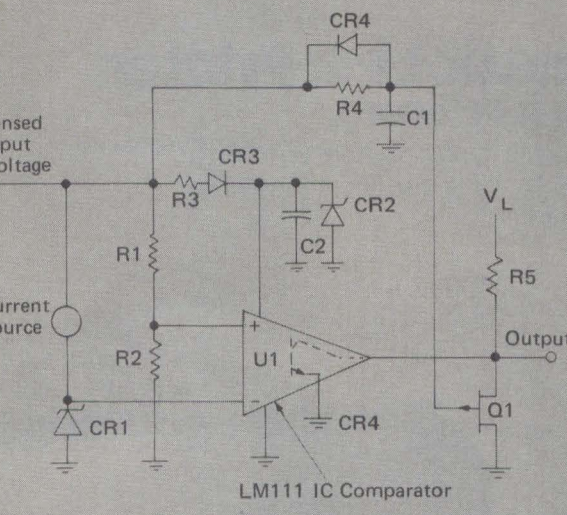


Fig 7 Precise voltage level detector, powered by the sensed potential, contains two principal circuit components, U1 and Q1. U1 is a high gain differential IC comparator, such as LM11, which has an open collector output and is able to operate over a wide range of supply voltage. Q1 is a p-channel JFET with a pinch-off threshold lower than the sensed input, V_I minus V_L, that controls the output by clamping it to ground level, until the LM111 has had time to stabilize after power ON.

analog applications

The range of analog applications for JFETs is almost limitless, particularly in conjunction with operational amplifiers. For example, when combined with a current-limited output

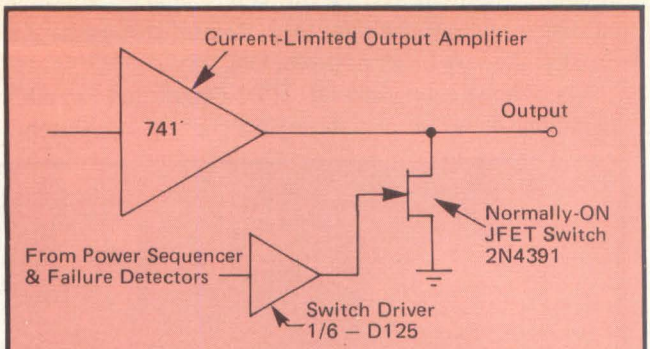


Fig 8 Although this typical basic amplifier output clamp uses a 741 current-limited output amplifier, one-sixth of a D125 switch drivever and a 2N4391 JFET as a switch, the designer can configure his own circuit with other components.

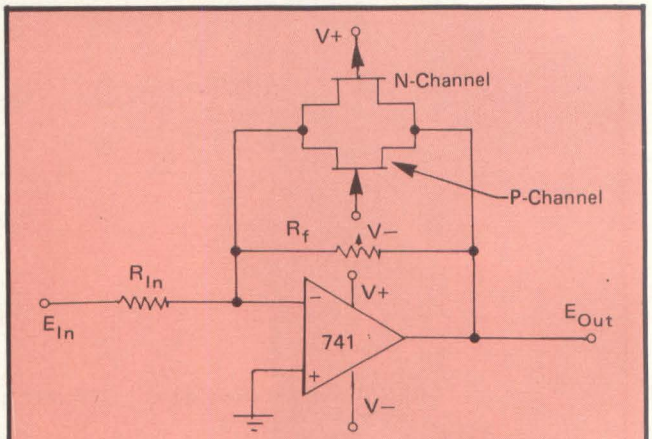


Fig 9 Two normally-ON JFETs connected in parallel across the feedback of the 741 op amp clamp the output to zero and provide a nearly zero feedback impedance. The FETs can also absorb high discharge current from charged up capacitors.

amplifier, the normally-ON device provides a high-speed, fail-safe clamp for amplifier output signals, which must not deviate significantly from zero during system power switching, an occurrence of transients or a power supply failure. Let's look at an example. Such an event might be an error signal derived in an auxiliary system that does not remain constantly on-line. When the auxiliary system does come on-line, it may be crucial that the error signal initially start near zero so that it may not cause a disruptive or destructive action. It may also be important that during the OFF-cycles of the auxiliary system all outputs are locked to near zero or a reference level, even in cases of failure within the auxiliary system.

A JFET circuit is sometimes needed for some amplifier circuits, because:

- All of the power supplies to the output amplifiers may not turn ON and reach full amplitude at the same time, or the amplifier may not react equally to all supplies and maintain a zero output, assuming a zero input. In addition, one of the power supplies could fail and cause the output to go to the remaining supply.
- If the output analog is derived from a digital-to-analog converter, the initial digital data supplied to the DAC may not be correct. The digital system supplying data to the DAC may also need time to initialize.

In the basic JFET clamping arrangement for an amplifier

The Facit 4555 Page Printer.

Fewer moving parts are a moving argument.

Introducing the Facit 4555 with only two moving parts in the printing head.

The rationale: fewer parts moving around means fewer parts wearing out.

But we didn't stop there.

We also gave considerable thought as to how well our page printer should produce a print-out.

So, unlike most page printers, our 4555 uses a character by character (asynchronous) print-out and an automatic ribbon control to give you big, easy-to-read characters at 6 or 60 characters per second.

And whether you need one, two or even three copies, your print-out will always come out crystal clear.

Our 4555 is even less trouble to hook up than most page printers. That's because we give you several interface versions. Among them are: The Facit SPI interface for bit parallel data transfer, and the EIA, RS 232C.

All things considered, the Facit 4555 page printer is one of those rare instances where less for your money is really more for your money.

Facit-OEM Division,
66 Field Point Road,
Greenwich, Connecticut
06830.

FACIT
Dedicated to Efficiency

CIRCLE 29

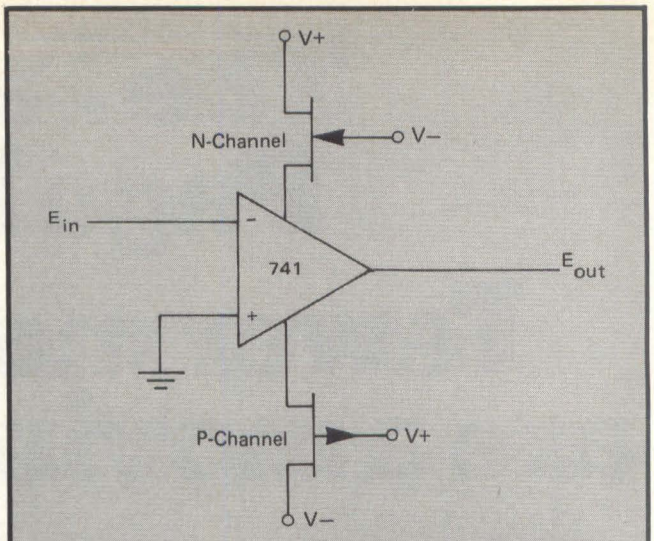


Fig 10 With its gate cross-coupled to the opposite terminals of the power supply, a JFET can cut off all power to an op amp in case the positive or negative supply fails. This arrangement prevents the op amp from going to an output level and disrupting a remote system receiving the signal.

output (Fig 8), the normally-ON device clamps the amplifier output to maximum voltage level, which is equal to the product of resistance and the maximum amplifier output current, until the switch driver forces the FET OFF. In a typical application, power supply sequencing and fault detection circuitry control the switch driver. The control signal would normally provide a delay before removing the clamp during power turn-ON and immediately apply the clamp after power turn-OFF or the occurrence of a power failure.

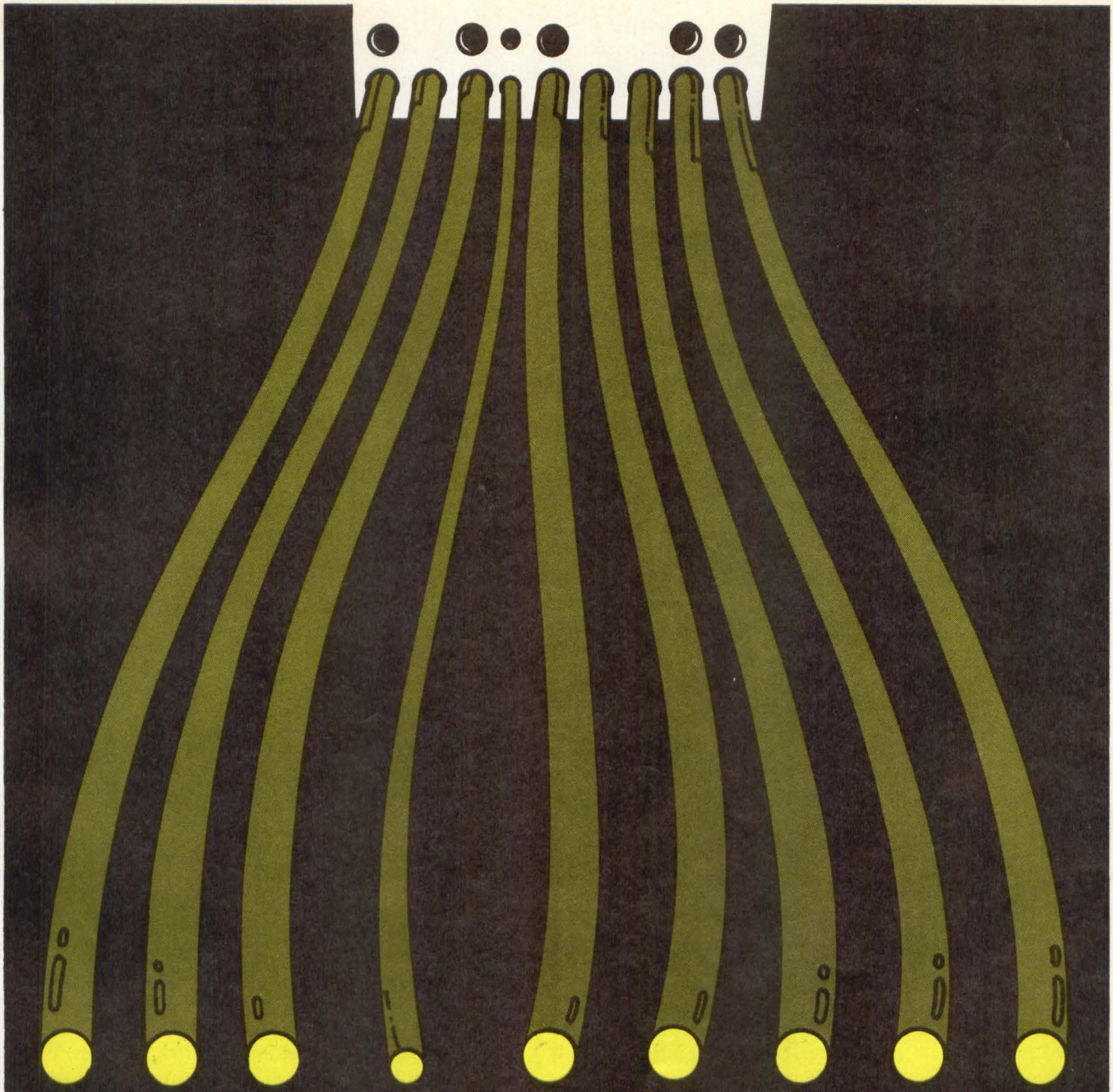
When you design a clamp, you must match a JFET with an ON-resistance within the current limit of the output amplifier, so that the clamped voltage drop due to the IR drop across the switch does not exceed system limits. The FET gate pinch-OFF level must prevent turn-ON within the normal operating range of the amplifier. Clamp turn-ON should begin to occur as the amplifier output approaches the pinch-OFF value of the gate potential.

Instead of clamping the output of an op amp directly, you could use one or two JFETs in the feedback path to clamp the output to zero whenever necessary (Fig 9). In sequencing or other types of circuitry, or in the absence or presence of supply voltages, two FETs, one in the positive and one in the negative supply line, could control the JFET gates (Fig 10). This arrangement of gates tied to the supply line can turn the op amp supply line OFF whenever a failure occurs on either line; it prevents the op amp from going to a false output level that could disrupt the system.

limitless applications

The possible uses for the normally-ON JFET characteristic in the digital and analog sections of a system are probably as enormous as the types and varieties of circuits. The few applications shown represent some of the more common clipping, clamping and limiting uses that I have found for the JFET. Surely, you can apply the JFET principle to similar uses for improving and simplifying circuits.

James E. Buchanan *is with the Westinghouse Electric Corp. based in Baltimore, MD.*



Our readers make light work.

Decitek photoelectric punched tape readers were all designed with state-of-the-art reliability — a fiber optic light distribution system and a beautifully simple patented dual-sprocket drive, which eliminates the need for level switches, tape guides and keepers. Since fewer actual parts go into our readers, greater performance comes out. It also gives us the lowest spare parts volume in the business. Decitek has, in a few years come from nowhere to such a strong penetration of the market that we are now the number one supplier to the photo-typesetting OEM industry and gaining in the machine control and mini-micro computer field. We got where we are purely because of performance, quality, reliability and price.

We will work with you to make, your equipment work better.

The more you know about punched tape equipment, the better you read us.

DECITEK

A DIVISION OF JAMESBURY CORP.
250 CHANDLER STREET, WORCESTER, MASSACHUSETTS 01602, U.S.A. (617) 798-8731

CIRCLE 32

DIGITAL PANEL METERS

by Edward A. Ross

The digital panel meter (DPM) possesses some of the characteristics of an instrument and some of the characteristics of a component. As an instrument it contains a multiplicity of functions within itself; as a component it performs a specific measuring function similar to that of an analog meter.

DPMs must accomplish three separate functions (Fig 1). They must:

- Measure and convert the analog signal to digital form.
- Display the data in numerical form.
- Supply power for each of the above.

A fourth function not provided with analog meters is a digital output. All DPMs use binary coded decimal (BCD) signals to drive the displays; most make the signals available

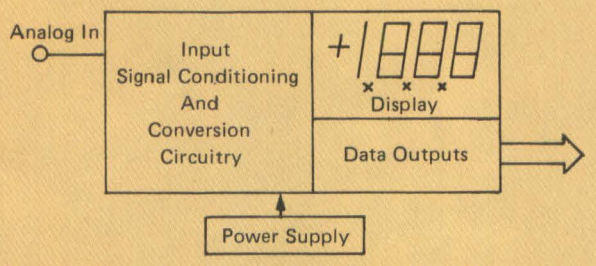


Fig 1 Three essential functions of a DPM include A/D conversion of an input signal, a numerical display and a power source.

to the user as well, for further use of the digital information. Other interface signals include outputs indicating "polarity", "overrange" and "overload" and input signals including "hold" and "trigger".

The analog to digital converter (ADC) is the heart of the DPM. Accepting an analog input, it converts the signal to digital binary coded decimal form. The BCD signals drive the display and are usually offered as an output. The dual slope ADC technique dominates the industry for all but the lowest resolutions and accuracies. For low resolution and low accuracy DPMs, the staircase ramp ADC is used. A third ADC technique, called successive approximation, is not used in DPMs.

dual slope conversion

Invented by Weston Instruments, dual slope conversion is licensed to other DPM manufacturers who pay Weston $3.15 per meter for use of the two patents involved.

Fig 2 shows typical dual slope configuration in block diagram form. V_{IN} is the voltage to be measured and V_{REF} is a precision reference voltage. When a measurement is to be made, the input switch is set to V_{IN}. At this instant the charge on the capacitor is zero and the counter is set to zero. During the time the measurement is being made, the counter runs at a fixed rate while V_{IN} is integrated, charging the capacitor C. That the dual slope converter provides averaging

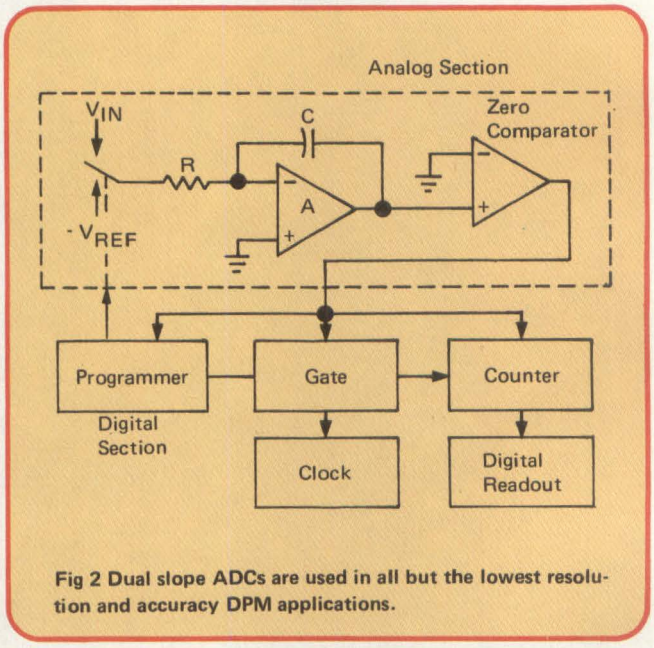


Fig 2 Dual slope ADCs are used in all but the lowest resolution and accuracy DPM applications.

of the input signal over the measurement period is an added benefit resulting from the integration.

When the counter reaches a predetermined count, V_{REF} (a reference voltage of opposite polarity) is applied to the integrator, discharging through the same resistor that was previously charging it. When the charge on the capacitor reaches zero again, the zero comparator sends out a signal to stop the counter (see Fig 3). The predetermined count is often chosen to be the maximum figure that will appear on the display (e.g. 2,000 counts for a 3-½ digit counter). The reading displayed on the counter is proportional to the input voltage.

The dual slope ADC is not subject to many of the sources of error found in other converters. Long-term clock frequency variation or drift does not affect the result because a single clock determines both the integrating time of the reference voltage and the integrating time of the input voltage. Errors due to inaccurate values of the resistor or capacitor or long-term changes in these components cancel because the same resistor and capacitor serve for the integration of the reference voltage. However, dual slope conversion accuracy does depend on the accuracy of the reference voltage and necessitates compensation for the effect of drift in offset voltage and gain.

Details of the technology used in capturing analog information and converting it to the digital data necessary for display operation.

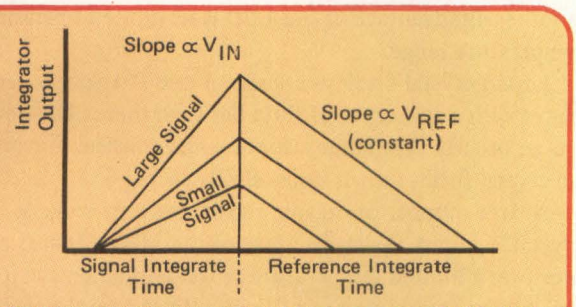


Fig 3 The dual slope conversion technique uses a single clock to govern signal and reference integration periods; thus frequency variations and drift do not affect performance.

ramp conversion

Less expensive than the dual slope ADC is the ramp style ADC. Used in low-resolution, low accuracy DPMs, the ramp converter employs a time-interval counter to measure the time required for a ramp-type reference to change from the input level to ground. The method of converting a voltage to a time interval is illustrated by the timing diagram shown in Fig 4.

At the start of the measurement cycle, a ramp voltage is initiated. The ramp is compared continuously with the voltage to be measured. At the instant they become equal, a coincidence circuit senses that the ramp has reached zero volts. The output pulse of this comparator closes the gate.

During the time the gate is open, clock pulses pass to totalizing circuits. The count should be proportional to the measured voltage. If the input voltage is negative, coincidence occurs first at zero and then at the negative input voltage. The value would appear as negative.

In the ramp converter, the output can be affected by errors in the ramp voltage, by errors in the clock and by other system factors. For 2-½ digit DPMs, ramp ADC accuracy is often sufficient.

successive approximation conversion

Successive approximation ADCs compare an input signal with the output of a digital to analog converter (DAC), for which the input is known. This form of ADC is rarely used in DPMs. Its advantages – high speed at very high resolution are not required for DPMs and it has the disadvantage of not averaging the input signal.

displays

After the ADC has transformed the analog input signal to a digital electronic format, the data must be displayed to the user in numerical form. Today, digital meters use several forms of displays including gas discharge, light emitting diodes (LEDs), liquid crystal displays (LCDs) and vacuum fluorescent displays.

seven-segment form

Today, the seven-segment numerical display is virtually the only one used in DPMs. These come in gas discharge, LED, LCD, and vacuum fluorescent form. All make use of a seven-segment planar configuration that employs combinations of bars to produce all digits from 0 through 9. See Fig 5.

Seven-segment displays have proven to be highly readable. In Fig 5, notice that for the '8' all segments are lit; for the '4' only four segments are activated. For a '1' only the two vertical segments of the far right are on; for a '0' all other segments except the horizontal center bar are illuminated (or rendered opaque for some liquid crystal displays).

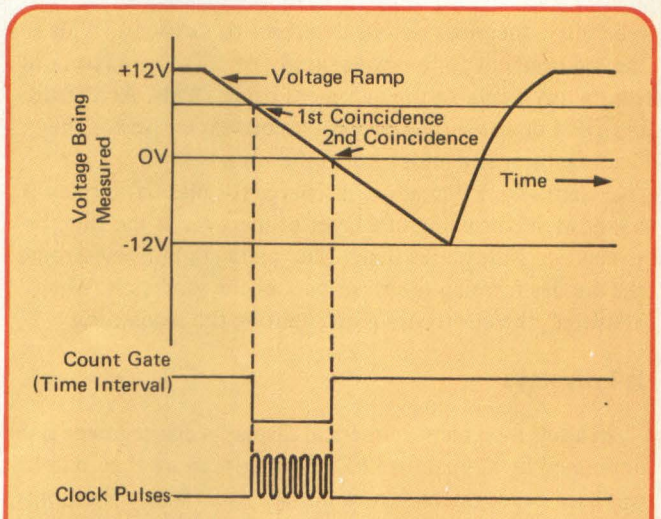


Fig 4 Ramp conversion is used in low-resolution, low-accuracy DPMs. Errors can come from the ramp voltage and the clock.

The first DPMs made use of a gas discharge tube produced by Burroughs and known as the Nixie. It is used now only in a few of the older designs. The Nixie does not use a planar arrangement. Each numeral is a complete, lighted electrode in the shape of the numeral. The electrodes are stacked so that different numerals appear at different depths, unlike a planar display in which all numerals are on the same plane relative to the viewer. The planar display is considered more desirable.

An advantage of the Nixie is that it is failsafe. If a filament fails, the numeral is not illuminated. In a seven-seg-

ment display, if one segment burns out, a number other than the intended number may be displayed. For instance, if a middle horizontal segment burns out, an '8' will appear as a zero; if the lower left vertical segment burns out, a '6' becomes a '5' and an '8' becomes a '9'. For this reason, the German electronic code rules out the seven-segment format. As a result, the market for Nixies used in DPMs in Europe has not declined as rapidly as it has in the U.S.

gas discharge displays

In spite of reports that have persisted for at least five years, LEDs and LCDs have not rendered gas discharge display obsolete. Today, the planar gas discharge tube is still a leader among DPM displays. Beckman Instruments, a major producer of gas discharge displays, markets a design it bought from Sperry. The reason that the Beckman display is still used in so many DPM applications is that it provides a better looking display than LEDs or LCDs by a substantial margin. Though disagreement exists concerning its

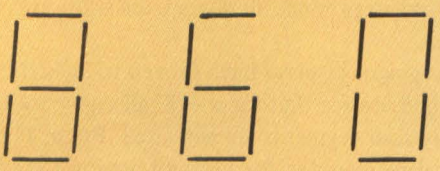


Fig 5 In a 7-segment digital display, a burned-out segment can go undetected and create false readings.

reliability, the most serious deterrent to its use in DPMs is the requirement for a power supply of 180 V – a level not commonly available in equipment using DPMs. As a result, the DPM power supply becomes more expensive for the manufacturer and adds cost to the user.

Essentially, a planar gas discharge (or plasma) display is a sandwich consisting of a layer of inert gas as the filler between two glass plates. Each glass plate contains electrodes; the anodes forming the front part of the sandwich. When activated, the electrodes glow, lighting the segments.

led displays

In a seven-segment numerical display, each segment is illuminated by a separate LED. Formerly, more than one LED was used per segment – now a single LED with a light pipe forms each segment. Though LEDs possess extremely long potential life, they are still inferior in brightness, general appearance, and viewing angle to the Beckman display. The voltages required for LEDs are readily available to electronic systems, but their current requirements are high. The LED is generally used in applications containing a +5 V supply. The Beckman display is more likely to be used in a DPM that operates from the AC power line.

liquid crystal displays

In the early 1970s, leading researchers and manufacturers predicted that LCDs would win a significant share of the DPM display market by 1975. This has not been the case. Only two DPM manufacturers make use of them. Success has always been just around the corner for liquid crystals and remains there today. The quality of the LCD is inferior to the Beckman display and to LEDs. Improvements have been made in LCD technology, but the competing technologies have been improved as well. An attractive feature of the LCD is its low power consumption. This property has helped the LCD to obtain a large share of the digital watch display market. An electronic wristwatch, complete with CMOS circuitry and an LCD display, consumes less than 20 μA.

Where ambient light levels are low, back lighting is required since the LCD does not emit its own light. When back lighted, the LCD display loses its low power advantage. Another disadvantage of the LCD is its limited operating temperature range.

Liquid crystal displays consist of two flat transparent plates with a thin layer of fluid between them. The fluid has an orderly crystalline structure and consists of a nematic crystal form, shown symbolically in Fig 6.

A large number of organic substances may serve as the crystalline fluid. A disadvantage of the LCD is that it operates over a limited temperature range defined on the low side by the freezing point of the liquid and on the high side by a disruption of the crystalline structure.

The field effect, transmissive LCD is the one used in digital panel meters. Essentially this device consists of two polarizing light filters which form a sandwich around two plates of glass which in turn sandwich a thin layer of liquid crystal material. See Fig 7.

In a transmissive LCD, starting from the rear where the light source is located, the light shines through a horizontal polarizer, entering the glass and liquid crystal as horizontally polarized light. The interior surfaces of the glass are polished, leaving tiny, microscopic grooves along which the surface molecules of the liquid crystal align themselves. The direction of the grooves are horizontal at the rear surface and vertical at the front surface that faces the observer. The liquid crystal molecules progressively reorient themselves

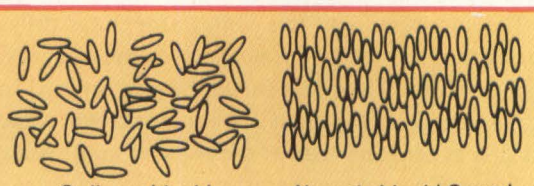


Fig 6 The orderly structure of liquid crystals can be disrupted by extreme temperatures, which cause LCDs to cease functioning.

between the surfaces from horizontal to vertical so that polarized light passing through is rotated by 90°. In the absence of an electrode voltage, light passing through from the rear is polarized horizontally, then rotated 90° in the liquid crystal so that it is vertically polarized when it reaches the front surface.

The vertically polarized light is not transmitted by the front horizontal polarizer, and the observer sees only darkness. When a voltage is applied to the electrodes, the electric field overcomes the molecular orientation produced by the polished inner surface of glass. The 90° rotation of the light in the crystal does not occur. Light passing through the crystal remains horizontally polarized as it was when it

At only $1088,* you can't offer your customers a better buy.

✻ Our quantity-50 OEM price for the *Silent 700*† Model 743 KSR Terminal is now just $1088. In larger quantities, the price goes below $1000.

And it keeps on costing less because the real payoff is in the cost of ownership. In the long run, it costs less than any other printer terminal with comparable performance.

The reason is easy. Superior design. The 743 KSR is built around a TI microprocessor. So, there are fewer components and circuit boards than in other printer terminals. That means less maintenance and more uptime performance. Plus standard EIA and current loop interfaces in a lighter, desk-top package.

The 743 features the speed, reliability and quietness that made the *Silent 700* terminal family so popular. Incoming data is buffered, so you get true 30-character-per-second throughput.

TI's Model 743 KSR

Disturbing noises associated with impact printers are eliminated with the 743's non-impact electronic printing.

Use it as a console I/O for software development. Keyboard terminal for inquiry/response.

Data entry. Interactive remote computing. Or as a message terminal network. And it's now available with APL. The 743 is backed by TI's worldwide maintenance and support services.

Find out more about TI's 743 KSR printer terminal. Fill out and mail the coupon today. Or call your nearest TI sales office, or Terminal Marketing, (713) 494-5115, extension 2126.

TEXAS INSTRUMENTS
INCORPORATED

Yes! I am interested in the 743 KSR Printer Terminal.
☐ Please have your representative call me.
☐ Please send me more information.

SILENT 700
electronic data terminals

Name _____

Title _____

Company _____

Phone _____

Address _____

City _____ State _____ Zip _____

Mail to: Texas Instruments Incorporated, P.O. Box 1444, M/S 784, Houston, Texas 77001

2-7-DD

†Trademark of Texas Instruments

*U.S. Domestic Price

TEXAS INSTRUMENTS.

entered the crystal. Light is transmitted by the front horizontal polarizer without impediment. The shape of the electrode defines the area in which the electric field operates to overcome the 90° rotation and so defines the shape of the numerals as well as the area in which light is visible.

Another type of LCD is the dynamic scattering display, shown in Fig 8. It utilizes the principle that a properly selected crystal material, normally clear, becomes turbid when a current passes through. It consists of a sandwich constructed of two glass plates containing electrodes with liquid crystal material inside. The normally non-conducting organic crystal material is doped sufficiently to allow enough current to pass through it to produce a readable image when voltage is applied to the electrodes. The current passing through produces turbidity or translucence in an electrode which is configured in the form of a segment of a numeral.

Both field effect and dynamic scattering LCDs can be either transmissive or reflective – light may be applied through the crystal from behind the rear surface or from the front side using the back surface as a reflector. Both provide good contrast and are readable in bright light. However, the disadvantages of the LCD, discussed previously, have outweighed its advantages and they are not widely used as DPM displays.

vacuum fluorescent displays

The vacuum fluorescent display consists of a vacuum tube in which a very fine filament is heated to a temperature just below incandescence. At that temperature it remains virtually invisible but emits electrons. Seven anodes, arranged in the seven-segment configuration, are covered with a phosphor which glows when struck by the electrons. When a positive voltage of 12 to 25 V is applied to the anodes, the electrons emitted by the cathode filament are accelerated and attracted to the anode segment which glows.

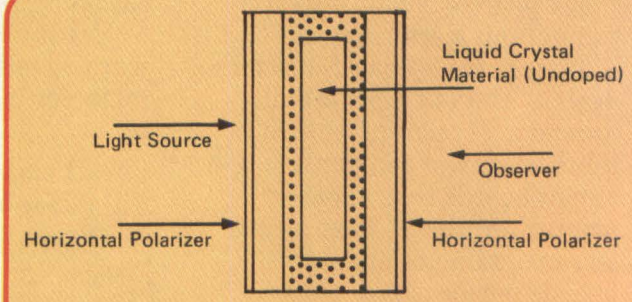


Fig 7 The transmissive LCD acts as a variable polarizer to display numerals.

incandescent displays

With their heated filaments in inert gas, incandescent displays are incomparable in terms of brightness. When digital data must be read in bright sunlight, as in a high flying aircraft cockpit, it is the most satisfactory display. The emitted light has a broad spectrum so that filtering can produce any color.

The most serious problem with incandescent displays is their slow response time. Another disadvantage is that more heat is generated by this display than by competitive technologies. Fears of short lifespan are not well founded because

the bulbs can be derated. Incandescent displays can be operated at 5 V.

The RCA Numitron, an incandescent display, is used in some DPMs. Separate coiled filaments form each of the seven segments. Separate incandescent bulbs may also be used with fiber optic light tubes to form the segments. The higher the light output, the slower the reponse time.

Incandescent displays are used in aircraft, boats, scales, gas pumps, and supermarket checkout equipment, but are seldom used in digital panel meters.

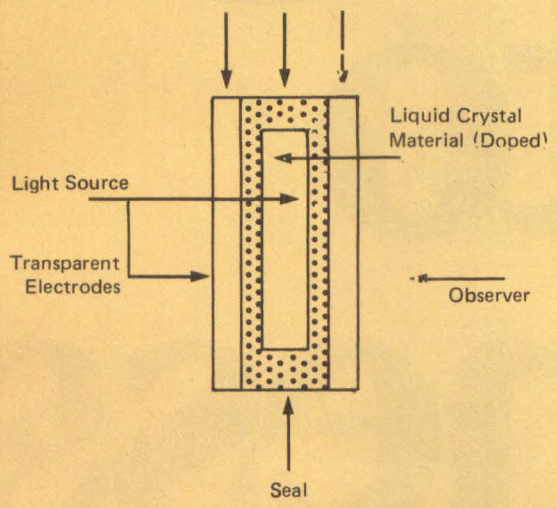


Fig 8 In a dynamic scattering LCD, the crystalline material simply becomes turbid when current passes through it.

digital control meters

A significant portion of the total analog meter market is held by the meter relay, a magnetic device that combines the indicating function of the meter with the switching function of the relay. On the same dial are displayed an indication of the measured parameter and the set points. The digital equivalent of the meter relay is the digital control meter.

A control meter is a digital panel meter with two setpoints: one high and one low. When the light value crosses either limit, a signal is transmitted for alarm or control functions, and a visual indication may also be given. In one model, for example, a pushbutton control causes the setpoints to be displayed instead of the measured parameter. The setpoints are not visible simultaneously with the display of the measured parameter. The amount of information available at a glance is less than that shown by a meter relay. The meter relay indicates how far from the setpoints the signal is at any time. For applications in medical equipment, the lack of a quick, easy indication of how far inside the normal operating range the input value may be has been a drawback to digital control meter usage.

nema standards

A NEMA committee has been working on a standard for digital panel meters for more than two years under the chairmanship of the chief engineer of Triplett. Eventually these standards will take the form of an American National Standards Institute document. However, nothing of importance

CIRCLE 22▶

Going into business sale.

National Semiconductor is going into the microcomputer business.

And to celebrate, we're having a "sale."

10% off the Intel 80/10.

To get 10% off Intel's 80/10, don't buy Intel's 80/10. Buy National's 80/10.

We're able to sell the 80/10 for less because of our improved board layout which permits automated assembly (such as using axial leaded components)...the fact that we make not only the 8080, but also—unlike Intel—most of the rest of the ICs on the board...and, of course, National's legendary competence in efficient manufacturing doesn't hurt either.

The industry standard.

Our second-sourcing of the 80/10 clears the way for the 80/10 to be the clear-cut standard of the microcomputer industry.

You can't effectively have an industry-standard without a second-source. Having two suppliers is a healthier competitive situation for you, the customer, and you have the security —and abuse-protection—of an alternate source.

What we make and how we make it.

What we're making is this:

Series/80 Cards:

BLC 80/10	BLC 104*
BLC 016	BLC 508*
BLC 406	BLC 416*
BLC 905	

*Available 3rd quarter '77

Series/80 Systems:

BLC 80P BLC 614 BLC 604

Series/80 Firmware:

BLC 910

(With more, much more, to come in the future.)

And how we're making them is this:

We're putting out the finest quality available. A cleaner board—better layout, all axial components, plug selectable options rather than wire wrap.

We "burn in" every board at elevated temperature, and run computer diagnostics during burn-in.

Think we're kidding about quality? We're offering a one year warranty. Which is just about four times longer than Intel's warranty period.

A microcomputer company small enough to do business with.

We're not dummies.

We know that to break into a field that somebody else has a lock on, we've got to offer something extra.

And extra quality for less money ain't a bad start.

But we're offering something else extra, too.

Desire.

As the little guy we can't afford a fat cat attitude.

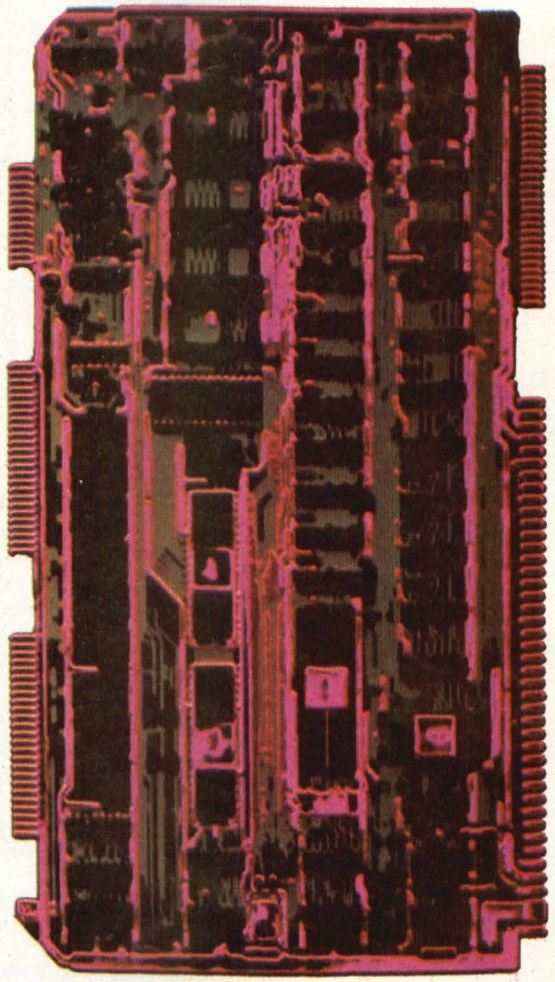
We'll do our best to meet impossible deadlines.

Our phone won't be busy. Etc.

In the microcomputer arena we're young, small, and hungry.

So if you'd like to see what you've been missing in 80/10's, see your local distributor or use this coupon to get our literature.

Help us celebrate our going into business sale by helping us *stay* in business.



National Semiconductor Corporation
2900 Semiconductor Drive, Santa Clara, CA 95051 DD7

Gentlemen: ☐ You've got my interest. Please send me more information on National's SERIES/80.
☐ I'm so turned on, I can't wait. Please have a salesman call me immediately.

Name_____ Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Telephone_____

My application is_____

☐ I'm presently using the other guy's 80/10.
☐ I'm not up to the 80/10 yet but I'm using the 8080.
☐ I have an 8080 software development system.
☐ Your BLC 80/10 will be used in house.
☐ I'm an OEM. Your BLC 80/10 will be shipped out as part of my equipment.

National Semiconductor

Table 1
COMPARISON OF DISPLAY TECHNIQUES

LED's	GAS DISCHARGE	LCD	FLUORESCENT	INCANDESCENT
Advantages:				
Resistance to: Temperature Change, Vibration, Shock	Pleasing Color, Brightness & Shape of Characters	Draws Little Power	Low Cost	Very Bright
Reliable	Large Size	Potentially Low Cost	Voltage Required Generally Avail.	Excellent Appearance
Long Life	Low Cost	Voltage Requirements Generally Available	Lowest Power Consumed except for non-backlighted LCD.	Can Produce All Colors
Extremely Fast Response	Long Life	Readable in Sunlight	Pleasing Color	5V Power Readily Avail.
Uses Low DC Voltage	Easy to Mount	High Contrast Ratios		Can Be Large Size
Low Cost	Rapid Response Time			
	Moderate Power Consumption			
Disadvantages:				
Limited Viewing Angle	Requires 170-180V Power	Needs Backlighting In Darkness Which Increases Power Consumption	Glass Package May Be Damaged	Slow Response
Not Very Bright	Difficult To Use With +5V DC	Difficult to Read at Some Viewing	Contains Filament	Consumes High Power
Hard to Read In Ambient Light	Needs Special Drivers	Looks Lifeless	Power Required	More Delicate Than Some Others
Limited In Size		Limited Temperature Range	Breakage Possible	
Requires Constant Current Source		Slow Response Time		
High Power Consumption		Difficult To Mount		
		Needs AC Drive Signal		
		Limited Life		
		Difficult To Multiplex		

is likely to result from these efforts for the following reasons:

- The many permutations and combinations of characteristics pertaining to digital panel meters make meaningful interchangeability practical.
- None of the leading manufacturers of DPMs is represented on the committee.
- There is no established industry leader who can set a de facto standard.

In attempting to formulate a standard for digital panel meters, the committee has been guided by the NEMA standards for analog panel meters; many grades and types exist. Among the classifications used are accuracy, size, shape – round, square, edgewise, switchboard – and parameter measured.

As difficult as it was to formulate an adequate standard for analog meters – and, in fact, the NEMA analog standards are little used except for switchboard instruments – a DPM standard is much harder to formulate, especially if interchangeability is required. Power supplies differ from one digital panel meter to another; analog meters require no power supply. Dimensions vary greatly in depth as well as in panel area required; temperature sensitivity has a wider range of different specifications; readouts are different; some have BCD outputs and overload signals which may be latched, unlatched or buffered. Inputs vary and power consumption is widely different. Especially difficult to standardize are pin configurations on connectors. Number of digits, latch or buffer of output and print commands all vary widely. Accuracy figures are muddied by bias current, stability, temperature variation and noise rejection. The only feature of a DPM that appears easy to standardize is the type of numerals; these are definitely Arabic rather than Roman.

safety standards

Digital panel meters are electrically active devices requiring power which is often brought in directly from the AC line. Those using gas discharge displays contain 180 V potentials. Whereas an analog panel meter is electrically innocuous, a digital panel meter may contain the same sort of safety hazards found in other electronic test equipment.

Underwriters' Laboratories is working on UL 1244, a safety standard for test and measuring instruments. Two drafts have been prepared and distributed for comment. A third revision is in preparation. UL 1244 is a standard for complete instruments rather than for the panel meters that are incorporated into them. Panel meters have no standard of their own.

Since the advent of the Occupation Safety and Health Act, the demand for UL approval of electrical equipment has quadrupled. Compatibility with UL 1244 would be desirable because some localities, such as Los Angeles and Chicago, have laws requiring that electrical equipment be approved by a nationally recognized testing organization. In practice this virtually means UL. Even though most of the United States has no statutory testing requirement, conformance is desirable because OEMs are reluctant to have to revise their product according to the locality of the order. Manufacturers should be aware of the new standard and keep abreast of its progress.

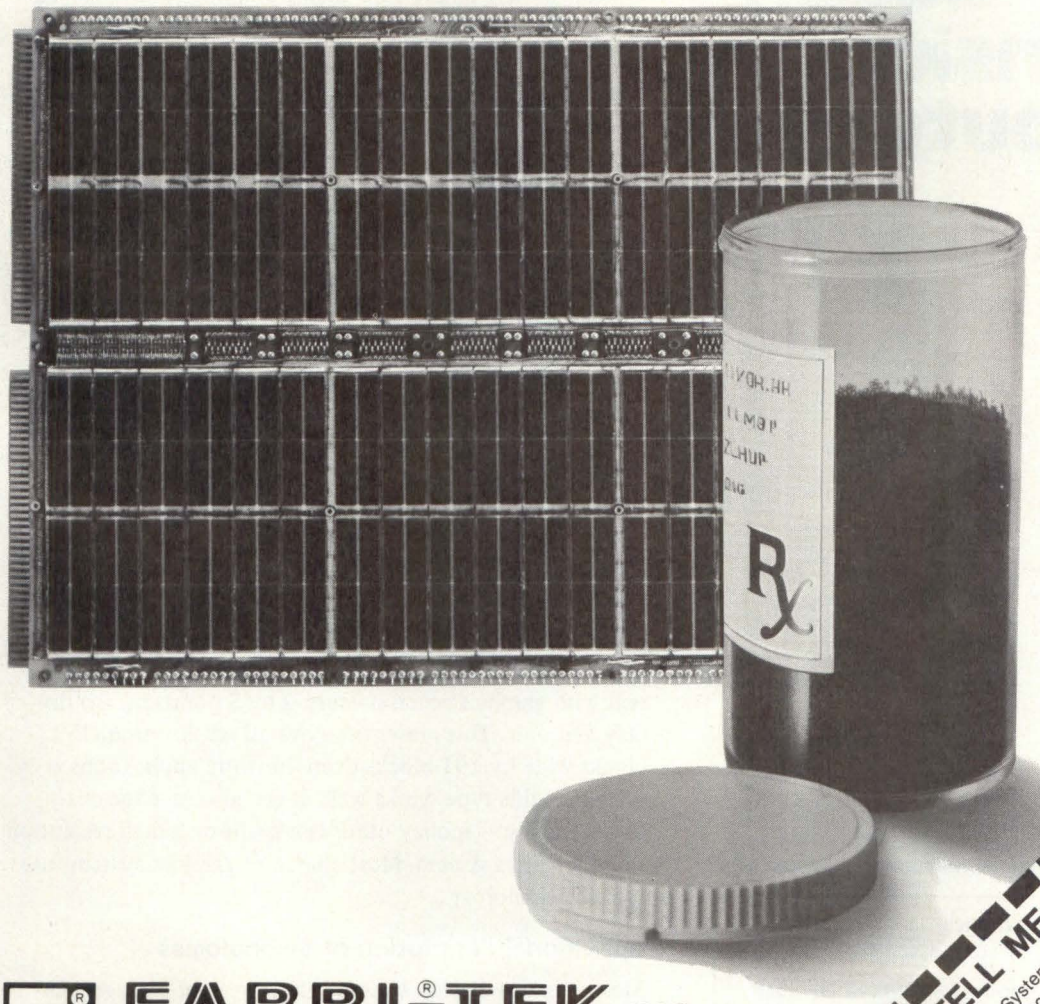
Edward A. Ross *is a senior consultant at Venture Development Corp., Wellesley, Mass., and publisher of an industry study from which this article was adapted.*

Suffering from temporary loss of memory?

Try the Fabri-Tek core remedy.

If you're like some people who've been on a straight semiconductor memory diet, you've probably been experiencing severe complications. Loss of memory when power is removed. "Soft" random errors that can't be diagnosed. Temperature sensitivity. Added cost and complexity of error detection and correction schemes and battery back up.

For no added cost, core memories provide greater reliability, maintainability, non-volatility and 20 years of proven technology. They're relied upon in process control and a lot of other demanding applications where a failure could be catastrophic. Take our Model 698: 64K bytes of 650 nsec cycle time and 250 nsec access time. You can build a system up to 512K bytes. (Micro 3000 compatible, too). Maybe its time you kicked the semiconductor habit. We're ready to help.



TELL ME MORE

☐ Model 698-32K X18 System ☐ Model 696-16K X18 System ☐ Future requirement
☐ Bulk Core Systems ☐ 30-90 day requirement ☐ Send literature
☐ Special memory needs ☐ Have salesman call

Name and Title _____
Company _____
Address _____
City, State, Zip _____
Phone _____

FABRI-TEK® INC.
COMPUTER SYSTEMS

5901 South County Road 18 • Minneapolis, MN 55436 • (612) 935-8811

Boston, MA	Hawthorne, CA	Dallas, TX
(617) 969-5077	(213) 973-0484	(214) 234-8438
Chicago, IL	San Jose, CA	Houston, TX
(312) 437-4116	(408) 246-8391	(713) 467-4373

CIRCLE 35

Graphic Display Systems

adding dimension to computer i/o

by **Sharon Pellerin**
Assistant Editor

Graphic data processing provides a common language of graphics and alphanumerics between man and the computer. A man thinks in terms of sketches, drawings, graphs, letters, characters and numbers. However, the computer relates to bits, bytes and registers. With a graphics display as the interface between the two, man can spend more time defining a problem in terms he understands best.

Graphic display terminals are used in the following broad categories of application; computer aided design, simulation, training, command and control, process control, mapping, data reduction and image analysis. Depending upon the application, these displays can present data on a character or point basis. Units with point resolution require large memories and support software and as a result carry higher price tags.

Storage tube and refresh tube technologies have carved out their own special areas of expertise. Each technology has its desirable features and only the application can determine which is appropriate. Some desirable features of graphic display systems are high data quantity, fast response time, high light output, multiple colors, special functions and low cost.

character vs point graphics

The main difference between a point graphics system and a character system is the amount of refresh memory. Instead of storing information for every point on the display, a character system stores only an 8-bit or less representation of the character. So if a character system can display 2,000 characters, it requires 2K bytes of refresh memory. With character graphics systems, the user can build special symbols that represent key components of a process. Taylor Instruments, Rochester, NY, for example, uses the Intercolor 8001 system manufactured by Intelligent Systems, Inc., Norcross, GA, to display the process flow chart in a nuclear power plant. Several special characters, appropriately linked, create an image of a pump or a valve. The 8001 system with graphics accesses every 2 by 3 points on the display as a unit. This presents an overall resolution of 159 blocks wide by 191 blocks deep. In many applications, a system of this type works well. It can also save the customer money – money otherwise spent on a high resolution point graphics system. Most character graphics systems use refresh technology.

operational description of technologies

Most graphics display systems use refresh or storage technology. Two main types of refresh techniques exist: stroke writing and raster scanning. Stroke writing display systems position an electron beam on the tube face much as one would draw on paper with a pencil. In raster scanning systems, the beam sequentially traces the entire face of the tube. When the beam arrives at a point that belongs to the picture under construction, a video signal "brights up" the beam to illuminate the screen. Since the persistence of the

Background

Modern computer graphics began about nine years ago at the MIT Lincoln Laboratory where Dr. Ivan Sutherland developed the SKETCHPAD program which allowed users to sketch pictures on a cathode ray tube. IBM's 2250, supported by a big CPU, came next. Then the storage tube came from MIT. The storage tube business has grown to the point that Tektronix alone has sold $50 million worth of storage tube terminals.

Compare the new Sanders Graphic 7 with other interactive terminals.

You'll draw a graphic conclusion.

Sanders' new Graphic 7 is plug-to-plug compatible with practically any host. And our price is easy to take.

The new Graphic 7 is an intelligent terminal with all necessary hardware and software as standard —not cost-you-extra—features.

But the Graphic 7 doesn't just save you money when you buy it. It also saves you money after you buy it.

Simply wheel your Graphic 7 through the door and plug it in. No installation problems.

Your programmer won't have to spend much time with your Graphic 7. It comes pre-programmed.

And your operators will be able to handle your Graphic 7 after a 10-minute briefing, because it works with a one-button initialize.

Application programs? Our Fortran-based graphic support package can reside in any host that supports Fortran.

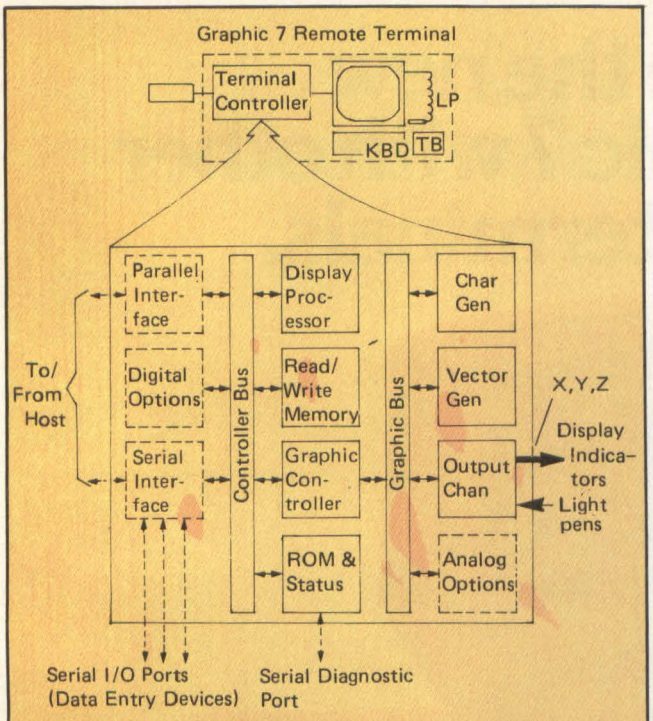
And with the intelligence at the terminal, there's minimum impact on the host. You can do more work faster.

Sanders experience? Our graphic terminal systems are used in computerized production projects. Tire-tread design. Avionics defense systems. Flight training. Land-use management. Air traffic control. And dozens of other areas.

Compatible, fully equipped, very low priced. What other graphic conclusion can you draw than the new Sanders Graphic 7? Send for specs and specific applications. Sanders Associates, Graphic Systems Marketing, South Nashua, NH 03060. 603-885-5280.

SA® SANDERS ASSOCIATES, INC.

CIRCLE 36



This block diagram of a graphics terminal controller shows a dual-bus structure. The Sanders controller uses two microprocessors — one called the display processor and the other called the graphic controller. As shown, this stroke writing system uses hardware to generate vectors and characters.

phosphor in the tube is low, CRTs using one of these techniques require periodic image refreshing. To prevent annoying flicker on the screen, these CRTs refresh the image at least thirty times each second. Two storage technologies exist: the storage tube and the plasma panel. With storage technology, the CRT receives its image the same as a stroke writing system. However, the tube stores the image, eliminating periodic refresh.

storage tube technology

Storage tube technology entered the graphics display industry in 1968 with Tektronix, Beaverton, OR, model 611 storage tube. Terminal manufacturers integrated the tube into a finished graphics terminal. Then in 1971, the firm decided to build its own terminal – the model 4002 – around the 611. Also in 1971, Tektronix introduced the model 4010, the first of the graphic display terminal line we know today. Currently, the firm offers seven "terminal only" models in different character sets and screen sizes. These units range from under $4,000 to $10,000. Recently, Tektronix has started selling graphics systems built around these terminals.

Storage tubes can store an image for several minutes without refresh. These tubes contain two electron guns: the write gun and the flood gun. The write gun generates a high energy beam that writes the image as positive charge on a grid electrode imbedded in the tube's face. Then, the flood gun produces a low energy beam that penetrates the grid at all positively charged areas and continues on to strike the phosphor. The continuous beam from the flood gun sustains the image. After some time, the positive charge on the grid electrode begins to break down, which requires image rewriting

Tektronix claims that its storage tube can display 120 picture elements per inch. The user receives an addressable matrix of 4,096 by 4,096 points. The viewable matrix is about one half that size. To make the lines look smooth, points on the tube overlap.

Work involved in laying down the screen properly makes the manufacturing process for storage tubes much more sophisticated and expensive than that for refresh tubes. Many electrodes, called collectors, stationed throughout the phosphor, create the local field necessary for the secondary emission phenomenon.

Storage tubes can also perform limited refresh graphics. Up to 1,000 inches of refresh information can be displayed along with the storage tube image. This capability lets the user build an image interactively and in sections. After completing a section in the refresh mode, the user can commit it to the storage mode. Storage tubes permit this refresh image because a decrease in the accelerating potential of the flood gun beam causes the screen to flash momentarily rather than store the image.

Storage tubes offer two advantages: • image storage by the tube, which eliminates complicated refresh circuitry to maintain the image; this feature translates into low cost; • storage of an enormous volume of data on the screen at a given time; this feature helps storage tubes find use in applications like computer-aided design in the electronics and automotive industries.

Necessary Features for Major Application Areas

Application	Data Volume	Response Time	Other Requirements	Most Suitable Technology
Computer Aided Design	high	medium	support software	Storage Tube
Simulation and Training	medium	fast	- - - - -	Stroke Writer
Command and Control	medium	fast	- - - - -	Stroke Writer
Process Control	medium	medium	bright display	Raster Scan
Imaging	high	medium	color	Raster Scan
Mapping	medium	fast	- - - - -	Stroke Writer

MEMO:

TO: *All potential Microprocessor Users*

Consider the NEW Memodyne 760 Series of high-performance digital cassette recorders with your micro processor (or your mini-computer or terminal)

Model 764 (Shown)

HIGH PERFORMANCE DIGITAL CASSETTE RECORDERS

FEATURES

HIGH SPEED Up to 32 kilobits per second. Searches forward and reverse at 100 inches per second.

FAST RESPONSE 200 millisecond start-stop-settle time.

RUGGED AND RELIABLE Only 2 moving parts. • MTBF > 10,000 hours. Soft error rate of 1 in 10^7.

LARGE CAPACITY Up to 1600 flux changes per inch or 5 million bits per standard Philips cassette.

VERSATILITY Accurate speed, very low skew and ANSI/ECMA compatibility permits use of all popular encoding schemes.

STATUS INDICATIONS BOT/EOT hole and leader sensor, Cassette-In-Place, File Protect and Busy/Ready.

DESCRIPTION

The Memodyne 760 Series of cassette recorders are compact, removable medium, storage devices for digital information. Their two track and high density capability provide up to 5 million bits of storage on a single standard Philips cassette. In their standard configuration they are capable of storing or retrieving data at a rate of 16 kilobits per second per track. A patented reel-to-reel constant tape speed servo (U.S. Patent Office #3,733,529) coupled with precision tape guidance allows implementation of any of the popular encoding schemes with low error rates, minimal tape wear, and high tape utilization. The simplicity of the transport mechanism and the use of conservatively rated, high quality parts give high reliability and maintenance-free operation. Three of these compact units can be fit on a single 5" x 19" standard panel. The enclosed cassette chamber holds the cassette firmly, resisting vibration while shielding the cassette from airborne contaminants.

SPECIFICATIONS

Status Signals:
Cassette-In-Place, File Protect, B/EOT, Busy/Ready — TTL Compatible.

Control Signals:
Run/Stop, Forward/Reverse, Slow/Fast — TTL Compatible.

READ AND WRITE PERFORMANCE (Read-While-Write)

Gap Spacing:
.150, ±.005 inch.

Dynamic Skew:
±100 microinches max.

Recording Density:
To 1600 flux reversals per inch nominal.

Transition Spacing:
Down to 625 microinches nominal.

Read and Write Rate:
Up to 32,000 transitions per second.

TAPE MOTION

Tape Speed:
20 inches per second,
100 inches per second,

Start Time to ±5% of 20 Inches Per Second:
75 milliseconds.

Start Distance to ±5% of 20 Inches Per Second:
1.00 to 1.25 inch.

Start Distance to ±5% of 100 Inches Per Second:
500 milliseconds maximum.

Stop and Settle Time:
150 millisecond recommended minimum.

ERROR RATES
Soft errors: 1 in 10^7 is easily obtainable in typical applications.

Priced $300. and up in OEM Quantities F.O.B. Newton, Mass.
Write for latest Memodyne Product Catalog

Memodyne CORPORATION

385 ELLIOT STREET, NEWTON UPPER FALLS, MA 02164
TELEPHONE (617) 527-6600-TELEX 922537

CIRCLE 37

Digital introduces DECstation. A big computer system that's small enough for anyone.

Digital put an amazing LSI version of the PDP-8 inside a DECscope, added some ingenious interconnecting devices and created something new. The DECstation. A complete computer system big enough to do all kinds of work and small, simple and inexpensive enough to do it for almost anyone.

DECstation. A complete computer system in disguise. It looks like a terminal, but look again. The DECstation has a powerful general purpose computer, a video terminal, a dual diskette drive, and its own special operating system. What's more, you can hook up two different printers and a second dual diskette drive. Then put the whole thing in a mini-desk, and when you're done you'll have the smallest big computer you've ever seen.

The Video Data Processor. It's the big reason the DECstation's so small. The VT78 Video Data Processor is a computer wrapped in a terminal. Inside the familiar DECscope you'll find an LSI version of the PDP-8 with 16K words (32K characters) of MOS memory and built-in interfaces. Two serial asynchronous ports feature speeds from 50 baud to 19.2 kilobaud. A disk port interfaces with up to 4 diskette drives. A parallel I/O port for printers and custom interfacing provides data transfer rates up to 180 kilobits/sec. All standard.

You can go from carton to computer in less than an hour. If you can push a button, you can run a DECstation. Because one button is all it takes to start things up. The bootstrap and self-test routines are built in.

Put it together, plug it in, and immediately you can begin to run anything from the PDP-8 software library. Which means you start with one of the most comprehensive sets of software tools available in a small system. Including two proven operating systems: OS/78 for stand alone applications and RTS/8 for real-time. OS/78, an extension of OS/8, supports a number of languages, including FORTRAN IV and BASIC. So all you have to do is load the operating system and start programming your application.

Whatever that application, if you're looking for a sophisticated little system, at the right price, and a remarkable OEM tool, consider DECstation. $7995 each. $5436 OEM quantity 50.

For our free brochure, write Digital Equipment Corporation, Parker Street, Maynard, MA 01754. European headquarters: 81 route de l'Aire, 1211 Geneva 26. Tel: 42 79 50. In Canada: Digital Equipment of Canada, Ltd.

digital

DD77

PDP-8 Marketing Communications
Digital Equipment Corporation, Parker Street, PK3-1, M34
Maynard, MA 01754.
Send me the free DECstation brochure. (please print)

Name_____

Company_____

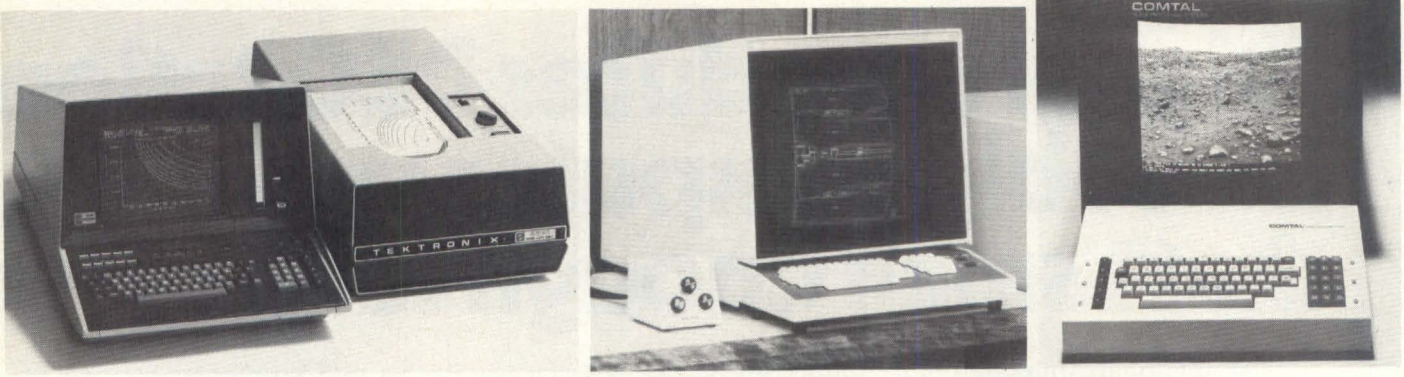
Address_____

City_____ State_____ Zip_____

Phone_____ OEM_____ End-user_____

Application_____

_____ Please send additional information about the PDP-8 family.



Storage Tube (left): Shown on the screen of this desktop computer with graphics from Tektronix, Inc., Beaverton, OR, is a family of waveforms presented as part of a product proposal for metric converters. The display plots price per unit against volume; each curve represents increments of expected earnings as a percentage of net sales. Stroke Writer (center): On the screen of this graphics system from Imlac Corp., Needham, MA is a pattern for a blouse. Interactively, a fashion designer can specify desired patterns. Image System (right): Shown on the display of this Comtal Corp., Pasadena, CA image processing system is the surface of Mars. The Jet Propulsion Laboratory used this system to correct color in images transmitted from that planet during the Viking mission.

Storage tube graphic systems offer many disadvantages: • the dim display doesn't suit high light environments; • also, storage tubes have short lives – about 2,000 hours at full intensity; • to support functions such as selective erase, zoom and pan, storage tube systems need minicomputers; • to erase a line on a storage tube, a system must erase the entire image and then rewrite a modified image; this feature can prove time-consuming.

plasma panel technology

The plasma panel – with its inherent storage capability – provides a bright, easily readable output. The matrix of electrodes within the panel's glass plate positions each element in the same relation to all other elements. Peak point luminescense or light output of 30 foot-lamberts minimum ensures visibility of each element. This characteristic provides high contrast ratios which suit the display for locations with high background and overhead lighting levels.

Magnavox, Fort Wayne, IN, manufactures plasma display terminals for graphic applications. The panel's resolution of 512 by 512 elements with 60 elements per inch provides an active viewing surface of about 8.5 inches square. Positioning of the display elements during manufacture makes these units accurate. On the other hand, plasma panels lack the addressing capability of CRTs. Cathode ray tubes can put out finer lines and more densely packed than plasma. Price-wise, plasma panels sit at the low end of the graphics display market, along with storage tubes. Magnavox's basic plasma panel graphics terminal sells for $6,000, similar to the price of Tektronix's 4012 storage tube graphics terminal.

An advantage of plasma displays over storage tube displays is selective erase. The user can selectively erase lines or sections on a plasma display without the need to erase and recreate the entire image. Further, Magnavox offers with its Orion-60 plasma display terminal a feature called "touch entry". A touch panel mounts within the front cover of the terminal and overlaps the flat display screen. This panel consists of an invisible x,y matrix of infra-red beams from light emitting diodes. The array of 16 by 16 LEDs forms 256 unique beam intersections. If a finger or other opaque device interrupts a pair of beams, photo detectors sense the condition to define a unique set of coordinates. An audible tone occurs when the touch panel accepts a pair of coordinates. "Touch entry" finds use in physician and medical-data entry and retrieval applications. Another application area for plasma displays is word processing. The plasma panels can hold over 4,000 characters in a 5 by 7 dot matrix with very bright light. Even though plasma terminals cost much more than character CRT terminals, in word processing these features justify the additional cost.

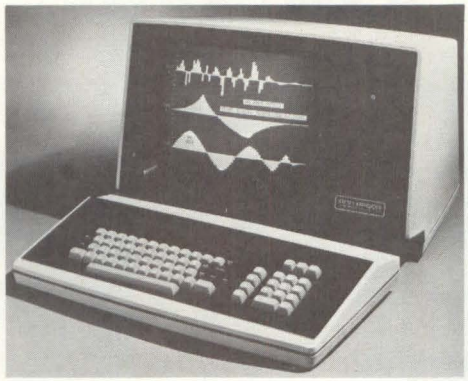
refresh technologies

There are three types of refresh systems: stroke writing, raster scanning and scan converting. Stroke writing and raster scanning systems resemble each other, differing only in their beam deflection techniques. Hybrid scan converters use a storage tube to store the image and then scan the storage tube information onto a raster scanning monitor to display the image.

Refresh CRT tubes contain only one electron gun which shoots an electron beam at the phosphor-coated screen of the tube. Along the beam's path, electrostatic or electromagnetic fields direct the beam toward a particular point on the tube's face. When the beam strikes the phosphor, the screen lights up but only briefly. How briefly depends on the persistence of the phosphor material; the length of time can range from tenths of microseconds to hundreds of seconds.

Since the phosphor lights up for only a brief time, the electron gun must rebombard the phosphor at periodic intervals to sustain the image on the tube's face – a process called refresh. All CRT tubes manufactured in this way require periodic refreshing to be useful.

About three years ago, graphic terminal applications began to specify raster scanning systems. Raster CRTs solve a number of problems inherent in storage or direct



Plasma Panel (left): This envelope image consists of a number of straight lines drawn tangent to a curve. The terminal is manufactured by Eprad, Inc., Toledo, OH. Character Graphics (center): This character graphics terminal from Ann Arbor, MI shows three traces. The first is a bar graph. The second trace is cusped waveform and the third, a damped sinusoid. Raster Scan (right): Hewlett-Packard's recent entry into the graphics market, the 2648B, shows a graph of Division – A's deviations from budget for a specified year. A point is plotted for each month of the year and the budget deviations extend from $1,000 over budget to $1,000 under budget.

Specific Applications of Graphic Display Systems

Engineering Drawings
Layout Drawings for Printed Circuits
Subdivision and Construction Layouts
Computer Aided Design Systems

Weather Maps
Contour Maps
Exploration Maps for Petroleum and Mining
Reservoir Sizing
Oceanographic Charts
Oil Production Maps

Layout Drawings for Petroleum and Chemical Processes
Unit Operations Drawings for Petroleum and Chemical Processes
Pole Line Distribution Drawings for Electric Utilities
Quality Control Displays
Temperature and Pressure Distribution Drawings

Antenna Scatter Displays
Multi Dimension Analysis
Research and Engineering Data Reduction
Calibration Curves
Power Spectral Displays
Fourier Analysis
Wave Research Drawings
Strip and Disk Chart Analysis

Medical Records
Business Graphs
Word Processing

Visibility Studies
Cockpit Visibility Studies
Aircraft Landing
Ship, Aircraft, Missile and Satellite Course Plotting

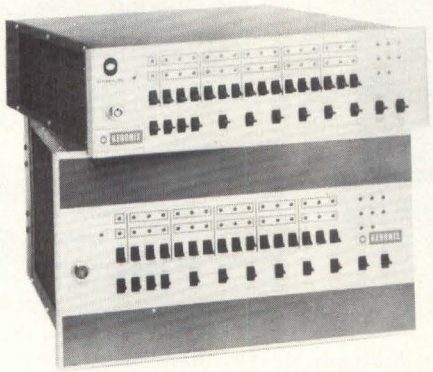
Image Enhancement
Image Recognition
Computed Tomography

writing CRTs. But up until recently, raster tubes did not provide the required resolution. Today, raster tubes claim competing resolutions of 1,024 by 1,024 elements. Raster tubes can provide color, selective erase and high brightness. Since the raster unit writes every element, a system can shade images and provide the orders of magnitude of data of a direct write tube, but with smaller spot size.

CBS Laboratories is researching laser deflection to get rid of the glass tube and its problems of distortion, size and cost. CBS has developed a piezoelectric device that can distort the laser rod and cause the beam to deflect. In about 3 to 5 years, this technique can become practical. The laser will, at that time not only produce an image but also perform an operation without conversion. Consequently all the drive electronics and software can be used for input and output. Software and hardware can be standardized and common to all systems.

Raster scanning systems are moving into traditional stroke writing system markets such as simulation and training. One of the requirements for simulation and training applications on graphics systems is dynamic motion. Stroke writers, since they generate vectors on the fly, perform a reasonable job with moving pictures. However, raster scanning systems must alter all refresh memory locations that change so as to display moving pictures. With color or gray scale pixels, this job can become horrendous. Genisco Computers, Irvine, CA, makes a color graphics system using raster scan technology with a feature that allows a dynamic motion display. Called "circumfill", this feature lets the operator specify a vector that represents the change from one increment to the next. For example, McDonnell Douglas uses Gensico's system to train aircraft pilots. The unit displays a horizon – the top half of the screen is blue and the bottom half green. Since aircraft motion changes a pilot's view of the horizon, and the simulation task required ten changes to the horizon per second, designers believed that raster scan technology could not respond swiftly enough. However, with "circumfill" the hardware algorithm

A Total Syste



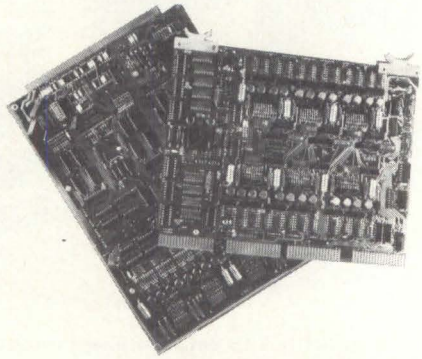
KERONIX IDS - 16 MINICOMPUTERS

A 16-Bit Full Parallel Synchronous, High-Speed General Purpose, Mini Computer

- INSTRUCTION SET, I/0 INTERFACE & MEMORY INTERFACE COMPLETELY COMPATIBLE WITH NOVA™ SERIES OF MINI COMPUTERS
- ADDRESS UP TO 65K (Without the Use of Costly Memory Management)
- HINGED FRONT PANEL WITH FRONT LOADING CIRCUIT BOARDS
- POWER FAIL & RESTART–STANDARD
- FOUR 16 BIT ACCUMULATORS
- 800, 1000, or 1200 NANOSECOND MACHINE CYCLE TIME USING ONE BOARD CPU'S
- 4, 8, 10, 13 OR 17 SLOT CAPACITY
- INTEGRATED MSI & LSI CIRCUITS THROUGHOUT. TRI-STATE ELEMENTS ARE USED FOR ALL I/0 & MEMORY LINES
- FORCED-AIR COOLING (UP TO 4 COOLING FANS)
- POWER SUPPLY IS MODULAR FOR EASY SERVICING & PROVIDES UP TO 50% MORE POWER THAN COMPARABLE UNITS
- MANY OPTIONAL FEATURES AVAILABLE
- EXTENSIVE SOFTWARE AVAILABLE
- LOANERS AVAILABLE ON OUR ONE-YEAR WARRANTY

LOOK FOR OUR COMPLETELY INTELLIGENT KERONIX MODEL KX-8000, COMING SOON!

For more extensive information on our IDS-16, please contact us directly.



KERONIX ADD-IN MEMORY PRODUCTS

4K, 8K, And 16K Words
PLUG COMPATIBLE CORE MEMORY SYSTEMS

- P-3 SERIES . . . FULLY COMPATIBLE WITH DATA GENERAL NOVA™ 1200 & DCC™-116
- P-4 SERIES . . . FULLY COMPATIBLE WITH DATA GENERAL NOVA™ 800, 820 and 840
- P-5 SERIES . . . FULLY COMPATIBLE WITH DATA GENERAL NOVA ™ 2 SYSTEMS
- I SERIES . . . FULLY COMPATIBLE WITH INTERDATA™ 70, 74, 7/16, 7/32 SYSTEMS
- D SERIES . FULLY COMPATIBLE WITH PDP-11™s
- J-1 SERIES . . . FULLY COMPATIBLE WITH MICRODATA™ 800 AND CIP™ 2000
- J-2 SERIES . . . FULLY COMPATIBLE WITH MICRODATA™ 1600
- G SERIES . . . FULLY COMPATIBLE WITH PRIME™ 100, 200, & 300
- E SERIES . . . FULLY COMPATIBLE WITH PDP™ 8E, F, M, AND A

IN ADDITION TO THE ABOVE, KERONIX MANUFACTURES ADD-ON MEMORIES, OEM MEMORIES, AND CUSTOM MEMORIES

ONE-YEAR WARRANTY WITH ALL KERONIX MEMORIES

KERON

WE HAVE REPRESENTATIVES

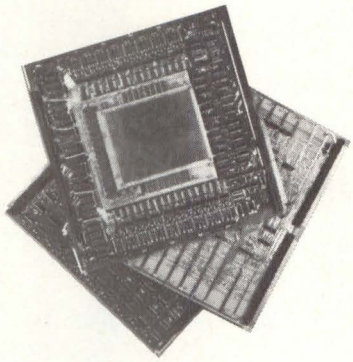
George
250 E. Emerson St. • Orange, (
TWX 91

ms Capability

VIDEO DISPLAY TERMINAL
KERONIX MODEL K-4000

- FULL KEYBOARD (Optional 10-Key Pad Available)
- HIGH RESOLUTION, NON-REFLECTING SCREEN; 9" X 7" (12" Diagonal); SWIVEL BASE; EASY VIEWING UP TO 10 FEET; BRIGHTNESS CONTROL; REVERSE VIDEO (Black Characters on White Background, Selectable)
- 80 CHARACTERS PER LINE, 25 LINES, 2000 CHARACTER DISPLAY; STORE UP TO 51 LINES & 4080 CHARACTERS; BLINKING CHARACTERS AT 3Hz RATE
- CURSOR CONTROL (Non-Destructive)
- INTERCHANGEABLE WITH TELETYPE USES STANDARD ASCII CODE
- INTERNAL POWER SUPPLY; RUNS OFF A SINGLE 15" X 15" P.C. BOARD
- VARIABLE BAUD RATE (75 to 9600 Bits Per Second); 10 OR 11 BIT CODE
- ODD OR EVEN OR MARK PARITY
- EITHER EIA OR 20 MA CURRENT LOOP

LOOK FOR OUR COMPLETELY INTELLIGENT



I/O AND PERIPHERAL CONTROLLERS
FOR KERONIX IDS 16 COMPUTERS AND NOVA ™ SERIES OF COMPUTERS

- 1007 I/O BOARDS
- 1008 REAL TIME CLOCK
- 1010 TTY INTERFACE
- 1011 PAPER TAPE READER CONTROL
- 1012 PAPER TAPE PUNCH CONTROL
- 1016 CARD READER CONTROLLER
- 1023 EIA INTERFACE
- 1034 LINE PRINTER CONTROLLER
- 1038 MULTI-PROCESSOR COMMUNICATIONS ADAPTER
- 1046 DISK CONTROLLER
- 1146 FLEXIBLE DISK CONTROLLER
- 1054 EXTENDER BOARDS
- 1060-4 FOUR LINE ASYNCHRONOUS MULTIPLEXER FOR FOUR EIA STANDARD LEVEL LINES (MUX)
- 1060-8 MUX FOR EIGHT EIA STANDARD LEVEL LINES

IN ADDITION TO THE ABOVE, KERONIX MANUFACTURES ADD-ON MEMORIES, OEM MEMORIES, AND CUSTOM MEMORIES

ONE YEAR WARRANTY ON ALL KERONIX IO PERIPHERAL CONTROLLERS

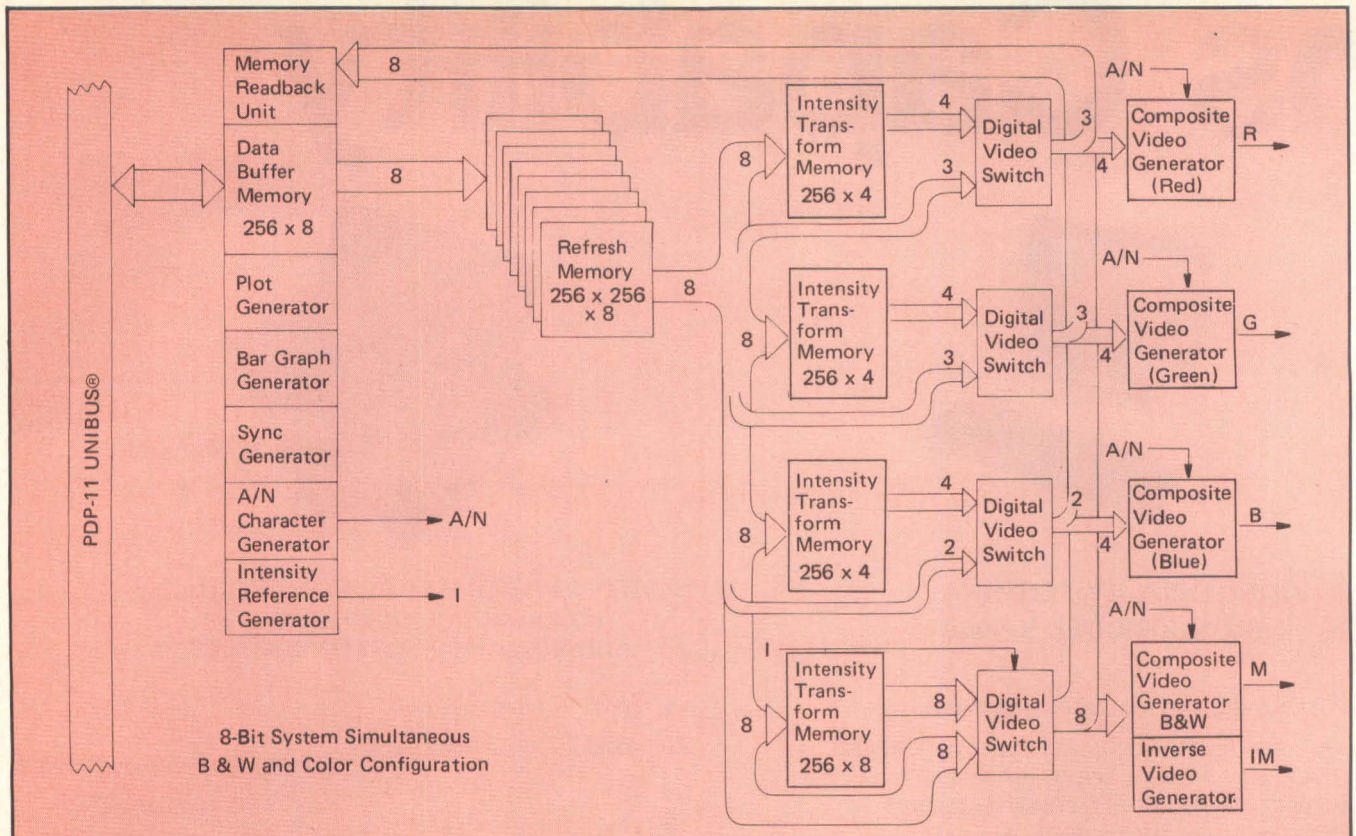
TM Trademarks registered by Data General Corporation
Endorsement of Keronix products by Data General not to be implied.

IX INC.

AND DISTRIBUTORS WORLDWIDE

Földvary
alifornia 92662 • (714) 974-0800

CIRCLE 40



DeAnza's model 2208/08C Image Display System is suited for applications which require both color and gray scale displays with a maximum of 256 colors or gray scale levels. The VIDEO OUTPUT porvides an RGB interface for a color monitor as well as two monochrome monitor interfaces. With the optional INTENSITY TRANSFORM MEMORY the 8-bit refresh memory is mapped to three 4-bit words and one 8-bit word. Each of the 4-bit sections is routed by the DIGITAL VIDEO SWITCH to a 4-bit digital-analog converter (DAC) providing 16 levels of intensity for each of the RGB monitor signals (4096 choices of the 256 possible colors). The 8-bit section of the INTENSITY TRANSFORM MEMORY is routed to an 8-bit DAC producing 256 levels of gray scale for a monochrome monitor. A separate video output provides inverted video data for camera or printer use.

draws only the vector of the new horizon and then automatically fills in the upper and lower parts with updated color. The operator need not specify new pixel data.

Stroke writers can display only a limited amount of data without flicker. Raster scan systems overcome this difficulty because of their constant rate of refresh. However, raster scan systems require more memory space, since every point on the screen must reference memory.

The selective erase feature of refresh graphics systems is a by-product of the technology. Since the memory stores the displayed image at all times, a change to this image requires only change to the memory. On the other hand, storage tube systems require a complete image erase and redraw to implement a change. It takes about one second to erase a storage tube display and another few seconds to recreate the modified image. When storage tube graphic terminals are used in a time sharing system, the erase and redraw times can become ridiculously long. Therefore, storage tube graphics terminals probably do not suit highly interactive graphics work.

One drawback to raster scanning systems is the "jagged" problem. A line drawn across the entire screen at a very small angle off horizontal requires the illumination of very few raster lines. At each point along the line, when the system "brights up" a subsequent raster line, a jagged edge appears. The overall result is a line with a jagged structure. On stroke writing systems, this problem doesn't occur.

In the Hughes Aircraft, Carlsbad, CA, Conographic 9 System, a scan converter tube within the system serves as refresh memory. However, this tube is not a direct view storage tube. It has an electrical input and output. In this system, the information on the storage tube or scan converter tube is raster scanned onto a digital tv monitor in a refresh manner. Information from the computer goes onto the scan converter tube in stroke writer fashion. The scan converter tube – buried within the electronics of the unit – measures only 2" in diameter and 10" long.

Down the road, memory prices will decrease and more sophisticated raster scanning systems will appear. According to sales manager Tom Raines at Hughes Aircraft, Carlsbad, CA, the raster scan technology offers the ultimate in interactive graphic systems.

Raster scan systems provide an additional feature – color – not possible with stroke writers. Color graphics aid quick recognition – the argument most often presented in favor of using color: an object in color stands out more sharply than one in black and white. Philadelphia Eiectric, Philadelphia, PA, uses color graphics to monitor its power lines. Each line appears on the screen, color-coded according to its load. If the power system undergoes failure, the display flashes an alert. The operator observes the warning, then determines how to reroute the power, making sure that in

the process, no other lines become overloaded.

Three-dimensional capability on graphic systems lets them present three-dimensional pictures in true perspective or in orthographic projections. A feature called depth cueing causes the z axis in a three-dimensional plot to fade in brightness as the axis moves away from the observer.

image analysis systems

Imaging applications permit users to study and modify each individual picture element to view the overall effect and extract information not readily discernible in the original data. Performing this requires operations such as generation of pseudo-color, fake manipulation of multi-spectral data or spatial enhancement. Image enhancement systems can superimpose additional data such as alphanumeric messages and labels, geographical grids, political boundaries and outlined areas of interest. But the graphics generation capabilities – usually minimal – only serve to improve the principal operation, the analysis and enhancement of image data. Some application areas show substantial promise for future growth: the medical diagnostic market with tomographic scanners, industrial x-rays for non destructive testing and color correction in the preprint operation for large volume printing.

Imaging applications require display systems capable of displaying many colors or shades of gray. Such display systems do not critically require high resolution in the x and y directions, but they do require large amounts of data in the z plane or in the color or gray scale plane. Imaging applications use raster scan technology.

A feature called depth cueing causes the Z axis in a three-dimensional plot to fade in brightness as the axis moves away from the observer

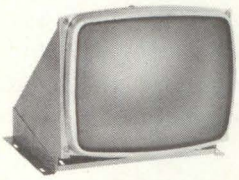
DeAnza Systems, Inc., Santa Clara, CA, offers an imaging system that can display 4,096 different colors. With a resolution of 512 by 512 elements, the system suits such applications as satellite data analysis, chromosome classification and aerial photography analysis. To display 4,096 colors, the system gives each of the primary electron guns (red, blue and green) sixteen shades of gray scale individually and then in combination. The system supplies z plane storage as in any raster scanning system.

However, to define 4,096 possible colors, each point on the display requires 12 bits of storage in memory (2^{12} = 4096). In a system with a 512 by 512 resolution display, the total memory requirement would be 393K bytes. That figure compares embarassingly to the 32K bytes required to store a black and white image on the same system.

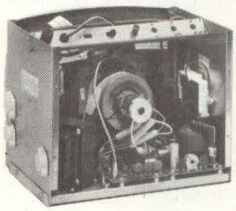
This large amount of refresh memory adds cost to the imaging system. DeAnza's system with 512 by 512 resolution sells for about $25,000. Presently, two memory types find use in the imaging world. DeAnza uses charged coupled devices (CCDs). The firm chose CCD memory devices because serial memory devices cost less than most other solid

Reliability: Our data displays are outstanding solid-state designs with critically matched magnetics to optimize the performance levels and dependability demanded by your customers. We use the most advanced engineering and production techniques to assure consistency of performance. No data display is built with more deliberate attention to quality and reliability.

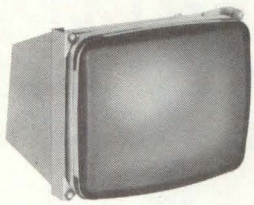
Delivery: We have been in the display electronics business long enough to know about rush orders. If you need it yesterday — we'll try to get it to you yesterday.



Experience: We've built thousands of displays for many of the major manufacturers in the country. Perhaps we already have a unit that would meet your requirements. With slight modifications. It would be less costly than starting from scratch. If you need a new, special package — we'll produce it for you, in the configuration you want, at minimal expense.



Cooperation: If you're developing a new data terminal, we will be glad to cooperate with your terminal design engineers in reviewing your exact specifications and developing the most economical display possible. And quickly! Whatever you need, we have the experience and talent to design it. And improve it.



But don't take our word. See for yourself by contacting us today.

You'll come up with your own reasons for using Setchell Carlson CRT display modules.

If you make top-quality data terminals, here are four reasons to use Setchell Carlson CRT display modules in your system.

SC ELECTRONICS, INC.
A SUBSIDIARY OF AUDIOTRONICS CORPORATION
530 5th AVE. N.W. NEW BRIGHTON, MN. 55112 (612) 633-3131

CIRCLE 45

state memory types and they consume less energy. Genisco Computer, another vendor of imaging systems, uses 4K MOS random access memory devices because they provide faster access to any point.

One company uses 4K MOS random access memory devices because they provide faster access to any point.

The intensity transformation table – featured on DeAnza's system – aids in image recognition. This table contains a color pixel for each gray scale pixel within an image. Gray images can take on pseudo colors to enhance or highlight areas of interest on the image. The gray scale pixel addresses a color (preprogrammed by the user) in the intensity transformation table.

software

Most graphics software is written in Fortran. For example, Tektronix supports an in-house library of programs available to customers free of charge – with documentation. The firm's basic software package called TCS (Terminal Control System) lets users call Fortran subroutines that perform graphics functions. In the mainline program, the user need only specify the location of the function.

The firm also offers an advanced graphics software package said to supply advanced graphics functions. With minimal information, this package draws, scales and labels any specified graph. The package works with the firm's newly announced interactive graphics software system.

markets

The graphics display industry is growing at a rate of 30-40% per year. This market breaks into three distinct sectors. On the bottom end, $4,000 to $15,000, Tektronix direct view storage tube systems dominate. In the middle range, the $10,000 to $50,000 bracket, sit raster scan systems (B/W and color) and the low-cost stroke writing systems. At the top of the market, the sophisticated stroke writers with 3-D capability can range in price from $30,000 to $85,000. Companies who offer products in this upper end include Vector General, Woodland Hills, CA Evans & Sutherland, Salt Lake City, UT, and Adage, Boston, MA.

Special acknowledgement to the following industry sources: *Roy Williams, Sanders Data Systems, Nashua, NH, Peter Cook, Tektronix, Inc., Beaverton, OR, Tyler Hunt, Magnavox Display Systems, Fort Wayne, IN, Ezra Mintz and Jim Coyle, Intelligent Systems Corp., Norcross, GA, Esmond Lyons, Comtal Corp., Pasadena, CA, Raymond Fortin, Imlac Corp., Needham, MA, Bill Huber, Genisco Computers, Irvine, CA, Charles Nordby, DeAnza Systems, Santa Clara, CA, Dave Snyder, Aydin Controls, Fort Washington, PA, Ken Anderson, Vector General, Inc., Woodland Hills, CA, Tom Raines, Hughes Aircraft Co., Carlsbad, CA.*

Information Storage And Retrieval:

Flexible Magnetic Disk Patent Activity

A BENWILL/TECHNOCAST REPORT

Last month's issue contained a state of the art report on cassette, cartridge and floppy disk drives. This month we report on the patent activity – worldwide – from the inception of the innovative concept of floppy disk information storage and retrieval to the end of 1976 (estimated). This kind of information is an addendum to our technology assessment and state of the art reports we have organized for you since the inception of Digital Design. We're adding reports of this type because we feel that designers innovating or using components of this type and applying them in systems need to know prior art and who owns it. Indeed, managers at all levels in high technology companies who have the responsibility of determining what they will be developing, marketing and financing three to five years from now usually need to be concerned about: how well protected the products they plan to introduce will be; how

Patent Activity (1963-1976) By Date of Patent Grant

Number of Patents

	Pre 63	1963	64	65	66	67	68	69	70	71	72	73	74	75	76	Total
Total		1	2	6		1	3		3	2	3	7	9	10	29	76
U.S Origin		1	2	5		1	3		1	1	3	4	8	7	23	59
Foreign Origin				1					2	1		3	1	3	6	17
Japan									1			2	1	3	2	9
Germany												1			4	5
Netherlands									1	1						2
France				1												1
U.S. Origin		1	2	5		1	3		1	1	3	4	8	7	23	59
U.S. Corp Owned		1	2	5		1	3		1	1	2	4	8	7	23	58
U.S. Govt. Owned																0
U.S. Indiv. Owned											1					1
Foreign Owned																0
Foreign Origin				1					2	1		3	1	3	6	17
U.S. Owned									1	1					1	3
Foreign Owned				1					1			3	1	3	5	14
Foreign Corp.				1					1			3	1	3	4	13
Foreign Govt.																0
Foreign Indiv.															1	1

Percent of Patents

	Pre 63	1963	64	65	66	67	68	69	70	71	72	73	74	75	76	Total
Total		100	100	100		100	100		100	100	100	100	100	100	100	100
U.S. Origin		100	100	83		100	100		33	50	100	57	89	70	79	78
Foreign Origin				17					67	50		43	11	30	21	22
Japan									33			29	11	30	7	12
Germany												14			14	7
Netherlands									33	50						3
France				17												1
U.S. Origin		100	100	83		100	100		33	50	100	57	89	70	79	78
U.S. Corp. Owned		100	100	83		100	100		33	50	67	57	89	70	79	76
U.S. Govt. Owned																
U.S. Indiv. Owned											33					1
Foreign Owned																
Foreign Origin				17					67	50		43	11	30	21	22
U.S. Owned									33	50					3	4
Foreign Owned				17					33			43	11	30	17	18
Foreign Corp.				17					33			43	11	30	14	17
Foreign Govt.																
Foreign Indiv.															3	1

Patent Activity (1963 – 1976) By Date of Patent Application

Number of Patented Applications

	Pre 63	1963	64	65	66	67	68	69	70	71	72	73	74	75	76	Total
Total		2		2	1		2	2	3	4	7	16	21	7		67
U.S. Origin		2		2			1	1	2	4	4	12	17	6		51
Foreign Origin					1		1	1	1		3	4	4	1		16
Japan							1				3	3	2			9
Germany									1			1	2	1		5
Netherlands					1			1								2
France																0
U.S. Origin		2		2			1	1	2	4	4	12	17	6		51
U.S. Corp. Owned		2		2			1	1	1	4	4	12	17	6		50
U.S. Govt. Owned																0
U.S. Indiv. Owned									1							1
Foreign Owned																0
Foreign Origin					1		1	1	1		3	4	4	1		16
U.S. Owned					1			1						1		3
Foreign Owned							1		1		3	4	4			13
Foreign Corp.							1		1		3	3	4			12
Foreign Govt.																0
Foreign Indiv.												1				1

Percent of Patented Applications

	Pre 63	1963	64	65	66	67	68	69	70	71	72	73	74	75	76	Total
Total		100		100	100		100	100	100	100	100	100	100	100		100
U.S. Origin		100		100			50	50	67	100	57	75	81	86		76
Foreign Origin					100		50	50	33		43	25	19	14		24
Japan							50				43	19	10			13
Germany									33			6	10	14		7
Netherlands					100			50								3
France																
U.S. Origin		100		100			50	50	67	100	57	75	81	86		76
U.S. Corp. Owned		100		100			50	50	33	100	57	75	81	86		75
U.S. Govt. Owned																
U.S. Indiv. Owned									33							1
Foreign Owned																
Foreign Origin					100		50	50	33		43	25	19	14		24
U.S. Owned					100			50						14		4
Foreign Owned							50		33		43	25	19			19
Foreign Corp.							50		33		43	19	19			18
Foreign Govt.																
Foreign Indiv.												6				1

Patent Numbers and Their Assignees

ADDRESSOGRAPH-MULTIGRAPH CORP.
3922086 3972054
ARVIN INDUSTRIES, INC.
3731292 3737880 3770908 3814441 3840897 3947893
BASF AKTIENGESELLSCHAFT
3981025
CENTURY DATA SYSTEMS, INC.
3936879
DYNASTOR, INC.
3947886 3951264 3959823
GENISCO TECHNOLOGY CORPORATION
3975768
INFORMATION TERMINALS CORPORATION
3931644
INTERNATIONAL BUSINESS MACHINES CORP.
3573771 3688285 3729720 3810243 3838461 3838462 3852820 3867723 3879757 3931645 3936880 3940794 3946439 3947885 3969767 3974524 3975769 3990109 3990111 3994017
INTELLIGENT MEMORY SYSTEMS, INC.
3846837
IOWA STATE UNIVERSITY RESEARCH FOUNDATION INC.
3703713
LICENTIA PATENT-VERWALTUNGS-GMBH
3767865 3967320
MATSUSHITA ELECTRIC INDUSTRIAL COMPANY LTD.
3488646 3805292
MCA DISCOVISION, INC.
3914444 3947888
MEMOREX CORPORATION
3864755
PERTEC CORPORATION
3940793
SANYO ELECTRIC COMPANY, LTD.
3891796 3900893 3931640
SHUGART ASSOCIATES, INC.
3890643 3898814
SONY CORPORATION
3764758 3778559 3863266
SYCOR INC.
3973272 3973274 3975774
TED BILDPLATTEN AKTIENGESELLSCHAFT AEG-TELEFUNKEN-TELDEC
3932710
UNIVERSITY OF ILLINOIS FOUNDATION
3537083
U.S. PHILIPS CORPORATION
3509553 3618055
ZENITH RADIO CORPORATION
3838460
PATENTS WITH NO ASSIGNMENT INFORMATION IN DATA BASE
3108259 3148362 3153241 3166997 3179945 3191179 3208056 3225338 3226701 3303485 3369227 3373413 3405405 3696350 3964101

Patenting (1966 – 1976)
Companies with 1 or more Patents

	Pre 65	1966	67	68	69	70	71	72	73	74	75	76	Total
IBM Corp.													
Patents Granted							1	1	1	4	2	11	20
Patented Applications					1	1	1		5	6	6		20
Arvin Industries, Inc.													
Patents Granted									3	2		1	6
Patented Applications							2	3		1			6
Sony Corp.													
Patents Granted									2		1		3
Patented Applications								2	1				3
Sycor Inc.													
Patents Granted												3	3
Patented Applications										3			3
Dynastor, Inc.													
Patents Granted												3	3
Patented Applications										3			3
Sanyo Electric Co., Ltd.													
Patents Granted											2	1	3
Patented Applications									1	2			3
Addressograph-Multigraph Corp.													
Patents Granted											1	1	2
Patented Applications										2			2
MCA Discovision, Inc.													
Patents Granted											1	1	2
Patented Applications								1	1				2
Shugart Associates, Inc.													
Patents Granted											2		2
Patented Applications									1	1			2
Licentia Patent-Verwaltungs-GMBH													
Patents Granted									1			1	2
Patented Applications						1				1			2
Matsushita Electric Industrial Co., Ltd.													
Patents Granted						1				1			2
Patented Applications				1				1					2
U.S. Philips Corp.													
Patents Granted						1	1						2
Patented Applications		1			1								2
Information Terminals Corp.													
Patents Granted												1	1
Patented Applications											1		1
Century Data Systems, Inc.													
Patents Granted												1	1
Patented Applications									1				1
Iowa State U. Res. Found. Inc.													
Patents Granted								1					1
Patented Applications							1						1
Genisco Technology Corp.													
Patents Granted												1	1
Patented Applications									1				1
Memorex Corp.													
Patents Granted											1		1
Patented Applications									1				1
Bas Aktiengesellschaft													
Patents Granted											1		1
Patented Applications									1				1
Ted Bildplatten Aktiengesellschaft													
Aeg-Telefunken-Teldec													
Patents Granted												1	1
Patented Applications										1			1
Intelligent Memory Systems, Inc.													
Patents Granted										1			1
Patented Applications									1				1
U. of Ill. Found.													
Patents Granted						1							1
Patented Applications				1									1
Zenith Radio Corp.													
Patents Granted										1			1
Patented Applications									1				1
Pertec Corp.													
Patents Granted												1	1
Patented Applications										1			1

effective their proprietary position will be on their planned new products: what early warning procedures they can set up or pursue to anticipate competition for their product; how they can identify their competition before they introduce their new products; and how they can tell what known and unknown competition is doing now.

Economic strengths of a company usually rest largely on their technological base, and their technological base is a function of their technological knowhow, patents and their knowledge of what the competition is doing. We hope this type of report, in addition to our technology assessment and state of the art information, does assist you in answering these questions. This new service of Benwill Publishing Corp. in conjunction with Technocast, Inc. of Washington, D.C., publishers of Technocast ® Reports, uses unique computer programs and a comprehensive data base. We will have eight or ten of these reports throughout the year. If any of you want to suggest possible topics you would like analyzed in the manner of this special report on floppy disks, just drop us a line. Obviously, we will tackle those subjects that receive the most requests. We can make special arrangements to provide you with a specific topic should you be among a relative few individuals requesting that particular topic. Send your request to Benwill-Technocast, 167 Corey Road, Brookline, MA 02146.

Next month, *Digital Design* will present another Benwill/Technocast state-of-the-art and patent activity analysis. The May issue of *Digital Design* included a report on magnetic bubble memories. In August we discuss the following types of memories: charge-coupled, semiconductor, magnetic core, magneto-optical, holographic, superconductive, ferroelectric, cathode ray tube, plated wire, planar film and domain tip propagation. This report will aid individuals needing information on recent activity in the industry, for example, managers planning the expenditure or R & D funds, researchers and users.

WE REPAIR DATA GENERAL™ AND DEC™ AND DCC™ EQUIPMENT

Consider These Advantages:

- **FAST TURNAROUND**
- **RELIABILITY**
- **LOW COST (repairs quoted before work begun)**
- **LOANERS AVAILABLE FOR MOST BOARDS***
- **30 DAY WARRANTY ON REPAIRS**

MAINTENANCE CONTRACTS AVAILABLE

*** Loaner Boards Subject to Availability**

KERONIX INC.

For Further Information, Contact:
George Földvary
Keronix, Inc.
250 E. Emerson St.
Orange, California 92665
(714) 974-0800 TWX 910-593-1344

WE HAVE REPRESENTATIVES AND DISTRIBUTORS WORLDWIDE

product news

LOGIC ANALYZER DEBUGS μP SOFTWARE

This 16-channel 50 MHz logic analyzer, designated the 50 DI6, uses a data trigger mode which allows you to insert up to three sample bits of delay in the trigger. The 50DI6 is especially effective in debugging software because the instrument can count trigger events. For example, you can pre-set a given delay and capture the data just before or right after the last counted trigger event. On the 50DI6 control panel a 3-digit LED display reads in sample bits, the distance between the trigger marker and the adjustable

cursor. The 50DI6 package measures 6¾" x 8½" x 14", and weighs 18 pounds. Price: $4,558. A data formatter option makes the 50DI6 fully software compatible. BP Instruments, Inc., 10601 S. DeAnza Blvd., Cupertino , CA 95014. (408) 446-4322. **Circle 130**

μP CONTROLS LOGIC STATE ANALYZER

With F8 microprocessor control and a memory 16 bits wide and 64 words deep, the 1602A logic state analyzer: displays events in 63 periods preceding the event designated as trigger; automatically self-tests when turned on; and interacts with you through its keyboard. Pushbuttons pick the desired logic polarity and which edge of the clock-pulse strobes data into memory. Other keys set the display to hexadecimal, decimal, or binary, or a mixed format of binary and any other higher base can be used. The

instrument requests the trigger word or address and any following delay, 0 to 65,535 clock-intervals before the data-trace, may be specified. The clip-on probe set plugs into a standard edge connector on the probe. The HP-IB option makes the 1602A totally key-programmable and able to dump its 64-word memory onto the bus on command for analysis by the computing controller. Price is $1800. Hewlett Packard, 1501 Page Mill Rd., Palo Alto, CA 94304. (415) 493-1501. **Circle 164**

AUTOMATIC TESTER FOR DIGITAL CIRCUITS

An automatic tester designed for digital, analog and hybrid circuit boards, the model 4700 includes an operator console and CRT display terminal. Users select a minimum TTL and CMOS logic configuration in 64 Unit-Under-Test (UUT) pin increments, expandable up to 1023 bi-directional interface pins. The system also comes with analog UUT and software-programmable all-logic-level (ALL) pins. Both are available in 32-pin modules and expandable up to 511 program pins. Each UUT pin switches between digital and analog signals without separate fixtures for testing hybrid boards. You can incorporate a choice of five or ten analog busses and up to 24 instrumentation ports in the hybrid package. Standard IEEE bus-compatible instrumentation includes multimeters, timer/counters, function generators, voltage sources, pulse generators and programmable loads. The ALL pins can interface a variety of logic families and can be programmed to two different logic families simultaneously, with voltage levels between -18 and +18 Vdc in 10 MV increments. Computer Automation, 18651 Von Karman, Irvine, CA 92713. (714) 833-8830.

Circle 158

ELECTRONIC COUNTER INPUTS 100,000 CPM

A compact electronic counter with two front panel programmable presets and LED display, the Model 215-Dual six digit counter operates from a variety of input sensors at up to 100, 000 cpm. Plug-in electromechanical or solid-state output relay options are available with the

Model 215-Dual, which mounts in panels up to ½" thick and measures 2 5/8" H x 3 1/8" W x 4¼" D. It operates from 115 Vac. Price: $234. Vorne Industries, Inc., 5023 West Belmont, Chicago, IL 60641. (312) 725-3077. **Circle 129**

ok wire wrapping center ok

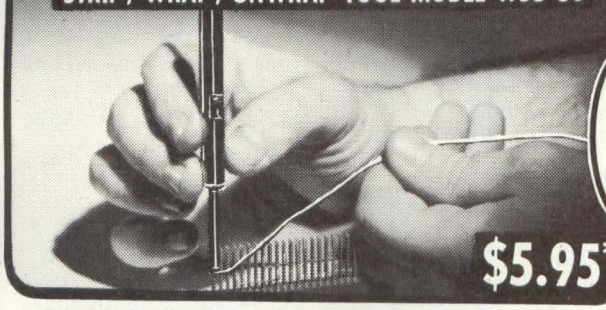
ANOTHER UNIQUE PRODUCT
DESIGNED, MANUFACTURED AND MARKETED WORLDWIDE
BY
OK MACHINE & TOOL CORPORATION

1

BATTERY WIRE-WRAPPING TOOL MODEL BW-630

$34.95*

STRIP / WRAP / UNWRAP TOOL MODEL WSU-30



$5.95*

2

ANOTHER UNIQUE PRODUCT
DESIGNED, MANUFACTURED AND MARKETED WORLDWIDE
BY
OK MACHINE & TOOL CORPORATION

ANOTHER UNIQUE PRODUCT
DESIGNED, MANUFACTURED AND MARKETED WORLDWIDE
BY
OK MACHINE & TOOL CORPORATION

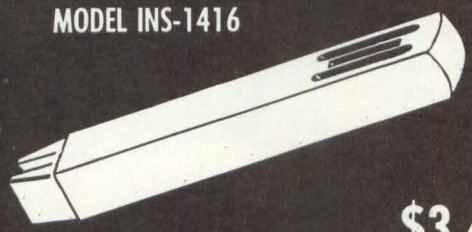
3

WIRE DISPENSER MODEL
WD-30-B

THE DISPENSER WHICH CUTS AND STRIPS THE WIRE

$3.45*

DIP IC INSERTION TOOL WITH PIN STRAIGHTENER
MODEL INS-1416



$3.49*

4

ANOTHER UNIQUE PRODUCT
DESIGNED, MANUFACTURED AND MARKETED WORLDWIDE
BY
OK MACHINE & TOOL CORPORATION

ANOTHER UNIQUE PRODUCT
DESIGNED, MANUFACTURED AND MARKETED WORLDWIDE
BY
OK MACHINE & TOOL CORPORATION

5

WHAT'S ? NEXT

* MINIMUM ORDER $25.00, SHIPPING CHARGE $1.00, N.Y. CITY AND STATE RESIDENTS ADD TAX

OK MACHINE & TOOL CORPORATION
3455 Conner St., Bronx, N.Y. 10475 ■ (212) 994-6600 ■ Telex 125091

CIRCLE 39

product news

ADD-ON MEMORY SYSTEM FITS IBM SERIES/1 UNITS

A magnetic-tape memory system incorporating a universal user's adapter allows connection of external devices to the I/O bus of models 3 or 5 of the IBM Series 1 computers. With the adapter, Series 1 users can tailor their system to their own requirements. The seven- or nine-track system permits recording densities of 200 bpi NRZ through 1600 bpi phase-encoded and speeds of

from 12.5 ips through 125 ips. As many as four transports can be used. A 5440 removable-media disk system incorporating the universal user's adapter is also available and is software-compatible with the IBM 4962 disk storage unit. With the universal user's adapter, which is available separately, the Series 1 user can interconnect several computers. Diagnostic and operational software is included with each system. Datum Inc., 1363 S. State College Blvd., Anaheim, CA 92806. (714) 533-6333. **Circle 127**

MULTIPLEXER CHANNELS 10 SIGNALS SEQUENTIALLY

The Dataplex 10 signal multiplexer allows up to 10 information-carrying signals to be channeled in sequence to a single recorder, meter, printer or similar device. It thus eliminates a bank of separate devices, each dedicated to a single function. Input channels connect to screw terminals on the front panel of the Dataplex 10; three 5-way binding posts (2 signal, 1 guard) provide output. You select the number of channels to be scanned (1-10) and set the duration of dwell at one to 20 seconds. In the SCAN mode, the unit feeds each channel in sequence to the single output. Dwell time in channel 1 is automatically set at 2x setting so that you can determine channel orientation on printout or strip chart. Ten panel LEDs indicate the channel being scanned. An accessory expander/marker allows tenfold expansion

of the basic 1-20 second dwell time per channel and provides channel marking and identification with a variable time signal blanking or shorting. It also activates the pen lift option on recorders. Hampshire Controls Corp., Drawer M, Exeter, NH 03833. (603) 772-5442. **Circle 135**

DIGITAL READOUTS FOR LINEAR, ROTARY TRANSDUCERS

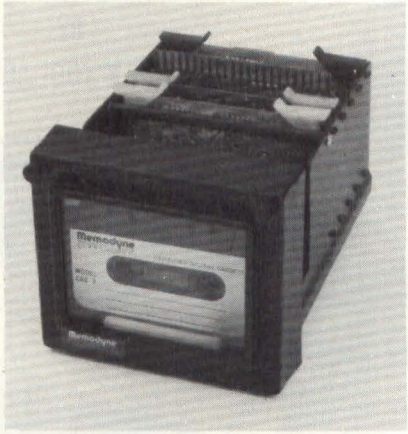
Suitable for freestanding or mounting inside a machine tool pendant, this family of one-, two- and three-axis digital position readouts is designed for universal use. Each axis has a bidirectional seven-decade and sign display and provides 0.01-mm resolution over ± 100 m measuring range, 0.001-mm over ± 10 m or 0.0001-in over ± 1000 in. Maximum traversing speed is 48 m/min. Inch or metric mode is selected on the front panel of the display. Zero setting is by a front panel push button, and units will work with built-in reference point finders. Pre-alarm is provided when contamination on the scale approaches an unacceptable level, and faulty information processing gives a full alarm. Five models are available: one-, two- and three-axis models for operation only with linear transducers and two- and three-axis models where one axis works with a rotary transducer. One- and two-axis models measure 125 mm x 280 mm x 217 mm, and three-axis models measure 176 mm x 280 mm x 217 mm. The units require 110, 220 or 245 Vac, 48 to 62 Hz. Phillips Corp., P.O. Box 523, Eindhoven, The Netherlands.

SWITCHING POWER SUPPLY CONSUMES UP TO 200 W

High density switching regulated power supplies deliver up to 200 W from a 190 in^3 package measuring 4¾" x 7-11/16" x 5-1/32" and weighing less than 5 pounds. All units have dual wide range inputs, 85 to 132 Vac and 170 to 264 Vac at 47-63Hz, selectable from the front panel. Output regulation is maintained for at least 30 ms after loss of input power. Units are fully rated at up to 50°C and regulation for both line, and load is 0.1% with less than 25 mV peak-to-peak ripple. Prices start at $265. Power/Mate Corp., 514 South River St., Hackensack, NJ 07601. (201) 343-6294. **Circle 162**

CASSETTE RECORDER SUITS ANSI/ECMA-34

ANSI and ECMA-34 compatible, the Model 819-34 digital cassette recorder uses an incremental digital transport. A card cage houses a write step card, a formatter card and an I/O card containing a cyclic redundancy check generator.



Other cards like an A/D converter and a 16 channel multiplexer card may be added. The unit requires 500 mW when recording and 20 mW of standby power. The unit accepts parallel input of up to 32 bits at 50 bps with formatted capacity of 1 Mbits. It measures 4.5" W x 4" H x 7" D and weighs 3 lbs. The cassette may be read on any ECMA-34 compatible reader, minicomputer or terminal plus ANSI compatible devices. Price: $995. Memodyne Corp., 385 Elliot St., Newton Upper Falls, MA 02164. (617) 527-6600. **Circle 134**

Mind Your Own Business

with computers — personal computers

Your business may be manufacturing, engineering or designing panel meters. Or your "business" may be looking for fun ways to improve your golf game — play chess — even make the perfect martini. Whatever your business may be — the computer can be your partner. Let Personal Computing show you how to mind your own business and have fun, too.

"MEET MY ACCOUNTANT!"

SUBSCRIPTION ORDER CARD

Please start my subscription to **Personal Computing**

Name_____

Address_____

City_____ State_____ Zip_____

☐ **6 issues $ 8**
☐ **12 issues $14**
Charge my: ☐ Master Charge ☐ Bank Americard
Account #_____
Card expiration date_____
☐ **Bill me**
☐ **Check enclosed**

Additional Postage:

Canada & Mexico	$ 2.00 surface; $ 4.00 air.
Other foreign	$ 4.00 surface; $18.00 air.

(Double rates for 12 issue subscription)

Now published every other month, PERSONAL COMPUTING will be published monthly starting January, 1978. Subscription rates listed above cover 6 or 12 consecutive issues. If you enclose your check, we'll extend your subscription by one extra issue for a 6 issue subscription and 2 extra issues for a 12 issue subscription. Of course, you have the right to cancel at any time and receive full credit for the unused portion of your subscription.

product news

32k x 18 ADD-IN CORE EXPANDS PDP-11 MEMORY

Equipped with options that allow you to expand PDP-11 memories, this single-board 32K x 18 core memory system comes in 16K x 18 or 32K x 18 configurations and is plug-compatible with DEC's MM11-D and MM11-DP single-board systems. The unit occupies nine PDP-11 connector slots or holds four DR-114 systems, providing a maximum capacity of 128K x 18. DEC peripheral units can be inserted in system units. The DR-11 offers parity control, cycles in 900 ns and accesses in 350 ns. Dataram Corp., Princeton-Hightstown Rd., Cranbury, NJ 08512. (609) 799-0071. **Circle 139**

A/D CONVERTER WORKS OVER ±72 DB RANGE

The MN5110 companding A/D converter, housed in a single 18-pin dual-in-line package, has ±72 db of dynamic range and converts ±5 volt input signals into 8-bit digital words. This digital output is composed of a sign bit, 3 chord bits and 4 step bits. The sign bit indicates the polarity of the analog input; the chord and and step bits, the magnitude. In the first chord, the sixteen step bits have a value of 1.25 mV. In the second chord, the sixteen step bits have a value of 2.5 mV. This doubling of the step values continues for each of the successive six chords. The output has resolution proportional to the input level rather than full scale. It thus provides the resolution of a 12-bit A/D converter at low input levels and that of a 6-bit converter as the input approaches full scale. Price: $155. Micro Networks Corp., 324 Clark St., Worcester, MA 01606. (617) 852-5400. **Circle 140**

12-BIT D/A CONVERTERS MEET MIL-STD-883

The DAC349 Series D/A converters combine CMOS switching techniques with precision thin film ladder. All models include an internal precision reference and a gain-selectable output amplifier. The DAC349 Series offers a choice of either 12-bit binary coding (-12 models) or 3 decade BCD coding (-3D models). By external pin connections, the binary models can be connected for unipolar output ranges of 0 to -5V or 0 to -10V and for offset binary coded bipolar outputs of ±2.5V, ±5V and ±10V. For ratiometric applications, the units operate from an external fixed DC reference of -10V ±10%. Power supply requirement is ±15 volts. All models are packaged in a miniature 24 pin DIP. Hybrid Systems Corp., Crosby Dr., Bedford Research Park, Bedford, MA 01730. (617) 275-1570. **Circle 145**

12-BUTTON KEYBOARDS OFFER MATRIX SWITCHING

These low-profile, 12-button keyboard pads offer matrix switching, single-pole/common buss and 2 out of 7 (row/column) coded outputs. The 3x4 button array comes with choice of standard or numeric telephone legends and clear snap-on caps for user legending. A choice of 0.500" or 0.750" button centers is offered. These keyboards are designed with standard post type mounting, allowing front or sub-panel mount. Buttons are recessed to prevent accidental actuation. A contact system provides audio and tactile feedback to the operator and interfaces with logic circuitry using standard buffering techniques. Grayhill, Inc., 561 Hillgrove, LaGrange, IL 60525. (312) 354-1040. **Circle 141**

RECORDER OPERATES AT UP TO 50 MM/SEC

This inkless DC powered thermal writing strip chart recorder provides tachometer speed control accuracy better than 2% and consumes 7 w. The multiple-speed recorder includes up to four chart speeds in 10:1 ratios and operates from 1 mm/sec to 50 mm/sec. It records on a 40 mm wide channel with a front loading type stylus. The M1-40 DCM operates from 10-14 Vdc with 1 cm frequency response of DC to 110 Hz. Amplifier sensitivity can be selected at 100 mV, 200 mV, 500 mV, or 1V/cm with a 100KΩ single ended input impedance. The unit comes with an optional left column event marker, measures 3.8" H x 2.5" W x 6.5" D and weighs 40 oz. MFE Corp., Keewaydin Dr., Salem, NH 03038. (603) 893-1921. **Circle 146**

V/F CONVERTER ENSURES ±0.01% LINEARITY @ 10KHZ

Offering guaranteed ±0.01% (12-bit) linearity at 10 kHz and operation to 0.5 MHz, VFC32 monolithic voltage-to-frequency converter serves either as a V/F or F/V device and has a six decade dynamic range (0.5 Hz to 0.5 MHz). Linearity at the top frequency is ±0.2% (8-bit), and at 100 kHz it is ±0.05% (10-bit). The VFC32 accepts voltage inputs of 0 to +10V or 0 to -10V and current inputs up to 0.25 mA positive and is compatible with DDT, TTL and CMOS logic. An external RC network, an additional pull-up resistor and one-shot capacitor are required for operation. Temperature coefficient of the full-scale accuracy is ±100 ppm/°C max, and the input offset voltage drift is less than ±2 ppm/°C. The VFC32 comes in three models and two package configurations. The lowest cost version (VFC32KP) is a 14-pin epoxy DIP specified at from 0 to +70°C. The BM and SM versions are contained in a hermetically sealed TO-100 package and specified at from -35 to +85°C and -55 to +125°C, respectively. All units have identical room temperature specs. Burr-Brown, International Airport Industrial Park, Tucson, AZ 85734. (602) 294-1431. **Circle 156**

microprocessors: from chips to systems

by **Rodnay Zaks.** Ref. C201 **$6.95**

THE BOOK

This book is based on the author's experience in teaching microprocessors to more than 2000 persons during the past 5 years, both in a professional, and in a university environment. The seminars have received the highest ratings for their educational and technical value, and have been taught worldwide.

This step by step book stresses:

1. How to assemble a complete system
2. Design trade-offs: advantages, disadvantages, problems, costs.

About 250 pages, over 70 illustrations. **Available August 1977**

CONTENTS

A comprehensive introduction to all the essential aspects of microprocessors and microcomputers:

Technical Introduction / LSI Technologies / Internal Architecture of a Microprocessor / System Components / The Microprocessor Families / Microprocessor Programming / Applications of Microprocessors / Building a System / Product Development / Design Aids / Microprocessor Selection / Evolution and Perspectives.

THE AUTHOR

Dr. Rodnay Zaks has been responsible for the design of industrial microprocessor systems since their inception in 1972. He is the author of 11 educational books in the field and more than 20 scientific publications.

CASSETTES

The 2 basic microprocessor courses are now available on cassettes. Each course includes 2 cassettes (2½ hours) and a special book:

S1 — An Introduction to Microprocessors **$29.95**
S2 — Programming Microprocessors **$29.95**

OTHER BOOKS

- **MICROPROCESSOR ENCYCLOPEDIA**

2 complete reference books, containing manufacturers' data and description of operation for every microprocessor. A necessary tool for any comparative evaluation.

E8 - 8 BITS MICROPROCESSORS: Am 9080, AMI 6800, EA 9002, Fairchild F8, GI LP 8000, Intel 8080 A, Intersil 6100, Mos Tech 650 X, Mostek 3880, 3850, M 6800, NS 8080 A, SC/MP, RCA CDP 1802, PPS-8, Signetics 2650, TMS 8080, Western Digital MCP 1600, Zilog Z-80. ..... **$29.95**

E5 - BIT SLICES: AMD 2901, Fairchild Macrologic, Intel 3000, MMI 5701, Motorola M 2900, M 10800, NS IMP, Signetics 8X02, 3000, TI SBP 0400. ..... **$18.00**

- **IMD — International Microprocessor Dictionary**

10 Languages: English — German — French — Spanish — Italian — Swedish — Norwegian — Danish — Hungarian —Polish. 30 Pages. **$1.95**

- **ACR-Microcomputer Acronyms** — 4-Page guide to abbreviations **$1.00**
- **SEMINAR BOOKS** (condensed notes)

B2 - Microcomputer programming **$39.95**
B3 - Military microprocessor systems **$39.95**
B5 - Bit Slice **$39.95**
B6 - Industrial microprocessor systems. **$39.95**
B7 - Microprocessor interfacing techniques. **$39.95**

IN-HOUSE TRAINING

SYBEX is independent from manufacturers and provides in-house training and education on all the above topics, as well as on specialized microprocessor techniques.

AVAILABLE SOON:

Microprocessor programming techniques (with 8080 and 6800 examples) **$7.95**

ORDER FORM

Name _____
Position _____
Company _____
Address _____
_____
_____
STATE/ZIP

☐ **Send me**
.....copies of..... =$ .....
.....copies of..... =.....
.....copies of..... =.....
Subtotal _____
In California, add tax +.....
Postage and Handling .....
TOTAL _____

Payment included: ☐ check ☐ P.O. ☐ money order ☐ other _____

TO ORDER

Handling (fourth-class rate): no charge. Faster delivery: $1.40 one book, $0.90 each additional one. ($2.50 overseas)

1. Fill attached coupon, or send P.O.
2. Enclose payment (prices are for U.S. only). In California, add tax.
3. Mail to **BENWILL PUBLISHING Corp.,** 167 Corey Rd., Brookline, Massachusetts 02146.

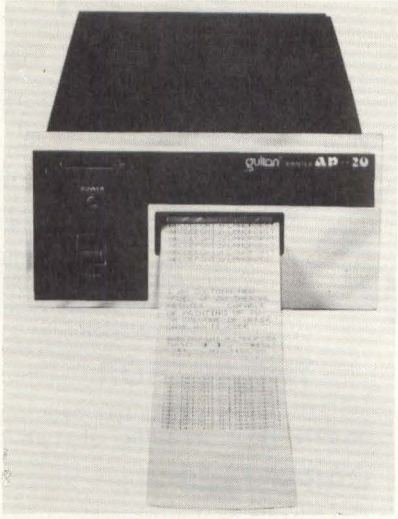
product news

MEASURE ANALOG WAVEFORM PARAMETERS WITH DIGITAL ACCURACY

A digital measurements booklet, "Digital Accuracy — Analog Interpretation", deals with applications of the digital plug-ins available for Tektronix 7000-Series oscilloscopes. These plug-ins permit you to simultaneously view analog waveforms and measure parameters with digital accuracy allowing greater insight into your system than obtainable with freestanding non-oscilloscope instruments. Just select on the oscilloscope display the points at which you would like to make highly accurate measurements of dc voltage, ac voltage, frequency, time delay and more. CRT readout provides easy viewing of the parameters measured. Plug-ins include A/D converters, sample and hold units and digital delays, as well as DMMs (including true rms and temperature) and counters. The booklet provides detailed descriptions of each of the digital plug-ins as well as advice on selecting and applying them to specific types of measurements. It shows you how to make your oscilloscope a more complete, versatile, accurate and easy-to-use measurement tool. Tektronix, P.O. Box 500, Beaverton, OR 97077. (503) 644-0161. **Circle 300**

20 COLUMN PRINTER OUTPUTS 2.5 LPS

A self-contained alphanumeric thermal printer comes with transport, electronics including power supply, controls and a panel mounting enclosure. Using a thick-film, dot-matrix thermal print head, it prints up to 20 columns of 5 x 7 dot characters at a 2.5 line/second rate. The AP-20 provides an upper-case, 64 character ASCII subset via a straightforward character-serial, bit-parallel interface controlled by a two-line handshake with the data source. Paper tape advances beneath the print head each time the printing



of a dot row is completed. The unit offers a permanent magnet DC stepper motor geared to increment the drive roller. The drive roller and its gearing are the only moving parts in the instrument. Gulton Industries Inc., East Greenwich, RI 02818. (401) 884-6800. **Circle 137**

PRINTER FAMILY OUTPUTS 55 CPS

A family of solid font character printers employing a "thimble" printing element includes five models, each capable of printing a 128-character set at up to 55 cps. Spinwriter printers incorporate LSI semiconductor technology and are microprocessor controlled. The printers provide a choice of five standard interfaces, plus custom interfaces; 10- or 12-pitch character printing; ASCII compatibility for communications applications; and numerous typefaces. The series includes Model 5510, a receive-only printer; Model 5520, a keyboard send-receive unit; Model 5530, for word processing; Model 5540, offering a split platen for users with multiple forms requirements; and Model 5500, a basic unit which includes the printer mechanism and LSI electronics for OEM's to configure their own printer. Spinwriter printers use an electronically-driven print hammer and servo motor-controlled positioning system. Microprocessor control facilitates functions like graphing, plotting, bi-directional printing, OCR-quality registration, superscripting and subscripting and horizontal and vertical tabbing. Spinwriters operate at 5°C to 40°C, use servo and stepping motors to control printing-related functions and use plug-replaceable circuit cards and snap-out head, carriage and tractor mechanisms. NEC Information Systems Inc., 5 Militia Dr., Lexington, MA 02173. (617) 862-3120.

Circle 132

INTELLIGENT PRINTER SERVES STANDALONE, NETWORK APPLICATIONS

This intelligent printing system combines a 120 character-per-second parallel printer with an eight-bit microcomputer system. A variety of input and storage peripheral devices interface to the Model 7000, allowing it to function as a standalone printing computer system or as a workstation within a distributed computing network. Model 7000 includes a standard parallel interface and produces an ASCII character set in standard or extended widths. Additional interfaces or character sets are available with a change in programmable read-only (PROM) memory. Printing functions require 1K words of RAM and 2K words of PROM, leaving up to 3K words of RAM and 4K words of PROM available for other user applications. The eight-bit microcomputer system includes eight input registers, six of which are available to users, and eight output registers, three of which are available. The microcomputer also contains a built-in diagnostic package. A stepping motor controls bi-directional paper handling. Dataroyal, Inc., 235 Main Dunstable Rd., Nashua, NH 03060. (603) 883-4157. **Circle 128**

product news

DUAL AND TRIPLE OUTPUT D.C. SUPPLIES FOR MICROPROCESSORS

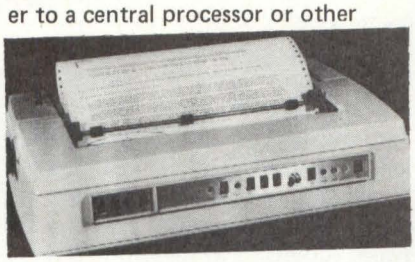
Adtech Power, Inc. has just announced a complete series of dual and triple output power supplies for microprocessors and other multiple power applications. Designated the "Gold Dust Twins" and "Big Red" series, the dual supplies operate over a range of 115/230 V. ± 10%, 47-63Hz at a temperature up to 50°C ambient with no derating required for 47-63Hz operation. Units may be operated up to 65°C. with derating. Highly reliable due to special design and conservative componetry, calculated MTBF using MIL-HDBK-217A guide lines is over 60,000 Hours. Warranty is 2 years. Overvoltage protection is available with either one OVP on each output or a single one to protect both outputs. Regulation is ± 0.05% for lines; ± 0.1% for load. Ripple is 1 mV RMS; (3 mV Peak to Peak maximum).

For triple output units, regulation is ± 0.1% for line and load with universal A.C. Input of 115/230V ± 10%, 47-63Hz. Ripple is 5mV peak to peak maximum; typically 1mV. Operating at full output power over the range of -20°C. to ± 50° C., the units can operate up to 65°C. with derating. Stability is ± 0.2%; outputs exhibit no overshoots as a result of turn-off, turn-on or power failure. Transient response is less than 50 microseconds. All three outputs are isolated from each other so that either positive or negative can be grounded on any output. Adjustment of output voltage is accomplished by means of screwdriver adjust isolated wire wound potentiometers. Temperature coefficient is 0.02%/° C. All units are rated fully with convection cooling up to 50°C in free air. Optional 70°C units are also available. Overvoltage is included in all units on the 5V outputs and foldback current limiting is standard for all three outputs. Remote sense is also provided on the 5 Volt output on all units. Adtech Power, Inc., 1621 S. Sinclair St., Anaheim, CA 92806. (714) 634-9211. **Circle 133**

product news

BYTE-ORIENTED PRINTER SERVES WORD PROCESSING

With its byte format, the Sprint Micro 5 family of printers plugs into the I/O channels of central processors without special interfacing or software. The unit reads both serial and parallel data. In byte mode, the command set defines the format and character spacing for the text to be printed. An 8-bit standard ASCII parallel interface connects the printer to a central processor or other

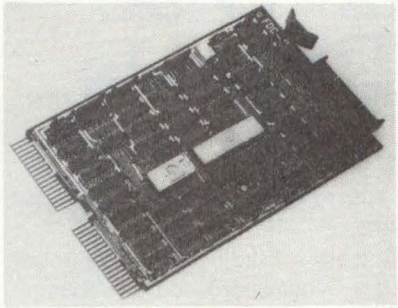


source of 7-bit ASCII characters. An optional EIA RS232C interface expands the printer's capabilities for remote terminal communication. Buffers for both interfaces allow the printers to receive parallel and serial data from two sources simultaneously. The control panel offers 11 switch selectable functions like the optional serial interface, automatic line feed, selection of form length and 10- or 12-pitch spacing. Other switches permit the operator to change the baud rate and select full- or half-duplex. Qume Corp., 2323 Industrial Parkway West, Hayward, CA 94545. (415) 783-6100.

Circle 299

FLOPPY CONTROLLER FITS LSI-11 COMPUTERS

The FDC-11 floppy disk controller fits on a dual-width card that plugs into the LSI-11 backplane. The FDC-11 uses standard LSI-11 voltages available in the backplane. Low power Schottky TTL and NMOS circuits minimize power consumption and heat generation. The controller provides a superset of the functions found in the DEC RX-11. All register and bit assignments and protocols are identical to assure compatability with existing software. An extra control bit allows up to 4 disk drives to be controlled. A function code allows formatting of blank or spoiled diskettes. An unused back-panel pin causes the controller to load the internally stored bootstrap program into the data buffer. The user can then transfer it to LSI-11 memory and execute with the ODT "L" command. Hardware WRITE PROTECT and FORMAT ENABLE are provided. The FDC-11 interfaces most diskette drives. The standard FDC-11 is designed to interface to up to 4 PERTEC FD400 or FD500 disk drives via personality cards, which provide daisy chaining logic. If drives with internal daisy chaining logic are used or only a single drive is used, personality cards may not be needed. The personality card includes an interface for a control/indicator panel. The panel indicates the READY/BUSY status of its



drive and permits user control of the WRITE PROTECT and FORMAT ENABLE functions. The personality cards come with a controller cable connector. Andromeda Systems, 14701 Arminta St. #J, Panorama City, CA 91402. (213) 781-6000.

Circle 138

SELECTRIC TERMINAL OPERATES AT 300 BAUD

A Selectric-based computer terminal incorporating a microprocessor enters and receives ASCII data asynchronously at up to 300 baud and is plug compatible with the serial I/O port of most calculators and computer systems. The system operates with acoustical couplers and modems via the RS232 interface. It is buffered with switch-selectable transmission rates of 110, 134.5, 150 and 300 baud and prints 15 cps. In the off-line condition, the terminal serves as a standard office typewriter. The terminal is available with two empty card slots for user-supplied interfacing. CPT Corp., 1001 South 2nd St., Hopkins, MN 55343. (612) 935-0381.

Circle 136

product news

RESIDENT ASSEMBLER SUITS SC/MP SYSTEM

A line-by-line resident assembler firmware kit designed for the manufacturer's SC/MP LCDS (low-cost development system) is contained in eight PROM/ROM devices that can be plugged into a blank ROM/PROM card. The assembled card is then inserted into the LCDS teletype system. Designated SUPAK, the 4K byte package consists of three programs: a line-by-line assembler, a paper tape line editor and a PROM tape punch program. The line-by-line assembler accepts a program in limited assembly language from a keyboard or paper reader and then assembles it into RAM. The paper tape line editor, which allows insertion, deletion or replacement of lines of program source code, punches either leader or trailer. The PROM tape punch program punches the contents of a specified memory range in BPNF or complemented binary format onto paper tape. Price: $300. National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, CA 95051. (408) 737-5000. **Circle 157**

WORD GENERATOR YIELDS FOUR PARALLEL OUTPUTS

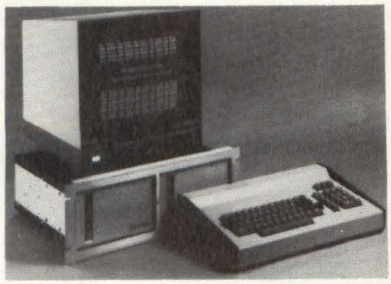
Operating at from 1 bps to 400 Mbps, the MG-400YH series programmable word generator provides a basic data matrix of four parallel outputs with 16 bits of serial data provided on each output. Internal multiplexing circuitry can produce longer words consisting of an interleaved pattern of the basic 16-bit words. There are no data gaps between successive words. Options on number of outputs allow all seven outputs to be available simultaneously or to share the basic set of four outputs as a function of multiplex mode. The output format on each of the channels may be individually selected between NRZ and RZ. Both true and complement outputs are simultaneously available. Output waveshapes feature 1 V amplitude and rise/fall times of less than 500 ps when driving 50 Ω. The bit rate is determined by an externally provided clock signal. Price: $7250. Tau-Tron Inc., 11 Esquire Rd., North Billerica, MA 01862. (617) 667-3874. **Circle 166**

DUAL POWER SUPPLY OUTPUTS ±12 TO ±15V

The model HE215 power supply provides a dual output voltage source for powering linear circuits. The unit achieves 75% efficiency at full load output of 3.0 A (total of both outputs) with less than 5 mV P-P of ripple and noise. The unit has the "footprint" and mounting dimensions of the Lambda package size "B" supplies: 6.5" x 4.5" x 1.5". The supply is adjustable from ±12 to ±15 V output. Computer Products Inc., P.O. Box 23849, Fort Lauderdale, FL 33307. (305) 974-5500. **Circle 161**

CRT CONTROLLERS DISPLAY 1,920 CHAR.

This series of rack-mountable CRT display controllers provides timing, memory, cursor and serial KSR boards plus power supply. R-Case units offer alphanumeric display formats ranging from 8 lines of 32 characters to 24 lines of 80 characters and can drive single or multiple



arrangements of RS170 video monitors. They measure 8.5″W x 5.85″ H x 12″L. Configurations include single unit in R-Case, two units bolted together with a spacer and rack-mounting in single or dual configuration. A multidrop option allows up to 64 displays to be remotely addressed and written over a single communications line. Other options include character accent, batch transmit and editing capabilities, printer add-ons and interface and display options. Ann Arbor Terminals, Inc., 6107 Jackson Rd., Ann Arbor, MI 48103. (313) 769-0926.

Circle 126

Z-80 BASED μCOMPUTER COMES WITH 4K RAM

The Mike 8 microcomputer system comes with 4K of RAM, a 1K monitor program in a PROM, the CPU board and a "console board" which has a calculator-type keyboard and six LED digits. The monitor allows users to enter and execute programs through the console and offers advanced debug features, including RAM test, single-stepping and setting traps. The system includes a PROM programmer so that users can permanently store programs in a blank 2708 PROM (which is included). An ultraviolet lamp for erasing PROMs comes with Model 882, which mounts on a base with its own switching-regulated power supply. Price: $895. Martin Research, 3336 Commercial Ave., Northbrook, IL 60062. (312) 498-5060.

Circle 131

product news

S/D CONVERTERS ACCEPT 60, 400 HZ INPUTS

Accepting both 60 and 400-Hz with no resistors, the 632, 634 and 636 synchro/digital converters offer resolutions of 12, 14 and 16 bits, respectively. These converters accept either 3-wire synchro plus reference or resolver plus reference input signals They are insensitive to line variations of voltage and frequency of up to 15%. Weighing less than 8 oz, model 632 measures 2.6" x 2.6" x 0.82", while models 634 and 636 measure 2.6" x 3.1" x 0.82". CMOS, TTL and low-power TTL outputs are available. The CMOS configuration consumes 0.5 W; the TTL, 2 W; and the LPTTL, 1 W. When tracking a rapidly changing angular motion, these s/d converters have no lag and offer zero velocity error of up to 7200 °/s for the 632 (12-bit), 3600 °/s for the 634 (14-bit) and 900 °/s for the 636 (16-bit). Accuracy for the 16-bit converter is 2 arc-minutes. These converters suit applications requiring digitized angular motion. Typical application areas are radar systems and process-control systems. Natel Engineering Co., 8954 Mason Ave., Canoga Park, CA 91306. (213) 882-9620. **Circle 151**

DC POWER SUPPLY INTERFACES WITH μPs

A DC power supply which provides unregulated power to microprocessors and peripheral equipment, the SMP 30B interfaces with microprocessors that have point-of-use voltage regulators on their printed circuit boards. The unit provides three upstream voltages of 9 Vdc @ 1.0 A and ±18 Vdc @ 0.5 A. Operating at 115 V or 230 V, 50 or 60 Hz input, it measures 3-3/8" W x 3-3/8"H x 4-3/4"L and weighs 2.1 pounds. Price: $27.50. Standard Power, Inc., 1400 S. Village Way, Santa Ana, CA 92705. (714) 558-8512. **Circle 149**

655K CORE MEMORY ACCESSES IN 250 NS

This mass core memory for single module or bulk memory applications consists of a 32K x 18 bit basic module that stores 655K bits, accesses in 250 ns and cycles in 600 ns. Temperature range is -55° C to +85°C. Measuring 6.4" x 9.0" x 1.4", the memory operates from -55°C to +85°C. A bulk memory unit can be concurrently developed to provide an ATR-long case. Such a unit would contain eight SEMS-14 modules, power supply and interface circuitry and provide 256K x 18 of mass storage. Electronic Memories and Magnetics Corp., 20630 Plummer St., Chatsworth, CA 91311. (213) 998-9090. **Circle 147**

192 CHARACTER PRINT SET

An option to increase the printable character set on the 8200 Series line printers from 64 to 192 characters has been announced by Houston Instrument. This option has no restrictions such as mixing different characters on the same print line allowing the same printer to be used with two or more languages. Model 8210 has 80 print columns and will print at speeds up to 2400 lines per minute. A 132 column version can print at speeds up to 1400 lines per minute. The line to line spacing is 6 per inch while the column to column spacing is 10 per inch resulting in large easy to read output. The interface signals for the printer have been arranged to allow ease of interfacing with most known mini and μP systems. Price on the option is $295. Houston Instrument, One Houston Square, Austin, TX 78753. **Circle 298**

INTELLIGENT TERMINAL SERVES OEM APPLICATIONS

Aimed at OEM and large volume end user markets, this diskette based computer system employs a single-chip LSI version of the PDP-8 CPU integrated into a video terminal. Floppy disks serve as the mass storage medium; system components are modular units that plug into the central system element. The central element of DECstation incorporates a 16K word RAM, while the video terminal includes alphabetic and numeric keypads, upper and lower case ASCII character set, special symbols and user-defined special-function keys. DECstation operates under the OS/78 executive, resident on floppy disks. Special programs, including special-purpose "bootstrap loaders," can be read through a program injection module. Five ports are available: two asynchronous serial interfaces for communications or terminals with speeds from 50 to 19,200 baud, one parallel unit for printers and custom interfacing, one for floppy disks and one to facilitate local input of programs. Price: $7,995. Digital Equipment Corp., Maynard, MA 01754. (617) 897-5111. **Circle 160**

product news

OSCILLOSCOPES TO BEST MATCH YOUR APPLICATION

A booklet from Tektronix offers guidance in selecting both plug-in modules and mainframes from the Tektronix 7000-Series and 5000-Series of oscilloscopes. The selection procedure is designed to best match an oscilloscope to your present needs while providing expansion capability to meet future needs.

Topics covered include selection of storage, non-storage, single-beam and dual-beam oscilloscope mainframes as well as selection from a wide range of analog, digital, sampling, spectrum analyzer and logic analyzer plug-ins to meet specific needs. Also covered are cost/performance tradeoffs between 7000-Series and 5000-Series oscilloscopes.

The booklet is designed to help users maximize performance, flexibility and expandability in the oscilloscope systems they select. Tektronix,Inc., P.O. Box 500, Beaverton, OR 97077. **Circle 297**

SHAFT ENCODER WITH BRAIN REPLACES CAMS

Fundamentally an absolute encoder, the Digi-Cam incorporates a memory that can perform control actions at specific angular shaft positions. Its logic level output signals may be used as inputs to computers, programmable controllers, or relay drivers to control machine elements, processes or transfer lines. What performs the sensing function in the Digi-Cam is an opto-electronic device without moving or rubbing parts which may wear or lose adjustment. It has a resolution of 1° in 360° and may be operated in both CW and CCW directions. The memory may be programmed to produce up to 2,160 control actions, formatted as up to 90 dwells on each of 12 cams. Or, the unit may be programmed to simulate multiple dwells on a lesser number of cams. Gould, Inc., 340 Fordham Rd., Wilmington, MA 01887 (617) 658-5410. **Circle 296**

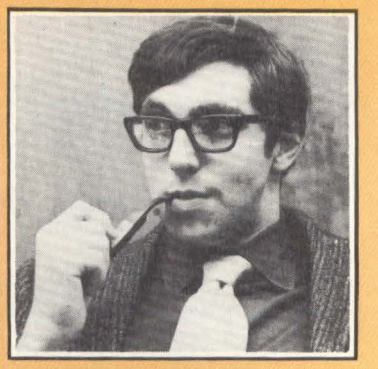
digital design

Advertiser's Index

Sales Offices

PUBLISHER Yuri Spiro **MARKETING PROGRAMS DIRECTOR** George Palken

NEW ENGLAND George Palken 167 Corey Road, Brookline, MA 02146 (617) 232-5470 **NEW YORK, WASHINGTON DC, PHILADELPHIA** Wes Schneider 30 P Village Green, Budd Lake, NJ 07828 (201) 347-7920 **MIDWEST, SOUTH** Ralph Petersen 1 Wheaton Center, No. 1706, Wheaton, IL 60187 (312) 653-2480 **LOS ANGELES, PHOENIX, DALLAS, SAN FRANCISCO** Alan Cazier 823 Enchanted Way, Pacific Palisades, CA 90272 (213) 454-0624 **WEST GERMANY** Maurice A. Coates Int'l. Media Reps. D-675 Kaiserlautern, Box 1610 **JAPAN** Hiro H. Irie International Business Corp. 11-8 Narita -Higashi 1-Chome, Suginami-KU, Tokyo 166 Phone: (03) 311-1746.



COMPONENT-SALES PROJECTIONS

Crystal Ball For Design Techniques

Just as oil-shipment statistics provide indicators for economic change, electronic-component sales figures can act as barometers for evolving design practices. For example, note how the growing volume of microprocessor shipments portends the increasing use of digital electronics for control and instrumentation applications.

And figures for less complex components can also help predict how and for what functions digital circuitry, including the ubiquitous microprocessor, will be applied. One example of such a crystal-ball component is the resistor network — a preformed array of up to 30 resistance elements. Projections on resistor-network shipments can foretell important changes in the use of A/D and D/A converters, the growing use of high-speed ECL circuitry and the continuing shift from noise-sensitive linear circuits to noise-immune CMOS and TTL.

Nearly all of today's resistor networks are fabricated with either thick- or thin-film vapor on a masked substrate in a vacuum- or low-pressure chamber. By contrast with the highly precise, accurate and costly process, thick-film networks result from screen printing a ceramic-metallic paste onto a substrate, which is then fired, much like potter's glaze, in an oven.

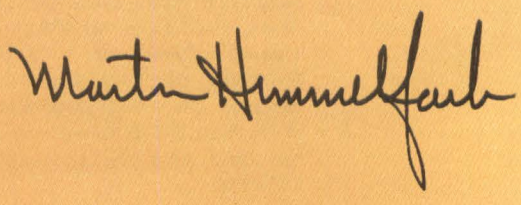
Thin-film networks tend to find application in high-precision circuitry; thin-film surface characteristics also result in less thermal-noise generation than that exhibited by thick-films. These electrical characteristics especially suit thin-film networks to uses in instrumentation amplifiers, feedback summing circuits, precision attenuators and voltage dividers, and A/D and D/A converters. Up to 50 times less costly than thin-film devices, the less stable, less precise and somewhat noisier thick-film networks find uses in applications where tight specifications take a back seat to price. Such applications include voltage setting and terminations for most digital circuitry as well as the combination of resistor functions into a single package in all types of consumer electronics. In dollar terms, over 75% of all networks shipped are thick-film types. In terms of units, because of their low price levels, thick-film types account for virtually all networks in use today.

What do possible changes in these figures portend for design practices in the next five years? Thin-film ladder networks, while they will grow in sales, will decline in market share, a development that indicates a shift away from today's typical hybrid-packaged converter in favor of monolithic units. These monolithic converters, which employ resistors diffused into the semiconductor substrate in place of separate network chips, will be less costly than current models and will thus open new data-acquisition applications.

And the increasing market share of thick-film pull-up/pull-down networks used for voltage-setting and interfacing in logic circuitry foretells designers' expanding practice of mixing logic types, like TTL and ECL or TTL and CMOS, as well as their overall substitution of digital for analog circuitry. Finally, the emergence of thick-film networks with built-in capacitors further emphasizes the expansion of high-speed logic, where terminations, like transmission lines, must be tuned.

As you ponder these potential developments, remember that overly specific applications of statistical reasoning can become dangerous. Marketing projections are subject to error, for no matter how complex and detailed the prediction model, unforeseen developments — nuclear holocaust, for example — inevitably crop up. And using anticipated design trends to predict component-market performance, which in turn is used to substantiate the very same design trends, can lead to circular reasoning. Finally, prophecies of design practices can become self-fulfilling, as was the case with the application of microprocessors.

So be warned that while they may act as barometers of evolving design philosophies, component-marketing projections constitute only one of the many factors you should consider when assessing the skills you'll need for designing tomorrow's products.



Editorial Board member and former Editor of this magazine, **Martin Himmelfarb** *is a senior consultant at Venture Development Corp., Wellesley, MA, which has published a resistor-network marketing study. We will be pleased to provide space for opposing views.*

Now you can get our disk systems within 30 days ARO at the industry's lowest prices:

• 80 Mbytes for under $12K*
• 300 Mbytes for under $20K*

Field-proven reliability, total software support and 30-day delivery. You've come to expect them all from us. And that's why we've become the world's largest independent supplier of minicomputer disk storage systems.

Now add low price. Lower than the minicomputer manufacturer, lower than any other independent—*the lowest in the industry*. Why? Because we buy more disk drives than anyone else, and we can afford to pass the OEM discounts on to you.

The prices listed above are for complete disk systems ready to plug into your minicomputer. Each system includes our high-performance controller, an appropriate minicomputer interface and the software of your choice.

When you buy disk systems from us, you'll save a lot more than a lot of money on the purchase price. You'll save precious time. Beginning with our 30-day delivery and continuing with our responsive, customer/software support, we'll get your system up quickly—and keep it up. For complete OEM pricing information and technical details, contact the System Industries representative in your area.

System Industries
An equal opportunity employer.

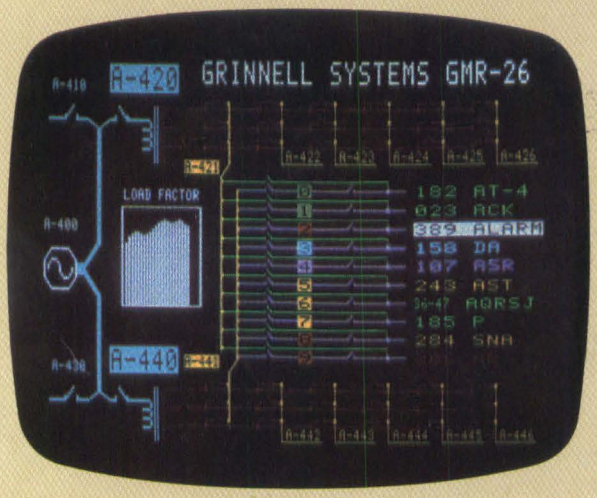
535 Del Rey Avenue
Sunnyvale, California 94086
(408) 732-1650, Telex 346-459

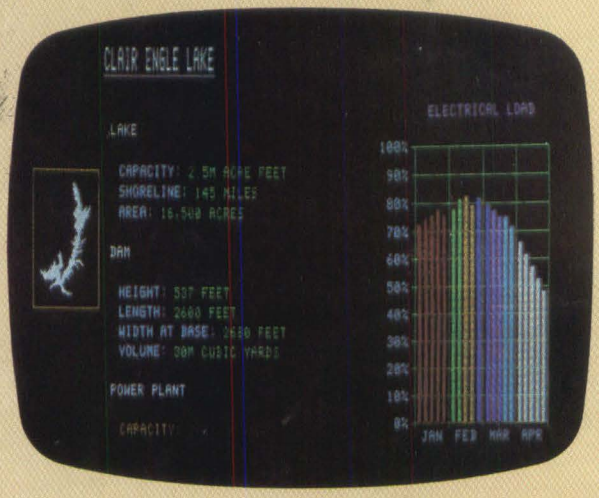
* OEM prices: 40-69 systems.

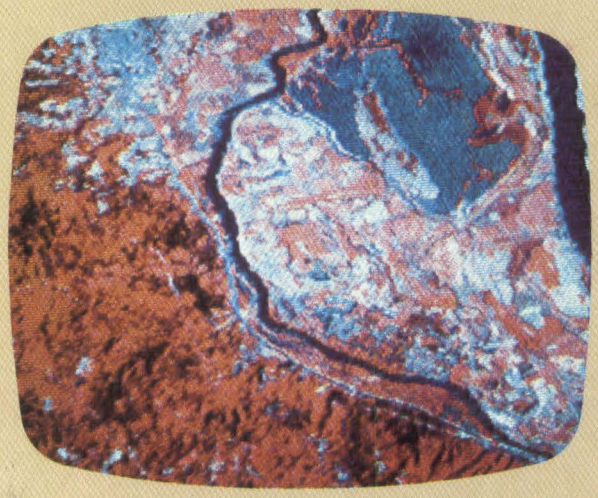
Sales/Service Representatives
Boston: (617) 492-1791. **New York:** (201) 461-3242; (716) 385-3021; (516) 299-4272; (201) 694-3334.
Washington, D.C.: (202) 337-1160. **Cincinnati:** (513) 661-9156. **Los Angeles:** (714) 752-8904. **Houston:** (713) 465-2700.
Sunnyvale HQ: (408) 732-1650. **Canada:** (416) 624-0320. **United Kingdom:** (4862) 70725.
Germany: 211-407542. **Sweden:** 08-236640. **Spain:** 45-7-5312.

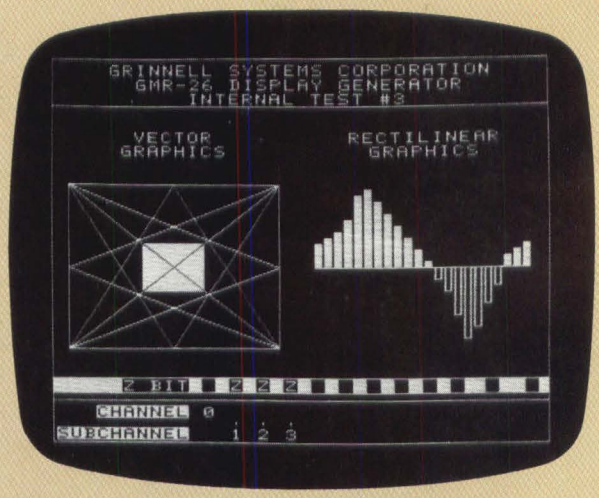
CIRCLE 2

GRINNELL DISPLAYS:









Complex color imaging . . . graphics . . . grey scale . . . basic black and white: our 100% solid state graphic television display systems can be matched to your computer display requirement, easily and economically.

And, they're intelligent. Powerful instruction sets minimize software overhead, simplify programming and eliminate the need for complex macro-instructions and high order programming languages.

Further, every Grinnell system includes a standard computer interface, full alphanumerics and graphics, 4K MOS random access refresh memories and your choice of standard resolutions: 256 x 256, 256 x 512 or 512 x 512. Plug-compatible interfaces for most minicomputers are available, along with a large number of operating options. All systems drive standard TV monitors.

So, before you make any decision about computer display systems, talk to the Grinnell experts. Our engineers have been in the display picture longer than most, and their experience shows. Complete operating systems start at $5,700, and quantity discounts are available. For detailed specs and/or a quotation, call or write.

GRINNELL SYSTEMS

2986 Scott Boulevard, Santa Clara, California 95050 (408) 988-2100

CIRCLE 3