Published
Feb. 1979

FORUM REPORT

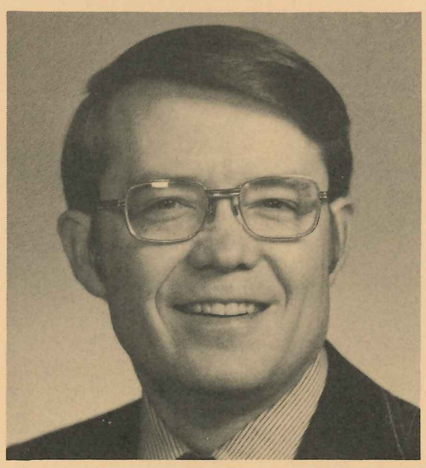
COMPANY CONFIDENTIAL

MICROPROCESSOR HOBBY FAIR: II

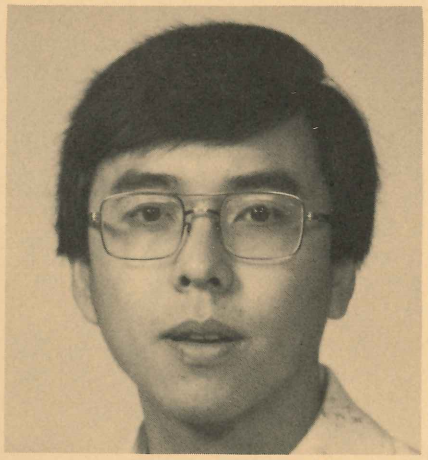
Bill Walker (executive vice president), in November 1976, formed the Engineering Activities Council to provide engineers with a forum in which to present directly, to multiple levels of management, what engineers themselves consider important in technology.

Forum 11, "the Microprocessor Hobby Fair II," was a departure from the usual engineering forum format. Held in September, 1978 in Wilsonville, the Hobby Fair included participants who presented microprocessor-based projects which they had developed either on their own time and for their own use or as "G-jobs" for their groups.

Co-chairpersons for Forum 11 were **Steve Joy** (Digital Product Coordination), and **Hock Leow** (Applied Research, Tektronix Laboratories).



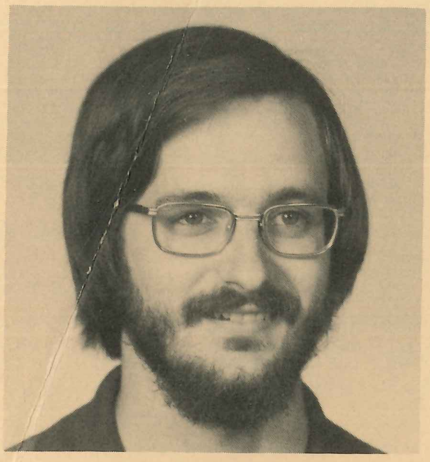
Steve Joy



Hock Leow

CHAIRPERSONS

7D01-DF2 Delta-Time Readout



Bruce Ableidinger

Bruce Ableidinger (Logic Development Products Engineering) presented the Delta-Time Readout, an option for the 7D01-DF2 Logic Analyzer. The option displays the time between the intensified trigger point and the moveable intensified cursor, or between one cursor position and a new cursor position (for pulse-width measurements). In the screen's upper right-hand corner the logic analyzer displays the time in nanoseconds, microseconds, or milliseconds or in units of clocks if the 7D01 is clocked externally.

Delta-Time Readout is an add-on to the existing 7D01-DF2. Hardware added to the 7D01 includes a parallel-loading CMOS shift register which latches the position value of the sample interval switch and sends that position to the DF2 under microprocessor control. The only other hardware required for this addition are zener diode level shifters and a few resistors.

Additional firmware includes an Intel 2716 EPROM which holds the MC 6800 program that (1) reads the sample interval switch position, (2) computes the number of internal or external clock samples between the present cursor position and the trigger (or between the present cursor position and the last stored cursor position), and (3) calculates the actual time between these points based on a 1-2-5 multiplier and a .1-1-10 "gain" multiplier. The program then displays the calculated result. Getting into this TIME READOUT mode is as simple as pushing the front panel MENU key and then MENU SELECTION 3.

FOR MORE INFORMATION

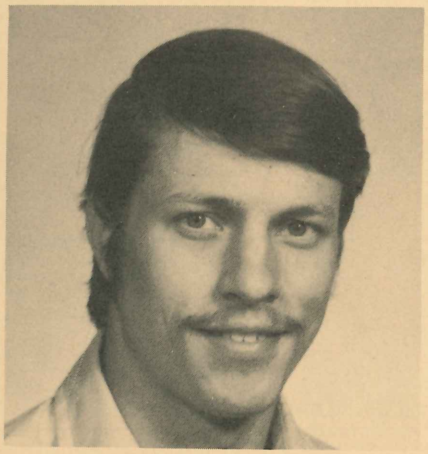
To upgrade your 7D01-DF2 hardware, call Bruce Ableidinger on ext. 7161 (Beaverton), or write to 39/149.

To have the Delta-Time Readout code burned into an Intel 2716 EPROM, send an erased 2716 to Bruce at 39/149. □

SIGNET SMART TERMINAL

Kevin Clark (High Frequency Component Development, part of LID) displayed a computer video terminal that uses a Signetics 2650 microprocessor. The terminal features an 80-character-by-16-line display, a 300-baud (30 cps) Kansas City Standard cassette tape interface for mass storage, an RS-232 serial communications interface with software-selectable baud rates up to 9600 baud, and inverse video characters (black characters on white background). Software performs such functions as scrolling and screen updating.

Kevin intends to add a programmable character font for special characters and graphics, a four-fold higher cassette data exchange rate, and local editing and transmit capabilities. Kevin also intends to use the completed terminal in a Z80-based microcomputer system.



Kevin Clark

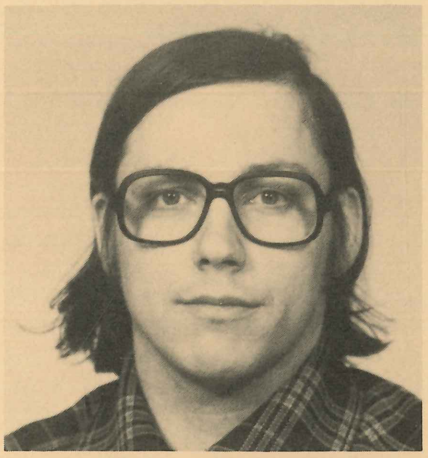
Kevin chose the Signetics 2650 microprocessor because of its capabilities and because the chip was available at a reasonable price (it was free). BASIC and an assembler are available for the processor.

Kevin built the terminal piecemeal, starting with an extensively modified Central Data computer board. He added a Ball monitor, a Univac keyboard and power supply, and a wire-wrap interface board and expansion bus. He enclosed the terminal in a Beehive cabinet.

FOR MORE INFORMATION

For more information about this Signetics smart terminal, call Kevin on ext. 5773 (Beaverton) or drop by 39/353. □

A Maze-Solving Mouse



Mike Cranford

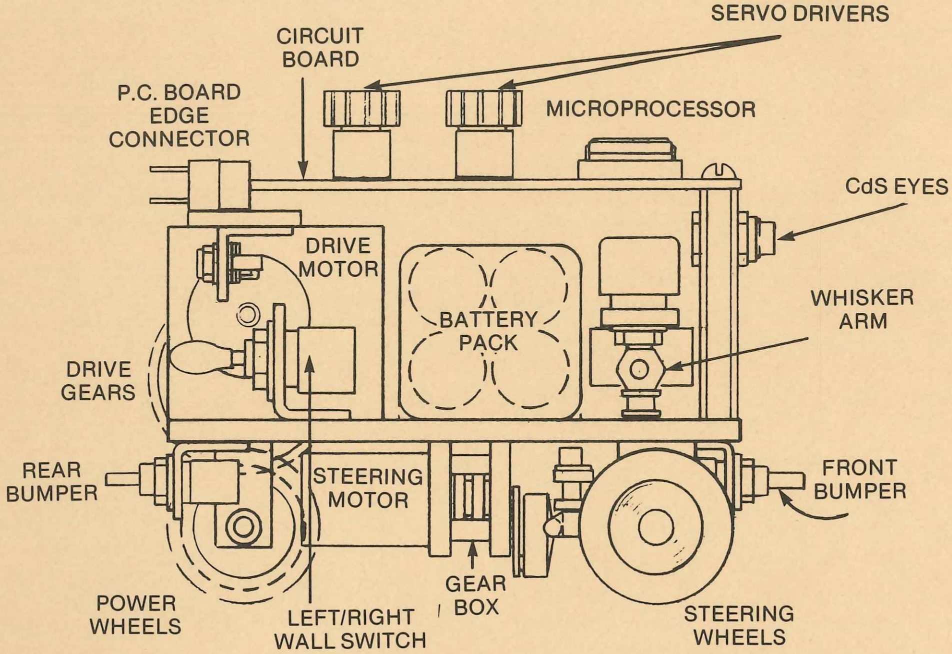
Mike Cranford (Electronic Technology Applications, part of Tek Labs) demonstrated a maze-solving mouse that he entered in IEEE Spectrum Magazine's Micro-Mouse contest in May, 1978.

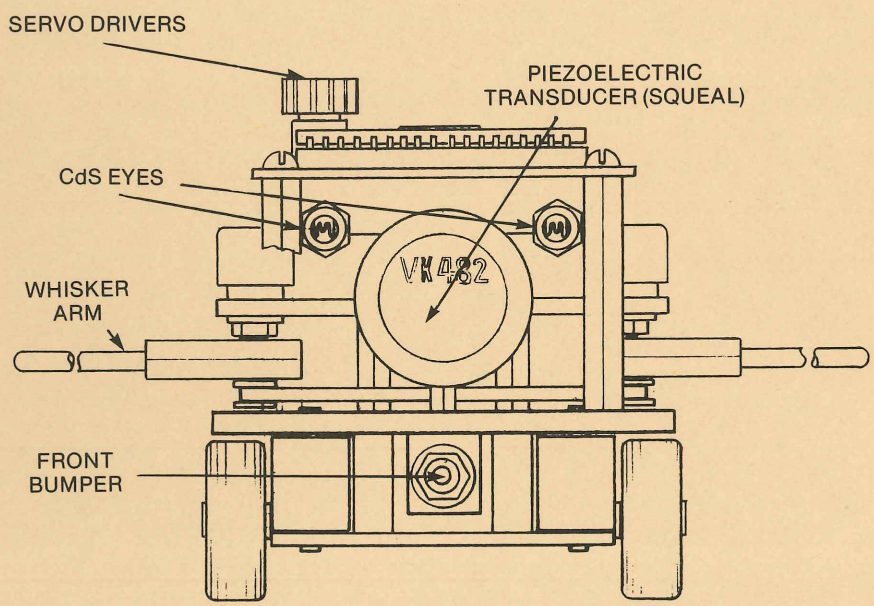
The contest required each mouse, three times in succession, to navigate a maze about 20 feet on each side. The winner was to be the mouse with the fastest run-time (none of the entrants completed three runs). The maze consisted of a series of seven-inch-by-seven-inch cells having three or fewer walls. Each mouse had to have its own intelligence and could be powered by any electromechanical or mechanical means except internal combustion engines (biological power sources were also excluded).

Contest rules did not restrict the mice's heights, but did specify that each mouse could be no larger than 10 inches on a side at heights greater than two inches (the height of the wall).

Mike pointed out that several design guidelines followed naturally from the sponsor's specifications. First, the mouse had to have enough power to complete three runs through the maze. Second, the mouse had to be able to sense walls and openings, and, third, turn and change direction. Because each mouse had to

Continued on page 4





Continued from page 3

make three runs for a best-of-three time, the mouse should be able to learn from its first two runs and make the fastest run on the third try.

Mike said he designed his mouse for purposes more general than running IEEE Spectrum's maze. In the Micro-Mouse contest, other mice ran the maze more quickly than Mike's, but most of the winning mice were too specialized to run outside that particular maze.

Mike's mouse has two whiskers (see diagram) for detecting walls and openings. Pressure-sensitive microswitches on the front and rear bumpers detect obstacles (such as walls and cats). Mike's mouse also has two light-sensitive cadmium-sulfide "eyes" but did not use them in the Micro-Mouse maze. Mike's mouse has a voice (a squeak) too.

An Intel 8748 microprocessor controls the mouse's speed and direction. Mike chose the 8748 because it provides outstanding single-chip control while requiring very little power. In the standby mode, a battery provides five milliamps at five volts. The mouse operates at currents ranging from 70 milliamps (while the drive motor idles) to 500 milliamps (when both the drive motor and the steering motor are stalled, as when the mouse is turning). An eight-channel analog-to-digital converter digitizes whisker position, front and rear bumper positions, and the outputs from the right and left eyes.

The mouse squeaks when it hits a wall and plays Mickey Mouse theme music when powered-up.

The mouse uses all of the 8748's 27 input/output pins and has 64 bytes of RAM memory for data but has a capability of accepting up to 512 more bytes for running more complex mazes.

An eight-pole dual-in-line-package switch selects one of the microprocessor operating modes: analog-to-digital test, drive electromechanical system test, steering electromechanical system test, squeaker test, and a mode for linking the mouse to a 4051 BASIC Computing System for interrogation and control. A three-position switch selects the wall mode: follow-right-wall, follow-left-wall, or optimize and take the shortest path.

Mike assembled all the mouse circuitry on a 2.5-inch-by-2.5-inch circuit board.

To make documentation and maintenance easier, Mike designed the software in four modules: input/output, tests, "smarts," and tables.

An internal counter/timer performs six functions on a timeshare basis: output-pulse time framing (50Hz for the servo drivers), analog-to-digital conversion, drive-pulse timing, steer-pulse timing, squeak timing and tune playing, and prescaling several 16-bit software timer/counters.

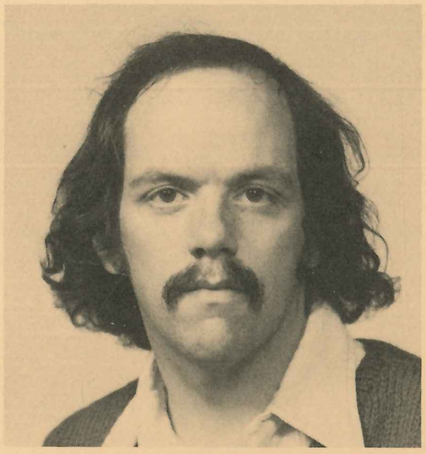
Mike has documented and debugged 600 bytes (of the 1024 available) of program in EPROM. Mike is now documenting and debugging the "smarts" part of the software, and intends to complete the software and make a few minor hardware modifications before the next annual IEEE Spectrum Micro-Mouse contest (in March, 1979).

Mike pointed out that there may be other benefits, besides fun, arising from the engineering efforts devoted to the contest mice. For example, it is now feasible to provide a problem-solving intelligence for a quadraplegic's motorized vehicle. With minimal effort such as spoken words or small body movements from the quadraplegic, a vehicle can move from one place to another, know its location, remember its path, and recognize obstacles (such as curbs, closed doors, and chairs) and move accordingly. Mike further indicated that such an application is one example of an increased use of artificial intelligence, a development which will dramatically affect our lives.

FOR MORE INFORMATION

For more information about Mike Cranford's maze-solving micro-mouse, call Mike on ext. 7557 (Beaverton). □

A MORSE CODE TEACHING MACHINE



Ward Cunningham

Wayne Downer

Ward Cunningham (Systems and Cybernetics, Tek Labs) and Wayne Downer (Digital Service Instruments) presented a project designed to help students learn Morse code. Cunningham explained that many technically-minded people have tried to learn the International Morse Code, and most have failed. Those who were lucky enough to have a patient friend to bang out hours of practice text probably finally learned the code. Students relying on code records and tapes were left frustrated.

The code-learning process is a simple conditioning process that invites automation. Using a small speaker, Ward and Wayne's microprocessor-based teaching machine sends the user a Morse character (the stimulus), and waits for the user to strike a keyboard key (the response). If the student strikes the correct key, the character (the reward) appears on the screen. The teaching machine helps each student respond correctly to at least a few codes. First, the program repeats a letter until the student types the correct key. Second, the program restricts the presented alphabet subset to a size the student can handle.

From a subset of the Morse alphabet, the teaching machine selects characters at random except that difficult characters are more likely to be selected. The program determines which characters the student finds difficult and presents those more often. When the student masters the subset, the machine adds a character. Thus, the machine automatically adapts the stimulus to the student's learning.

Ward adapted their control software to four 8-bit microprocessors, and let several students try the machine. The program quickly established an impressive track record: most students achieved a five- to eight-word-per-minute proficiency in four to six one-hour sessions. Ward published these results last year in an article ("A Fully-Automatic Morse Code Teaching Machine") in the May, 1977 issue of **QST**.

In the article, the author assumed most students have or were willing to buy a complete hobby computer system. In fact, most students were not able to buy such a system.

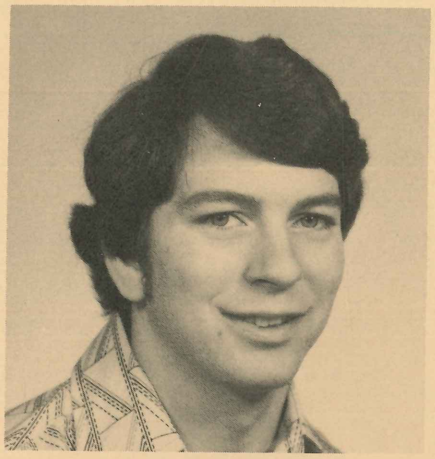
The teaching machine demonstrated at the Hobby Fair is a low-cost, special-purpose system that most amateur radio operators can afford. Aiming for a low parts-count, Wayne squeezed a processor, power supply, and RS-232 interface onto a three-inch-by-four-inch board. The teaching machine requires a calculator charger and a TV terminal as accessories.

Ward said "We hope every Morse code student at Tektronix has access to one of our machines. To that end, we are particularly interested in reaching instructors who would like to build a machine for their students."

FOR MORE INFORMATION

For more information about the teaching machine, call Ward Cunningham on ext. 6875 (Beaverton) or drop by 50-362.□

Foundation For A Robot



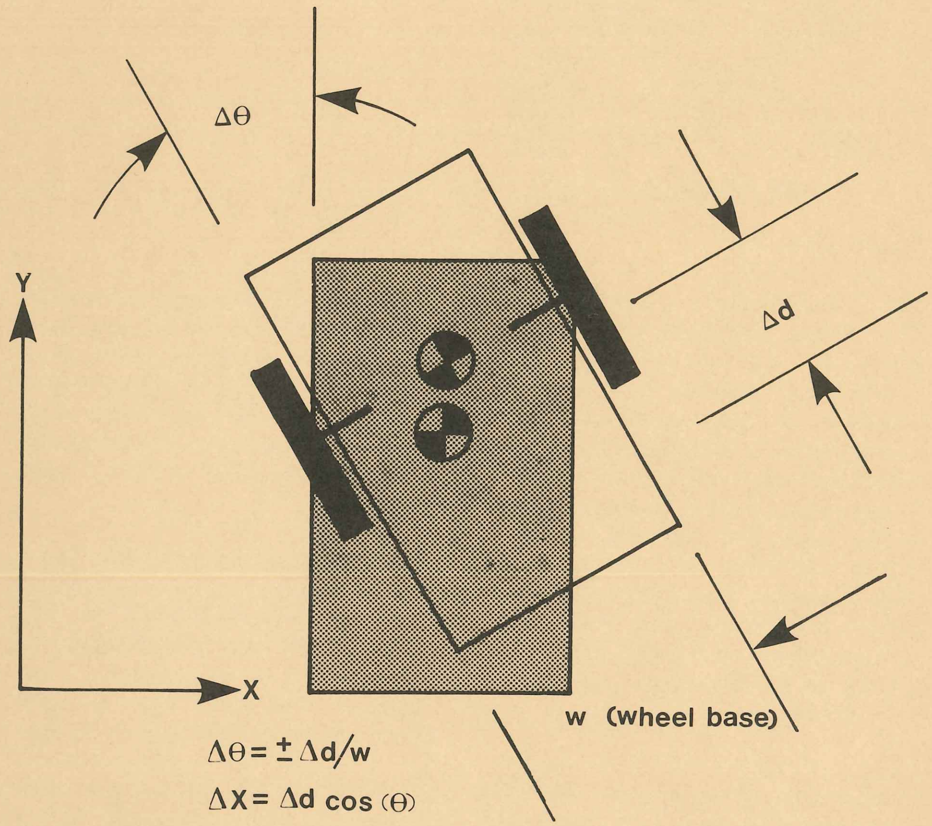
Wayne Downer

Ward Cunningham

Wayne Downer (Digital Service Instruments) and Ward Cunningham (Systems and Cybernetics, Tek Labs) presented a project that can serve as an intelligent, mobile base for a robot. Their intent was to solve the basic problems of transportation so that they could develop the rest of the robot independently. In the project displayed at the Hobby Fair, a wheeled chassis reported its position to a Tektronix 4006-1 Display Terminal which displayed a map of the chassis' movements.

The hardware consisted of a chassis (having two casters and two driven wheels that sensed position as well as turned the chassis), a microprocessor and a battery-pack. For demonstration purposes, Wayne and Ward connected the 4006-1 and the chassis with an umbilical cord.

The microprocessor simultaneously controlled several tasks: (1) communicating data to the terminal about chassis operation, and (2) calculating chassis position by determining the chassis' angular orientation in an x/y coordinate system. The microprocessor calculated chassis position by interpreting each driven wheel's shaft encoder. Each shaft encoder outputs a two-bit Gray code (a code in which successive combinations change one bit at a time) that indicates the direction and amount of movement of a wheel.



$$\Delta\theta = \pm \Delta d / w$$

$$\Delta X = \Delta d \cos(\theta)$$

$$\Delta Y = \Delta d \sin(\theta)$$

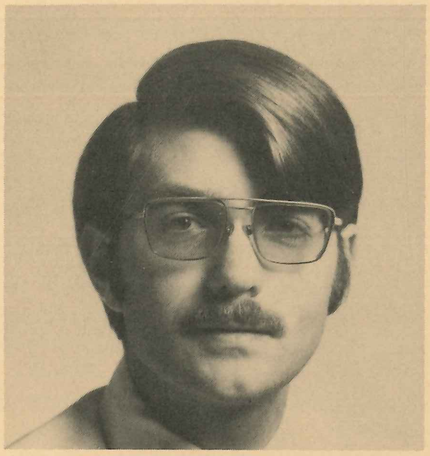
To calculate the chassis' current position, the microprocessor determines direction and incremental movement of the chassis each time a shaft encoder indicates there has been movement. (The microprocessor references the position to a point halfway between the two driven wheels; see the accompanying figure.)

With the position-identification chore out of the way, Wayne and Ward will work on pathfinding and obstacle detection problems.

FOR MORE INFORMATION

For more information about the foundation for a robot, call Wayne Downer on ext. 6551 (Beaverton) or drop by 50-433.□

PROGRAMS FOR AN APPLE II COMPUTER



Dennis Feucht

Dennis Feucht (Applied Research, Tek Labs) demonstrated several programs he wrote for his Apple II Personal Computer. The Apple II computer system includes a DDT-like disassembler, a mini-assembler, memory-load and examine commands (in hex), and a debugger with single-step and trace capability. The computer has standard bit-map graphics (40-by-40 pixels, 16 colors), 16-bit fast-integer BASIC (in ROM) and nine-digit floating-point extended BASIC, with graphics and debug commands for both forms of BASIC. In addition to the standard graphics, the Apple II system offers a high-resolution bit-map graphics package: 280-by-192 pixels, four colors, and firmware plotting subroutines that define shapes and perform rotations, translations, scaling, point-plotting, and vector-plotting.

Dennis demonstrated four programs. The first was his modification of Joseph Weizenbaum's ELIZA psycho-analysis program. This simple version of ELIZA demonstrates conversational English by examining keyboard response for key words and phrases and then responding to them in a Rogerian style.

Dennis also demonstrated AUTOPLOT. AUTOPLOT is an automatic function-scaling and function-plotting program. AUTOPLOT plots a function by determining the function's range and domain, generating and scaling a graph, and then plotting the function on the graph.

Dennis' third routine was PLFM, a piece-wise linear function modeling program. For applications such as logarithmic conversion in a digital multimeter and optimally determining the breakpoints in a function generator's triangle-to-sine converter, this program asks for the endpoints in the modeled function's domain, the number of segments, and the deviation of displacement error among the segments. PLFM then determines breakpoints and plots the function along with the piecewise-linear approximation. The user can obtain a table of breakpoint values by changing computer operation to the TEXT mode.

Dennis' fourth routine, Epidemic Simulation, presumably has no direct engineering application but does demonstrate Apple II's usefulness. In standard resolution graphics, the routine plots, as a function of time, the percentage of a population that is sick. The program asks the user for the percentage of the individuals in a population who are sick, the probability of an individual catching the disease when exposed to it, and the probability on any given day of an individual recovering from the illness.

Dennis pointed out to Hobby Fair viewers that Apple II may be useful to Tektronix engineers for local software development. An Apple II system having a minifloppy disk with 48k mainframe, a printer, and a color monitor costs about $3500. The Apple II uses a 6502 microprocessor, which is becoming more popular. Assemblers and editors are already available for the 6502. Other software, such as Pascal, will probably be available soon. Microsoft, Inc. has used the 6502's optimized instruction set to write a 6502 BASIC that out-performs their comparable 8080 BASIC by as much as 100-to-1 in benchmark programs.

FOR MORE INFORMATION

For more information about Dennis' programs or his evaluation of the Apple II system, call Dennis on ext. 5630 (Beaverton) or drop by 50/362. □

Tiny Teco-6502

Bob Haas

At the Hobby Fair, Bob Haas (Graphic Computing Systems Engineering, IDG) demonstrated a text editor he developed for his home computer, an expanded KIM-1 (a 6502-based hobby computer). Bob's editor is a subset of TECO (Text Editor and Corrector), a text editor used with most Digital Equipment Corporation computer systems.

For firmware development at Tektronix, Bob uses TECO on PDP-11 and PDP-10 computers. To avoid shifting programming gears at the end of each day, he wanted a home editor similar to the one he uses at work.

The "Tiny TECO-6502" is a very small (2 kilobytes of code) subset of TECO, but it covers about 95% of his home text-editing needs. Bob included insertion, deletion, pointer manipulation, searching, and simple iteration commands in Tiny TECO 6502.

FOR MORE INFORMATION

For more information about Tiny TECO-6502, call Bob on ext. 2519 (Wilsonville) or drop by 61-272.□

PET AND FRIENDS

Keith Lofstrom

Keith Lofstrom (Integrated Circuit Design, Tek Labs) demonstrated a Commodore PET (Personal Electronic Transactor) computer system plus several peripherals and programs.

Keith's PET system provides four interfaces: a processor bus, a video user port having video and self-test outputs, an IEEE-488 bus, and a second cassette interface in addition to the internal PET cassette deck. Keith also connected 28 kilobytes of memory to the memory already on the processor bus, and added an ATARI video game ROM cartridge interface.

In Keith's system, the user port can drive a light pen, an Advent large-screen monitor, and a speaker. With the IEEE-488 bus, he controls a Tektronix 4924 Tape Unit and a home-built talker-listener board for "dumb" peripherals. The added cassette interface can connect two PET's or drive a modified audio cassette deck.

At the Hobby Fair, Keith pointed out many advantages of using a PET system. This low-cost and easy-to-use system is easy to interface to other hardware. Because there are now many PET owners, dozens of peripherals and thousands of programs will be available to all users.

Keith, who intends to use PET for hardware and software development as well as for fun, also said PET has a very fast and well-implemented BASIC interpreter and accepts machine code programming. He uses a machine-language assembler, disassembler and monitor program to construct fast subroutines for BASIC programs. Keith has used these software tools to analyze the PET and to generate a listing of the ROM's in the PET.

Keith also observed that most commercially-available home-computer programs are games (Blackjack, Quest, and Star Trek games were popular at the Hobby Fair). Cassette "magazines" provide half a dozen new games every month. However, Keith believes PET users will soon exploit more of PET's practical uses.

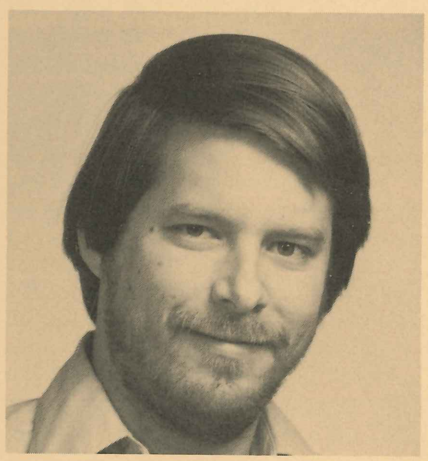
FOR MORE INFORMATION

If you are interested in PET, call Keith on ext. 6207 (Beaverton) or drop by 50-316.□

A 6502-Based Computer System

At the Hobby Fair, Bill Meyer (IDP OEM Engineering) displayed a 6502-based microprocessor system. His design goal was building a system as inexpensive as possible without sacrificing chances to expand it later. Bill ran a simple game program to demonstrate his system.

Bill's system features an RS-232 port, an eight-bit parallel input/output port, a programmable interval timer, one kilobyte of static RAM, two kilobytes of ROM, and two resident monitors. According to Bill's estimate, the system hardware cost less than $75.



Bill Meyer

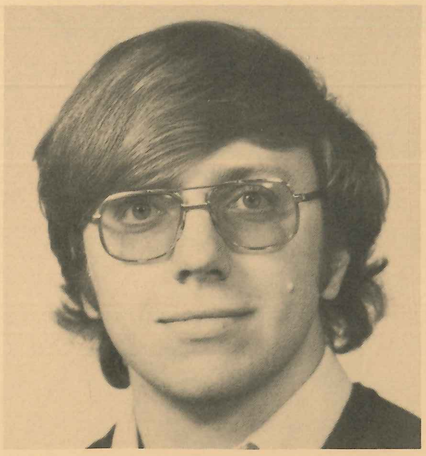
Bill wrote a hex keyboard monitor that interfaces to a modified Tektronix 4081 hexadecimal keyboard and display. The monitor handles enter and execute functions such as LOAD ADDRESS, EXAMINE, DEPOSIT, and RUN. This monitor uses only 256 bytes of EPROM, leaving more than 700 bytes for implementing functions performed by the unassigned command keys on the 4081 hex keyboard.

Bill's system also includes a second resident monitor, TIM (Terminal Input Monitor). TIM is a product of MOS Technology, Inc. for handling communications with a terminal on his system's RS-232 port and with a paper tape reader on the parallel port.

FOR MORE INFORMATION

For more information about Bill's 6502-based computer system, call him on ext. 2826 (Wilsonville) or drop by 61-243.□

4051 Video Interface



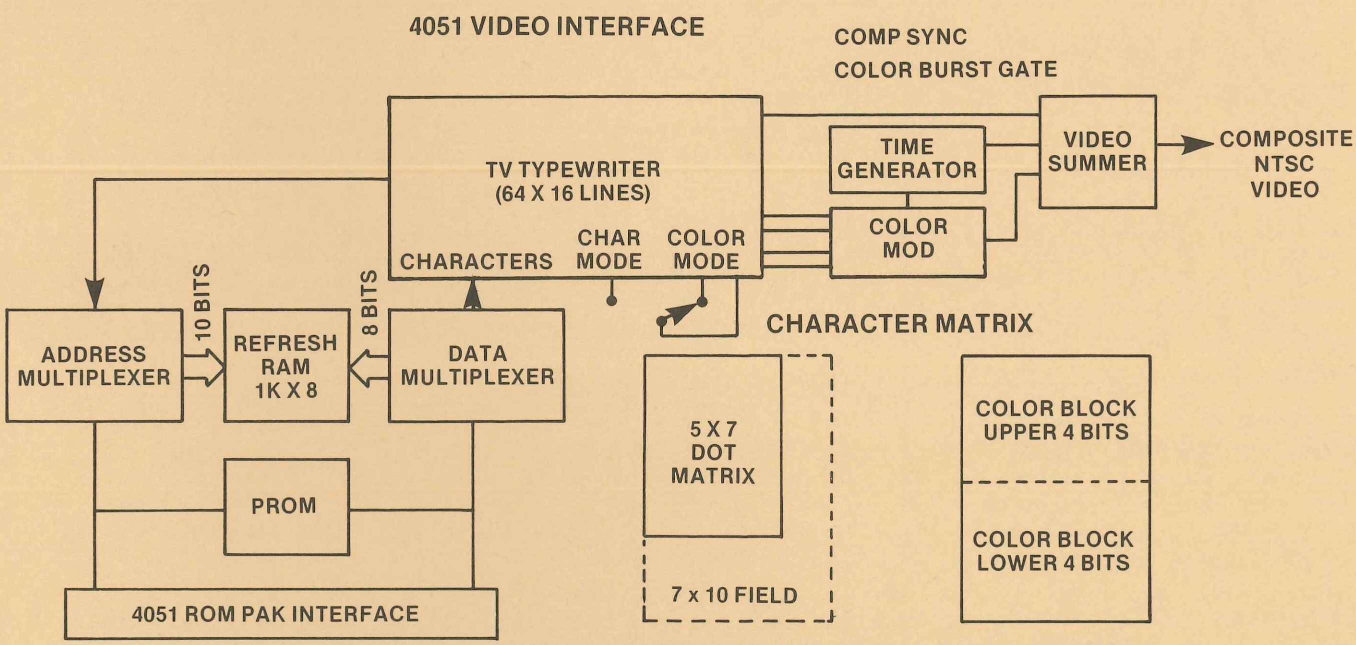
Mike Mihalik

Mike Mihalik (TM500 Engineering) demonstrated a 4051 Basic Computing System with enhanced display capabilities provided by a ROM pack he developed. This ROM pack allows users to add a color or black-and-white video monitor to the 4051's built-in display. With this addition, the 4051 can display information to larger groups of viewers than is possible with a single 4051 screen. The video monitor displays alphanumerics and some color graphics.

Mike made eight commands available with the ROM pack: LIST (program listing), PRINT (character or numeric output); TLIST (tape directory); HOME (move cursor to HOME position); PAGE (erase screen); CALL "PLOT" x,y,z. (graphic plotting and character positioning); INPUT (numeric variable or string); GIN x,y (find cursor position).

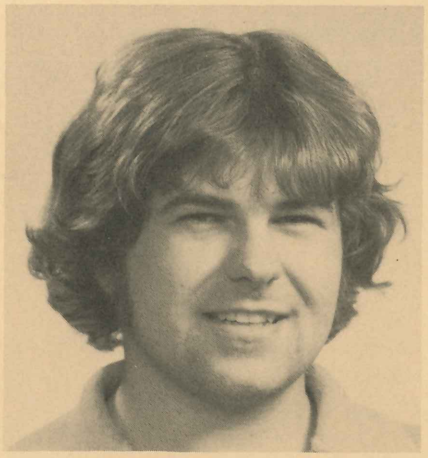
This video interface ROMPAK contains PROM's for the control program, address and data multiplexers, and 1000 eight-bit words of refresh RAM for the video display. This ROMPAK also interfaces a 4051 to a "TV typewriter" but also adds such improvements as a standard NTSC synch generator.

For more information about Mike's video interface ROMPAK, call him on ext. 1533 (Walker Road) or drop by 94-513. □



COLOR BLOCK IS 7 X 5 PIXEL (½ CHARACTER POSITION).
FOUR BITS ALLOWS 16 COLORS OR GRAY LEVELS.
THEREFORE, RESOLUTION IS 64 X 32.

Learning About Microprocessors



Vernon Rupp

Recognizing the difficulties many engineers face in learning about microprocessors, Vernon Rupp (Manufacturing Training) gathered and displayed many learning resources.

The following lists of books, articles, and tapes may seem overwhelming to beginners, but should be useful to others for reference. At the Hobby Fair, Vernon suggested that Tektronix people who want to advance their knowledge of microprocessors can take advantage of the many aids offered by Education and Training.□

BOOKS AVAILABLE THROUGH TEP

M6800 Microprocessor Instruction Set Summary	Motorola
M6800 Microcomputer System Design Data	Motorola
M6800 Programming Reference Manual	Motorola
M6800 Microprocessor Applications Manual	Motorola
6800 Programming For Logic Design	Osborne and Associates
8080 Assembly Language Reference Card	Intel
8080 Assembly Language Programming Manual	Intel
MCS-80 Users Manual (Intro. to 8085)	Intel
8080 Microcomputer Peripherals User Manual	Intel
Understanding Microprocessors	Motorola
Digital Computer Circuits and Concepts	Deem, Muchow, Zeppa
Microprocessor System Design	Klingman
An Introduction To Microcomputers Vol. I Basic Concepts	Osborne and Associates
An Introduction To Microcomputers Vol. II Some Real Products	Osborne and Associates
Z80-CPU Programming Reference Card	Zilog
Z80 Assembly Language Programming Manual	Zilog
Microprocessor Applications In Business, Science, and Industry	Nation Semiconductor
A Computer Glossary	IBM
Microprocessor Buzz Words	Schweber Electronics
LSI-11 Microcomputer Glossary	Digital Equipment Corporation
Words Of The Computer Age	Newsweek

All books are available through E & T. To receive a copy, fill out a TEP enrollment card with/without managers approval and send to E & T.

If not in stock, some books may need ordering.

ENGINEERING

A list of periodicals held in the Tektronix Library

ELECTRONICS

Acta Electronica
Audio
Bell System Technical Journal
Canadian Electronics Engineering
EDN
EE/Systems Engineering Today
Electrical and Electronic Abstracts
Electrochemical Society Journal
Electronic Applications Bulletin
Electronic Components
Electronic Design
Electronic Engineering
Electronic News
Electronic Packaging and Production
Electronic Products
Electronics
Electronics Letters
Elektronik
Evaluation Engineering
IEEE Journal of Oceanic Engineering
IEEE Journal of Quantum Electronics
IEEE Journal of Solid-State Circuits
IEEE Proceedings
IEEE Spectrum
IEEE Transactions (all 34)
Institution of Electrical Engineers Proceedings
International Journal of Circuit Theory and Applications
International Journal of Electronics
Journal of Electronic Material
Medical and Biological Engineering & Computing
Medical Research Engineering
Microelectronics
Microelectronics and Reliability
Mullard Technical Communications
Popular Electronics
The Radio and Electronic Engineer
Radio Engineering and Electronic Physics
Siemens Review
Solid-State Electronics
Solid State Technology
Wireless World

COMPUTERS, DISPLAYS, AND CONTROL

ACM Collected Algorithms
ACM Communications
ACM Journal
ACM Transactions on Database Systems
ACM Transactions on Mathematical Software
APL Quote Quad
Byte
Canadian Controls and Instrumentation
Computer and Control Abstacts
Computer-Aided Design
Computer Decisions
Computer Design
The Computer Journal
Computer Program Abstracts
Computers and Graphics
Computers and People
Computerworld
Computing Reviews
Computing Surveys
Control Engineering
Data and Communications Design
Data Communications
Datamation
Datapro 70
Datapro Reports on Minicomputers
Digital Design
Digital Processes
IBM Journal of Research and Development
IBM Systems Journal
IEEE Transactions on Automatic Control
IEEE Transactions on Computers
IEEE Transactions on Industrial Electronics and Control Instrumentation
IEEE Transactions on Software Engineering
Infosystems
Medical & Biological Engineering & Computing
Mini-Micro Systems
New Logic Notebook
Online
Online Review
Production Engineering
Quarterly Bibliography of Computers and Data Processing
Society for Information Display Journal
Society for Information Display Proceedings

TEKTRONIX EDUCATION PROGRAM CLASSES

HARDWARE

SC/MP MICROPROCESSOR
MICROPROCESSORS FOR THE CURIOUS, I AND II.
MICROCOMPUTERS FOR MANAGERS.

SOFTWARE

MICROPROCESSOR SOFTWARE ON THE CDC CYBER COMPUTER.
TESLA PROGRAMMING FOR MICROPROCESSORS.

MICROPROCESSOR KITS

SC/MP ISP 8k/200	$ 70
MEK 6800D2 MOTOROLA	$185
KIM1 MOSTEK	$235
SDK-85 INTEL	$250

FOR THE M.S. DEGREE PROGRAM

COMPUTER ENGINEERING: SYSTEM DESIGN.

VIDEO CASSETTES

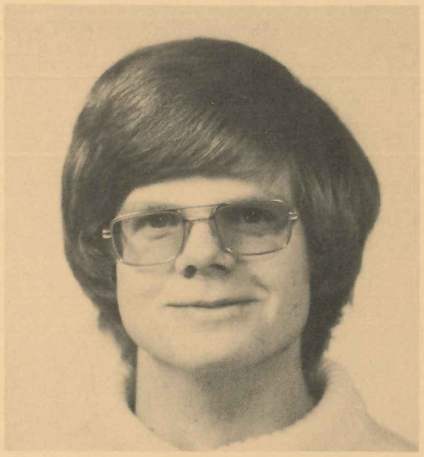
TROUBLESHOOTING MICROPROCESSOR-BASED SYSTEMS

DESIGNING WITH MICROPROCESSORS
8001 MICROPROCESSOR DESIGN AID
MICROPROCESSOR LAB 8002 INTRODUCTION
8002 MICROPROCESSOR DEVELOPMENT AID DEMONSTRATION

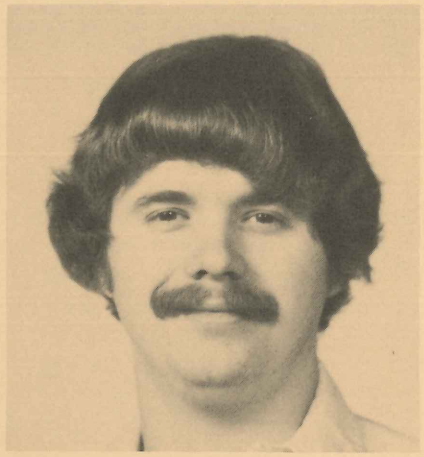
FOR A COPY OF ANY OF THESE TAPES, CALL BEV GILL ON EXT. 7474 (BEAVERTON) OR WRITE TO D.S. 43/012.

For a copy of any of these video tapes, call Bev Gill on ext. 7474 (Beaverton) or write to D.S. 43/012.

An Intelligent Terminal



Steve Sekel



Rod Strange

At the Hobby Fair, Steve Sekel (TM 500 Engineering) and Rod Strange (TM 500 Engineering) presented an intelligent terminal they designed. After reading an article in **Kilobaud** about a low-cost home-computer terminal interface, Steve and Rod decided to build a terminal that uses a microprocessor instead of discrete logic to generate the raster scan for the terminal screen.

Using a microprocessor offers several advantages. Fewer parts (which means smaller space and lower cost too) are required than with fixed logic, and a designer can change the display format by loading different software, rather than changing hardware. Also, the designer can use the microprocessor to load display memory with characters and process cursor movement and erase functions.

Because the processor spends most of its time producing video timing signals, little time is available for other functions. Steve and Rod decided that microprocessors are inexpensive enough to dedicate another microprocessor to the terminal, thus freeing the computer's microprocessor. They chose a 6502 microprocessor because it met their timing requirements and because there is some software available for it.

A small bipolar PROM decodes the 6502's upper four address lines to provide horizontal and vertical sync signals and buffer/memory ENABLE control lines. Other address lines determine which row of the five-by-seven character matrix the screen will display. The terminal produces timing and control signals by having the processor jump to the right memory address at the right time. Software operation, therefore, depends greatly on the address and timing of a scan subroutine. A designer must write the scanning subroutine to require a certain number of instruction cycles for execution.

Although the terminal software maps into the bottom 59 kilobytes of the 65-kilobyte memory, the scanning routine itself fits into about 400 bytes. Memory requirements are one kilobyte of PROM, 128 bytes of RAM for execution, and up to 4 kilobytes of RAM for display memory.

The display memory holds two 64-by-32 character pages. Because the starting location of the displayed page is a vector, the terminal can scroll lines up and down without shifting the display memory.

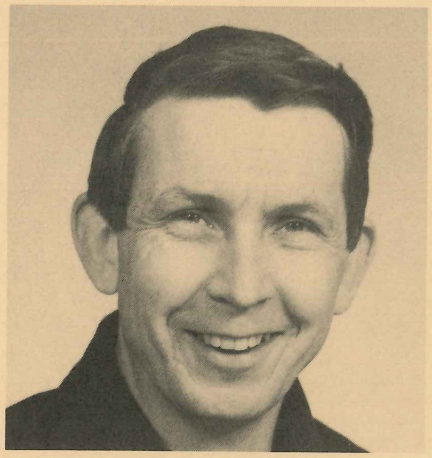
The terminal has a 75-to-1200 baud, full-duplex RS-232 interface. When it receives a character, the UART requests a processor interrupt. If the character is a print character, the processor puts it in display memory. If the character is a control character, the processor performs the control function and then returns to the display routine. The present system responds to these instructions: cursor up, down, left, and right; home-up, page, and erase end-of-page.

Rod and Steve also said they have left-over memory and they intend to add more intelligence to the terminal.

FOR MORE INFORMATION

For more information about their system, call Rod or Steve on ext. 1555 (Walker Road) or drop by 94/513.□

GAS 6800 Graphics Microcomputer



Gary Spence

Gary Spence (Display Device Engineering, Tek Labs) demonstrated a repackaged 4051 Graphics Computer System.

In repackaged form, Gary's 4051 provides at least eight advantages over the standard 4051. (1) The materials cost was $981.27. (2) The computer is portable (it weighs only 25 pounds), (3) compact enough to be stored on a bookshelf, and (4) compatible with 611 Monitors. (5) The computer contains an eight-position ROMPACK Expander that Gary redesigned. (6) Gary redesigned other 4051 circuits to provide more functions, greater versatility and greater reliability. (7) Gary added a BUSS Monitor which uses an EXAMINE MICROCODE feature to debug system ROM. (8) Gary's 4051 also has built-in 8k Extended BASIC.

Gary will soon add a joystick and an analog X-Y input for slow-speed digitizing and recording of signals, a 32-bit I/O parallel interface backpack, and a standard T.V. video interface.

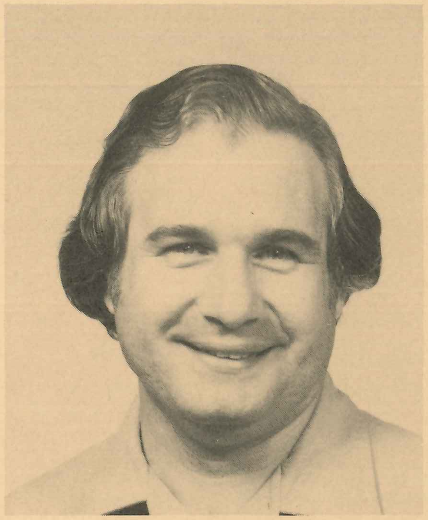
The GAS 6800 Graphic Computer has other capabilities that Gary added: 32 kilobytes of user RAM; addressable data tracking ROMPACK; a BASIC program that allows the computer to verify all its own firmware; and an RS-232 programmable input-output communications ROMPACK.

Gary's plans for his GAS 6800 Graphic Computer include color hardware vector graphics on a standard color T.V. set, and a multipage memory map BACK-PACK that simulates a Digital Processing Oscilloscope (a P7001 processor).

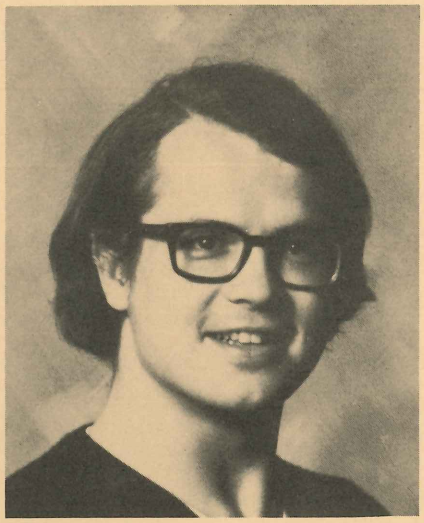
FOR MORE INFORMATION

For more information about Gary's system, call him on ext. 7942 (Beaverton) or drop by 50-276.

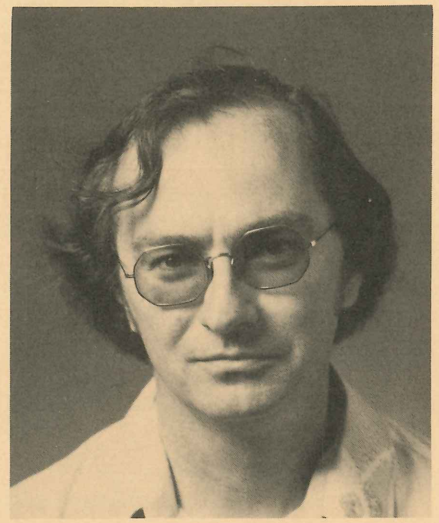
Also presenting projects at the Hobby Fair were **Lynn Cochran** (SID Engineering), **Sam Mallicoat** (IDO Engineering), and **Keith Taylor** (LDP Engineering).



Lynn Cochran



Sam Mallicoat



Keith Taylor

MAILING LIST COUPON

- ☐ Engineering News & Forum Reports
- ☐ Software News
- ☐ ADD
- ☐ REMOVE
- ☐ CHANGE

Name : ____________________

Old Delivery Station : ____________________

New Delivery Station : ____________________

Payroll Code : ____________________

(Required for the data processing computer that maintains the mailing list)

MAIL COUPON TO : 19-313

Forum Report is distributed over the **Engineering News** mailing list. To add your name to the list, or change your delivery station, fill out the coupon inside.

Forum Reports *can not be WOW'd. However, unused* ***Forum Reports*** *may be sent along with other non-WOWable paper to Material Evaluation at D.S. 71-474. Non-WOWable paper should be marked "SCRAP."*

Managing editor: Burgess Laughlin, ext. 6792, D.S. 19/313. Compiled and edited by the Technical Publications Department (part of T&M Publicity) for the benefit of the Tektronix engineering and scientific community in Beaverton, Grass Valley, and Wilsonville.

Graphic design: Joan Metcalf.

Tektronix, Inc. is an equal opportunity employer.

COMPANY CONFIDENTIAL

FORUM REPORT
MAUREEN L KEY
60-553

NOT AVAILABLE TO FIELD OFFICES