$1.75

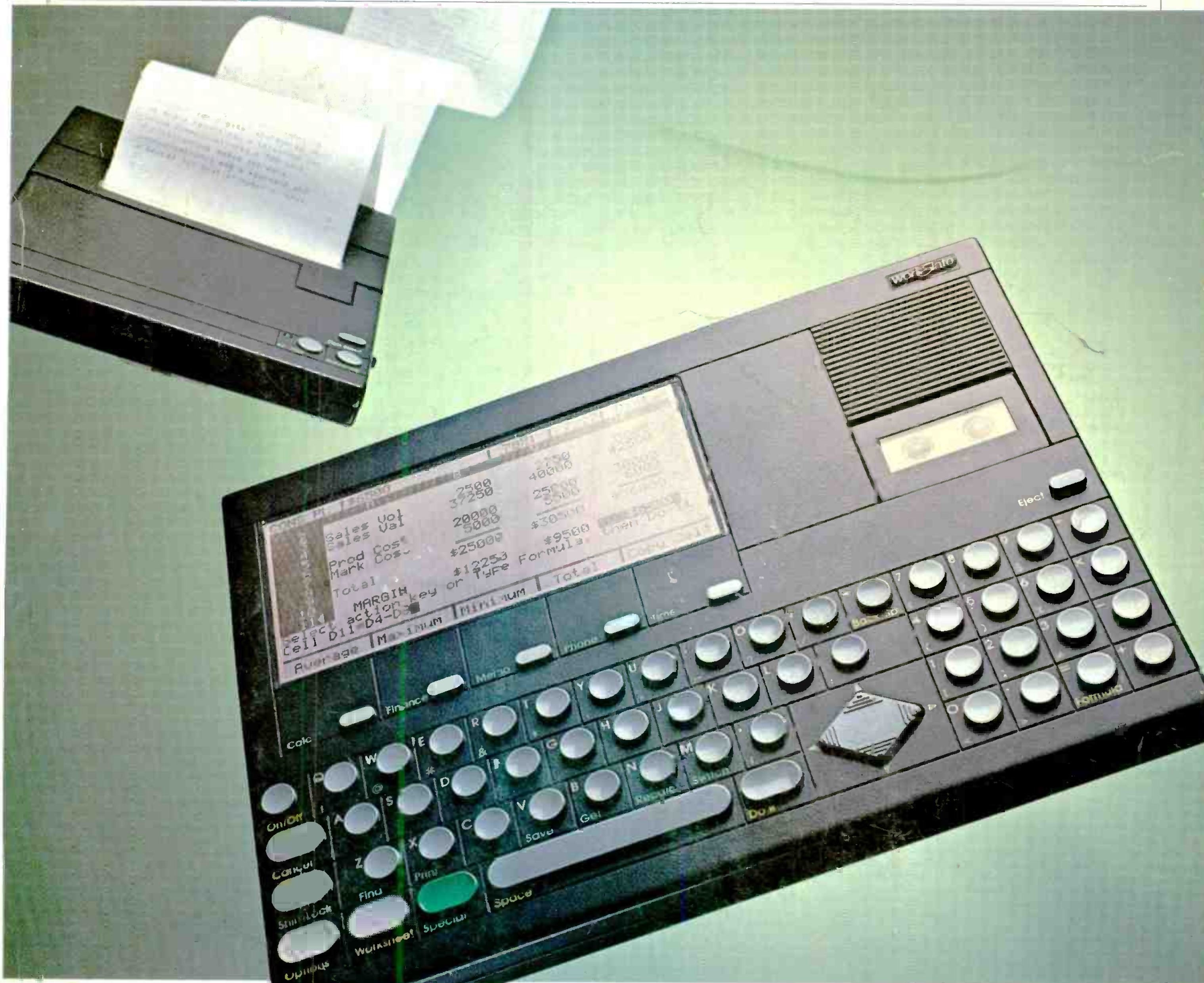
Computers & Electronics

NOVEMBER 1983

Timex Sinclair's New $199 Computer

Experimenting with Wireless Joysticks

Customizing an Apple with EPROMs



0 14024 14278

READSHEET POWER
THE PALM
YOUR HAND

ALL MINI DISKS COME ERROR FREE.

THE HARD PART IS MAKING SURE THEY STAY THAT WAY.

A disk is built with certain safeguards. That's why most disk makers offer guarantees that the product you receive comes to you error free.

We at Memtek Products are concerned that the minidisk remains error free. *Every* time you use it. After exposure to dust, cigarette smoke, fingerprints, even wear caused by your computer. And so, we have built safeguards around the disk, as well.

Memtek Products' latest innovation... acknowledgment of a real world beyond the laboratory.

The hub ring. Designed to prevent our minidisks from jamming in your machine. Rigid. Durable. Reinforced.

The coating. A critically-controlled coating of high-energy magnetic oxide particles that covers the disk's surface, which is then micro-polished to improve head to disk contact, preventing dropouts, lowering head abrasion.

The lubrication system. A constant lubricant protects both the disk surface and the drive head from wear.

The sleeve. Comes with a soft liner that protects the disk while gently cleaning the surface.

The guarantee. We'll replace, free, any minidisk if it fails to accurately store and retrieve data due to a defect in materials or workmanship for up to 5 years from date of purchase. Simply mail the disk back.

The Memtek lineup. Premium, double and quad density minidisks as well as 10- and 15-minute computer cassettes and a 5¼" disk drive head cleaner.

WE PLAY FOR KEEPS™

Circle No. 73 on Free Information Card

Computers & Electronics

NOVEMBER 1983 VOLUME 21, NUMBER 11

FEATURE ARTICLES

EQUIPMENT REVIEWS

COLUMNS

DEPARTMENTS

COVER ART BY TRUMAN MOORE

Computers & Electronics

WILLIAM S. DAVID Publisher

ARTHUR P. SALSBERG Editorial Director

LESLIE SOLOMON Technical Director

JOHN R. RIGGS Managing Editor

JAMES KIEHLE Art Director

A. W. BURAWA Senior Editor

JOSEPH DESPOSITO Technical Editor

JOSEF BERNARD Technical Editor

ANDRE DUZANT Technical Illustrator

CARMEN VELAZQUÉZ Production Editor

JEFF NEWMAN Editorial Assistant

Contributing Editors: Walter Buchsbaum, Len Feldman, Julian Hirsch, Sol Libes, Forrest M. Mims, III

Editorial and Executive Offices
One Park Avenue, New York, N.Y. 10016
212 725-3500

Sales Offices

New York
Tom Ballou 212 725-3578
Ken Lipka 212 725-3580

Midwestern
Robert Vanek, Suite 1400, 180 N. Michigan Ave., Chicago, IL 60601 312 346-2600

Western
Joe Mesics, J.E.M. Associates, Francisco Bay Office Park, 1750 Montgomery Street, San Francisco, CA 94111 415-989-4643

Representation in Japan
J.S. Yagi, Iwai Trading Co., Ltd. 603 Ginza Sky Heights Bldg., 18-13, Ginza 7-Chome, Tokyo, Japan 104

Consumer Computers & Electronics Magazine Division
Larry Sporn President
Jeff Hammond Vice President, Marketing
Carole Mandel Vice President, Circulation
Eileen G. Markowitz Vice President, General Manager
Peter J. Blank Creative Director

Ziff-Davis Publishing Company
Richard P. Friese President
Albert S. Traina President, Consumer Magazine Division
Paul H. Chook Executive Vice President Marketing and Circulation
Phillip T. Heffernan, Sidney Holtz, Edward D. Muhlfeld, Philip Sine Senior Vice Presidents
Baird Davis, George Morrissey Vice Presidents
Selwyn Taubman Treasurer
Bertram A. Abrams Secretary

Editorial correspondence: COMPUTERS & ELECTRONICS, 1 Park Ave., New York, NY 10016. Editorial contributions must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of manuscripts, art work, or models submitted.

The publisher has no knowledge of any proprietary rights which will be violated by the making or using of any items disclosed in this issue.

Member Audit Bureau of Circulations

EDITORIAL

Future Speed Shock

WE love speed for speed itself. Beyond mere numbers, however, some computer applications desperately need every bit of extra speed that can be squeezed out. For example, there's never sufficient computing speed for artificial intelligence, ballistics, and other complex challenges. What's needed is another revolution in computer design.

In the beginning there was the vacuum-tube computer, ENIAC. Clearly not a desktop computer, it covered 1500 sq ft, weighed 30 tons, and contained about 18,000 vacuum tubes. Supplanted by transistors, then integrated circuits, computers became faster, smaller, and cheaper.

However, you won't see numbers like 4.5 MHz among the big daddy's of computers, say, Control Data Corp., Cray, NEC, Hitachi, and Fujitsu, among others. With these supercomputers, speed is measured in gigaflops (billion floating-point operations per second). To give you an example of how fast "fast" is, CDC's Cyber 205 is rated at 800-megaflop peak. The company's 2XX eight-Von Neumann-type-processor machine will reportedly beat this by 40 times. It's due on the streets in 1987, with some 20,000 CMOS logic arrays and liquid-nitrogen cooling.

The speed barrier, though, is still "Von Neumann," whose serial-style computer architecture has been followed for decades. To get around the problem of a processor acting on one instruction at a time, cryogenic devices that use superconductivity have been developed in the labs, such as IBM's Quiteron and Bell Labs' Josephson junctions. Using a few processors with enhanced control-flow architecture is another approach to faster computers. But the real future for super speed seems to lie in parallel architecture—using hundreds of processors in parallel to speed up data flow. Just imagine the switching network required to handle this, not to mention the software requirements!

Most advanced industrialized countries have companies working on super-speed computer technology. Japan's vaunted "Fifth Generation" computer, with a government-sponsored $400-million in the kitty is one. The 10-year project has 9 years to go, and what will come out of it is anybody's guess right now. But it appears to be Japan's effort to leap frog to the forefront of the computer industry, a market outside the country that it has not been able to gain a toehold in when it comes to the basic computer itself and software.

Interestingly, much of Japan's computer and electronics success in the world has been owed to technological advances or lower production costs, not marketing. Head on with domestic companies without one of these two assets, Japan has not been able to encroach on anyone with its products. It has only a 2% share of the U.S. market in $3,000 and over personal computers.

> "Supercomputer speed is measured in gigaflops."

Regardless of which country or company comes up with a speed breakthrough, you can be sure such advances will filter down in time to lower-cost computers. When this happens, artificial-intelligence computers will be commonplace, interacting with their operators to make decisions and solve problems based on judgements made from uncertain information. There are already scores of AI knowledge systems used, you know. Some are in the medical field, where patient data is analyzed and possible disorders identified.

Chances are, I believe, that a facile "thinking" and talking computer will be at your side before the turn of the century, much as a word-processor system is now.

Art Salsberg

You can count on 3M diskettes. Day after day.

Just like the sun, you can rely on 3M diskettes every day. At 3M, reliability is built into every diskette. We've been in the computer media business for over 30 years. And we've never settled in. We're constantly improving and perfecting our product line, from computer tape and data cartridges to floppy disks.

3M diskettes are made at 3M. That way, we have complete control over the entire manufacturing process. And you can have complete confidence in the reliability of every 3M diskette you buy.

Look in the Yellow Pages under Computer Supplies and Parts for the 3M distributor nearest you. In Canada, write 3M Canada, Inc., London, Ontario. If it's worth remembering, it's worth 3M diskettes.

3M hears you...

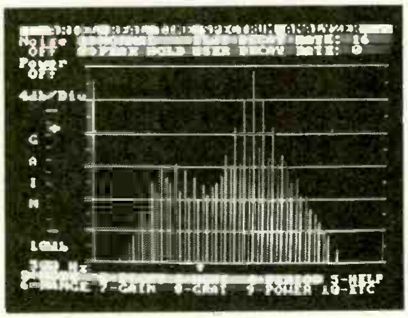
3M

CIRCLE NO. 48 ON FREE INFORMATION CARD

NEW PRODUCTS

VIDEO INFORMATION TERMINAL

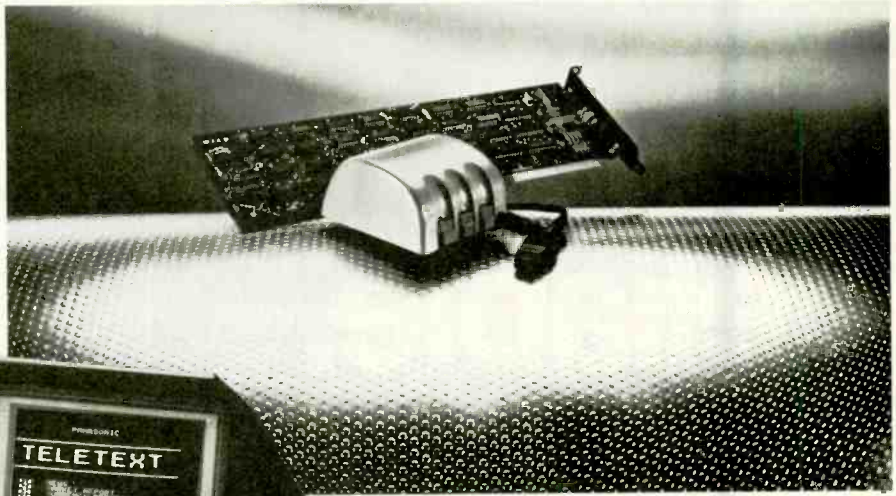
Matsushita's new portable, rear-projection TV weighs 6.6 lb. It can be used as a desktop video terminal for Teletext and Videotex and other video information services as well as a regular broadcast receiver. The collapsible set folds down into a 12″ case and operates on either ac, dc, or rechargeable batteries. The set contains three 2″ projection tubes for red, green, and blue, and a flat square screen with Fresnel/lenticular surface. Horizontal viewing angle is ±30°; vertical viewing angle, ±15°. It also has a video input terminal for VCR hookup. Power consumption is 12 W.



IBM PC SPECTRUM ANALYZER

The Ariel RTA 331 is a 1/3-octave a-f spectrum analyzer that plugs into a single expansion slot in the IBM PC. It divides the spectrum into 31 bands from 20 Hz to 20 kHz and displays the relative amplitude of each frequency band. The unit also converts incoming audio into 8-bit digital words for storage in the PC's memory. $649.95.

Circle No. 84 on Free Information Card



COMPUTER MOUSE

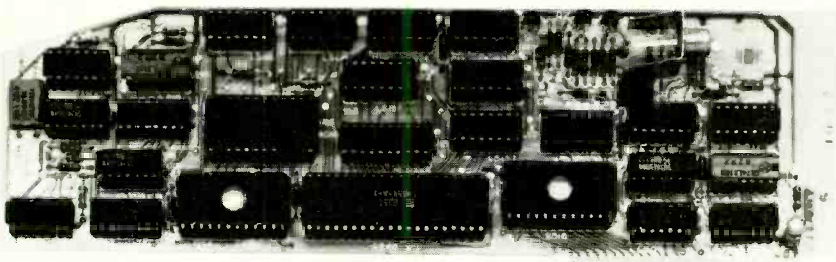
Wico's new Computer Command™ "Mouse" is an optically encoded mechanical cursor controller for use with Apple II and IBM PC personal computers. By simply sliding the hand-held device across a desktop surface, computer users can edit, draw lines, or select menu choices from the CRT without touching the keyboard. It features light-encoded wheels and multiple-function buttons and comes with a hardware interface controller card and a 5′ connecting cord. The Mouse with interface is $180 for an Apple II and $230 for an IBM PC.

Circle No. 85 on Free Information Card

MONITOR FOR APPLE II

Apple has announced a monochrome video display designed to blend with its Apple II family of personal computers. It features high-resolution, 80-column text and graphics display; an anti-reflective, high-contrast screen; and a tilt mechanism for adjusting the screen's angle. The 12" screen displays up to 24 lines of 80 characters of text in P31 green phosphor. A contrast control knob is located on the right side of the monitor; and other controls for vertical hold, vertical amplitude, and brightness are located on the back. $229.

Circle No. 86 on Free Information Card



FRANKLIN 80-COLUMN CARD

The ACE Display card from Franklin Computer expands the video display capabilities of Franklin ACE 1000 and Apple II computers to a full 80 columns by 24 lines to provide ease of viewing and versatility. The card provides four cursor choices. It can be displayed as a blinking block, a nonblinking block, a blinking line, or a nonblinking line. The display card also offers reverse video as a standard feature. In addition, it accommodates the full upper- and lower-case 128-character ASCII set, including line-drawing graphics. The character matrix is 7 × 9 in a 9 × 10 field. Lower-case characters have true descenders that don't run into the line below.

The display card operates automatically, switching between 40 and 80 columns and between text and graphics to suit the program in use. It operates with CP/M and PASCAL programs. It is offered as an accessory for the ACE 1000 and Apple II computers, and is included as standard equipment with the ACE 1200 computer. Available at authorized Franklin dealers. $199.

Circle No. 87 on Free Information Card

COMPUTER SOURCES

Apple Case. If you carry around your Apple, Atari, or VIC-20/64, along with a disk drive, small printer, etc., then you should take a look at the Microcase. The heavy-duty plastic case is lined with 5" dyecut foam to support the computer, two disk drives, printer, cable, manuals, etc. The case weighs under four pounds and is waterproof, machine washable, and resists water and mildew. It comes in a variety of colors. **Address:** The Casemaker, 1754-C Junction Ave., San Jose, CA 95112 (408-971-8711).

•

Static Removal. Static electricity can cause all types of problems, including catastrophic destruction of MOS devices, dirty CRT screens, and printer damage as rushing paper generates large charges. Staticide is a liquid and spray that is used to combat static electricity. It can be wiped on surfaces, or sprayed on a carpet or other floor covering. Staticide wipes are $4.98 for a box of 24, with each wiped surface lasting about two weeks. A brochure is available. **Address:** ACL Inc., 1960 East Devon Ave., Elk Grove Village, IL 60007 (312-981-9212).

•

IBM PC Peripherals. The Business System for the IBM PC includes a high-resolution color video monitor, an X-Y coordinate plotter, a memory/graphics expansion interface and Business Graphics software. Optional hardware includes a 6-pen plotter and a 3" floppy disk drive system. The package allows producing professional-looking graphics and more than doubles the PC memory capacity. Data can be documented with pie charts, bar charts, horizontal bars, lines, points, areas, or any combination of graphics, and it interfaces with dBaseII, VisiCalc, SuperCalc, and WordStar. **Address:** Amdek Corp., 2201 Lively Blvd., Elk Grove Village, IL 60007 (312-364-1180).

•

Sinclair/Timex Memory Kit. The kit fills the transparent 8K between 8-16K of the ZX81 16K system. It uses HM6116LP CMOS RAM with a built-in power source. This allows data in the RAM to remain even when power to the system is turned off. At some later date, it is possible to replace the RAM with 2716 or 2732 EPROMs. $29.95 plus $1.95 shipping and handling. **Address:** Hunter, 1630 Forest Hills Drive, Okemos, MI 48864.

COMPUTERS ARE CREATING JOBS FOR NRI-TRAINED PEOPLE.

IF YOU'RE SERIOUS ABOUT MAKING MONEY IN MICROCOMPUTERS, NRI IS SERIOUS ABOUT SHOWING YOU HOW.

The U.S. Department of Labor projects job openings for qualified computer technicians will soon double. International Resource Development, Inc., estimates a 600% increase in these jobs in a decade. And most of these will be new jobs, created by the expanding role of computers.

NEVER HAS THERE BEEN A FASTER-GROWING FIELD OF TECHNOLOGY.

Many people are afraid of losing their jobs to computers, but thousands of jobs will be created for those who are prepared to meet the challenge.

With NRI training, you'll be prepared. You can have a profitable, exciting future as an expert who can handle the operational, programming and technical aspects of all kinds of microcomputers and microprocessors.

LEARN IN YOUR SPARE TIME.

NRI trains you in your own home, at your convenience...no classroom schedule to meet, no need to quit your job. As a class of one with complete course materials and the backing of a staff of professional electronics instructors, you'll get extraordinary hands-on training on the latest model in the most popular line of microcomputers: the new TRS-80™ Model 4, with disk drive for greater memory capacity. The TRS-80 Model 4 complete with advanced features

Your NRI course will include the new TRS-80 Model 4 with Disk Drive or the TRS-80 Color Computer with NRI Computer Access Card...plus a professional LCD multimeter, NRI Discovery Lab and hundreds of demonstrations and experiments. It's all yours to keep.

that are built right in...features that are offered as options on other microcomputers. Designed to perform diverse personal and business functions and to accept the most software, the TRS-80 Model 4 is a great computer to learn on...and it's yours to keep, along with the disk drive!

LEARN HOW TO USE, PROGRAM AND SERVICE STATE-OF-THE-ART MICROCOMPUTERS.

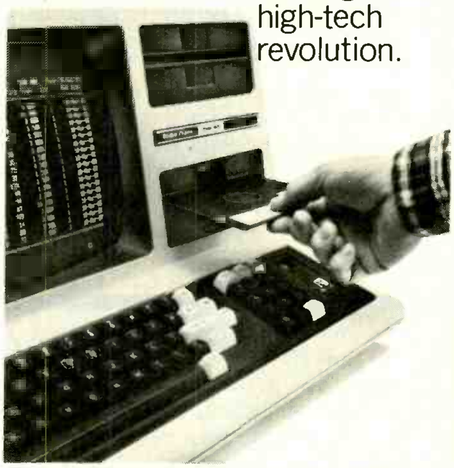
Through your carefully designed NRI course, you'll get a wealth of practical experience. You'll build circuits...from the simplest to the most advanced ...with your NRI Discovery Lab.® You'll use a professional 4-function LCD digital multimeter for analysis and troubleshooting.

With NRI training you'll explore your computer's registers, memory and input-output ports. You'll even write programs to control the circuits you've designed and built. You'll perform hundreds of challenging experiments, always backed by a full-time faculty ready to help you personally.

When your NRI training is complete, you'll be a computer technician, ready for your first job — servicing, testing or programming all types of microcomputers — in a rewarding and challenging new career.

THE CATALOG IS FREE. THE TRAINING IS PRICELESS.

Send the postpaid card today for your FREE 104-page catalog. It's a valuable guide to opportunities and training in the high-tech revolution.



For greater computer memory capacity, a double density disk drive is included.

You'll see how easily you become part of the growing high-tech world of microcomputers.

If the card has been removed, please write to us today.

NRI McGraw-Hill

NRI School of Electronics
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016

We'll give you tomorrow.

TRS-80 is a trademark of the Radio Shack division of Tandy Corp.

NEW PRODUCTS

IBM PC Word Processor. The Leading Edge Word Processor is designed to take full advantage of the features of the IBM PC. All edit and format commands can be performed with one or two keystrokes, utilizing function keys, etc., rather than a control-key sequence. Keyboard overlays and a keyboard reference chart are available for ease of learning and use.

The word processor is screen oriented so that, for the most part, what you see on the screen is what you get. An exception is the proportional spacing feature, which does not appear on screen but can be printed. Menus direct the novice user, but experts can override them for maximum speed.

All normal word-processing functions such as insert, delete, block move, etc. are included. Among the more sophisticated functions are a split-screen feature that permits calling up two documents on the same screen (in two windows) and transferring copy between them; an I/O spooler that permits printing one document while editing another; a transposition of characters feature that speeds correction of typos such as "fo" to "of"; and a "Go To" function that enables a user to quickly call up any page within a document.

A variety of printers are supported, foremost those that are marketed by Leading Edge. For printers not specifically supported, a generic printer driver allows one to select necessary parameters. Commands such as boldface, double-wide, double-high/double-wide, superscript, subscript, underline, and double underline avoid having to embed control codes in the document to exploit the full capabilities of a particular printer. A selection of character fonts and colors is also available. A "hot print" feature enables the user to highlight any text in a document and have it printed out with just a touch of the print key.

The Leading Edge Word Processor uses a cache-memory technique, which means that input is constantly saved to disk. This gives it a virtual memory that can store documents up to 32M bytes long. It also means that any type of power failure would affect only a small portion of the document. When a disk is full, the user is signaled, and asked to segment the document at an appropriate place before proceeding.

Planned enhancements for the Leading Edge Word Processor are a mail merge, spelling checker, and thesaurus. Also, a compatible financial speadsheet is under development.

The complete package includes a program disk; manual, quick-reference guide; keyboard overlay; and a cue card. The manual is said to avoid technical language and is written "by an end user for end users." The word processor runs on the IBM PC with PC-DOS and 128K RAM. Although it's possible to use the package with one disk drive, two disk drives are strongly recommended. Suggested retail price is $300. **Address:** Leading Edge Products, Inc., 225 Turnpike St., Canton, MA 02021 (800-343-6833).

68000 FOR THE IBM PC

A processor board from Sritek Inc. turns an IBM PC or XT into a 68000-based, multi-user, COBOL-oriented computer and provides 8088-based machines with a powerful paged-memory management unit to perform address relocation and memory protection. It also increases system execution speed by using the 68000 for central processing and the 8088 as an I/O processor. It is available at 8 or 10 MHz. With RM/COS and 256K of memory, $2495. Add 256K, $2995.

Circle No. 88 on Free Information Card

COMPUTER SECURITY

The Omni-Lock, from Micro-Metrics, is a security system designed for the Apple II and III or the IBM PC to allow keyboards, disk drives, and video monitors to be locked in place by a single lock on the shelf spindle. When unlocked, the shelves automatically swivel 360° to allow access to internal cards. Rotation of the shelves permits re-positioning of components for maximum user convenience.

Circle No. 89 on Free Information Card

Apple Graphics Upgrade. The Arcade Board is a sprite-graphics and sound effects board for the Apple II, II+, and IIe computers. It generates arcade-quality color graphics and sound effects. Using the TMS9918A Video Display Processor and the AY-3-8910 Programmable Sound Generator, it features 16 colors in all three graphic modes, two HiRes modes with 256 × 192 pixels, 32 sprites for animation, and 16K bytes of RAM for storing up to 14 pages of high-resolution 16-color graphics. It also has LoRes of 64 × 48, 60-Hz interrupt for synchronized page flipping, three independent sound channels with 9-octave range and separate volume control, noise generator, and automatic envelope control. $225. **Address:** Third Millennium Eng. Corp., 1015 Gayley Ave., Suite 394, Los Angeles, CA 90024 (213-473-2102).

FULL-PAGE DISPLAY

"The Genius" is a full-page display from Micro Display Systems that features a high-resolution, high-density monitor, reverse or normal video, 57 lines by 80 characters and flashing attributes. The Model 101 is for Apple II and IIe, Franklin Ace 1000 and 1200; and the Model 102 is for a standard RS-232 port. The full-page display is available in a choice of phosphors or screen filters, in green or amber.

It is designed for word processing, financial modeling, text editing, and software development and functions at up to 19.2K baud with all interface functions controlled by a Z80 microprocessor. Internal memory of 16K provides buffering and an internal screen memory. $1795.

Circle No. 90 on Free Information Card

LOW-COST 80-COLUMN PRINTER

The Alphacom 81 can print 80 characters (one line) per second and combines a single-chip microprocessor with an Olivetti THM-125 dot-matrix print mechanism. $169.95. *Circle No. 91 on Free Information Card*

Singing Speech. The Voicebox for the VIC 20 and 64 computers plugs directly into the user port and has its own speaker, volume and pitch controls, and an unlimited vocabulary potential. It incorporates a machine-language text-to-speech program that can be merged with BASIC and occupies only 2033 bytes of RAM; an on-screen "face" whose mouth moves in sync with the speech; special instructions for use with BASIC programs; a program that allows the face to sing; and a spelling quiz program featuring both the speaking face and a vocabulary of 75 words. $95. **Address:** The Alien Group, 27 West 23rd St., New York, NY 10010 (212-741-1770).

Color Basic Compiler. The Color BASIC Compiler allows Radio Shack Color Computer users to write programs in BASIC and then compile them to run as much as 40 times faster. It features a total of 46 commands and functions, most of them a subset of Extended Color BASIC. The Color Compiler generates position-independent machine-language code that lets the program reside anywhere in memory, even in a ROM-pack. The utility requires a Color Computer with 32K of RAM and at least one disk drive. $39.95. **Address:** Computerware, Box 668, 4403 Manchester Ave., Suite 102, Encinitas, CA 92024 (619-436-3512).

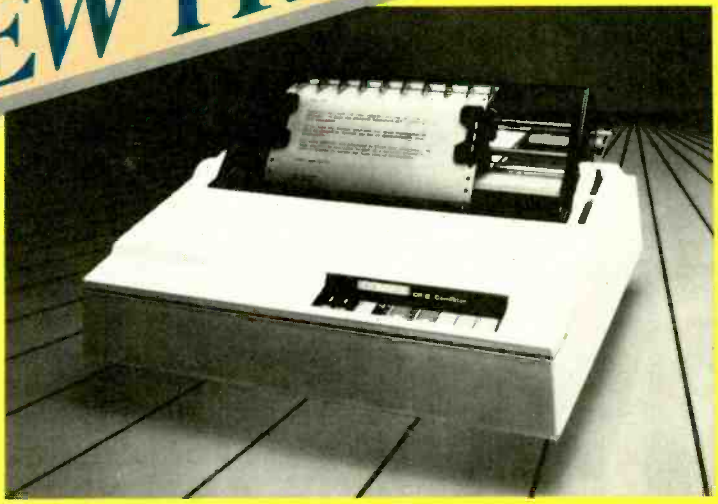
COMPUTER OPERATES IN FORTH

The Jupiter Ace 4000 offers FORTH programming language in ROM. It is suitable for real-time measurement and control applications as well as use as a personal computer. It includes a Z80A microprocessor operating at 3.25 MHz. User RAM is expandable to 51K. The computer suports a text mode of 32 columns by 24 lines and a low-resolution graphics mode of 64 by 46 pixels.

Circle No. 92 on Free Information Card

How to test drive the IBM Personal Computer.

NEW PRODUCTS



LETTER-QUALITY PRINTING

The ComRiter CR-II, from Comrex, provides word-processing features such as superscript, subscript, backspace, underline, boldface, double strike, and proportional spacing. The daisy-wheel printer, with letter-quality printing, has a 5K buffer that allows a user to reproduce original and multiple copies of documents stored in memory. It can store up to 3 pages of data. The CR-II prints at an average speed of 12 characters/second or 140 words/minute. Print motion is bidirectional and logic seeking. The print wheel is an ASCII-standard cassette type with 96 pedals per wheel.

Circle No. 13 on Free Information Card

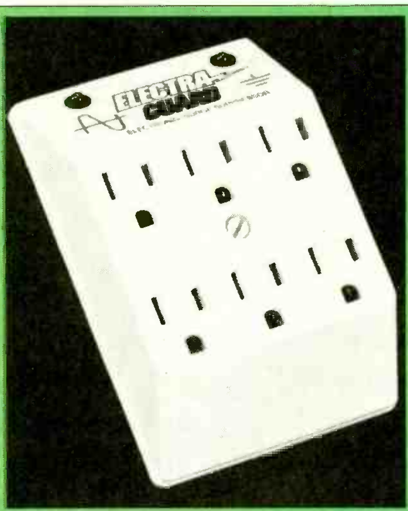
IBM Streaming Tape. The SYSGEN Image for the IBM XT (hard disk version of the PC) includes a controller, drive electronics, and tape drive. It is software compatible with either PC-DOS or CP/M-86. Under software control, the Image will perform complete archival backup from a hard disk at 2.5M bytes per minute. Storage capacity of the cassette is 20M bytes. $995. **Address:** Sysgen Inc., 47853 Warm Springs Blvd., Fremont, CA 94539 (415-490-6770).

•

Clock For Kaypro. The K-Clock battery-operated, real time clock/calendar for the Kaypro II and IV eliminates the need to constantly re-enter time and date. It plugs directly into a socket in the computer and requires no modifications. A diskette containing clock setting routines is included. $99.50 (add $5 shipping/handling). **Address:** Holmes Engineering, 5175 Green Pine Dr., Murray, UT 84107 (801-261-5652).

•

Commodore 64 DBMS. Mirage Concepts' Database Manager is a comprehensive electronic filing system for the Commodore 64 that makes it easy to organize, maintain, and make use of information. The program is written entirely in machine language for speed and can sort on any field at any level. It permits free-form design and input, and allows the use of calculated fields. Hardware requirements are: Commodore 64 computer, Commodore 1541 or 2031 disk drive, Commodore 1525 printer or other parallel printer with interface. $99.95. **Address:** Mirage Concepts, Inc., 2519 W. Shaw #106, Fresno, CA 93711 (209-227-8369).



COMPUTER PROTECTION

The Electra-Guard System 2 solid-state clamping device eliminates undetected, submicrosecond overvoltage transients in electrical circuits that can damage unprotected hardware. It has six protected outlets at 15 A and provides clamping protection with a response time of less than 5 ns. $49.95.

Circle No. 33 on Free Information Card

VIC-20 Memory Expansio. The Select-A-Ram is a 64K-byte memory expansion module for the VIC-20 computer. It also provides two expansion slots for program and game cartridges, or additional memory expansion to 192K bytes. Decoding circuitry allows RAM and ROM switching in 8K-byte blocks by inputs from the keyboard or by software command. It plugs directly into the expansion slot of the VIC-20 and uses the VIC power supply. It also includes write protection, a reset switch, and an optional external power source. $169. **Address:** Advanced Processor Systems, PO Box 43006, Austin, TX 78745-0001 (512-441-3202).

•

Apple Disk Emulator. The FLASH-CARD is a solid-state disk emulator for the Apple that operates up to 10 times faster than a disk. It is available in 147K-byte and 294K-byte versions and fits in one Apple slot. The system includes the board, DOS 3.3 interface software and manual. CP/M and Pascal interface software is $50 extra. The 147K version is $395; the 294K, $695. **Address:** Synetix Systems, 15050 N.E. 95th St., Redmond, WA 98052 (800-426-7412).

•

IBM PC Multifunction Card. The RAM+3 for the IBM PC and XT provides a time-of-day clock/calendar with battery backup, a parallel printer port, an RS-232 serial port, and options for 256K bytes of additional RAM plus Flash Disk software. It eliminates the need to manually input the date and time each time the system is turned on. The software integrates with DOS 1.1 or 2.0 and the RS-232 port is functionally identical to and compatible with the IBM Asynchronous Communications Adapter. The parallel port is functionally identical to and compatible with the IBM Printer Adapter. The Card can be ordered with sockets but no additional memory for $320, $395 for 64K, $470 for 128K, $545 for 192K, and $620 for 265K bytes of RAM. Expansion 64K chip sets are $80. **Address:** Seattle Computers, 1114 Industry Dr., Seattle, WA 98188 (800-426-8936).

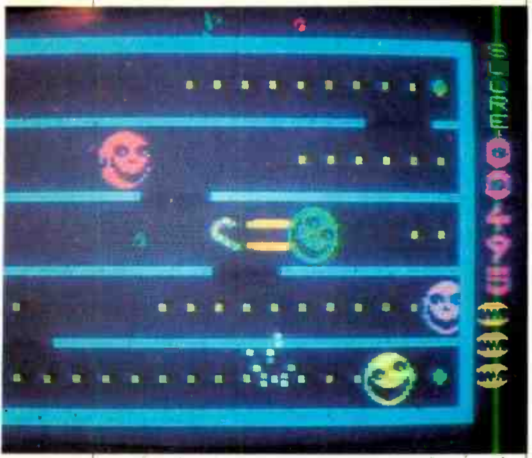
COMPUTER VIDEO GAMES

Hands-On Reviews of Recently Released Game Software

JAWBREAKER

Diskette for Atari 400/800
Sierra On-Line, Inc., Sierra On-Line Building, Coarsegold, CA 93614; 209-683-6858. $29.95

Graphics ★★★★
Gameplay ★★★★
Sustained Interest ★★★★
Type: *Joystick action game*
Memory Required: *16K*



There are lookalike games and there are pure fun games, and this one is certainly the latter—although there are definitely shades (or remembrances) of Pac-Man that are overshadowed by sheer good times and a few laughs.

You are a set of teeth (they look like the kind my grandmother had—the ones that go into a glass of water every night) that you move back and forth on each of five rows of candy drops. The teeth chomp away, gobbling up goodies, but on each of the five horizontal rows are smiling faces that pull the teeth if they touch you. When that happens, the teeth fall out of the gums in a noisy shower like falling chiclets.

You move from row to row through trap doors that are always in motion—always trying to evade the rolling happy faces. There are also energy candies in each of the four corners of the screen. Eat one of those and you can gobble the happy faces while you're in the energized mode. A bonus candy cane pops up in the middle of row three every so often, also.

Finish a round, and a toothbrush comes out and scrubs the teeth before you start the next go-around. Okay, it may not be Pac-Man, but Jawbreaker is fun and laughs.

JUICE!

Diskette for Atari 400/800/1200; ROM cart for Commodore 64
Tronix Publishing, Inc., 8295 South La Cienega Blvd., Inglewood, CA 90301; 213-215-0529. $29.95 (Atari); $34.95

Graphics ★★★★
Gameplay ★★★★
Sustained Interest ★★★★
Type: *Joystick strategy/action board*
Memory Required: *32K*

Every so often we see a new game that takes us by surprise because of its interest, originality and playability. Juice! is a one-player game that can keep jaundiced and game-hardened computer people at the joystick for hours.

This is a game that should be especially appealing to readers of this magazine because it involves building a circuit on a checkerboard-like screen that's tilted to provide a three-dimensional view sort of the same way that Zaxxon does. Your hero is named "Edison" and he completes circuit elements by jumping onto each square of the board.

There are bad guys too, and they move down the board (from the top to the bottom of the screen), and one, the Killerwatt, develops legs and starts to chase Edison. To touch any of these creatures is an instant loss of a life and of valuable time. Like many games, you're playing against the clock as well as the many enemies.

When you complete the circuit, current flows in dazzling hues for a moment, your score is totaled, and you proceed to the next screen, which is a little harder. The fourth screen in the first level is strictly a circuit-completion vs. the clock array with no bad guys to bother you. This one is good for bonus points.

Then it's on to Level Two, where the activities get more and more complicated. There is a lightning bolt that moves down the board (Flash) disconnecting all the circuit elements you worked so hard to get into place. You can stop the Flash by touching him, and this earns some bonus points.

There are six levels (we must admit we haven't gotten to the top yet), and high scores are saved on the game disk for future generations to gaze at with awe. Juice! is an excellent and captivating game, and if it hadn't been for M.U.L.E., it would have been our choice as Game of the Month.

MOUNTAIN KING

ROM Cartridge for Atari 400/800
CBS Electronics, 41 Madison Avenue, New York, NY 10010; 212-481-6400. $30.00

Graphics ★★★
Gameplay ★★★★
Sustained Interest ★★★
Type: *Joystick action game*
Memory Required: *Resident ROM*

This latest CBS cartridge game for the Atari computer is better than most we've seen of its genre, and it takes some heavy-handed practice on the joystick to get a decent score.

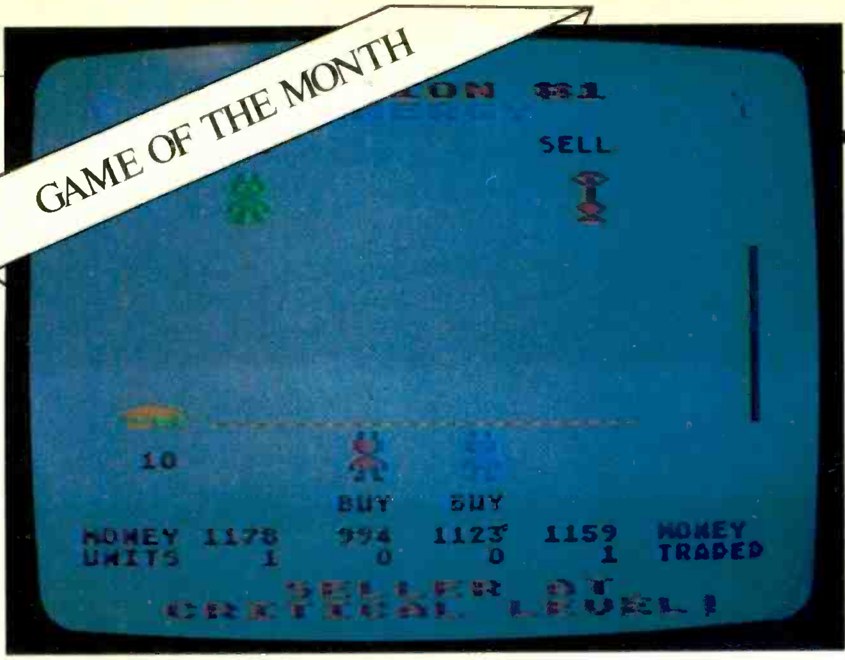
Sound effects include electronically synthesized "From the Hall of the Mountain King" by Grieg—rather appropriate, except that in this case, the mountain is tunneled by level after level of labyrinths that you run through gathering diamonds.

There's a treasure chest which you can find in the darkened tunnels only by turning on your flashlight. The object is to capture the crown from the Temple Chamber and carry it safely to the top of the mountain as many times as you can. That's easier said than done, because there are many, many hazards, including a giant spider who wraps you up nicely in a web and then comes back to suck your juices dry (ugh!).

The game is innovative, difficult, and has eight different levels of play. As we said, there are lots of hazards, and once you get killed, the game's over; you get no bonus or free lives here.

(Continued overleaf)

GAME OF THE MONTH



M.U.L.E.

Diskette for Atari 400/800
Electronic Arts, 2755 Camput Drive, San Mateo, CA 94403; 415-571-7171. $40.00

Graphics ★★★★+
Gameplay ★★★★+
Sustained Interest ★★★★+
Type: *Joystick strategy game*
Memory Required: *48K*

M.U.L.E. has got to be one of the most imaginative and intriguing games we've seen in quite a while. Strictly speaking, it's a board-type game done through the medium of the computer. Where to start? The graphics, the sound track and the pure, unadulterated creativity of *everything* are so captivating—even the screen credits have so much entertainment value that it's almost a shame to shut them off to start the game.

M.U.L.E. is a game of one to four players. There are *always* four players; if you're going solo, the computer takes the other three turns. It's one of the few games we've seen that really takes advantage of the Atari 800's four joystick ports, although you can play with just one joystick and pass it around as play turns change.

You first choose your marker color and your creature from a galaxy of fascinating and just plain "cute" extraterrestrial creatures. The scenario then starts with a spaceship landing on an alien planet. The players each can pick a plot of homestead ground during the land grant at the beginning of each round of play. Ideally, you try to get abutting plots covering different areas of production: food, energy and mining for Smithore.

After you get your land, go to the corral in the village and buy a M.U.L.E. (Multiple Use Labor Element) for $100. Then have him outfitted for the right kind of work depending on the type of land you have. You start with $1000 and $300 worth of goods and try to keep from running out of cash.

How do you get money? You can go into the saloon at the conclusion of your turn where you always win some money at poker. The amount varies depending on how much time is left in your turn. But the real money-crunch comes during the end-of-round auction where you try to sell your surpluses and buy to make up for shortages. This is where the competition among human players can get really cutthroat.

There is a single beginner's playing token that gives the learner an extra $300 in cash at the game's outset. There are three levels of play: beginner's, standard and tournament games. Until you get really good, it's not a bad idea to stay at the beginner's level.

The imagination of M.U.L.E.'s designers runs rampant. Strange Wampus creatures earn bonus money if you catch them. There are such random events such as planetquakes, acid rain and pest attacks that can destroy your land site or your crops. Your relatives in another galaxy can send you some gifts of food, ore and whatever, which is added to your assets. A status board shows how much surplus (or shortage) of food, energy and Smithore you have at the end of each round of play, followed by three auctions: one each for each of these three categories.

We've heard the game described as a sort of electronic, outer-space Monopoly—and it's very much like that good, old-fashioned great-grandaddy of board games. It has the various chance elements—chosen by a random command in the program instead of a roll of the dice and a turn of the card. There are properties to be acquired and developed; there is buying and selling and auctioning and total assets to be contended with.

The game is so extraordinarily complex and imaginative, that it's bound to keep this reviewer's household busy for quite a few evenings that should be spent at the word processor instead. Everybody here loves Monopoly, and this love may soon be replaced by M.U.L.E.

SPELLING BEE GAMES

Diskette for Atari 400/800; Apple II system
Edu-Ware Services, Inc., Box 22222, Agoura Hills, CA 91301-0522; 213-706-0661. $39.95 (Atari disk); $29.95 (Atari cassette); $39.95 (Apple disk)

Graphics ★★★
Gameplay ★★★★
Sustained Interest ★★★
Type: *Joystick/keyboard educational game*
Memory Required: *48K*

This one is strictly for the kids—ages 5-10—but we couldn't resist having a look to see what today's educational software looks like. We liked what we saw, because this particular program makes spelling and memory development fun to do.

The spelling invariably involves simple words. You have several ways of "moving" scrambled letters into the correct place to identify the picture in question. You can use a helicopter with a skyhook, guide an airplane past a list of words, targeting in on the correct spelling; you can try to recall the location of each of six hidden pictures after seeing them for just a few seconds; kids can take turns spelling words.

Overall, the graphics and techniques are very well done, and we have to overlook the lack of patience we, as adults, have with seemingly slow-moving spelling processes. But it's great for kids. ◇

IF YOU'VE GOT THE WATTS, WE'VE GOT THE TAPE.

To get the most out of today's high performance stereos, you need a high performance tape.

Maybe that's why so many manufacturers of top-rated tape decks recommend Maxell. Our tape is designed to help good equipment live up to its specifications.

Unlike ordinary tape, Maxell can handle sudden bursts of power without any distortion. And it can deliver the extreme highs and lows that sometimes get left behind.

So if you'd like to get the most out of your sound system, try Maxell.

But a word of caution. Always keep your seat belt securely fastened.

IT'S WORTH IT.

Circle No. 7 on Free Information Card

Bits&Bytes

NEWS, VIEWS & GOSSIP/BY SOL LIBES

RUMORS & GOSSIP

▶ Look for **Atari** to unveil an IBM-compatible portable early next year. They thus follow in the footsteps of TI, Commodore and Tandy (the latter two also expected to introduce IBM lookalikes before year-end). This will leave Apple as the only major personal computer vendor not selling an IBM-compatible machine. Atari is also expected to introduce other products that can be used with the IBMs . . . There are also rumors that Atari may introduce systems with Apple II and CP/M-80 compatibility . . . **Apple** is expected, early next year, to replace the DOS 3.3 operating system used on the Apple IIe with a new system to be called "ProDOS." It will be compatible with the SOS (Sophisticated Operating System) used on the Apple III, which has a hierarchical file structure and can handle larger files and more disk capacity. Expect Apple to provide software to allow DOS 3.3 programs to be converted to ProDOS format . . . Also Apple may introduce a new hard-disk system for the Lisa near year end. It should be faster and store more data. Too many customers have complained about the slow program loading . . . **Hewlett-Packard** is rumored about to introduce a microWinchester drive with a 3½" form factor. Miniscribe, Seagate, and Tandon are also believed readying such units . . . There are vague hints that **Sinclair** intends to bring out a $500 business-oriented computer . . . There are hints that Atari may introduce a 16-bit personal computer early next year . . . **Commodore** is rumored phasing out the VIC-20 and replacing it with a new machine that is not software compatible. (Why should they change their tactics now?) Speculation is that the Commodore 64 still has about a year's life left in it.

WOZNIAK BACK AT APPLE

▶ Steve Wozniak, the designer of the Apple I and II computers, has returned to work at Apple's Cupertino PC Systems Division. He had left two years ago after surviving a plane crash. In the interim, he returned to college to complete work toward a degree and organized the Us Generation Festivals of music and technology, on which he lost a reported $20 million.

It is rumored that Steve, who is noted for designing "gutless wonder" circuitry, will be working on the design of a new Lisa-like computer that will be less expensive, with fewer parts and more software.

LAYOFFS HIT PC MAKERS

▶ Atari, which earlier this year, laid off approximately 2000 workers in its computer games and personal computer divisions, recently announced a consolidation of the two divisions resulting in the layoff of 750 additional workers. The division is now down to about 4000 employees, most outside this country.

Texas Instruments, hard hit by losses in the personal computer area, announced a curtailment of production and the layoff of 750 at two plants which make the 99/4A personal computer. And Mattel Inc., maker of the Intellivision home video game, recently announced that it laid off 260 workers at its game division.

Meanwhile, Commodore, which eight years ago was nearly forced into bankruptcy when TI entered the calculator business (TI supplied the chips Commodore used in its calculators), has reported its best year yet. It now has over 30% of the home computer market and reports earnings of over $28 million on $675 million sales. It is shooting for $1 billion this year. Maybe it has a secret ambition to force TI out of the home computer business. TI, Atari, and Matel, the other leading home computer makers all reported sizeable losses for this past year.

RECESSION HITS JAPAN ROBOT INDUSTRY

▶ There are reports that there is a slump in the robot industry in Japan that has caused prices to drop 30% or more. There are currently about 200 companies in Japan assembling robots, and the country, which is about the size of California, has more robots in use than all the rest of the world combined.

INTEGRATED SYSTEMS BEING INTRODUCED

▶ At the recent Computer Electronics Show, Coleco Industries shook up the industry by introducing a completely integrated system with an expected retail price of $600. It includes the basic computer and keyboard, printer, storage device, and application software. Intended to be sold by mass merchandisers, it goes contrary to the current approach where consumers are sucked in with very low prices for the basic machine only to find out that they have to go back to the dealer for additional peripherals and software before they can really use the machine to do useful work. In the end they pay considerably more than $600.

The Coleco "Adam" system is expected to be in the stores in time for the Christmas season. However, Commodore and Atari are not sitting still. They are expected to integrate com-

Two facts you'll find hard to believe . . .

1. This phone, with engineering for the year 2001, is yours right now.
2. Your cost is only $119.95.

Some of the brightest electronic engineers in the world decided to build a telephone that makes all others obsolete.

This phone would have a **big** memory to remember (and dial with one or two buttons) a lot of phone numbers.

It would handle one or two lines, with a "hold" button, for big-phone performance and convenience.

It would work with rotary pulse or Touchtone®, so you can use it to talk to a computer or to use MCI, Sprint, or any of the tone-code long distance services.

It would display the number being dialed in LED-illuminated figures, to prevent errors even in the dark.

Most of all —

It would be beautiful, a magnificent sleek instrument to enhance any room.

Ladies and gentlemen, we give you...

The **Electronic Secretary-Phone**

Every other state-of-the-art phone we've seen handles either just one line or (bulkily) five lines.

The ELECTRONIC SECRETARY-PHONE is about half the size of most phones, but its innards are crammed with advanced electronic technology.

What a timesaver! It "remembers" up to 32 numbers! Enter them just once — then call any of them by pushing one or two buttons.

Two-In-One, with "Hold" Button

You control two separate phone lines, which means you can have a true multi-line conference call without involving the phone company.

Talk on Line 1; or put the call on Line 1 on hold while you talk on Line 2; or *tie both lines together by depressing both buttons!*

Best of all, you can touch one key and you'll have a hands-free speakerphone whose sound fidelity is surprising. Your phone has a volume control, of course.

Before we tell you how little it costs, here a few more timesavers and conveniences built into your Electronic Secretary-Phone:

Elegant, Expensive-Looking, Easy!

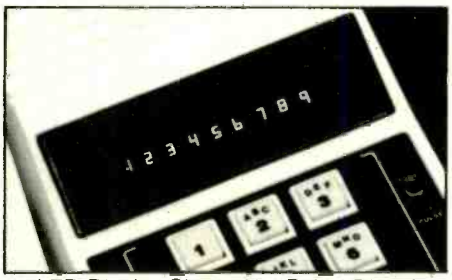
We've seen phones you need an engineer's degree to operate. A child will have no trouble putting this wonder-phone through its paces.

You won't dial a wrong number because an LED display shows you, digitally, the number you're calling.

You can call MCI, Sprint, your computer, or anywhere you need the touchtone signal. A touch of your finger switches back and forth from pulse to touchtone.

Automatic redialling of the last number? Of course. No jangling ringer-bell; the ringer is a pleasant electronic tone.

But we think what you'll like most about the Electronic Secretary-Phone is its beauty. If ever a phone could win an award for design, this is it. You'll be proud to have this phone in your home or office.



LED Display Shows No. Being Dialed.

Get It Far Below Market Place

We originally planned to sell this phone for $169.95, and it would be a bargain at that price. When we decided to feature it in our catalog, we lowered the price to $129.95.

Now we've been able to contract for enough of them that *you can own an Electronic Secretary-Phone for only $119.95!* At that price, while we have them, you should order two.

Our absolute guarantee means you'll have a month to use this phone and see for yourself that our claims about it are true. Enjoy it!

WE ABSOLUTELY GUARANTEE!
Plug in the ELECTRONIC SECRETARY-PHONE. Use it for up to 30 days. If you decide for any reason you don't want to keep it, return it for a 100% refund.

- **Handles TWO Phone Lines**
Use the "Hold" button to switch back and forth. Or use them together for conference calls!

- **Conference Call Feature**
Just push both buttons and both lines are open. They're interactive, so you can tie two calls together!

- **Speaker Phone**
If you have a roomful of people, or if you just don't want to hold the instrument, your Speakerphone has wonderful sound fidelity plus volume adjustment!

- **32 Memories**
Your phone "remembers" up to 32 numbers. Enter them just once, then dial by pushing one or two buttons. Even remembers long strings of numbers like MCI!

$119.95 complete
SAVE $20.00! Two for $219.90
(+ $2.50 per total order for shipping)

Order TOLL-FREE
For fast delivery on credit card orders call toll-free 24 hours a day, 7 days a week:

800-443-0100
Ask for Ext. 111

Or send check or money order. Please add indicated shipping cost.

NEW HORIZONS Dept.C11, 5-31 Fiftieth Avenue
Long Island City, NY 11101

Circle No. 17 on Free Information Card

LES SOLOMON ON COMPUTER HARDWARE

Smaller is Better?

DURING a recent discussion on the relative display merits of video monitors and TV receivers, a couple of people asked why it is that a small-screen TV receiver displays a much "smoother" picture than a large-screen version. And, if this is true, wouldn't this make a small-screen TV receiver ideal for computer readout?

Let us take a look at what produces this "smoother" visual effect on a small screen.

No matter where the video originates—from a computer or TV receiver, it must modulate the electron beam of the display CRT to create the visual image. In the case of color, three electron guns have to be modulated. However, in this example, we will just discuss one electron gun since the same thing happens if there are more than one.

As shown in Fig. 1, the electron beam leaves the CRT "gun," is propagated down the CRT and "squeezed" by the focus electrode to come to a sharp point where the electron beam impinges on the phosphor that coats the inside of the faceplate.

When the electron beam strikes the phosphor, it causes photons to be emitted, thus producing a bright spot. The brightness of the spot is determined by the beam modulation produced by the video signal and the setting of the system brightness and contrast controls. The position of the bright spot along the particular trace is a function of the horizontal sweep system.

The bright spot formed by the impact of the electron beam with the phosphor is circular in shape, as shown in Fig. 2. Note also that, as a result of the high velocity impact between the electrons and phosphor, secondary electrons are emitted. After bouncing off the rear of the faceplate, these secondary electrons produce a "halation" ring around the bright spot and a "dark" ring is consequently produced between the bright spot and the partially bright halation ring.

Thus, it can be seen that even if the associated electronic system had the maximum bandwidth, it is the CRT electron beam that actually determines just how small each pixel really is.

Let us examine a couple of scan lines that cover part of a vertical line (Fig. 3). Note that, when the scanning lines are spaced further apart than the halation rings (as would be the case with a 25″ CRT), each bright spot is clear and distinct, with the resulting display a trifle grainy-looking due to the gap between the lines. On the other hand, when the scanning lines are close enough so that the adjacent halation rings overlap (as in small-screen display) the resulting overlap makes the total image appear smooth.

About the only thing that the casual viewer can do to reduce the halation effect is to adjust the TV receiver brightness and contrast controls downward until the picture clears up. Unfortunately, the payment to be made for this is a dimmer-than-usual picture.

Obviously, the small screen makes for a much smoother image when playing games. However, the smooth images do not help alphanumerics, making the small screen a little difficult to use. So, you pays your money and makes your choice. ◇

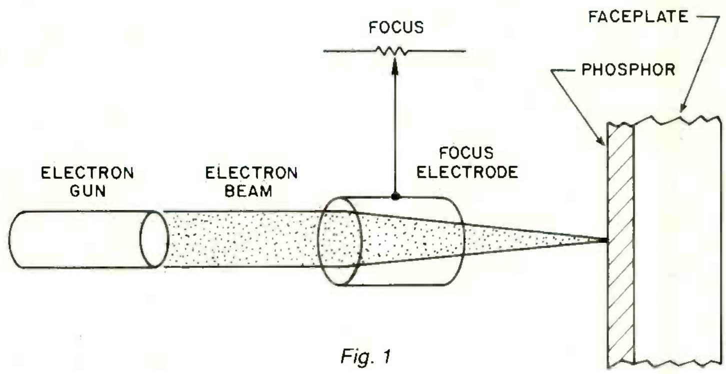


Fig. 1

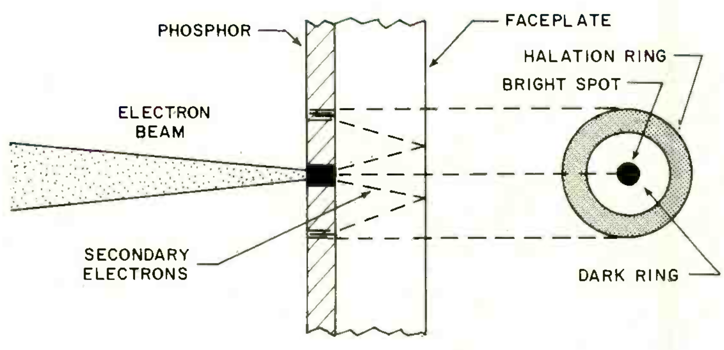


Fig. 2

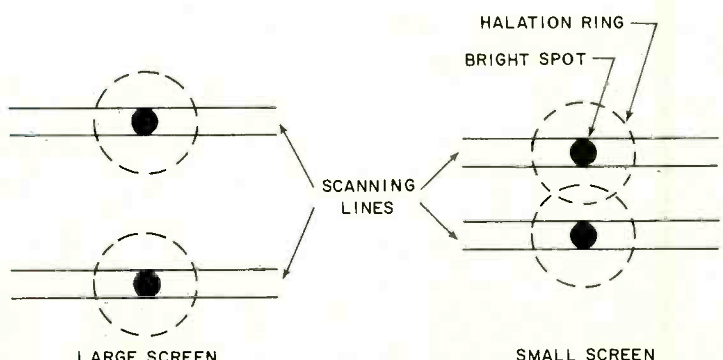


Fig. 3

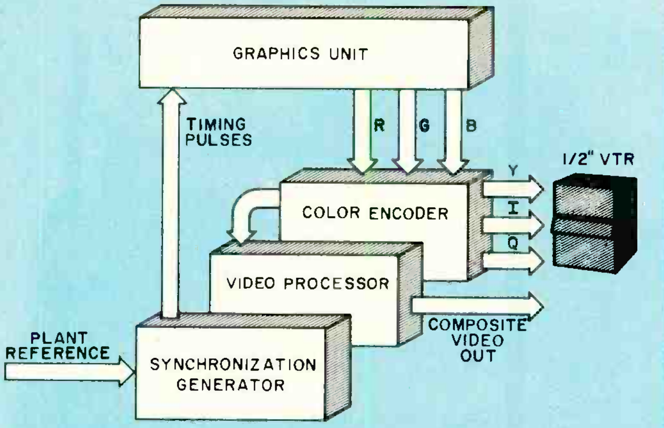
Stereo TV—Is There a Better Way?

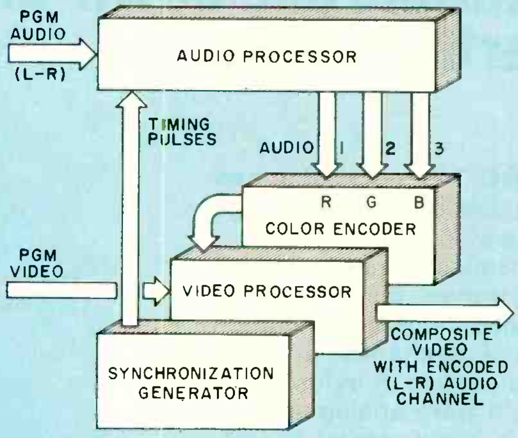
By Len Feldman

ACCORDING to the timetable of the industry committee set up to study and test the three different systems for stereo audio on TV, we might have expected a decision by now. Unfortunately, things don't always go as planned. One of the three contenders made a significant change in its proposed system *after* the lab and on-the-air tests were completed. A second contender, whose own system had not been tested in all its possible configurations, threatened to bring legal action against the first contender if the committee voted for the "untested" version of the first system. So, instead of making a decision, the committee decided to go "back to the drawing board" or, in its words, "complete the record." This is expected to take several more months of testing and talking.

A Fourth System. Meanwhile, from an unexpected source, a totally different approach to stereo TV has been demonstrated. At the recent conference of the Society of Motion Picture and Television Engineers (SMPTE) in New York City, Grumman Aerospace Corp. demonstrated a unique new method of broadcasting stereo audio for television. The system is called "Rainbow Sound." It is an outgrowth of a Grumman product called "Sync Proc" which, in its original development, had nothing whatever to do with audio. The Grumman Sync Proc color encoder was developed to support video graphics generation while meeting all the timing requirements and NTSC encoding of R(ed), G(reen), B(lue) graphics output. As shown in Fig. 1, the Grumman Sync Proc system also provided Y (luminance), and I and Q (chroma) outputs from the color encoder so that high-quality graphics can be stored on a standard ½" VCR.

What has all this to do with stereo audio for TV? Well, in Grumman's SMPTE demo, they illustrated a method for encoding a channel of audio into a video format, using the very same Sync Proc and color encoder developed for graphics generation (Fig. 2). What happens, in essence, is that samples of the audio signals are routed to the RGB inputs of a standard color encoder, where they are matrixed into NTSC composite form, as shown in Fig. 3. The encoded color frame that results from





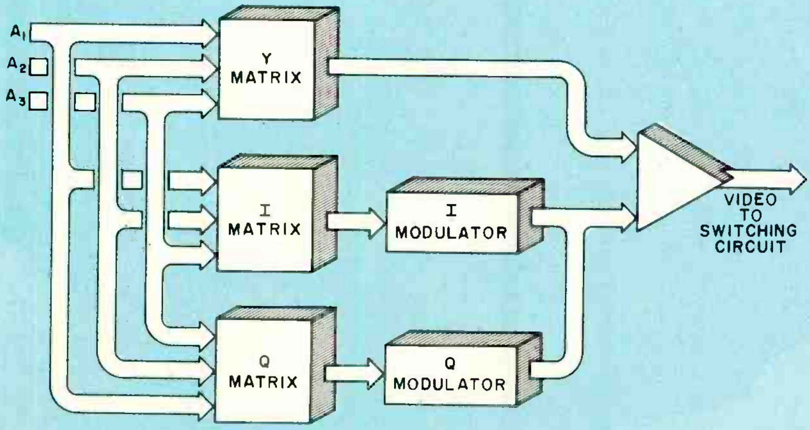


Fig. 1 (upper left). Grumman's Sync Proc color encoder translates RGB video graphics to standard NTSC components.

Fig. 2 (upper right). The same system as shown in Fig. 1 can be used to develop a novel signal sampling system for stereo audio on TV.

Fig. 3 (left). Samples of the (L – R) audio signal are substituted for the RGB samples.

NTS Electronics

Learn Robotics, Microcomputers, Microprocessors, Digital Video, Test Equipment and more with NTS INTRONIC™ home training. Courses include state-of-the-art equipment, lessons and texts to make your hands-on programs exciting and down-to-earth practical.

NTS Intronic Training is a carefully developed and tested learning system providing a thorough intergration of advanced electronic hardware with modern lesson texts. The relationship between theory and practical applications is made clear through the hands-on experience of building and assembling kits of state-of-the-art equipment. Courses include a wide variety of test instruments, both digital and analog, as well as other units not shown here. And, depending on the NTS program you select, you can earn up to 30 CEU credits for successful completion. Our full-color catalog has complete details. NTS has taught industrial skills for over 78 years—a record that has no equal.

HERO 1 is included in two courses, one basic and one advanced. You'll cover principles of industrial electronics, microprocessor troubleshooting, fundamentals of mechanics, and robotic applications in industry. You'll learn analog and digital skills, radio control, fluidic, pneumatic and servo-mechanisms, as well as computer interfacing and robotic programming. HERO 1, complete with arm, gripper and speech synthesis board, is a fully self-contained electro-mechanical robot—the featured unit in the most exciting training programs ever offered in home study.

disc player to the encoding system, and from there to an r-f modulator whose output is connected directly to the antenna terminals of a TV receiver. The audio information is then decoded and fed to an external stereo audio amplifier and a pair of properly positioned speakers.

A more detailed representation of the encoding process is shown in Fig. 10. Using a video disc as a video and stereo audio program source, the video is processed through a time base corrector (TBC). Left and right stereo signals are converted into sum-and-difference signals. The (L + R) signal joins the video signal as the primary modulation of the transmitter. The stereo difference signal (L − R) is processed as described earlier. The program video with the encoded (L − R), along with the (L + R) audio channel, are routed to an r-f modulator and then to the antenna terminals of the TV receiver.

The Receiving End. In order to decode the stereo signal in a home TV receiver, the receiver requires some modification. The latter consists primarily of tapping into the horizontal sync signal, the color subcarrier, and the separate Red, Green and Blue feeds (Fig. 11). The monophonic audio channel (L + R) is broken and brought out of the set for subsequent matrixing with the recovered (L − R) signal.

The three audio samples recovered from the TV receiver as individual R, G, and B signals are routed to sample-and-hold circuits. Timing logic derived from the horizontal sync pulse and the color subcarrier provides the necessary timing to restructure the three samples (per line) 21 microseconds apart. The signals are then filtered with a low-pass filter that recreates a continuous audio waveform that is amplified as the recovered (L − R) audio channel. This part of the process is shown in Fig. 12.

The same sort of summing amplifiers that were used to create the separate sum-and-difference audio signals back at the transmitting end are now used to recombine those signals to recreate the original "L" and "R" stereo signals, us-

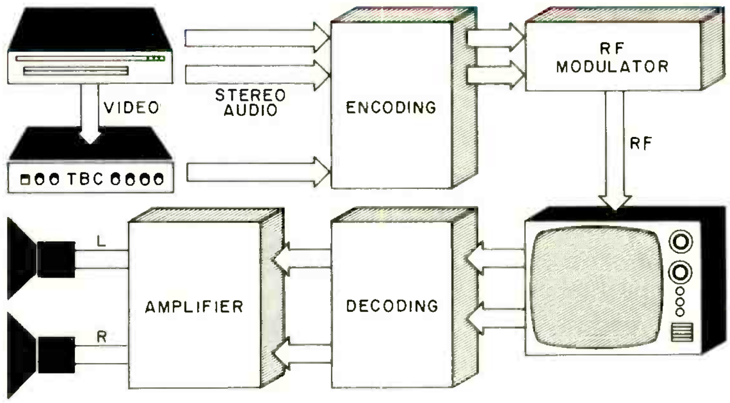


Fig. 9. Block diagram of closed-circuit stereo audio demonstration by Grumman.

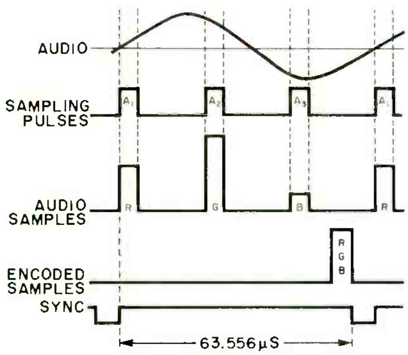


Fig. 7. Audio is sampled three times per horizontal line (bottom) and encoded into a single 2-μs signal.

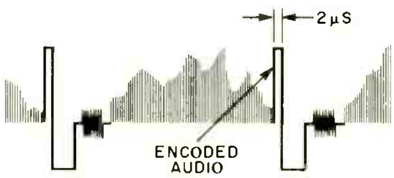


Fig. 8. Encoded audio is inserted at the end of each line of video information.

Now Apple plots color.

Since color graphics are becoming ever more important in business, we've been hearing more and more calls for a color plotter as reliable as an Apple.

Here it is:

Apple's new Color Plotter can generate all kinds of presentation graphics, engineering drawings or anything else you have to illustrate in up to eight brilliant colors.

And it can perform its art on any size paper up to 11" x 17." Or, with optional transparency pens, it can draw right on transparent film for overhead projection.

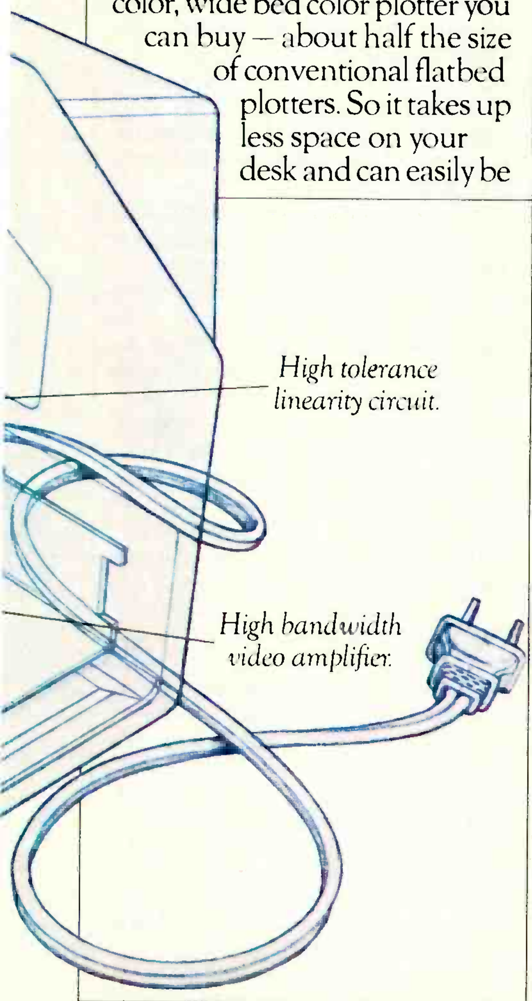
Measuring just 4.8"H x 16"W x 12"D, it's the smallest four-color, wide bed color plotter you can buy — about half the size of conventional flatbed plotters. So it takes up less space on your desk and can easily be moved to someone else's desk.

There are two color plotter accessory kits to choose from to assure a perfect marriage with your Apple II or IIe, or Apple III.

Each kit comes with eight color pens — red, blue, green, black, burnt orange, gold, violet and brown. Plus a starter package of plotter paper. Plus all the manuals, documentation and cables appropriate to your particular kind of Apple. So you can get up and coloring right away.

Apple also offers a complete selection of 24 different pen packages — so you can choose whatever colors you need in a variety of widths for a variety of applications and media types.

As you might expect, all of the above is available at many of our authorized Apple dealers.



Carry on with AppleCare℠ Carry-In Service.

No matter how long you've owned your Apple system, you can now get a long term service contract at a very reasonable cost.

AppleCare Carry-In Service is a service plan that will cover most Apple-branded components in your system for one full year.

It covers an unlimited number of repairs and is honored by over 1500 authorized Apple dealers nationwide.

Apple-trained technicians assure you of the highest quality service, fast — in most cases less than 24 hours.

AppleCare Carry-In Service is ideal for anyone who needs to know ahead of time the cost of maintenance for their system.

So check out the details — you'll find it's the lowest cost health plan an Apple can have.

Apple Computer Inc., 20525 Mariani Ave., Cupertino, Calif. 95014. For the authorized dealer nearest you, call: (800) 538-9696. *© 1983 Apple Computer Inc.*

AppleCare is a service mark of Apple Computer Inc.

Circle No. 35 on Free Information Card

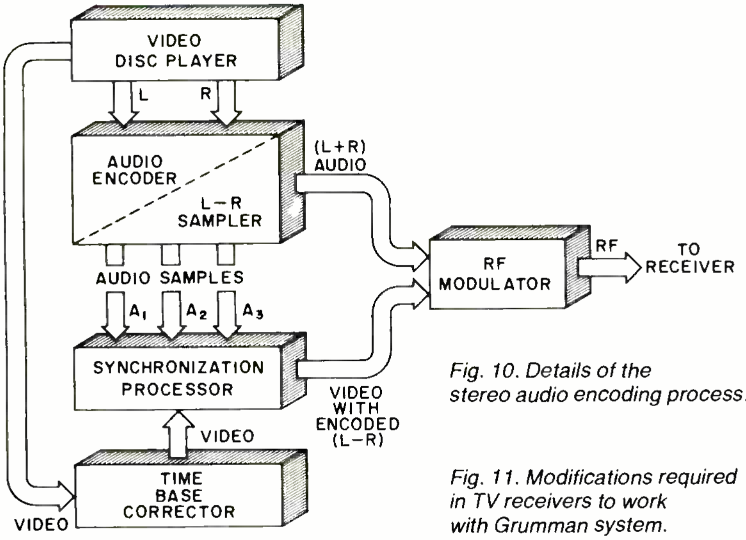
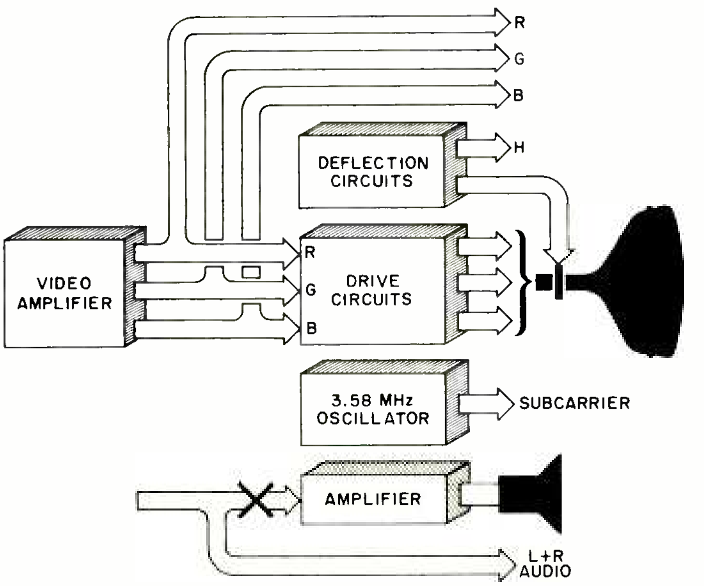


Fig. 10. Details of the stereo audio encoding process.

Fig. 11. Modifications required in TV receivers to work with Grumman system.



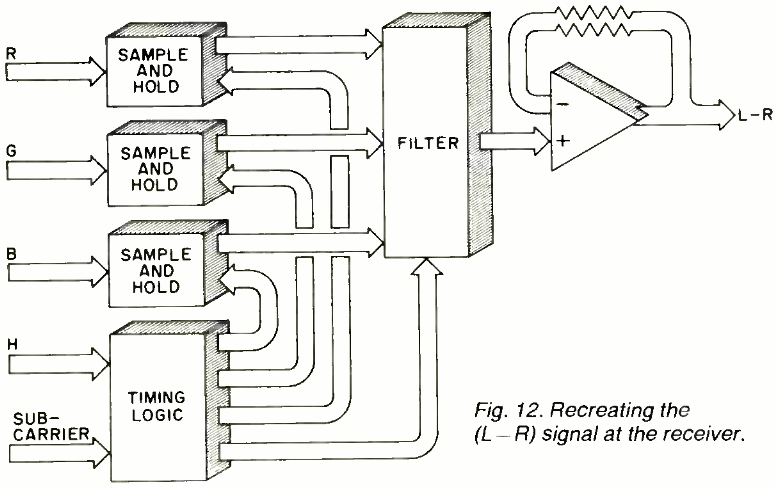


Fig. 12. Recreating the (L − R) signal at the receiver.

ing the familiar algebraic addition and subtraction, (L + R) + (L − R) = 2L and (L + R) − (L − R) = 2R. In actual practice, some time delay must be added in the (L + R) channel to equal the processing delay of the (L − R) channel.

What Next for Rainbow Sound? As simple and clever as this stereo TV audio system seems, there are some practical problems if it is to succeed either as an over-the-air broadcast system or as a cable system. For one thing, it is very late in the game for a fourth challenger to join the list of manufacturers whose systems have been under investigation since 1979.

In addition, while the Rainbow Sound system could certainly be used either for transmitting stereo or a second language, it seems clear from Grumman's description that both of these services could not be implemented simultaneously by a single station. Yet the three other systems now under consideration for multi-channel TV audio are able to provide stereo service *and* a separate audio program (bilingual or even a completely unrelated audio service) at the same time. The industry committee lists precisely that ability as one of the necessary requirements for any system being considered for stereo TV audio.

As already mentioned, the FCC now seems inclined to support only the most general kinds of broadcasting rules—allowing the industry and the public to decide which specific broadcast techniques should predominate. It is unlikely, however, that their general rules would be broad enough to include a system that is as different from others as the Rainbow system is, without insisting on some independent study by an industry organization such as the Electronic Industries Association. Grumman's press release concerning its own system said that "The simplicity of this technique may enable stereo audio to be incorporated in home TV systems as early as 1984." Obviously, that's wishful thinking, or else Grumman has never dealt with the broadcast division of the FCC—which isn't noted for its alacrity when it comes to rule-making. Still, Grumman's system should not be overlooked just because it is a latecomer.

Incidentally, in case you are wondering why the name "Rainbow Sound" is used, it's because a narrow color stripe appears at the extreme right of the video picture. It's not visible, of course, unless the horizontal deflection system is unable to sweep fully across the screen. ◇

BREAKING THE 40-COLUMN BARRIER

The difference between a TV receiver and a video monitor for computer use
By Leslie Solomon

WHY is it that some computers, like those of the Apple II family, and the Commodore and Atari computers, can display their outputs on the screen of ordinary TV sets, while others will not give satisfactory results without the use of a special video monitor? What makes a monitor different from a TV receiver, and when should you use one or the other? What should you look for in buying a monitor? In this article, we'll try to answer these and other questions about video displays.

Some computers, like the Heath/Zenith H/Z-89, have their own built-in displays. Most, though, require an external means of displaying the data they output in video form. Computers used in offices and scientific installations frequently combine an input device (keyboard) with an output device (monitor) in a piece of equipment known as a terminal. Many home and personal computers, however, rely on a separate unit just for display—either a TV receiver or a video monitor.

Depending on the capabilities of the computer, the display it uses can be either monochrome (black-and-white, -green, or -amber) or color. Knowing how information from a computer gets onto the screen of the display will help you understand the differences between a TV receiver and a video monitor.

No matter what type of video display is used, character generation begins inside the computer with an integrated circuit called a ROM (Read Only Memory). Each character that the computer is capable of producing is stored in the ROM as an array, or matrix, of bits, each of which represents a dot (bright spot) or "undot" (dark spot or absence of a dot) that makes up a portion of the dot-matrix character that will be displayed on the video screen (Fig. 1).

ROM character generators use a variety of dot matrices, ranging from 5 × 7 (a 35-dot matrix five dots wide by seven dots high) to a very dense 17 × 19 (323 dots). The greater the number of dots in the array, the better the appearance of the displayed character. The least dense (5 × 7) dot matrix does not allow for proper descenders on lower-case letters. (Descenders are the parts of the letters that extend "below the line." Examples of letters with descenders are j, p, and y.) The most common dot-matrix used—one that has a happy combination of good-looking characters with a reasonable number of dots—is the 7 × 9 array. It affords an 80% greater resolution than a 5 × 7 array.

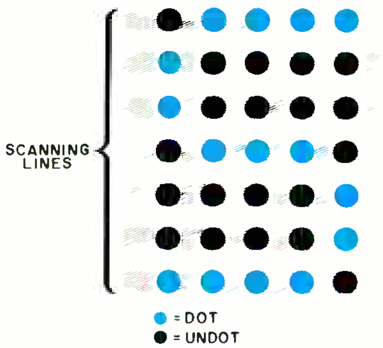
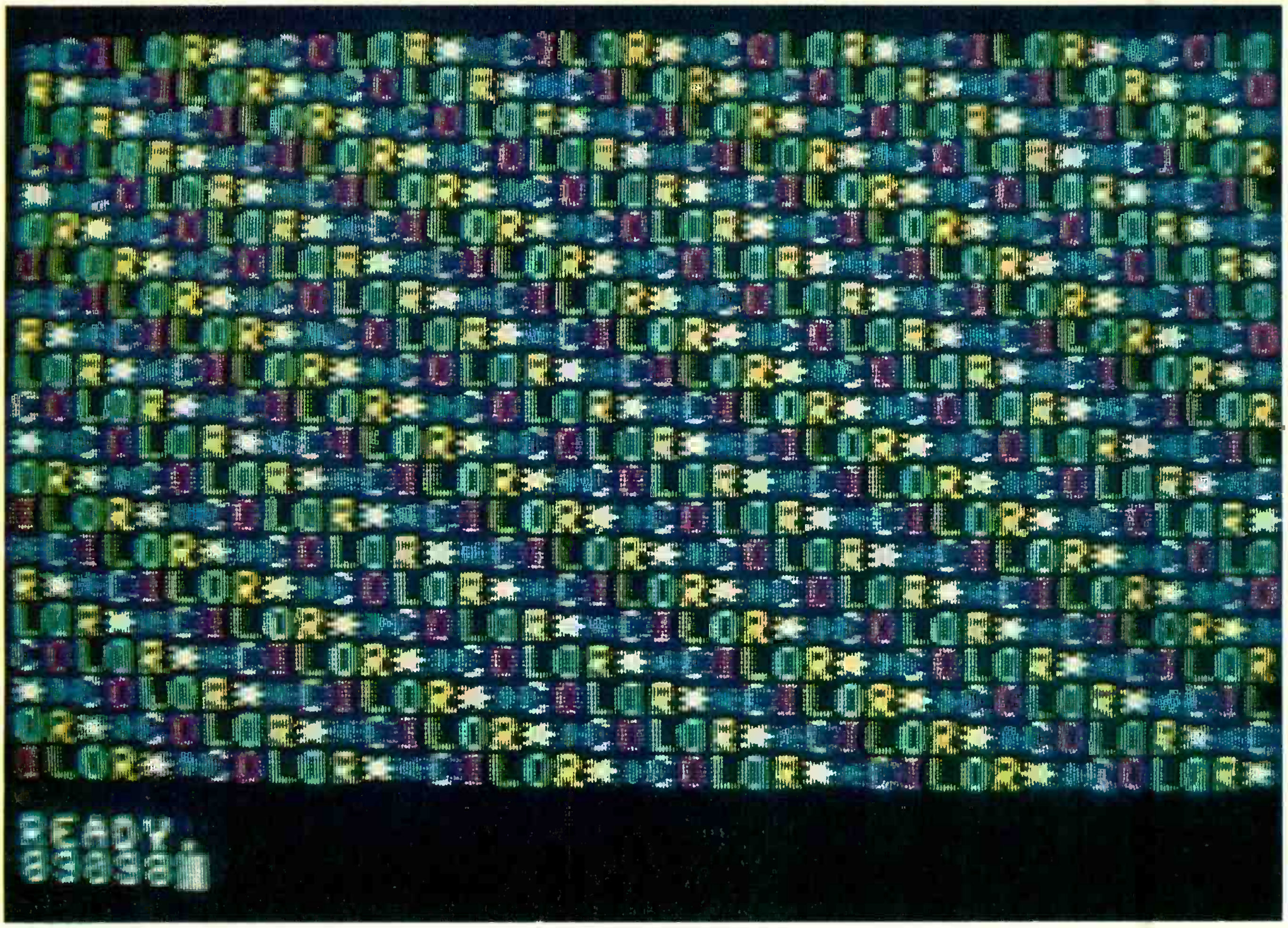


Fig. 1. How a dot-matrix character is displayed on screen.

Resolution. The term resolution refers to how sharply an image can be defined on the screen of a CRT (Cathode Ray Tube or picture tube to those of you using TV sets).

In video, there are both vertical and horizontal resolutions. Vertical resolution is the ability of the system to resolve *horizontal* lines. Although it might seem logical to assume that the 525-line raster used in our television system would yield 525 lines of vertical resolution, this is not so. Resolution in video is not the same as resolution in photography. For example, four black lines separated by three white lines of equal thickness would be defined as four lines of resolution in photography. In video, all the lines are counted, which means that, in this case, we would have seven lines of resolution.

In video, the diameter of the electron beam used in the CRT must be considered, since it forms the "brush" that "paints" the image on-screen. The relationship between that diameter and the width of the line that is "painted" on the screen is called the *Kell factor*, which is optimally 0.7. To find the vertical resolution of any video system, therefore, simply multiply the number of scan lines by 0.7. For example, if there are 260 scan lines, the vertical resolution is a maximum of 182 lines. In conventional TV using 525 lines, the Kell factor indicates that the maximum resolution of the viewed image will be 343 lines. That takes into account the lines lost in the vertical blanking interval, that black bar you see when the picture on the screen "rolls."



On this page is a four-color display filling the entire screen of a TV receiver. Opposite is the same display

Horizontal resolution is related to bandwidth, a subject we'll get to shortly. It is defined as the ability of the system to resolve *vertical* lines. The horizontal resolution of a system can be calculated by multiplying the bandwidth by the active scan time, and then multiplying that result by two. For example, if we assume a 4-MHz bandwidth and a 40-μs active scan time per horizontal line, the horizontal resolution will be (4,000,000 $\times$ 0.00004) $\times$ 2, or 320 lines. Horizontal resolution is the figure you'll usually see quoted by the manufacturer of a display device. As a rule of thumb, you can assume about 80 lines of resolution (*not* 80 characters!) for each MHz of bandwidth.

Thus, all references to 525 (or more) lines of horizontal or vertical resolution on a standard TV receiver should be taken with something more than a grain of salt.

Bandwidth. Figure 2 illustrates the envelope bandwidth of an ideal TV signal. It should be noted that what appears to be a smooth curve line is actually a tightly packed series of bursts of information at 15.734-kHz intervals. (15.734 kHz is the frequency at which horizontal lines are scanned.) It is this "packet" arrangement that permits color information to be added to what would otherwise be a monochrome signal consisting of only brightness information.

The envelope starts at dc and continues to 4.5 MHz, by which point the video portion of the signal has dropped off to almost nothing so as not to interfere with the audio portion, which is located 4.5 MHz above the start of the envelope. If the audio and video signals were to mix, or intermodulate, the result would be a series of wavy lines called "herringbones," along with other sound-related

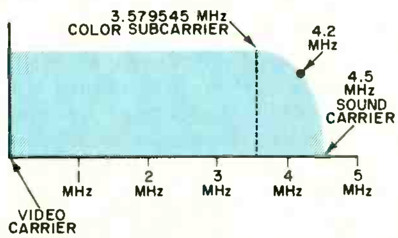
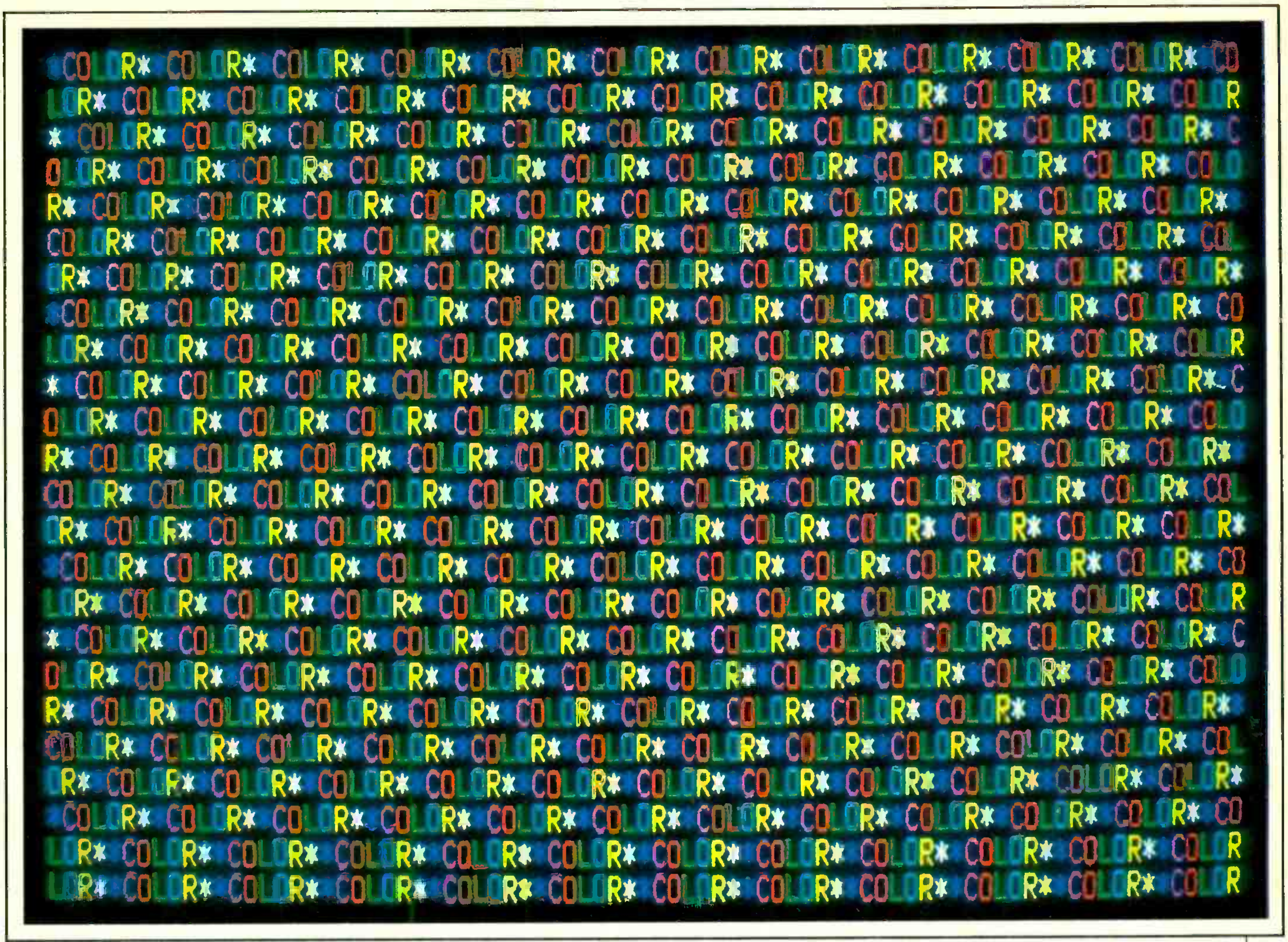


Fig. 2. Envelope bandwidth of an ideal television signal.

distortions that would cause the picture quality to vary according to the sound or music that accompanied it. This can be simulated in a properly working TV receiver by turning off the afc and mistuning the channel selector slightly.

In reality, the bandwidth drops to the 3-dB point, where it is half its original strength, at 4.2 MHz. Actually, the usable video bandwidth of even a good black-and-white TV receiver is no more than 3.8 MHz. In a TV receiver, the bandwidth limitations are the result of more than just the video amplifier stages. Keep in mind that every stage between the antenna terminals and the CRT makes its own contribution to restricting bandwidth if it has been poorly aligned or has drifted out of alignment. Furthermore, if a signal enters through the antenna terminals, that means that the video was first superimposed on an r-f carrier, and later demodulated (separated from the carrier). This is also cause for image degradation.

The image is formed on a CRT screen by a series of lines that are scanned from left to right and from top to bottom, as illustrated in Fig. 3. Thirty frames (full



on a video monitor. For such things as word processing, the difference in readability is obvious.

images) per second are formed, each made up of two fields. Therefore, there are 60 fields of 262½ lines in every second's worth of 525-line frames. Ideally, the two fields are interlaced so that the lines of one fall between the lines of the other. In practice, this is rarely the case; true interlace is hard to find. Each horizontal line is scanned at the rate of 15,734.264 Hz. Converting frequency to time ($1/F$) gives us approximately 60 μs per active line across the screen.

That figure is reduced somewhat by several factors. First, for reasons of economy, the tolerances of the components used in off-the-shelf TV receivers are not very tight. To make certain that your picture is not smaller than the size of the face of the CRT (which could happen if certain components were far enough away from the proper value) and because, by a fortunate coincidence, most TV action takes place at the center of the screen, manufacturers resort to what's known as "overscan." That is, the picture is made slightly larger than the display area so that the screen will be full no matter what the values (within reasonable limits) of the components determining the picture size are. To account for this, we have to subtract about 5 μs worth of raster from each end of each horizontal line, leaving at most 50 μs of usable trace.

To make things worse, since the picture displayed at the center of the CRT is sharper than that at its edges and corners, most computers blank the sides (and top and bottom) of the display they produce. That subtracts a few microseconds more from the time allotted to each active display line (now you know where the term "active" comes from). We are eventually left with about 40 μs of active display time per line.

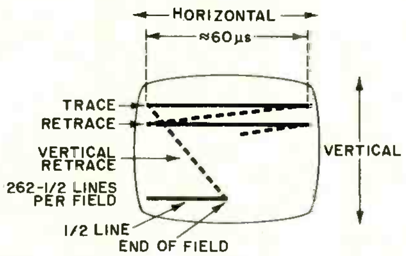


Fig. 3. How the image is formed on a CRT screen by scanned lines.

With all that under our belts, we can now determine how many characters per line can be resolved for a given bandwidth.

Let's assume that we want to display 80 characters on one line. That means that we are allowed, in round figures, 0.5 μs per character (40 μs/80). With a 7 × 9 dot-matrix character generator, the maximum width of one of the up-to-nine lines making up the character would be seven dots plus two dark "undots" to produce the space between adjacent characters. We would thus have to display nine dots in 0.5 μs, 18 dots in one μs, or 18,000,000 dots in a full second.

The video bandwidth required can be closely estimated by dividing the latter number (18,000,000) by two. Thus, for an 80-column line of 7 × 9-matrix characters, the bandwidth required would be 18,000,000/2, or 9 MHz! As we've seen, that's far greater than what's available from any conventional receiver. A 64-column display would require a bandwidth of 7.5 MHz and even a 40-column one 4.5 MHz.

If we were to generate a 5 × 7 character set, with each character having two "undots" to allow for horizontal spacing, things would get a little better, but not much. Each character would require 1.25 μs per line to display. An 80-column display would require a monitor with a 5.6-MHz bandwidth, and a 64-column display one with a bandwidth of 4.48 MHz. It is only when we reduce the number of characters per line to 40 or fewer that we enter territory that can be handled by a TV set. A 40-column display of 5 × 7 characters can be managed with a bandwidth of only 2.8 MHz, well within the capabilities of a standard TV receiver, and a 32-column display needs only 2.24 MHz. A nomograph showing the relationship between bandwidth and characters-per-line appears in Fig. 4.

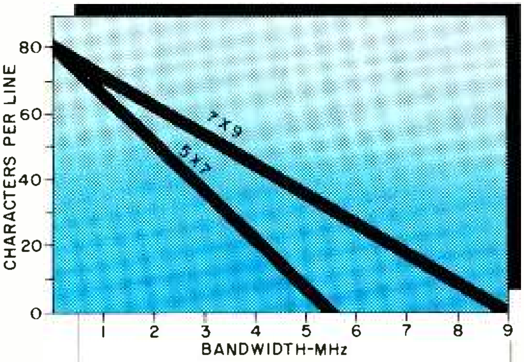


Fig. 4. How bandwidth and characters per line are related.

There are several other factors that limit the number of characters that can be displayed on an ordinary TV screen. As was mentioned earlier, a single 525-line video frame is made up of two fields of 262½ lines each. Ideally, the two fields are interlaced; that is, the lines of one fall between the lines of the other.

Unfortunately, not all computers can deliver an interlaced 525-line raster, and not all TV receivers are adequate to display a two-field, fully interlaced 525-line raster. This has led to the widespread use of a non-interlaced raster consisting of 260 (or so) horizontal lines.

Now, if 5 × 7 characters are being generated by the computer, each character requires seven horizontal scan lines to display its full height. To allow for the spaces between lines and, in some cases, to allow for an underline-type cursor, at least 10 or 12 raster lines per character are used. If, therefore, only 260 scan lines are available, only 16 to 20 lines of characters can be displayed.

And that explains to a great extent why you can't use your TV set to get a good sharp 64- or 80-column display. It's like the farmer trying to put ten pounds of fertilizer into a five-pound sack. To do the display justice, you need a monitor that can comfortably accept all the video information fed to it.

Color. So far, we've restricted our discussion of the limitations of TV sets as display devices to monochrome. What about color?

The NTSC system used in this country for transmitting color leaves a lot to be desired. If you are old enough, you can remember the early days of green faces and purple bananas. The chroma, or color, information is carried on a 3.579545-MHz subcarrier that is quadrature modulated. That is, it uses phase shifting to transmit color information. In fact, the tint control on a color TV is a phase changer; and, if you make even a small adjustment of that control, you'll see how the colors change. A change in phase relationship of only three or four electrical degrees can make things appear noticeably different.

Color is of relatively low importance in the scheme of our TV system because it was "squeezed into" an already existing monochrome system.

The same bandwidth restrictions that hamper monochrome TVs also apply to color receivers, but there are a few more of them. In color receivers, there is a trap at 3.579 MHz to take out the color-burst signal that carries the chroma information, and another at 920 kHz to remove the beat frequency that results from the mixing of the 4.5-MHz audio carrier and the 3.579-MHz color burst signal (4.50 − 3.58 = 0.920). Each trap removes some video information and therefore causes the display quality to deteriorate. Color displays also present several additional resolution problems unique to them.

Our previous discussion of resolution was based on a monochrome display. The phosphor coating on the screen of a monochrome CRT is solid; wherever the electron beam hits, it will strike some phosphor material and cause it to glow. If you have ever looked closely at the face of a color CRT, you know that it is very different. It is coated with an *array* of phosphor dots or stripes.

Three sets of phosphors are used: red, green, and blue. By exciting these phophors to various degrees and in various combinations, almost any color can be produced. All three glowing together will yield white. But, while on a monochrome tube a single spot of light can represent one dot of a dot-matrix character, on a color tube it takes three color dots (plus the spaces between them) to display that same white point. As close together as the phosphor elements may be, they will not be able to resolve as small, or as sharp, a point as could be obtained on a monochrome screen.

The space between the phosphor dots is referred to as pitch. A color monitor with a fairly high resolution may have a CRT with a pitch in the neighborhood of 0.31 to 0.43 mm. In contrast, the pitch for a CRT used in a home TV receiver may be well in excess of one mm. The smaller the pitch, the greater the number of phosphor elements, and the more detail that can be presented.

Another factor that can affect the resolution of a color display is convergence—how accurately the electron beams (one for each color phosphor) strike the phosphor elements they're intended to strike. Convergence is adjusted by the use of small adjustable permanent and electro-magnets, which force the three electron guns to converge their electron beams at the same three-phosphor point on the shadow mask of the CRT (Fig. 5).

The colors from a properly converged CRT will be true and clean. If the convergence is somewhat off—even slightly—the electron beams can strike more than one phosphor dot or stripe, producing a smeared image regardless of the quality of the rest of the system.

The convergence quality of a color TV receiver or video monitor can be observed by carefully examining a portion of the displayed image and looking for color fringes around some areas. If a ring is present, the convergence should be touched up by a qualified technician. If the chroma (color) control is turned

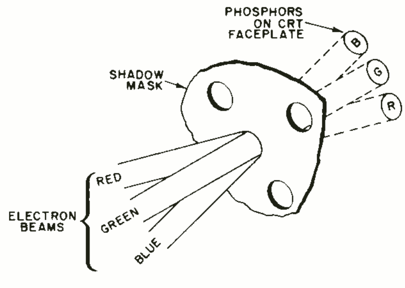


Fig. 5. Electronic beams are converged at one point on shadow mask.

all the way down while a color image is being displayed, the result should be a clean monochrome with no fringes.

RGB Monitors. There are several ways of getting a color signal into a color monitor. Monochrome and some color monitors accept a composite video signal, which is what is generated by most video games, closed-circuit TV cameras, and (of course) computers that have a direct-video output. That signal conforms to the NTSC standards used in broadcast television. The luminance (brightness), chroma (color), and sync information are all combined into one signal.

The RGB (Red-Green-Blue) ap-

MAJOR NEW PRODUCT ANNOUNCEMENT!

RADIO SHACK'S MOST POWERFUL COLOR COMPUTER EVER!

64K Extended BASIC TRS-80® Color Computer

399^95^

26-3003
Less TV

Only $28 Per Month On CitiLine Credit

The Heart of a Sophisticated, Disk-Based Color Graphics System

Perfect System for the Advanced Programmer. Double your programming power with our new TRS-80 Color Computer—now with 64,000 characters of memory! There's even a new electric typewriter-quality keyboard in a compact, white case. With this professional computer, you can access 32K memory and create detailed charts, diagrams and animation using the powerful, built-in Extended BASIC language—or experience the full 64K with our new, advanced programming tools!

Comprehensive Disk Operating System. Add a new Color Computer Disk Drive (26-3029, $399.95) and you can step up to our new OS-9 with Editor/Assembler (26-3030, $69.95). OS-9 is a real-time disk operating system that accesses the entire memory of the 64K Color Computer. It supports multi-tasking, and offers 40 utility programs, as well as a full-featured editor/assembler to let you create assembly language programs with speed and efficiency.

Professional Computing at a Low Cost. This complete TRS-80 system—including the 64K Extended BASIC Color Computer, OS-9 operating system with editor/assembler and Color Disk Kit—is just $869.85!

Find Out More! Stop in today at your nearest Radio Shack Computer Center, participating store or dealer.

Radio Shack®

The biggest name in little computers®

A DIVISION OF TANDY CORPORATION

Prices apply at participating Radio Shack stores and dealers.

New 1984 TRS-80 Catalog! Send for your free copy.

Mail To: Radio Shack, Dept. 84-A-678
300 One Tandy Center, Fort Worth, Texas 76102

NAME ____________________

ADDRESS ____________________

CITY ____________ STATE ______ ZIP ______

TELEPHONE ____________________

proach differs in that each of the three color signals has its own independent channel. The sync signal may be separate or, in some systems, may ride on one of the color signals (usually the green). Most computers require a special board to generate an RGB signal.

The major advantage of RGB is that, since the color signals are not demodulated by a set of synchronous demodulators with their attendant phase and gain problems, the quality of the color image is much better than that of one generated using the composite-video approach. Phase and gain variations are the principal enemies of the NTSC color system, and they do not exist in RGB.

There are actually two different types of RGB systems. One is analog, where the level of each color signal can be varied continuously to yield a near-infinite range of brightness levels and colors. The other system uses TTL logic-level signals to drive the electron guns, where each electron beam is either on or off. Excluding the sync signal, this can be done with three bits to generate eight colors (including white and black).

Other Factors. One of the most common complaints heard in computer stores has to do with the relatively high cost of video monitors. Since most people (at least those who haven't read this article) still think that a video monitor is a conventional TV receiver without the tuner and i-f strip, they feel that the price of the monitor should be less than that of a TV receiver.

With some low-cost monochrome monitors, this is actually the case since they are indeed "unfinished" TV receivers. However, it must be pointed out that these monitors, which usually incorporate a 4.5-MHz sound channel, also have the minimal video bandwidth of a TV receiver. You gain very little by using such a monitor.

A true video monitor is one that was designed from the start to be a video monitor. Its bandwidth is higher, its sweep linearity is better, and its convergence and phosphor pattern (in the case of a color system) are better. If the monitor has an audio input, it is usually for baseband audio, and the sound does not affect the video signal in any way.

Obviously, superior design means superior components, and that increases costs. Some video monitors have such excellent specifications that their cost can be in the thousand-dollar region.

Price is usually a function of CRT size and system bandwidth because the larger CRTs are more expensive, require larger video and sweep drive signals, and are more prone to misconvergence and other nonlinearities. These latter elements mean that a better-quality-controlled (more expensive) sweep system is required. Increased bandwidth usually means more stages of amplification, which also ups the price.

Some monitors and TV receivers have rather tight constraints on the sync and video signals they will accept. Many computers generate video signals that are slightly different from those considered to be standard. If your computer is one of them, you might experience a problem in obtaining proper horizontal or vertical sync, or the best contrast or color. In many cases, older TV receivers (which had looser tolerances) produce more stable images than those of recent manufacture.

Resolution is especially critical on color displays.

What to Look for. By now you should have a good idea of what sort of display device—TV receiver or video monitor—is best for your computer and purposes. How do you go about choosing the right one?

Before buying any video monitor or TV receiver, be sure that it will work to your satisfaction with the computer you have. There are a couple of tests that you can make.

With the computer and monitor (or receiver) connected and powered up, type a screenful of lower-case m's. This letter is formed from three short vertical lines connected at the top. Note that each of those lines is formed from a bright dot, a dark "undot," and another bright dot. When the letters are typed side-by-side (mmm . . . mmm) they represent close to the maximum number of pixels (dots) that the computer can generate for display on one line.

If the display has good bandwidth, then each individual "m" across a line will be clear and distinct, with no trace of blurriness or smear. (Actually, a *little* horizontal smear can be a good thing; it makes the characters look more "solid." There should be no smear between characters, though.) Note also that each line of characters should be straight across the screen, with no bowing or bending in the middle. Also, the lines should be straight up and down at the sides. If either of these two types of distortion is noticed, the CRT's sweep linearity needs to be corrected. If the upper few horizontal lines are "ragged" at their extremes, then the horizontal sync is at fault and needs looking after. The display should not jitter or flicker.

If your computer is capable of generating color, use the color commands in its BASIC to generate a simple color display and use it, in conjunction with the chroma and tint controls on the monitor or receiver, to check the quality of the display. What you see should be close to what's described in your computer's manual. Resolution is especially critical on color displays.

Check the range of focus, brightness, and contrast available. The focus (the control may be inside the video device) should be adjustable to either side of optimum. The brightness and contrast should be adequate for the conditions under which you will be viewing the display and the image should not degrade noticeably when the contrast is turned fully up. A good video monitor will have provisions for adjusting the level of the input signal to compensate for the different video levels available from different computers.

Do not choose a screen that is too small since that will probably force you to squint to make out the characters. In most cases, an 11" or 13" screen is the smallest you should consider. A 25" color TV is great for games, provided you don't watch it from too close up.

Note that a lower-priced monochrome monitor will invariably produce a better image than a more expensive color monitor. This is due to the effects of convergence, color separation, and the limited bandwidth available. However, color can make a tremendous contribution to most software, and can be the lifeblood of games.

If you've read this far, it should be apparent why a conventional TV receiver cannot give the results that can be obtained from a video monitor. The problems that arise from resolution and bandwidth restrictions are barely noticeable when playing games in color, or when watching TV programs or movies, since the color, sound, and action take your mind off the relatively poor display. When you start using a computer, though, and really start concentrating on what's on the screen, you'll quickly realize the value of a broadband video monitor. ◇

We don't care which computer you own. We'll help you get the most out of it.

CompuServe puts a world of information, communications, and entertainment at your fingertips.

CompuServe is the easy to use videotex service designed for the personal computer user and managed by the communications professionals who provide business information services to over one fourth of the FORTUNE 500 companies.

Subscribers get a wealth of useful, profitable, or just plain interesting information like national news wires, electronic banking and shop at home services, and sophisticated financial data. Plus, a communications network for electronic mail, a bulletin board for selling, swapping, and personal notices and a multichannel CB simulator.

You get games on CompuServe, too. Classic puzzlers, educational, sports and adventure games and fantastic space games featuring MegaWars, the "ultimate computer conflict."

To learn more about CompuServe, call toll-free, 800-848-8199, for an illustrated guide to the CompuServe Information Service. The videotex service for you, no matter which computer you own.

CompuServe

Consumer Information Service, P. O. Box 20212
5000 Arlington Centre Blvd., Columbus, OH 43220
800-848-8199 In Ohio Call 614-457-0802
An H&R Block Company

Circle No. 60 on Free Information Card

CASSETTE CONTROLLER FOR TRS-80 COMPUTERS

Provides proper interfacing to save wear and tear and give an audio output

Edward Ting

WHEN connected between a TRS-80 and its associated cassette recorder, the Cassette Control Box described here performs all the required interfacing to help produce better tape loading, saves wear and tear on the computer's internal reed relay, and provides an audio output for use in sound effects programming. The circuit is shown in Fig. 1.

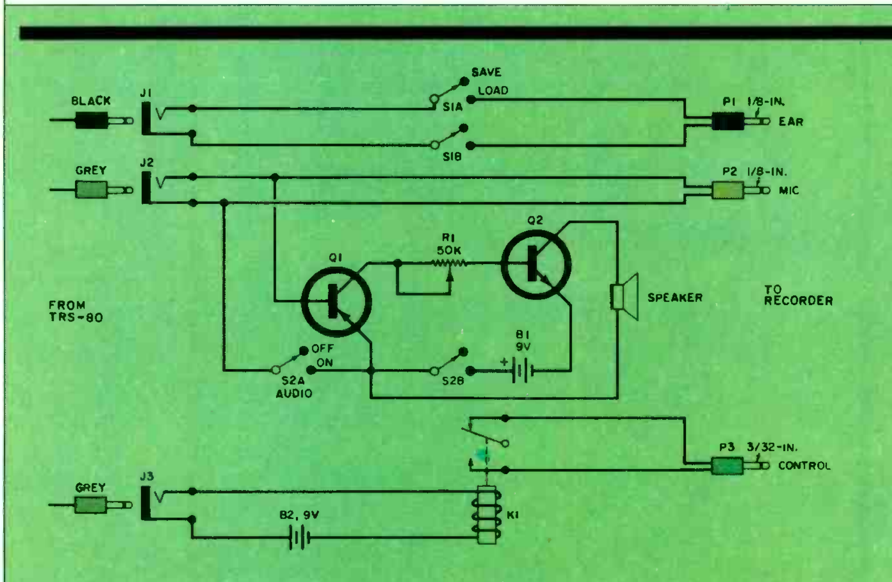
The plug that normally goes to the cassette recorder EAR jack is connected to *J1*, with *P1* connected to the cassette EAR connector. Switch *S1* is closed when loading a tape and opened when saving a program. This will keep extraneous electrical noise (mostly hum) from reaching the recorder.

The slender ($^3/_{32}$") grey connector that conventionally goes to the cassette recorder power control input is now connected to *J3*. Within the TRS-80, this line comes from a low-power reed relay whose contacts are power limited and can be fused under certain loading conditions.

Do not use the internal reed relay as a sound-effect device. Avoid any program lines such as FOR X = 1 TO 10: OUT 255,4: OUT 255,0: NEXT. This will cause a buzz at the top right-hand corner of the TRS-80. Run the above line *once* to hear this sound then *never* use it again. In the Control Box, this output drives a higher-power relay *K1*, which in turn, can be used to control higher-power external devices. The contact rating of *K1* is contingent on the load. The contacts of the relay that is called for in the Parts List can handle up to 1 ampere.

The TRS-80 line that normally goes to the cassette recorder MIC input is connected to *J2* and directly coupled to *P2*, which is now connected to the cassette MIC connector. The two-transistor circuit (*Q7* and *Q2*) is switched into this line when *S2* is closed. In this mode, signals fed to the MIC line can be heard. This circuit is used for sound effects programming. Any pnp silicon transistor can be used for *Q1*, and any npn silicon transistor can be used for *Q2*. Potentiometer *R1* serves as a volume control.

The three circuits can be mounted within a small metal enclosure with all connectors and switches suitably identified. ◇



The three circuits operate independently between cassette and computer.

PARTS LIST

B1,B2—9-V battery and holder
J1,J2—⅛" minijack (Radio Shack 274-333 or similar)
J3—$^3/_{32}$" mini jack (Radio Shack 274-292 or similar)
K1—9-volt relay (Radio Shack 275-004 or similar)
P1,P2—⅛" mini plugs (Radio Shack 274-286 or similar)
P3—$^3/_{32}$" mini plug (Radio Shack 274-289 or 291 or similar)
Q1—Pnp silicon transistor
Q2—Nnn silicon transistor
R1—50 kilohm potentiometer
SPKR—8 ohm speaker
S1,S2—Dpdt switch
Misc.—Suitable enclosure, cable, mounting hardware, press-on type, etc.

Today, you're doing more than ever. So should your phone.

AT&T introduces GENESIS™ Telesystem.

Genesis telesystem is designed to help organize and streamline your life in so many ways.

The Genesis telesystem remembers all your important numbers, including emergency numbers. And it dials with just a touch. It times your calls and even has a built-in speaker.

But the really terrific thing about the Genesis telesystem is that you can customize it to fit your own needs. Add an optional cartridge, and you've got one-touch access to call forwarding, call waiting, and three-way calling. Or add another cartridge, and you have the convenience of automatic re-dial of busy or unanswered numbers. And that's only half of it.

Soon, you'll be able to add a module with an electronic directory that memorizes names and numbers in alphabetical order.

Or the reminder cartridge, to remind you of special occasions and appointments.

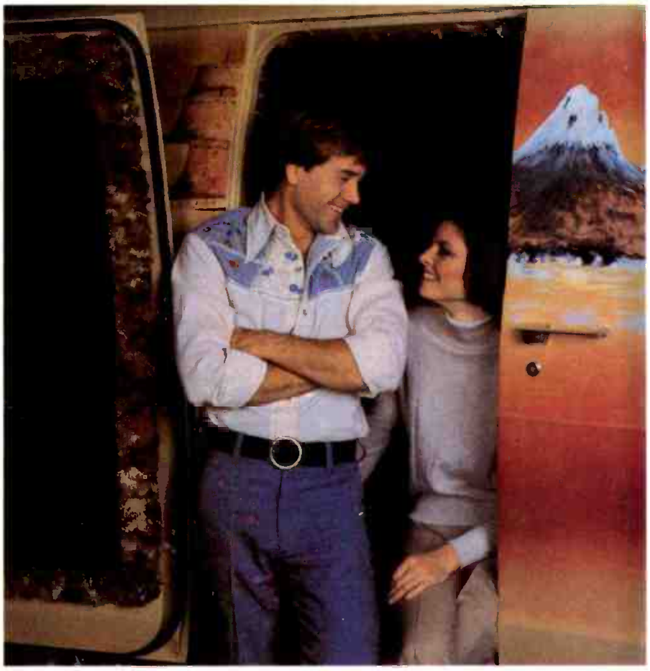
Genesis telesystem. The more you do, the more it will help you do it.

We set the standards.

AT&T

See it at your AT&T Phone Center, now at thousands of leading retail stores.

Go after the best of everything.



Don't settle for less. Especially when it comes to electronics training...because everything else in your life may depend on it. That's why you ought to pick CIE!

You've probably seen advertisements from other electronics schools. Maybe you think they're all the same. They're not!

Meet the Electronics Specialists.

When you pick an electronics school, you're getting ready to invest some time and money. And your whole future depends on the education you get in return.

That's why it makes so much sense to go with number one... with the specialists...with CIE!

There's no such thing as bargain education.

If you talked with some of our graduates, chances are you'd find a lot of them shopped around for their training. Not for the lowest priced but for the best. They pretty much knew what was available when they picked CIE as number one.

We don't promise you the moon. We do promise you a proven way to build valuable career skills. The CIE faculty and staff are dedicated to that. When you graduate, your diploma shows employers you know what you're about. Today, it's pretty hard to put a price on that.

Because we're specialists, we have to stay ahead.

At CIE, we've got a position of leadership to maintain. Here are some of the ways we hang onto it...

Our step-by-step learning includes "hands-on" training.

At CIE, we believe theory is important. And our famous Auto-Programmed® Lessons teach you the principles in logical steps.

But professionals need more than theory. That's why several of our courses get you started fast with "hands-on" training. Depending on your course selection, you could start with CIE's Personal Training Laboratory, including multimeter. Then, progress to the Digital Learning Laboratory and build your own security control device from a kit. Continue your education with CIE's Microprocessor Training Laboratory. You'll build a working microprocessor "from scratch" and learn how to program and interface it with displays, memories, switches, and more.

Our specialists offer you personal attention.

Sometimes, you may even have a question about a specific lesson. Fine. Write it down and mail it in. Our experts will answer you promptly in writing. And the answer you get becomes a part of your permanent reference file. You may find this even better than having a classroom teacher.

Pick the pace that's right for you.

CIE understands people need to learn at their own pace. There's no pressure to keep up...no slow learners to hold you back. If you're a beginner, you start with the basics. If you already know some electronics, you move ahead to your own level.

Enjoy the promptness of CIE's "same day" grading cycle.

When we receive your lesson before noon Monday through Saturday, we grade it and mail it back—the same day. You find out quickly how well you're doing.

Progress to an Associate Degree, an FCC License, or both.

One of the best credentials you can have in electronics—or any other career field—is a college degree. That's why CIE gives you the opportunity to earn an Associate in Applied Science in Electronics Engineering Technology. Any CIE career course can offer you credit toward the degree...more than half the number needed in some cases.

You can also prepare for the government-administered FCC (Federal Communications Commission) Radiotelephone License, General Class. It can be a real mark in your favor...government-certified proof of your specific knowledge and skills.

Send for more details and a FREE school catalog.

Mail the card today. If it's gone, cut out and mail the coupon. You'll get a FREE school catalog plus complete information on independent home study. For your convenience, we'll try to have a CIE representative contact you to answer any questions you may have.

Mail the card or the coupon or write CIE (mentioning the name and date of this magazine) at: 1776 East 17th Street, Cleveland, Ohio 44114.

PE-98

CIE **Cleveland Institute of Electronics, Inc.**
1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

YES...I want the best of everything! Send me my FREE CIE school catalog... including details about the Associate Degree program...plus my FREE package of home study information.

Print Name ____________________

Address ____________________ Apt. ______

City ______________ State ______________ Zip ______________

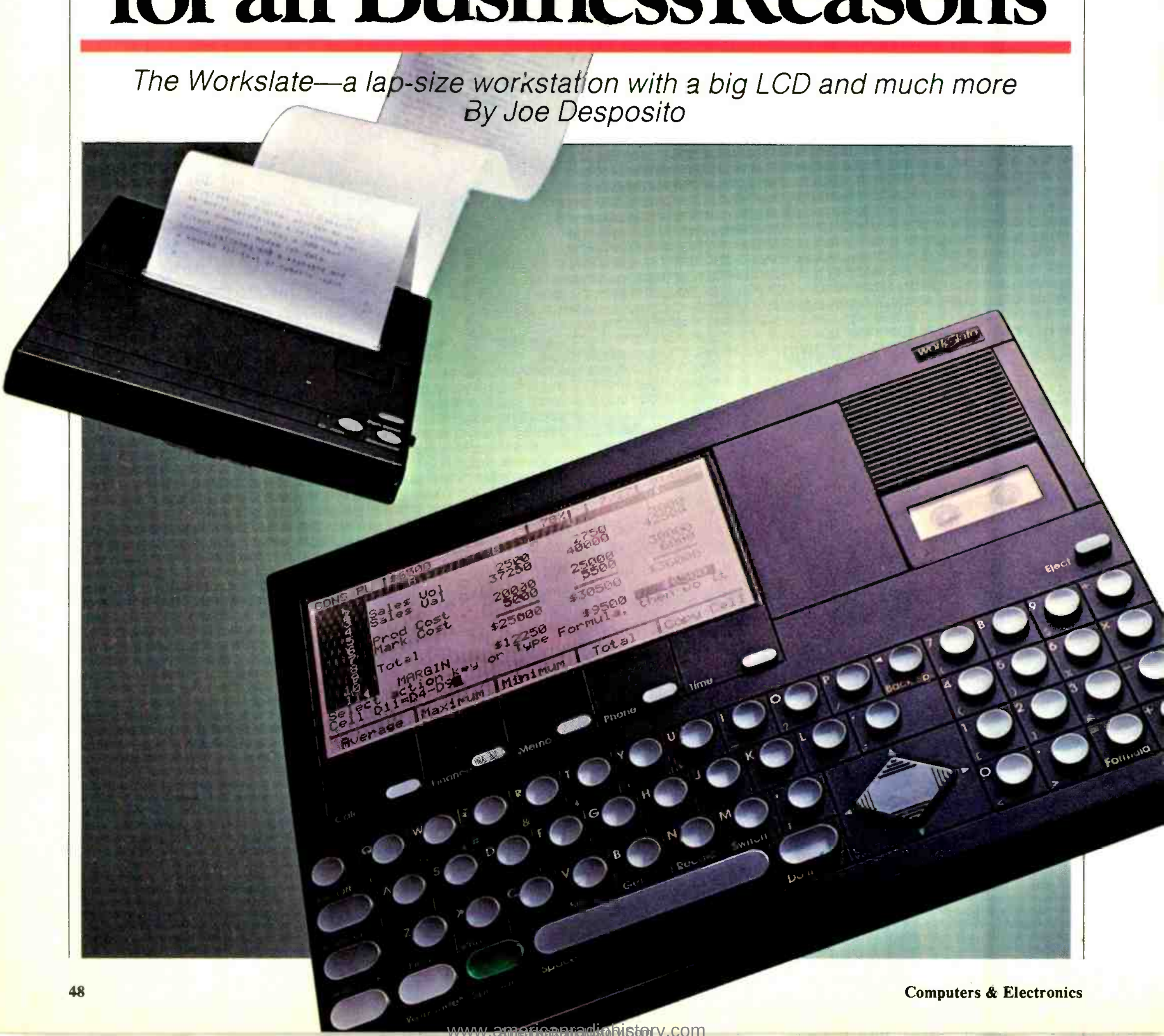
Age ______________ Area Code/Phone No. ______ / ______________

Check box for G.I. Bill bulletin on Educational Benefits: ☐ Veteran ☐ Active Duty

MAIL TODAY!

A Spreadsheet-Based PORTABLE COMPUTER for all Business Reasons

The Workslate—a lap-size workstation with a big LCD and much more
By Joe Desposito



It was inevitable that someone would create a lap-size portable computer with built-in spreadsheet software. The surprise, though, is how it was done. The product, called Workslate, in not your standard microcomputer. Designed by California-based Convergent Technologies, Inc. with the non-computerist business person in mind, Workslate uses an extensive series of menus, selected with "action" keys, to achieve results. Other keys, such as the DO IT key that is actually an "enter" key, enforce its non-computerist image. In fact, this computer doesn't even include BASIC!

Workslate's standard features are impressive: a 46-character by 16-line liquid-crystal display; a keyboard and keypad; a 300-baud modem; a telephone amplifier; a microcassette for data storage and audio recording; three built-in worksheets called Memo Pad, Phone List, and Calendar; a real-time clock and alarm; blank ready-to-go spreadsheets; and a simple but powerful spreadsheet programming language.

Workslate's design looks like something out of a Pierre Cardin collection. A black plastic case is decorated with green, white, and yellow words and letters, a large display, and gray keys (except for a single green one) in assorted geometric shapes. The computer, or should I say personal business workstation, measures 8½" × 11¼" × 1" (about the size of half a ream of typing paper) and weighs just under 3½ lb. Power is supplied by four AA alkaline batteries or an ac adapter. The suggested retail price of the unit is $895.

A Tale of Two Worksheets. Before we get into the nitty gritty of the Workslate's features let's talk about a couple of ways that this machine can be used. Suppose you were interested in the performance of certain stocks. You could press the WORKSHEET key, select your "Stocks" worksheet (or whatever name you called it) and review the prices for the last few weeks.

Then you could log on to Dow Jones and have Workslate automatically enter today's prices into your file. At this point, you could decide to buy, sell, or hold based on the formulas that you had entered into the spreadsheet. If you need to call your broker, just have Workslate dial the number automatically, and you can talk to that person via Workslate's telephone amplifier. How's that for some fun?

Or else, you might take Workslate out in the field on a sales call. Of course, your products, prices, quantities, discounts, etc. would all be neatly entered into your "Catalog" worksheet. Then when you get the inevitable question, "What can you do for me?" it's just a matter of changing a number in one of your formulas and pressing a button to have Workslate calculate a new list of prices for you.

These are just a couple of examples to give you a feel for what Workslate is all about. Now let's examine the machine in more detail.

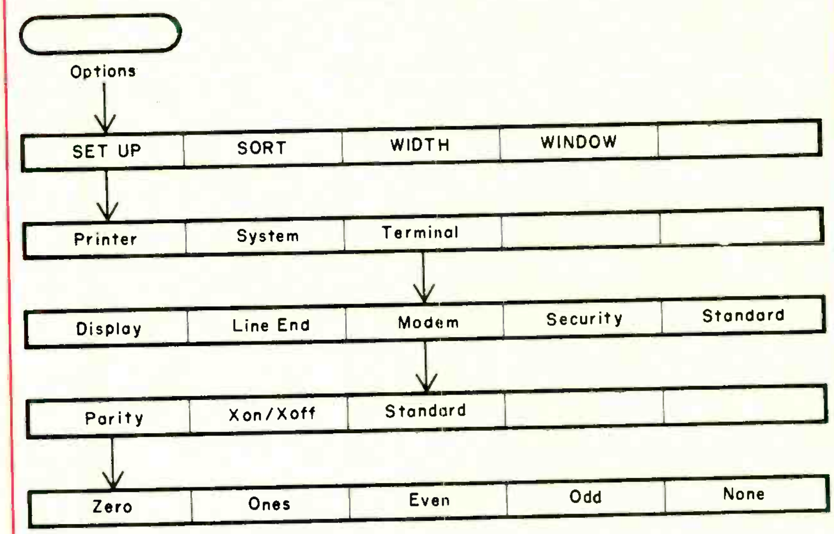


Fig. 1. A sample of Workslate's menu structure.

The Display's the Thing. Workslate's display is 42-characters across by 16-lines down. Compared to the most popular lap-size on the block, the Radio Shack Model 100, Workslate displays more than twice the number of characters. However, there's one drawback—the screen isn't twice the size. To fit on the 3" × 6" screen, Workslate's characters are 3/16" high, which is considerably smaller than the Model 100's. But the characters are completely legible, and there is an adjustment dial at the left side of the unit to make them as readable as possible. The only problem you might encounter with the screen is reflections from overhead fluorescent lights.

The display is divided into four areas, which may or may not be present simultaneously. The top line of the display is the status line, which shows the file name, cell data or formula, % of memory remaining, date, and time of day. When operations are being performed, a square blinks on and off in the percent memory box. If the modem or phone is in operation, a phone symbol appears in the box before the date. Warning messages such as "Replace back-up batteries" appear here, too.

Just below the status line is the spreadsheet work area which takes up the major portion of the display. It is anywhere from 11 to 15 lines long depending upon what else is being displayed. Two lines from the bottom is a two-line area that is used to give information to the user on the type of input that is expected. This area is where spreadsheet formula information is entered, among other things. The last two lines contain the Workslate's menus. There are five keys, one below each menu item, which are known as the "action" keys.

The screen can display high-resolution graphics as well as text. Graphics symbols are available as a menu item although specific graphics software is not.

=Dial("123-4567",Data)+GoTo(A2)
=Send("CPS")+GoTo(A3)
=WaitFor("ID:")+Delay(1)+GoTo(A4)
=Send (70000,000$_{CR}$")+GoTo(A5)
=WaitFor("Word:")+GoTo(A6)
=Send("SECRET:WORD$_{CR}$")

Fig. 2. Log-on procedure.

A Key by Any Other Shape. Circular keys? They can't be serious, I thought, when I first laid eyes on the Workslate. But after typing on them for a while, I realized that they did the job very well. And don't confuse these keys with the "chiclet" keys found on some low-cost computers. They are worlds apart.

There are 60 keys in all, and other shapes besides circles. There's a large diamond-shaped key that is used to advance from cell to cell on a spreadsheet, and an oblong key that says DO IT. So I did it! It's just an "enter" key in disguise, but its name underlines what this machine is all about—it's a modern-era workslate. Another oblong-shaped key is green (all others are gray) and marked SPECIAL. It activates any function or character printed in green on the keyboard.

Two other oblong keys are marked OPTIONS and WORKSHEET. The OPTIONS key displays menus on the screen. A sample is:

Change-Clear-Copy-Delete-Display

Directly underneath the words are the so-called "action" keys to select the item of your choice. These keys are oblong, but smaller than the DO IT and SPECIAL keys.

If you're not happy with this menu, just press OPTIONS again and you'll be rewarded with another set (there are three primary menus). When you find what you're looking for, you just press the corresponding key and a secondary menu is displayed. This continues on for as many as five menus in some cases. However, the average is three.

The WORKSHEET key brings up a menu that shows the files currently stored in memory. A total of five can be stored at any one time. On initial power up, if you press WORKSHEET the menu looks like this: empty-empty-Memo Pad-Phone Lst-Calendar. The three files listed are actually templates. That is, they are set up for use as a memo pad, a phone list, and a calendar. One thing to note here is that everything Workslate does is spreadsheet based. Thus, the memo template is really the "A" column of the spreadsheet extended to accommodate 128 characters. In similar fashion, the phone list template utilizes three columns and heads them: Name, Phone Number, and Company.

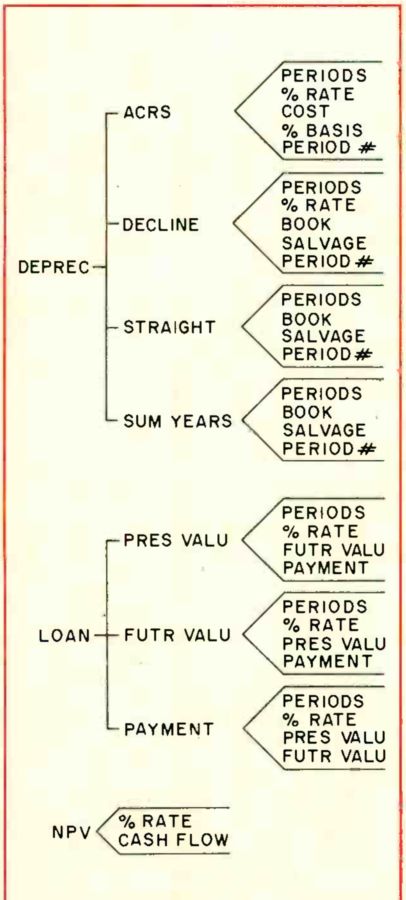


Fig. 3. Financial menu tree.

The keyboard layout is different than what you would expect on a normal typewriter. Although the Qwerty format is used, the top row of number keys is missing. Instead, there is a numeric keypad for numbers. Upper and lower case is available on the main keyboard, but to type standard characters such as @, #, $, etc., you must first press the SPECIAL key. This makes typing a sentence such as "Hi Dad! Send $$$$." somewhat awkward because you have to shift back and forth from the SHIFT key (only one key, located on the left of the keyboard) to the SPECIAL key, and side to side from the main keyboard to the numeric keypad. But this machine is not really meant for words, it's meant for numbers.

A few other keys that deserve mention are the CANCEL, BACK SP, and FORMULA keys. CANCEL allows you to obliterate any words or numbers that you start and subsequently become disenchanted with. However, since this key is right atop the SHIFT key you may sometimes obliterate when you mean to shift.

The BACK SP key does just what it says—it moves you back a space and cancels any number or letter it meets (destructive backspace). To go forward you would just press the spacebar (a destructive frontspace?). In any case, there is no provision to go back and forth in a non-destructive way while you are in a cell. However, if you choose the CHANGE option, non-destructive moves can be made with the diamond-shaped key.

The FORMULA key is used to place a formula in a cell. When you press it, a directive appears on the screen that states, "Select an action key to Type Formula, then Do It." Beneath this is the start of a formula, for example, Cell D11=. Below this are five choices: Average-Maximum-Minimum-Total-Copy Cell. These can be used in the formula ("Copy Cell" will just copy a formula from one cell to another). To select one of these items, you just press the corresponding key below it. It you want to insert a formula without using one of the options, you just type it in.

Most items on the keyboard are printed in white, green or yellow above and below their respective keys. However, there are some functions and characters that are hidden. For example, if you want to send a control character you must press the SPECIAL key and hold it down; then you press C and release both keys (they cannot be pressed simultaneously). The next letter pressed will be a control character. Green legends are absent from the middle line of circular keys (except for the last key), but most will print a symbol if you hold down the SPECIAL key. This is where you can find such infamous characters as backslash, underline, and open-single quote, among others.

You may also type graphics characters with Workslate. To do this you just select the Draw option. Fourteen graphics characters are available. Four of them appear on the screen along with the word "more." Selecting "more" gives you access to the rest of them.

What I've said thus far about the keyboard does not exhaust all of its functions, but I'll deal with the remaining ones later.

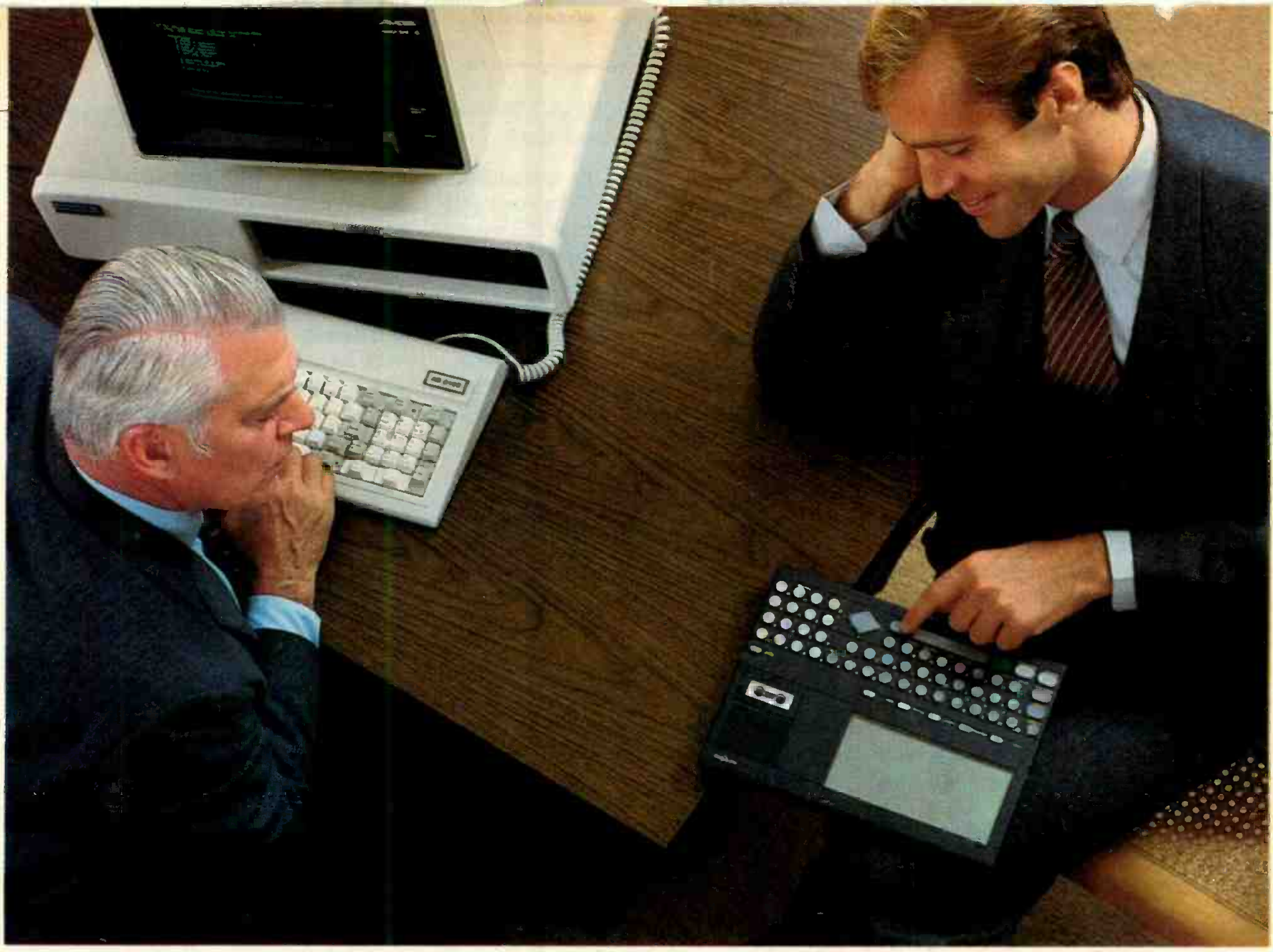
To Store or Not to Store. Sitting about midway up the right-hand side of Workslate is a microcassette tape well. Normally, when one sees this on a computer, storage comes to mind. This is true for Workslate, too, but not completely. The microcassette can also be used for voice recording.

The microcassette records (and plays) on two tracks, one for audio and one for digital. To make an audio recording, you press the SPECIAL and MEMO keys simultaneously and the following menu appears: Record-Play-Stop-Rewind-Forward. You can perform any function on the menu by pressing the key below the corresponding menu item. For example, if you use a dictaphone in your office, you can dictate a letter, pop the microcassette out of the recorder, and hand it to your secretary.

For data storage, you press SPECIAL and SAVE simultaneously. You are then queried as to which worksheet you wish to save. You respond by pressing the key under the corresponding worksheet (which appears in the menu section of the screen) and the worksheet is automatically saved to tape.

The recorder uses a saturated digital technique for storing data. Since the transfer rate is 2400 baud, the operation is fairly fast although not as fast as a disk drive.

To retrieve a worksheet, you press SPECIAL and GET simultaneously. The screen then displays up to five worksheets that are stored on the tape. This, in a sense, is the tape's directory. To load the desired worksheet, you just



Workslate is an ideal tool to take along with you when traveling or making business calls.

press the key below it. The tape is automatically fast forwarded to the correct spot and loading of the worksheet begins. Thus, it is completely computer controlled.

When storing data, you also have the option of recording an audio message with it. For instance, you might say: "This file contains my expenses for the trip to XYZ, Inc." Then, when you retrieve the worksheet you are given the option of playing back anything you may have recorded. Each microcassette can store up to five worksheets per side or 30 minutes of audio recording.

At the side of Workslate is a volume control to adjust the audio from the speaker. There are also two jacks for a microphone and earphone.

Reach Out and Touch. One of the features of Workslate that gives credence to the term "business workstation" is a built-in telephone amplifier. Using this feature in conjunction with the phone list worksheet makes "reaching out" a very simple process. The scenario goes like this. First you press WORKSHEET and select "Phone Lst" from the menu. Then you press SPECIAL and PHONE. A menu appears and you select "Dial." You may dial manually by punching in the number on the numeric keypad. (It is possible to reconfigure the numbers on the keypad to agree with touch-tone operation through an appropriate menu selection.) However, it is easiest to let Workslate dial automatically. This is done by positioning the cursor in the cell that contains the number you want to call. Now when you select "Dial" and press DO IT, Workslate dials automatically. When you're through talking, or if you get infuriated midway through the call, just press the "Hang Up" option. For those who need it, a provision is made for dialing from a rotary line. To avoid using the SPECIAL and PHONE keys you can save the menu on your phone list worksheet and it will appear when you select the list. Also on the menu is "Receive." This doesn't mean that you can use Workslate as an answering machine, but it will automatically make a phone-receive connection and issue a recorded message to the caller.

Besides voice communications, Workslate is capable of data communications. This is accomplished via a built-in, direct-connect, 300-baud modem and communications software.

To set up parameters for communications, you start at "Set Up" from the primary menu. From this point, there are four levels of menus as shown in Fig. 1. Selecting parity takes eight keypunches if you consider that "Set Up" is the third "Options" menu. Although this is tedious, it is not the usual procedure with Workslate.

To connect to an information source such as CompuServe, you simply press SPECIAL and PHONE. You are then presented with the phone menu. From this menu, you select "Dial" and enter the number. When the tone is received, the computer automatically shifts into terminal mode. Then you enter the necessary information to log onto the network.

If manual log-on is not your style, you can do it automatically. In fact, the whole operation can be performed automatically, from dial-up to exit. For example, suppose you wanted to call up EMAIL on CompuServe, have it retrieve your mail, and then log off. This can be done using spreadsheet-type commands. An automatic log-on procedure is shown in Fig. 2. Note the spreadsheet commands such as "Dial," "Send," and "Wait For," and the references to spreadsheet cell numbers.

To activate the procedure, you place the cursor at the first cell and then press SPECIAL and DO IT. Also note that carriage returns can (and must) be imbedded in the commands. These are available in the menu structure as further options under "Line Send" shown in Fig. 1.

For those who wish to transfer files from Workslate to a computer such as the IBM PC (or vice versa) a special software package is currently under development for the purpose. It will permit sending spreadsheets between Workslate and either Multiplan, Lotus 1-2-3, or VisiCalc. The software will be available first for the IBM PC. Of course, Workslate-to-Workslate file transfer is supported now.

The phone line is connected to Workslate via a modular jack at the rear. A second modular jack allows you to connect a telephone to Workslate (to make a handset accessible to the user).

Convergent Technologies plans to market a fold-up acoustic modem in the near future. This will enable the modem to be used in hotels and other places where a modular plug is not available.

The Heart is a Lonely 6303. Nowadays, many microcomputers include more than one microprocessor to handle different tasks. Workslate uses only the Hitachi 6303 (CMOS version). This is essentially Motorola's 6800 CPU. However, some additional help is provided in the form of two proprietary logic gate arrays that handle the display and microcassette functions.

Included with the system is 64K ROM and 16K RAM. The RAM will be expanded to 32K in the near future as a standard feature, according to a company spokesman, although there will be no expansion packs sold per se.

A Spreadsheet for All Reasons. On initial power up, a blank spreadsheet appears to the user. You can begin using it immediately, since commands are either on the keyboard (hard-keys) or in the menu area (action-keys). All that's necessary is to position the cursor in the cell of your choice and type away.

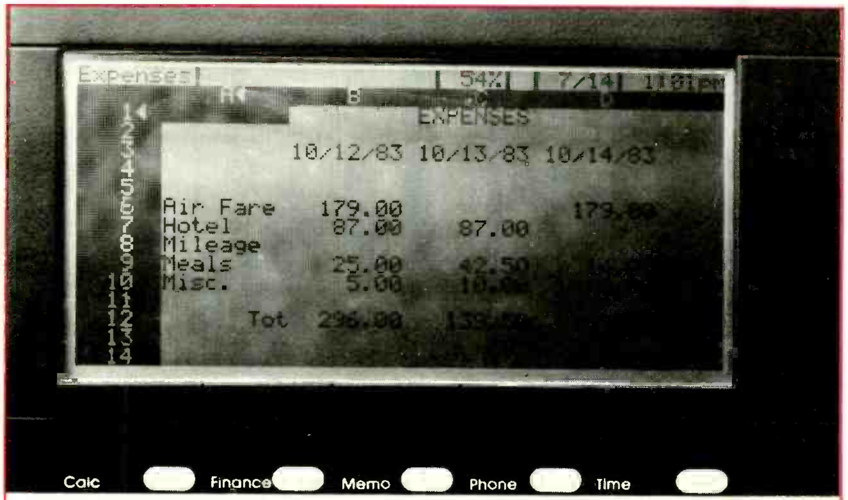
Anytime you want to use a formula, you just hit the FORMULA key and enter it. Workslate can do most of the functions of sophisticated spreadsheets and, in some cases, more. What's even more appealing, as noted before, is that most functions are initiated by selecting them from a menu.

Some common spreadsheet functions of Workslate are copying a cell or cells, totals, average, maximum, minimum, decimals, whole numbers, left or right justify, clearing a cell or cells, inserting rows or columns, and others. Some of the more sophisticated functions are absolute as well as relative cell references, sorting numbers or words (from high to low or low to high, or from A to Z or Z to A), checking for numerical or alphanumeric input, and others.

Three particular functions are assigned green labels on the keyboard (which means they work with the SPECIAL key). FIND is a feature that allows you to go to any cell on the spreadsheet within the limits of 1 to 128 for rows and A to DX for columns. RECALC permits you to turn off the automatic recalc function (on the menu) and recalculate all values only when desired. SWITCH is used in conjunction with the "Window" feature from the menu. In other words, "Window" shows two different parts of the spreadsheet and SWITCH permits you to move the cursor from one part to the other.

the riddle, "What's a spreadsheet whose 'A' column is 128 characters wide?" can be answered, "Memo Pad."

While we're on the subject, let's discuss "Memo Pad" further. Basically, this worksheet gives you some word processing capability. (I use the term very loosely). You may type up to 128 characters on a line and then press DO IT or the cursor key to begin a new line. If you make any mistakes you must use the change option to edit the line. The



This is a typical display on Workslate's 16 by 42 LCD screen.

I tried some of these functions while developing a spreadsheet and found out the following. To achieve an absolute cell reference, you must precede the cell coordinates with an @ symbol. Another feature concerns entering numbers into a cell. If you begin an entry with a number and then try to input a letter or a space you get beeped. This helps you avoid entering letters in a numeric field. However, if you want to enter a parts number such as 74LS167 into a column, you'll have to begin with a space.

At the top of the display there is a number that tells you the amount of memory left in RAM as a percent (there is 16K total). I was able to reach 0% (memory full) with a 30 × 24 spreadsheet (720 cells). In this state it took over two minutes to perform a simple function such as inserting a blank row into the spreadsheet. And you must remember that five worksheets share the memory. Obviously Workslate isn't meant for heavy-duty spreadsheet work.

Initially, five blank spreadsheets are in memory. Two are classified as "empty," while the others go by the names of "Memo Pad," "Phone List," and "Calendar." The difference between the empty and named worksheets are just some headings, graphics, and modifications of column width. This is really a clever use of the spreadsheet format. So

only way you can make corrections while still on the line is by using the destructive backspace. If you accidentally hit DO IT, CANCEL, or the cursor key instead of pressing SHIFT, you're out of luck. Now you're forced to hit "Change" to continue the line. These factors plus a keyboard that is awkward for word processing make the whole task very tedious.

Other built-in software can be found by pressing the SPECIAL key along with one of the top-row keys. CALC puts you into the calculator mode with basic features such as: M+-M—-ClrEntry-Recall-StoreM. A calculator display is shown on the lower half of the screen for a realistic effect.

FINANCE allows you to make automatic calculations for depreciation, loans, and net preset value. Fig. 3 shows the menu tree for this key.

TIME allows you to set the date and time upon initial power up (or at any other time). These appear adjacent to each other in the upper right corner of the display. Once they are set, you may subsequently set an alarm for any date and time. Suppose you wanted to remind yourself of Mom's birthday, which is two months from now. Just set the alarm for the correct date and time and you can be sure you'll be reminded about it (if Mom doesn't get to you first). A timer is also included (for min-

utes and hours) so that you can keep track of those long-distance calls. A reset-timer option sets the timer back to zero.

The two other keys, MEMO and PHONE were discussed earlier. Note that any menus related to these keys can be saved with appropriate worksheets. For example, when you save "Calendar," the TIME menu can be saved with it. Remaining built-in software that can be accessed by the user includes the system of menus and a unique "spreadsheet" language. The menu system, which has been alluded to in several parts of this article, is entered into by pressing the OPTIONS key. The menu diplays five options at a time and consists of several levels depending upon the application. You can retreat from a lower level all at once by pressing CANCEL or in smaller steps by pressing DO IT. However, it's not always possible to backstep exactly one menu at a time.

Although a language such as BASIC is not included with Workslate, certain "words" are available to the user. I refer to these words as the "spreadsheet" language (how about SSL?). Some of the commands are COUNT, DELAY, INDEX, etc.; other words refer to logical operations such as IF ... THEN ... ELSE, AND, OR, etc.; and some words are mathematical operations such as ABS (absolute value), INT (integer), etc. All of the words that appear in the menus can be typed in, too. An example of the use of this language is shown in Fig. 2.

EXPENSES

	10/12/83	10/13/83	10/14/83
Air Fare	179.00		179.00
Hotel	87.00	87.00	
Mileage			
Meals	25.00	42.50	14.00
Misc.	5.00	10.00	6.00
Tot	296.00	139.50	199.00

EXPENSES

	10/12/83	10/13/83	10/14/83
Fare	179.00		179.00
l	87.00	87.00	
Mileage			
Meals	25.00	42.50	14.00
Misc.	5.00	10.00	6.00
Tot	296.00	139.50	199.00

The optional printer has two modes—standard or compressed.

Peripherally Speaking. For those who would like a printer that attaches to Workslate in an aesthetically pleasing way, there is one available for about $250 (suggested retail price). It's not really a printer though, it's a four-color printer/plotter. It uses 4½" rolled paper, and can print across the width of the paper or sideways along its length. Normal characters are ⅛" high, but in condensed mode, characters can be printed at half that size. In condensed mode you can get 80 characters along the width of the paper. A sample of the two print modes is shown in Fig. 4. The printer plugs into the back of the unit.

If you would rather use a dot-matrix or letter-quality printer, you can purchase an expander for $199 that will give you both an RS-232 and Centronics interface. Parameters for the printer can be set under the menu items "Set Up" and "Printer."

A mass storage device such as a disk drive is not under consideration for Workslate at present.

Final Considerations. A few items haven't been addressed yet. First, how does a computer-illiterate person who may also have a touch of compuphobia learn to use Workslate? Included with the package are two instruction tapes called "Teach Me Now" and "Teach Me Later." The tapes weren't available to me for review, but they were described as a way to quickly get your feet wet (Teach Me Now) and a way to learn the machine in depth (Teach Me Later).

The second item is, will any more software be available? The answer to this is yes and no. If by software, you mean something such as a real word processing package—I don't think so. However, there will be tapes available in the future that contain templates similar to those used for "Memo Pad," "Phone List," and "Calendar." These "Taskware" tapes will be for applications such as Real Estate, Taxes, etc.

The last item, which we've already touched on briefly, has to do with power considerations. The basic unit comes with an ac adapter/recharger. This may be used in conjunction with four AA-size nicad batteries. Alternately, four AA alkaline batteries can be used. To prevent against memory loss, however, you must insert two Eveready 186 (or similar) button-type batteries at the back of the computer.

Thus, once you begin to use Workslate, it will store all inputted data—even when turned off. To delete data, you choose the appropriate menu item.

If nothing has been input to the machine for five minutes or so, it will beep. Unless a key is pressed, it automatically shuts down a minute later to conserve power, but still retains the contents of memory. If desired, the machine can be reset to its initial state by inserting a pen or other pointed object into a small hole on the bottom of the machine.

How Do I Rate Thee? Workslate is without question a most interesting and easy-to-use computer. The menu system is impressively good, although at times you may find yourself pushing a lot of buttons to perform a seemingly simple operation. However, because the Workslate holds all the information you put in it, even when turned off, you rarely have to reset parameters after it is done once. I thought the spreadsheet functions were advanced, yet easy to use.

However, as a professional tool, the Workslate's present 16K RAM memory (which is basically used to hold data input) must be questioned. It doesn't take too many cell entries to fill up the memory to capacity. Once that occurs (or almost occurs) the machine becomes unbearably slow. This has to be taken into consideration for those who work with large spreadsheets.

I do not recommend Workslate for any but the most simple word processing needs. The keyboard is awkward for straight typing. But as a spokesperson for Workslate said, "This machine is not meant for people who type their own work." She's right.

Some minor annoyances were the reflections from the display and the unit beeping after five minutes of inactivity, even when using the ac adaptor.

The communications package is excellent and the addition of a telephone amplifier is an indication that Convergent Technologies has thought of just about every convenience.

Workslate's features are geared to the business person who wants spreadsheet capabilities in a portable package without all the fuss of learning about computers. For these people and for others who want a portable business tool, I feel that Workslate has hit its design mark. (Note: Workslate will not be available in computer stores until 1984.) ◇

"I built this 16-bit computer and saved money. Learned a lot, too."

Save now by building the Heathkit H-100 yourself. Save later because your computer investment won't become obsolete for many years to come.

Save by building it yourself. You can save hundreds of dollars over assembled prices when you choose the new H-100 16-Bit/8-Bit Computer Kit – money you can use to buy the peripherals and software of your choice.

H-100 SERIES COMPUTER SPECIFICATIONS:

USER MEMORY:
192K-768K bytes*

MICROPROCESSORS:
16-bit: 8088
8-bit: 8085

DISK STORAGE:
5.25" disk drive,
8" disk drive
Winchester drive

KEYBOARD:
Typewriter style, 95 keys,
13 function keys,
18-key numeric pad

GRAPHICS:
Always in graphics mode.
640h/225v resolution; up to eight colors are available**

COMMUNICATIONS;
Two RS-232C Serial Interface Ports and one parallel port

DIAGNOSTICS
Memory self-test on power-up

AVAILABLE SOFTWARE:
Z-DOS (MS-DOS)
CP/M®
Z-BASIC Language
Microsoft BASIC
Multiplan
SuperCalc
WordStar
MailMerge
Data Base Manager
File Manager
General Ledger
Accounts Receivable
Accounts Payable
Inventory Control
Sales Invoicing
Lotus 1 2,3
PeachText 5000
Fortran-86
Cobol-86
Pascal
Basic Compiler
Most standard 8-bit CP/M Software

*192K bytes standard.
**Optional.
CP/M is a registered trademark of Digital Research.

The H-100 is easy to build – the step-by-step Heathkit manual shows you how. And every step of the way, you have our pledge – "We won't let you fail." Help is as close as your phone, or the nearest Heathkit Electronic Center.†

And what better way to learn state-of-the-art computing techniques than to build the world's only 16-bit/8-bit computer kit? To run today's higher-speed, higher-performance 16-bit software, you need an H-100. It makes a big difference by processing more data faster.

Dual microprocessors for power and compatibility. The H-100 handles both high-performance 16-bit software and most current Heath/Zenith 8-bit software.

Want room to grow? The H-100's standard 192K byte Random Access Memory complement can be expanded to 768K bytes – compared to a 64K standard for many desktop computers.

And the industry-standard S-100 card slots support memory expansion and additional peripheral devices, allowing your investment to grow.

High-capacity disk storage, too. The H-100's 5.25" floppy disk drive can store 320K bytes on a single disk. The computer also supports an optional second 5.25" and external 8" floppy disk drives. For maximum storage, an optional internal Winchester disk drive is also available.

For more information, circle the reader service number below. Better yet, visit your Heathkit Electronic Center for a demonstration!

The H-100 gives me the most for my computer dollar!

Heathkit
Heath Company

A subsidiary of Zenith Radio Corporation

†Heathkit Electronic Centers are units of Veritechnology Electronics Corporation.

Circle No. 28 on Free Information Card

Customize Your Apple with an EPROM Plug

Here's a simple way to change the standard ROMs in your Apple II

By S. F. Mitchell, Jr.

How would you like to customize your Apple II without making hardware modifications and be able to change back to the original condition in about 30 seconds? The EPROM plug discussed here allows you to replace the Apple Autostart ROM (F8) with a specially programmed EPROM. This means you can make firmware changes without making hardware or software modifications.

The EPROM plug accepts the Texas Instruments TMS2516 EPROMs (or Intel's 2716, or similar) in place of any of the original Apple ROMs (or all if you wish to make more extensive firmware changes). By substituting EPROMs in place of the Apple ROMs, you car customize an Apple II to the limit of your programming ability. Detailed instructions follow for changing the "Apple][" title display, eliminating the lower-case sieve routine, permitting a title of up to 14 characters, adding a security code to uniquely identify your Apple, changing the system monitor routine prompt character, and modifying the NMI vector to allow regaining control of the computer from *any* program.

Since the EPROM plug accepts the TMS2516 EPROM, you must have a way of programming this chip. Alternately, you can use a professional EPROM programming service (such as the one given in the Parts List on the opposite page) to create a custom EPROM for your Apple.

The EPROM Plug. The EPROM plug is easily constructed with the proper kind of machined-pin sockets (Augat 524-AG10D, or similar). Using these special sockets, with the diagram at right as a guide, carefully clip the narrow ends of pins 18 and 21 from the socket that will be used on top (*SO1*). As shown, the pins are clipped at the point where they narrow. Dress the clipped pins with a small file so that when *SO1* is plugged into the bottom socket (*SO2*), these pins *do not* make electrical contact with *SO2*. Eventually, *SO2* will plug into the Apple motherboard.

Prepare two 1½" lengths of wire-wrap wire by stripping ¼" of insulation from each end. One end of a wire is soldered to pin 18 on *SO1*, with the other end inserted in, and soldered to, pin 21 on *SO2*. Use a small-tip, low-wattage soldering pen and narrow diameter solder. Trim any excess bare wire after soldering, and be careful that no bare wire is left exposed that could short circuit to an adjacent pin.

Using the same technique, solder the other wire from pin 21 on *SO1* to pin 18 on *SO2*. Plug *SO1* into *SO2* and check to make sure that pins 18 and 21 on *SO1 do not* make contact with the corresponding pins on *SO2*. Fold the excess wire so that it lays flat and is sandwiched between the two sockets, which should seat together firmly.

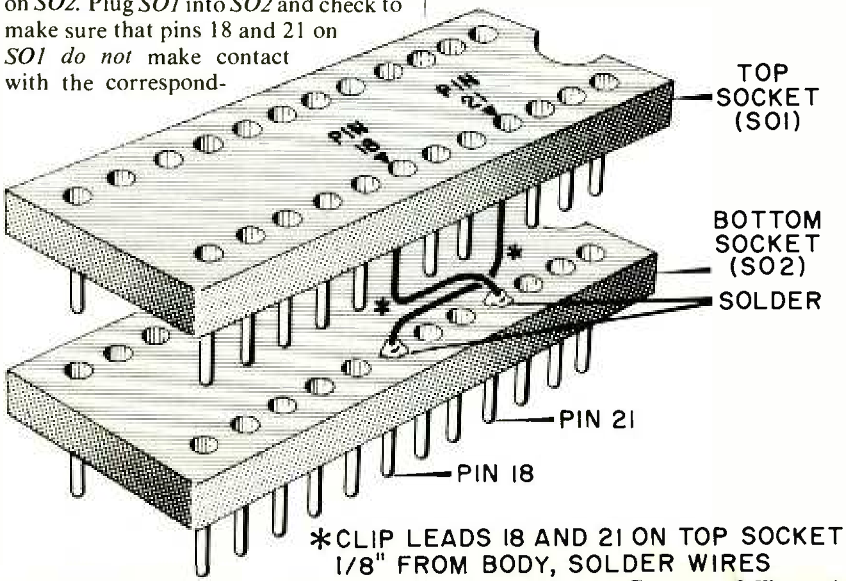
Use a continuity tester to determine if the clipped pins are touching the mating holes on *SO2*. If so, pry the sockets apart and dress the clipped pins again so they don't touch the holes. Resolder the leads if required. With the continuity checker, assure that there is continuity between pin 18 of *SO1* and pin 21 of *SO2*, and between pin 21 of *SO1* and pin 18 of *SO2*. If everything checks out, a permanent bond should be made between *SO1* and *SO2*.

Employing a fine-tipped soldering iron and fine solder, carefully solder together the four corner pins of the two sockets (pins 1, 12, 13, and 24). However, this soldering is difficult, and you may scar the plastic of the sockets slightly with heat from the soldering pen. The scarring will not hurt the sockets, though. At this point, check for continuity between similar pins on both sockets (except for pins 18 and 21). It may be necessary to solder some pins.

As an option, fill the gap between the two sockets with some type of filler, such as epoxy. The filler is not necessary for using the EPROM plug, but it makes it look neat. If you do use filler, however, make sure that it is electrically nonconductive!

Customizing the Apple. The Apple Autostart ROM (*F8*) contains many of the machine-language subroutines that make the Apple powerful. Here are a few customizing ideas that you might want to try.

Title. When an Apple with an Autostart ROM is powered up, the screen is cleared and "APPLE][" appears centered at the top of the screen. This first example involves changing "APPLE][" to another title—your



*CLIP LEADS 18 AND 21 ON TOP SOCKET 1/8" FROM BODY, SOLDER WIRES name or, for the sake of this demonstration, "ORANGE 2." The letters for "APPLE][" are stored in locations $FB09 to $FB10 (Note: a $ precedes hexadecimal numbers). The present contents of these locations are:

$FB09 = C1 (A)
$FB0A = D0 (P)
$FB0B = D0 (P)
$FB0C = CC (L)
$FB0D = C5 (E)
$FB0E = A0 (Space)
$FB0F = DD (])
$FB10 = DB ([)

Since we know where the locations are in the F8 ROM, it is easy to change them. If you are not familiar with programming EPROMs, the following is a brief summary of how to do it.

For Apple disk systems, boot DOS; for cassette systems, simply power the Apple up. From this point to saving the code on disk or cassette, the procedure is the same. Type CALL −151 (RETURN). You should now be in the system monitor. An asterisk (*) appears for a prompt. Type FB09.FB10 (RETURN). You should see C1 D0 D0 CC C5 A0 DD DB. These are the contents of the locations that we will ultimately change, but first we have to move the *entire* F8 ROM into RAM. To make the move, type 2000 < F800.FFFFM (RETURN). This moves the F8 ROM contents down to RAM locations $2000 to $27FF. (Keep in mind that $ equals hex.) The F8 ROM memory page boundaries are now in the following locations in RAM:

$F800 = $2000
$F900 = $2100
$FA00 = $2200
$FB00 = $2300
$FC00 = $2400
$FD00 = $2500
$FE00 = $2600
$FF00 = $2700

PARTS LIST

IC1—Texas Instruments TMS2516JSP-45 EPROM or *exact* electrical equivalent
SO1,SO2—24-pin IC socket with gold-plated, screw-machined pins (Augat 524-AG10D or equivalent
Misc.—Wire-wrap wire

Note: The following are available from Martcomm, Inc., PO Box 74, Mobile, AL 36601: Two 24-pin, gold-plated, screw-machined pin sockets for $8.25 plus $1.75 for postage; two sockets assembled as described in text for $14.95 plus $1.75 postage; TMS2516 EPROMS for $6.50 each, plus $1.75 postage. For programming, send $10.00 plus a tape or disk prepared as described in the text. Alabama residents add sales tax.

APPLE II KEYBOARD MODIFICATION

LIFT off the top of the Apple and locate the pc board under the keyboard. There is a row of 25 wire pins that connect the pc board to the keyboard. Attach a wire to the second pin from the right (as you face the Apple). Attach the other end of the wire to pin 4 of the game port socket. Alternately, you can connect the wire to pin 1 of the IC just in front of the game port socket (74LS251).

From the above memory page offset table, we see that the locations we want to change, $FB09 to $FB10, are now located at $2309 to $2310. Confirm this by entering 2309.2310 (RETURN). Again we should see C1 D0 D0 CC C5 A0 DD DB. We must now decide what changes to make to these codes for "ORANGE 2" instead of "APPLE][."

Table I shows normal ASCII screen characters, which we want for this example, but you can use any combination of normal, flashing (Table II), or inverse (Table III) characters. If you have a lower-case character generator, you could even use lower-case characters. Refer to your lower-case character generator manual for the appropriate codes.

The following codes are from Table I:

0 = CF
R = D2
A = C1
N = CE
G = C7
E = C5
(space) = A0
2 = B2

Keep in mind that there are only eight locations available for the title and that spaces count.

To replace the original "APPLE][" with "ORANGE 2," type 2309: CF D2 C1 CE C7 C5 A0 B2 (RETURN). This procedure changes RAM locations $2309 to $2310 to the desired codes for the new message. The changes can be checked by typing 2309.2310 (RETURN). The only thing left is to save the changes to disk or cassette. If you

TABLE I—HEX CODES FOR NORMAL CHARACTERS

Space	= A0	@	= C0
!	= A1	A	= C1
"	= A2	B	= C2
#	= A3	C	= C3
$	= A4	D	= C4
%	= A5	E	= C5
&	= A6	F	= C6
'	= A7	G	= C7
(	= A8	H	= C8
)	= A9	I	= C9
*	= AA	J	= CA
+	= AB	K	= CB
,	= AC	L	= CC
-	= AD	M	= CD
.	= AE	N	= CE
/	= AF	O	= CF
0	= B0	P	= D0
1	= B1	Q	= D1
2	= B2	R	= D2
3	= B3	S	= D3
4	= B4	T	= D4
5	= B5	U	= D5
6	= B6	V	= D6
7	= B7	W	= D7
8	= B8	X	= D8
9	= B9	Y	= D9
:	= BA	Z	= DA
;	= BB	[	= DB
<	= BC	\	= DC
=	= BD	]	= DD
>	= BE	^	= DE
?	= BF	_	= DF

TABLE II—HEX CODES FOR FLASHING CHARACTERS

Space	= 60	@	= 40
!	= 61	A	= 41
"	= 62	B	= 42
#	= 63	C	= 43
$	= 64	D	= 44
%	= 65	E	= 45
&	= 66	F	= 46
'	= 67	G	= 47
(	= 68	H	= 48
)	= 69	I	= 49
*	= 6A	J	= 4A
+	= 6B	K	= 4B
,	= 6C	L	= 4C
-	= 6D	M	= 4D
.	= 6E	N	= 4E
/	= 6F	O	= 4F
0	= 70	P	= 50
1	= 71	Q	= 51
2	= 72	R	= 52
3	= 73	S	= 53
4	= 74	T	= 54
5	= 75	U	= 55
6	= 76	V	= 56
7	= 77	W	= 57
8	= 78	X	= 58
9	= 79	Y	= 59
:	= 7A	Z	= 5A
;	= 7B	[	= 5B
<	= 7C	\	= 5C
=	= 7D	]	= 5D
>	= 7E	^	= 5E
?	= 7F	_	= 5F

are using a disk, type BSAVE ROMF8,A$2000,L2050 (RETURN). The program should now be saved on disk.

If you are using a cassette recorder, type 2000.2800W, place the recorder in record, wait about five seconds, and hit RETURN. The saved code can be used with an EPROM programmer to program your EPROM. If you don't have an EPROM programmer, you can use a professional programming service.

Lower Case. If you have modified your Apple keyboard to generate lower-case characters, you might want to eliminate the lower-case sieve that is in the F8 ROM keyboard-input routine. This is easily accomplished by changing ROM locations $FD82 and $FD83 from $29 $DF to $EA $EA. After the change, typing a lower-case character on the keyboard actually gets the character into the Apple (past the keyboard-input routine) as a lower-case character. Again, the actual changes are made in RAM after you have moved the ROM contents down to RAM, as previously described. Therefore, the actual locations that you will change are $2582 and $2583 in RAM. Type 2582: EA EA *(RETURN)* to make the change. Verify that the change was properly made by typing 2582.2583 (RETURN). If the change was properly made, you will get EA EA. After the change, you must save the code on tape or disk to program your EPROM. (See box.)

Longer Title. There are 14 "free" locations in the F8 Autostart ROM that can be used for a short machine-language subroutine or, if you like, a 14-character title. These "free" locations are $FBB3 to $FBC0. To create a 14-character title, the F8 ROM "Print the Title" routine at locations $FB63 to $FB6A must be changed. The 14 characters that you want for your new title will be placed in locations $FBB3 to $FBC0. First, move the F8 ROM down to RAM locations $2000 to $27FF, then make the following changes in RAM by typing:

2363: A0 0E B9 B2 FB 99 0A 04 (RETURN)

This change allows 14 letters in the title, centered on the screen. The 14-character title must be placed in locations $FBB3 to $FBC0, with the characters selected from the normal, inverted, or flashing character tables. If you use less than 14 characters, you must "center" the characters in the 14 locations by using leading and trailing space characters ($A0). Assuming that you have already moved the F8 ROM down to RAM, the 14 locations for your new title are now at locations $23B3 to $23C0. The usual contents of locations $23B3 to $23C0 are 14 $EA characters, the 6502 microprocessor NOP code (No OPeration, or "do nothing" code). Change the 14 locations as follows (where the XX represents the codes you have selected from Tables I, II, or III):

23B3: XX XX XX XX XX XX XX XX
XX XX XX XX XX XX (RETURN)

After the changes, save the code from $2000 to $2800. The saved code is used to program your EPROM.

Title Call. After you have your personalized title working and want to use it in a program, CALL −1184 will clear the display and put your title on the screen. If you are in the system monitor, typing FB60G (RETURN) will do the same.

Security Code. The 14 locations from $FB63 to $FBC0 can also be used to uniquely identify your Apple. Simply place your own security code (social security number, serial number, etc.) in these "free" locations. If you make this change, your Apple will be unique since it will be the only one existing with your identification in EPROM. The characters that you want for identification should be selected from Table I since you will not be printing the security code on the screen. As usual, first move the F8 ROM contents down to RAM. Then enter the "security" code by making changes starting at location $23B3.

**TABLE III—
HEX CODES FOR
INVERSE CHARACTERS**

Space	= 20	@	= 00
!	= 21	A	= 01
"	= 22	B	= 02
#	= 23	C	= 03
$	= 24	D	= 04
%	= 25	E	= 05
&	= 26	F	= 06
'	= 27	G	= 07
(	= 28	H	= 08
)	= 29	I	= 09
*	= 2A	J	= 0A
+	= 2B	K	= 0B
,	= 2C	L	= 0C
-	= 2D	M	= 0D
.	= 2E	N	= 0E
/	= 2F	O	= 0F
0	= 30	P	= 10
1	= 31	Q	= 11
2	= 32	R	= 12
3	= 33	S	= 13
4	= 34	T	= 14
5	= 35	U	= 15
6	= 36	V	= 16
7	= 37	W	= 17
8	= 38	X	= 18
9	= 39	Y	= 19
:	= 3A	Z	= 1A
;	= 3B	[	= 1B
<	= 3C	\	= 1C
=	= 3D	]	= 1D
>	= 3E	^	= 1E
?	= 3F	_	= 1F

The changed code should be saved on tape or disk for programming your EPROM.

Monitor Prompt. It is a good idea to change the system monitor prompt if you substitute an EPROM for the F8 System ROM. The nonstandard prompt character will remind you that the original ROM is not installed in the Apple. The code for the system monitor asterisk prompt ($AA) is located at $FF6A. To change the prompt character to a flashing asterisk, for example, consult Table III, which indicates that the proper code is $2A. Therefore, the code at $FF6A must be changed to $2A. Assuming that you have moved the ROM contents down to RAM, the location to change will be $276A. Make the change in RAM with the system monitor by typing 276A: 2A (RETURN). Verify that the change was made, and save the changed code on cassette or disk for programming your EPROM.

$\overline{\text{NMI}}$ Vector. Most protected programs prevent the user from going into the system monitor where the program can be examined. By changing the $\overline{\text{NMI}}$ (non-maskable interrupt) vector to return to the system monitor, control can be regained from *any* program. This is accomplished by changing F8 ROM locations $FFFA and $FFFB from $FB $03 to $69 $FF. Remember, $FFFA and $FFFB will be locations $27FA and $27FB in RAM, where the changes are actually made. Type 27FA: 69 FF (RETURN) to make the change. Verify that the change was made by typing 27FA.27FB (RETURN), which should give you 69 FF. Save the changed code on disk or tape for use in programming your EPROM.

After this change, you can return to the system monitor from any program simply by grounding the $\overline{\text{NMI}}$ line on the system bus. A single-pole, single-throw, momentary pushbutton switch will suffice. The switch should be connected so that closure grounds pin 29 of one of the peripheral connectors (which connects to the $\overline{\text{NMI}}$ pin on the 6502 microprocessor).

Some "protected" programs do a checksum test on the F8. If there have been any changes to the ROM, the protected program aborts or hangs up.

Using the EPROM Plug. After burning your custom program into an EPROM, insert it into the EPROM plug with pin 1 of the EPROM toward the notch in the top socket (pin 1 is usually identified by a dot or notch). Make sure the Apple is turned off and unplugged from the ac power line, then replace the desired Apple ROM with the EPROM plug, keeping the notch toward the keyboard end of the motherboard. ◇

OUR SUP' R TREE IS BULGING WITH GREAT PRODUCTS FOR YOUR COMPUTER

SUP' R MOD

An "FCC APPROVED" high performance interface that converts any standard home TV into a full video display for your personal computer, CCTV (home video) camera, or similar systems. Externally powered, easy to connect, with a built-in voltage regulator. Comes with matching video cable, wall transformer, and impedance matching transformers.

The *SUP' R TREE* was created by M&R Enterprises as a standard of excellence for the type of add-on products necessary to make your computing more productive, more reliable, and less complex. New products are continually growing on the *SUP' R TREE*.

ADAPTABOX

Save time interfacing systems and peripherals with this easy to use breakout box for RS-232C cabling. You will have access to the 11 conductor configurations most commonly used to interface microcomputers and peripherals. Two configuration jumpers included for additional interconnection capability. Comes with 10-foot cable terminated with 25-pin "D" connectors.

SUP' R LEDGER

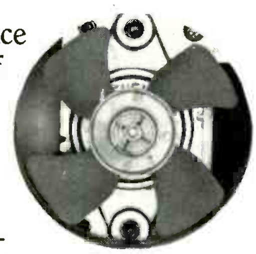
For the Apple II and IBM PC. The most powerful general ledger program ever put on a microcomputer. It will handle 200 seperate accounts, 1400 transactions per time period, and up to 10 cost centers. Easy menu driven input with error checking capability. Comes with 19 user-defined journal sources including Auto Recurring and Auto Reversal journal sources.

SUP' R BUFFER

No more waiting for your printer to finish so you can start inputing data again. *SUP' R BUFFER* lets your computer and printer work simultaneously. Computer data is stored in the buffer (up to 64K) and allows you to printout data from the buffer storage, eliminating computer "wait"-time. Independent power supply, automatic test, data compression, pause control and with copy capability.

*Apple II Plus is a Trademark of Apple Computer Co.

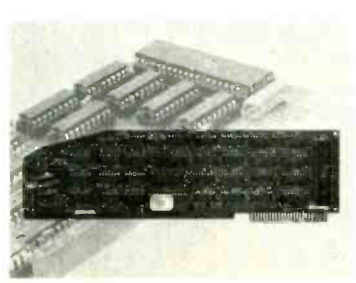
SUP' R FAN



Now you can lower the surface temperature of your ICs for longer component life. This safe, high performance cooling fan is simple to install, makes no electrical noise, and will not damage magnetic disks or tape. Mounts inside the Apple cabinet, no drilling required. For Apple II Plus.

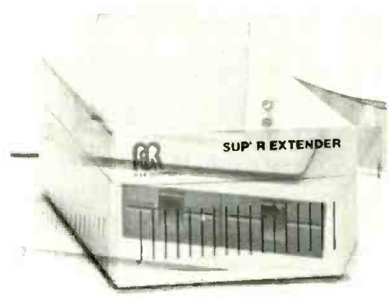
SUP' R TERMINAL

Now your Apple II can have an 80-character line with upper and lower case characters (with true descenders) AND, faster clearing, faster scrolling, and "clean screen" operation. *SUP' R TERMINAL* offers you more user control and programmability than any other board you can buy. Complete with all 128 ASCII characters.



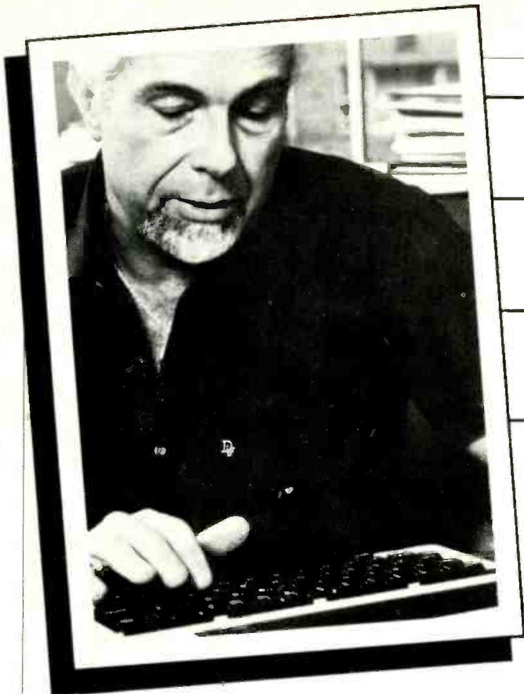
SUP' R EXTENDER

Expands the capability of your IBM PC by providing six additional peripheral card slots. Includes an independent power supply for safe, reliable operation. Self-contained fan to keep components cool. Advanced circuitry for network termination. The perfect match for your IBM PC, Eagle and others. Simple to install.



For information on these and other *Sup' R Tree* products, see your computer dealer or contact M&R Enterprises direct at: 910 George Street, Santa Clara, CA 95050, or call (408) 980-0160.

M&R Enterprises



NERO

"He's also interested in utilizing his computers as controllers."

```
F I N G E R   P R I N C E ,   I N C . : P A Y R O L L
 PAYROLL INFO FOR JULY 19, 1983, DAYTON OH
FEE=       $0 :  TRANSPORTATION INCLUDED: YES. AMOUNT>>
------------------------------------------------------------
              * SMITH                    * JONES
            TAXABLE   NON-TAXABLE     TAXABLE  NON-TAXABLE
------------------------------------------------------------
SALARY       $500                      $500
REHEARSAL     $75                       $75
SETUP(S)               $40
DAY(S) OFF             $20.00                     $20.00
MISC. EXP.             $142.30                    $133.26
PHL  REIMB.    $0                        $0
------------------------------------------------------------
TOTALS       $575      $202.30         $575       $153.26
```

Example 7

```
 *     ****   SUMMARY FOR SMITH     AND JONES      ****
                  * SMITH                      * JONES
DATE  CITY        SAL  REH SU  MISC PHLPOP  SAL  REH MISC PHLPOP
------------------------------------------------------------------
JUL19 DAYTON OH   500   75  40 162      0   500   75  153     0
JUL20 CLEVELAND   500  150  60  53      0   500  150  104     0
JUL21 ERIE PA     450    0  20 100   -137   450    0  100  -137
==================================================================
TOTAL            1450  225 120 315   -137  1450  225  357  -137

>>>>>>>>>>>>>>>>>>>>>>>> P A Y  O N
```

Example 8

```
 *           >>>>>>>>>>   R  E  C  A  P   <<<<<<<<<
-----------------------------------------------------------------------
          ******   PAYROLL INFO FOR SMITH          ******
                                                      TOTALS
DATE     CITY         SAL  REH  SU    MISC PHLPOP   TAXABLE   REIMB.
-----------------------------------------------------------------------
JUL19    DAYTON OH    500   75  40  162.30    0.00   575.00   202.30
JUL20    CLEVELAND    500  150  60   52.50    0.00   650.00   112.50
JUL21    ERIE PA;     450    0  20  100.00 -137.00   313.00   120.00
=======================================================================
TOTAL                1450  225 120  314.80 -137.00  1538.00   434.80

>>>>>>>>>>>>>>>>>>>>>>>> P A Y  IMMEDIATELY. SEND CHECK TO HOME.
```

Example 9

```
 *           >>>>>>>>>>   R  E  C  A  P   <<<<<<<<<
-----------------------------------------------------------------------
          ******   PAYROLL INFO FOR JONES          ******
                                                      TOTALS
DATE     CITY         SAL  REH          MISC PHLPOP   TAXABLE   REIMB.
-----------------------------------------------------------------------
JUL19    DAYTON OH    500   75   0  153.26    0.00   575.00   153.26
JUL20    CLEVELAND    500  150   0  104.00    0.00   650.00   104.00
JUL21    ERIE PA;     450    0   0  100.00 -137.00   313.00   100.00
=======================================================================
TOTAL                1450  225   0  357.26 -137.00  1538.00   357.26

>>>>>>>>>>>>>>>>>>>>>>>> P A Y  IMMEDIATELY. SEND CK TO L.A._
```

Example 10

4 shows what the screen looks like on the menu section. Example 5 shows the screen for INPUT, where the program searches the file for duplications that come up on the screen for deleting or editing. Example 6 shows the screen output for this section. Example 7 shows a summation of the INPUT section, while Example 8 is designed to be sent to the bookkeeper who makes appropriate deductions and then processes the check. RECAPS (Example 9 and 10) are then sent to each employee.

"My future is in my computers, especially the portable," Nero says. "It gives me more time to attend to my musical career. I haven't tackled assembly language yet . . . maybe one day. My portable's 32K is very powerful, but sometimes I do run out of memory when I'm on the road for, say, two or three weeks. I store data on tape when that happens."

When Nero programs, he sets a flow chart mentally and then picks lines for categories. He uses subroutines as much as possible, as well as subfiles with markers to denote beginnings and endings. To demonstrate, he punched in some programs on his Model 100. One "bombed." Numerical data came up on a different line of the display. Nero promptly ran several sections on the LIST mode, all the while mumbling to himself. In short order, he verbalized a flowchart, identifying the variables until he came up with the one he wanted. He then made some changes, re-ran the program, mumbled a little again as he concentrated, did another verbal flowchart, found another variable, and, bingo!, solved the problem.

What computer does he want? Being a musician, he'd like a system connected to his computer that will score what he plays on piano and display it on a video screen . . . with printout capabilities, of course. He's intrigued by the possible roles that might be played by microcomputer-controlled robots in the future, expecting them one day to take over a variety of menial tasks. Right now, though, he plans to give some attention to analog-to-digital and digital-to-analog converters with appropriate sensors to, say, sense when his lawn needs sprinkling. He's also interested in utilizing his computers as controllers, and was pressing for more information on using house power lines to carry data to and from his computers. "I saw an ad in a J & S catalog . . . "

In sum, Peter Nero, a leading music personality,can capsulize his views about computers and computing by referring to the number he played on an NBC Emmy-Award-Winning tribute to George and Ira Gershwin: "S'Wonderful, S'Marvelous." ◊

First Look at Timex/Sinclair's New Color Computer

The T/S 2068 is an "under-$200" basic computer offering many features missing on the 1000

By Fred Blechman

THE new Timex Sinclair 2068 Personal Color Computer is much different than the computer originally announced at a trade show in January 1983 as the "Timex Sinclair 2000." The computer has gone through a great metamorphosis. Those of you having Timex 1000s will find that the things you complained about—membrane keyboard, memory wobble, slow and unreliable cassette loading, limited BASIC language, no color, no sound, limited graphics, etc.—have been corrected in the T/S 2068. With 48K of on-board RAM, the machine has evolved into a sophisticated "under-$200" basic computer offering many special features.

Background. In April 1982, Timex made an agreement with Sinclair Research Ltd. in England to utilize Sinclair computer technology for computers to be made under the "Timex Sinclair" label and distributed in North America. The Timex 1000 was an almost direct copy of Sinclair's ZX81 and, according to the *Wall Street Journal,* Timex sold 550,000 T/S 1000s in five months!

When Sinclair came out with its low-priced color computer, the Spectrum, in mid-1982, it was assumed Timex would bring it into North America very quickly. Indeed, the original Timex Sinclair 2000 shown to dealers and press in January appeared to be a Spectrum in a slightly restyled case—same size, same keyboard, same specifications.

But the introduction of the T/S 2000 was delayed and rumors abounded. Finally, at a June 1983 industry show, Timex unveiled the Timex Sinclair 2068, which bore no physical resemblance to the Spectrum at all! By the time you read this, the T/S 2068 should be available through larger retailers and mail order houses with a suggested retail price of $199.95. However, it has already been scheduled for advertising in one major mail-order catalog for $148.32. Although in June, a T/S 2048 was also announced (with 16K RAM instead of 48K, and for $50 less), it appears that only the T/S 2068 will be available at this time.

This report is based on a pre-production T/S 2068 operating with a production Timex Sinclair 2040 Personal Printer and an inexpensive cassette tape recorder. A standard black-and-white 12″ TV receiver and a 5″ color TV/video monitor were used as displays.

General Description. The T/S 2068 is contained in a light gray plastic case whose upper surface is painted with a dull aluminum finish. The full-size keyboard uses light gray keys with easily read black printing on the keys, and clear black "keywords" above and below most keys. It's a smart-looking package. It's also relatively large: almost 15″ wide, 7½″ deep, and almost 2″ high. It weighs about four pounds.

In a drastic departure from the Spectrum physical design, Timex upgraded the Spectrum's rubbery, closely spaced "chiclet" keys with "hard" typewriter-like keys—the same as used on the Brother EP-20 Personal Electronic Typewriter. The keyboard is standard typewriter size and the full-travel keys have the standard QWERTY layout. An indication of the care given to detail is that the F and J keys have raised finger-tip sensitive dots, since these are the "home" keys for touch typists. Several of the keys in the top row are used to specify display colors, and these have colored legends above them in the color they control, which is a very handy feature.

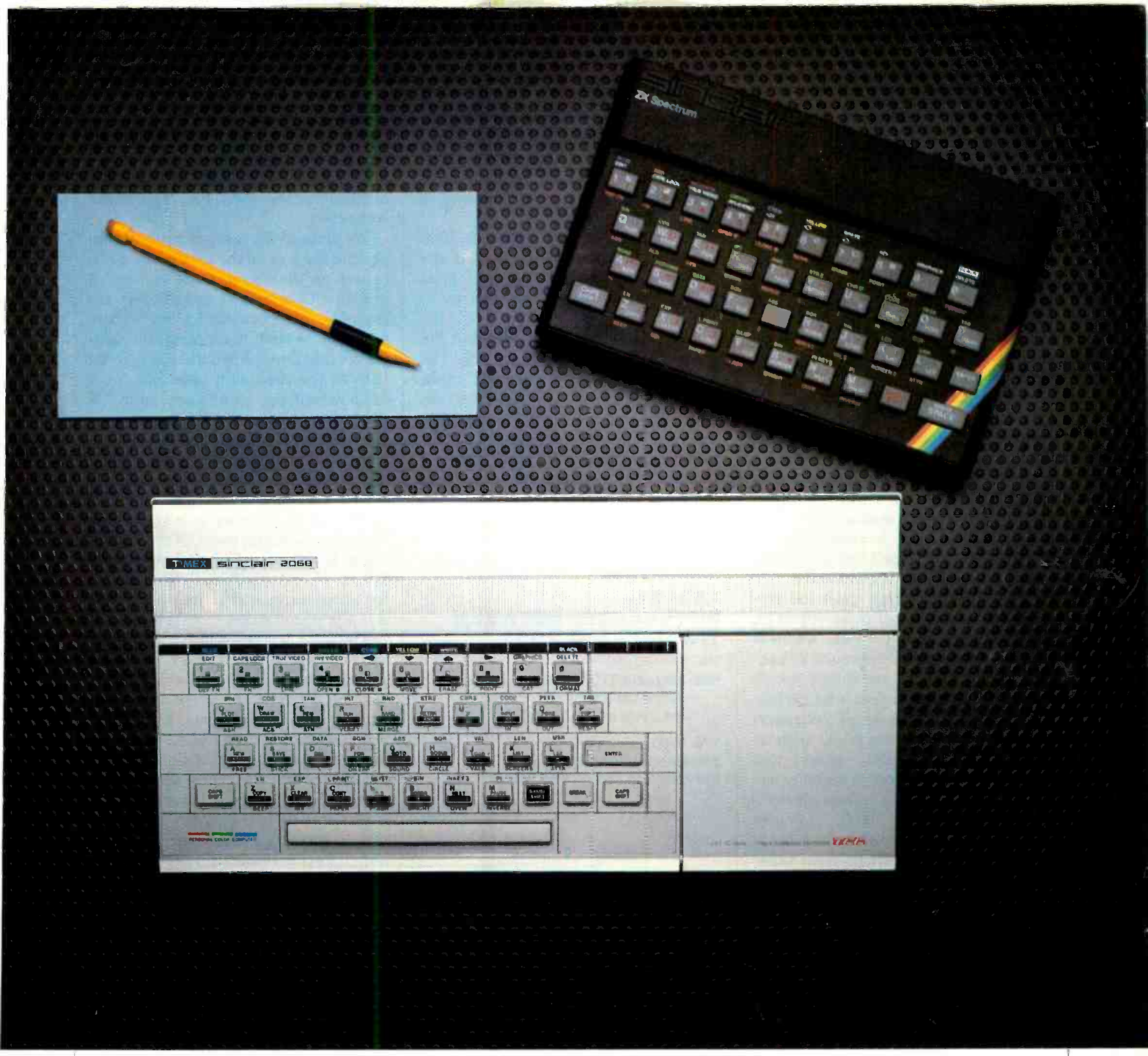
There are 42 keys that include 36 alphanumeric and symbol keys, a SPACE bar and a CAPS SHIFT key on each end of the keyboard, with automatic repeat. Most of the keys do multiple duty, since single-keyword entry is provided for over 150 BASIC commands and statements. Most keys perform five different functions, while seven keys have six functions. Functions are identified by one of six different letters that appear within the block cursor.

Eight of the keys directly provide 16 graphic blocks; and 21 high-resolution, 64-pixel, user-defined characters can be programmed for individual keys. Many special symbols are available, such as a copyright symbol, an "at" sign, an English "pound" sign, and much to the joy of T/S 1000/1500 owners, an exclamation point!

On the left side of the computer there's an on-off switch and an Atari-standard 9-pin joystick connector. There's another identical joystick port on the right side. On the back, a snap-off cover reveals a 64-finger gold-plated card edge—the main computer bus. Five jacks are clearly marked along the back side of the T/S 2068: MONITOR (yes, direct video for a monitor), EAR, MIC, POWER, and TV. Underneath there is a small switch to select Channel 2 or 3 when using a TV receiver for the display.

The T/S 2068 uses the 8-bit Z80A microprocessor that can directly address 64K bytes of memory. However, utilizing a special Timex-designed system and a "function dispatcher," up to 256 "banks" of 64K memory can be utilized in 8K "chunks," for a total of over 16 megabytes (but no more than 64K at any one time.) The 24K ROM (16K plus a bank-switched 8K) includes a powerful expanded BASIC interpreter and operating system, and 48K of RAM is built-in and accessible for user programs.

Timex, and probably others, will offer "Command Cartridges," 2½″ square plastic cases that plug into an interface built into the upper right surface and are accessible via a lift-up door on



People who have 1000s will find many things they complained about have been corrected in the T/S 2068.

the T/S 2068. The cartridges contain pre-programmed ROM, with their own operating system included; the T/S 2068 ROM can be switched out to allow more cartridge capacity. As of this writing, some 25 titles covering games, utilities, and business/home software are available.

Cartridges only need to be inserted into the computer and don't require loading (which is necessary when using cassette tapes). They operate in the same manner as cartridges for video game machines, like the Atari VCS, ColecoVision, Intellivision, and others.

The display can be programmed to show various "attributes" (characteristics) for each character space in most display "modes." Eight colors are available for PAPER (background), INK (printing) and BORDER (outside the regular display area). Also, there are two BRIGHTness levels for each color, and FLASHing is available for each character space. INVERSE VIDEO provides for a switching of PAPER and INK colors in any character space. All this provides the capability for a variety of special effects.

Not only that, the T/S 2068 has *four* display modes. (The Spectrum has only one!) The Normal Display Mode 1 provides 22 rows of 32 characters on a line available to the user, plus two more lines the computer uses for line entry, editing and status reports. This same mode offers 16 character-space graphic blocks (four sections to each block) or 256 "pixels" (picture elements or "dots") on a line, with 176 lines of pixels from top to bottom.

Display Mode 2 is the 64-Column Mode, with 22 rows of 64 characters on a line, and a pixel resolution of 512 by 176. The 64 characters on each line, however, reside on two memory "pages" of 32 characters each, and appear on the screen in alternate spaces. Therefore, it takes special programming (probably machine language) to show 64-character text on the screen. Such software is in the design phase at the moment.

Display Mode 3 is a second "normal" screen, like Mode 1. By switching rapidly between Modes 1 and 3 you can produce animation.

The fourth, Display Mode 4, is called "ultra-high color resolution." It has the same character and pixel resolution as Mode 1 (32 character lines, 256 pixels on a line), but with an important difference. Each character space contains eight rows of eight pixels each. In this mode each *row* of pixels in each character space can be assigned various color parameters (INK, PAPER, BRIGHTness and FLASHing). This allows great flexibility in color mixing and other visual effects—but definitely requires sophisticated programming.

The language used in the T/S 2068 is Sinclair Expanded BASIC, sometimes referred to as Spectrum BASIC, with a number of additional commands not found on the Spectrum. To give you an idea of the power of the 2068, it has more than 50 commands and statements that are not available on the Timex 1000/1500 (see Table I). For example, FREE displays the amount of free RAM space left; STICK calls the joysticks; SOUND can call three voices on the built-in speaker; ON ERR, which is similar to Applesofts' approach to handling internal errors; and RESET, which is used to initialize a particular peripheral. It even has a number of commands for devices not yet available, such as FORMAT, OPEN, CLOSE, MOVE, and ERASE, which will work with an external disk and disk-like storage devices. For the former T/S 1000/1500 user who has been frustrated by not being able to translate programs from other computers, these new commands (such as READ, DATA, RESTORE, and others) should make the task feasible.

The T/S 2068 has four "voices" produced through a built-in speaker, with three of the voices programmable in eight octaves. On those three voice channels, the SOUND command allows specifying tone, duration, amplitude, and various envelope parameters. The single-channel BEEP command allows specifying any of 130 semitones and a duration. The Spectrum, incidentally, has only the BEEP command directed to a very small sounding device.

Eight-position industry-standard (Atari compatible) joysticks are used with the STICK command. In addition to game control, creative programmers will likely use these joysticks for graphic art generation, as well as cursor control in word-processing, data-base, and spreadsheet programs.

User Comments. The T/S 2068 comes with all the necessary accessories to get it up and running, except the display. The very detailed over-300 page User Manual—in color, with many, many screen displays—really holds your hand through the early stages of getting the system together and learning how to use the confusing keyboard. The User Manual is basically a reference and getting-started book. It describes the use of most commands, but is not intended to teach programming.

We plugged the Timex Sinclair 2040 Personal Printer onto the bus at the back of the 2068, and then plugged in its 24-V ac power supply. (Be sure *not* to plug the printer power supply into the computer, since the computer and the printer have exactly the same jack. The printer power supply is ac and might damage the computer, which is designed for a dc input.) We used both a black and white TV receiver and a color monitor for displays. If you're using a TV receiver, connect the (supplied) computer/TV isolation switch to the TV antenna terminals and then plug the (supplied) video cable between the switch and the TV output jack on the rear apron of the computer. If you're using an NTSC or black-and-white monitor, plug the video cable between the monitor and the MONITOR output of the computer.

We plugged the computer power supply into the jack on the back of the 2068, turned on the monitor, set the switch box to "Computer," and flicked the computer power switch to "on." There is no "on" switch marking on the sample we examined. Also, there is no pilot light on the 2068, so if your monitor is not powered, you won't know your T/S 2068 is on. A large black block appears momentarily on screen, followed by a screen clear and two copyright notices: Timex and Sinclair. So far, so good.

The keyboard has a soft touch. If you're not dead-center on a key, it still registers. This is far more forgiving than some keyboards. The 6"-long SPACE key, however, was "dead" at each end for about an inch (but remember, this was a pre-production model).

The 2068 worked without any flaws in black and white, though the color produced by the pre-production model was "off." That is, the colors were not as marked on the keyboard. (We've been told that this has been corrected on production units.) On a black-and-white TV or monitor, each color appears as a different shade of gray. We tried all the keys and most of the BASIC functions, except for those used with presently nonexistent peripherals. No surprises.

We used an inexpensive cassette tape recorder to SAVE and LOAD programs. Timex even supplies a cable with dual plugs on both ends for the EAR and MIC jacks on the computer and recorder. A costly cassette recorder is not needed, therefore, and may not even work as well as a "cheapie."

Cassette operation (1500 baud, or about 150 characters per second) was very reliable with a broad range of loading volume. We loaded a 3373-byte BASIC program in about 24 seconds, including about 4 seconds for the program "leader." Programs are assigned filenames when saved, and the program name appears on the screen as the program loads. Striped moving bars on the screen confirm loading and saving.

The printer COPY command duplicated every ink dot on the screen—32 characters or 256 pixels on a line—including high-resolution graphics. Listings also appeared the same as on the screen. On those screen displays with color, the printer only showed the ink color dots, and totally ignored paper color dots.

The printer output was sharp, fast and quiet, and photocopied very well. The printer uses 4¼" wide thermal paper, and you can make only one copy at

TABLE I—DIFFERENCES BETWEEN T/S 1000 AND 2068

New keys on T/S 2068:

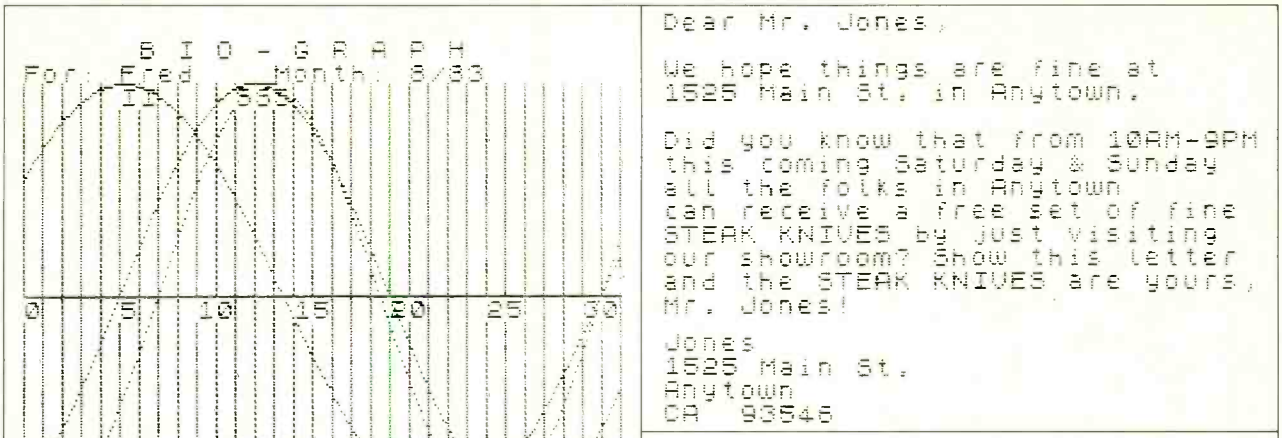
Second CAPS SHIFT key
New SPACE bar

T/S 1000/1500 commands/statements/functions and punctuation not on T/S 2068:

" " (double quotes)
UNPLOT
SCROLL
** (↑ on 2068)
"S" cursor ("?" cursor on 2068)
"F" cursor ("E" cursor on 2068)
Function key

T/S 2068 commands/statements/functions and punctuation not on T/S 1000/1500:

CAPS LOCK	BORDER
TRUE VIDEO	FLASH
INV. VIDEO	BRIGHT
DEF FN	OVER
FN	INVERSE
LINE	CAPS SHIFT
OPEN #	READ
CLOSE #	DATA
MOVE	RESTORE
ERASE	BIN
POINT	DRAW
CAT	[(left bracket)
FORMAT	] (right bracket)
VERIFY	{ (Left brace)
MERGE	} (Right brace)
IN	© (Copyright sign)
OUT	\ (Backslash)
RESET	@ (at sign)
FREE	↑ (** on 1000/1500)
STICK	#
ON ERR	!
SOUND	%
CIRCLE	&
SCREEN$	' (apostrophe)
ATTR	_ (underline)
BEEP	"E" cursor
INK	"C" cursor
PAPER	"?" cursor



Samples from the author's upcoming book, "Timex 2000 Beginner/Intermediate Guide," published by Howard W. Sams, Book #22225

Samples of Timex Sinclair 2040 Printer output.

a time. However, for word processing or any serious use, or to reproduce the 64-character display mode, you'll want to connect a standard 80-column printer and print on regular paper, with multicopy capability. Timex, at this writing, only offers the 2040 Printer, but is said to be working on an 80-column printer. Other companies have designed printer interfaces for use with the Timex 1000 and 1500, allowing the use of Centronics parallel printers. It can be expected that this will also be done for the T/S 2068.

We tried the BEEP and SOUND commands produced through the small built-in speaker, and were even able to play simple tunes. The SOUND command is quite complicated, since it can produce three voices with several parameters. The BEEP command, however, is simple to use. In both cases, we found that by connecting an amplifier to the computer output marked MIC (which normally goes to the cassette MIC input) we were able to get plenty of sound or beep. While the BEEP command has no volume control; the command for SOUND does.

We did not test the joystick or cartridge capabilities, or the other three display modes, and we did not try the RGB monitor output available on the 64-pin bus.

Out of curiosity, we checked the power consumption of the computer, since the power supply was marked 17.5 V dc at 1 ampere, and this would amount to 17.5 watts—higher than we would expect. In actual use, however, the power supply was delivering only 215 milliamperes at 21 V dc, or less than five watts. Unlike the Spectrum, both the power supply and the computer hardly warmed up! Timex has really tamed the heat problem that plagued the Spectrum.

Conclusions. Except for the "dead-ended" SPACE key and the off-colors (both of which can be attributed to the fact this was a pre-production model), I was very impressed with the performance of the new 2068, as well as the potential of those things we *didn't* test at this time (the 64-character mode, animated and ultra-high resolution displays, the cartridge and joysticks, the complex sounds, and the ability to memory-bank select over 16 megabytes). As software wizards produce programs to access these features, we'll start using them. About the only things we'd like to see added are a power-on indicator, a remote control for the recorder, and distinctively different power-input jacks for the computer and the printer.

Although most BASIC programs written in England for the Spectrum will LOAD and RUN in the T/S 2068, most machine-language programs will not. However, at least one U.S. company, SoftSync (14 E. 34th St., NY, NY 10016), is converting Spectrum programs for the T/S 2068. It also appears that Timex will be offering about 25 programs for the T/S 2068 when it is expected to hit the marketplace around the end of October.

As for the future of the T/S 2068, Timex has already announced plans to produce a telephone "modem" for the computers. With appropriate programming, this will enable communication, information exchange, and even the capability to "upload" or "download" programs. You'll be able to connect to "bulletin boards" and large networks and data bases like CompuServe and The Source, leaving messages (electronic mail) or carrying on real-time exchanges in a conference, or on a CB simulation.

We can also expect some programming and hardware geniuses to produce "light pens" (to draw directly on, or to select items from the screen), "bit pads" (the same thing on a flat surface in front of you), "mice" (cursor positioning devices), and other not-yet-thought-about devices for the T/S 2068. Certainly, the software at first will be games, games, and more games, followed by word-processing and personal software.

The T/S-2068 is a solid learning/home computer. Its cost is not prohibitive for these purposes, assuming one is going to use an already-owned cassette recorder and TV receiver. Of course, a horde of software and hardware additions will take time to develop in the marketplace, a shortcoming that most newly introduced computers share. This Timex machine has a head start in this respect, however, since there are so many Spectrum machine-language programs in the U.K. that can be easily converted to operate on the T/S-2068, as well as more hardware.

Since the T/S does not use a typical memory map scheme, using ultra-high resolution color graphics and the 64-character mode cannot easily be taken advantage of without using advanced programming techniques. This was not addressed in the machine's manual.

Moving out of the very-low-priced T/S-1000 class into the modest category throws the new T/S-2068 into an area where there are a handful of tough, entrenched competitors. However, its nice attributes make it deserving of buying consideration in its class. ◇

Circle No. 92 on Free Information Card

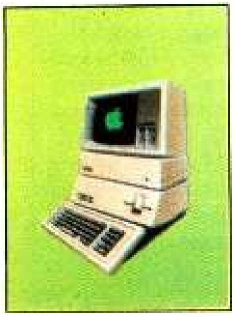
A NEW BREAKTHROUGH

SAVE UP TO 50% WITH OUR CHARTER SUBSCRIPTION OFFER!

Introducing A+, the Most Significant Advance in Apple History!

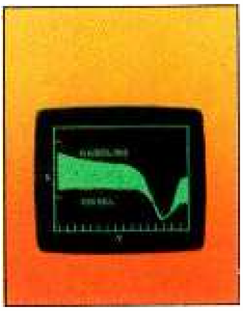
It's here! Big, bold and bursting with page after page of the latest in hardware, software, programming—and more! **A+** is the monthly magazine written exclusively for your Apple microcomputer. Each issue gets you involved with a host of fascinating features, probing updates, unique departments—and reaches to the depths of your imagination to challenge you with daring new strategies and adventures!

Here's just a sampling of what A+ is all about:



HARDWARE: From the latest advances in telecommunications and networking...to new ways to augment memory and access a wider variety of peripherals with greater ease...each issue of **A+** gets you involved.

SOFTWARE: What's new on the market and how you can make your system more powerful...plus full reviews and programming information.



UTILITIES AND DIAGNOSTICS: In addition to language utilities, **A+** helps you troubleshoot problems... makes you faster and more efficient...with utilities ranging from record processing to data transfer.

BUSINESS AND FINANCE AIDS: Software for financial forecasting and analysis...general accounting programs...financial news retrieval services...and business graphics so you can see just where your money is going.

GAMES: Take the **A+** challenge—with hoards of innovative brain teasers...from games to help you learn spelling and arithmetic...to games that provide fun and adventure!

Matchmaker!
Matchmaker!

Interfacing with Parallel and Serial Ports

By Alex Marx

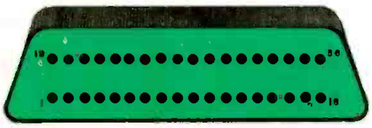
COMPUTER interfacing can be very confusing and frustrating. Although the two "standard" interfaces, "Centronics" *parallel* and "RS-232" *serial*, are supposed to allow simple plug-in connections, in reality this is often not the case. Frequently, a manufacturer adds features that don't fit the definitions of a given standard. The interfaces are really "conventions" that have come to be frequently used rather than "standards," which means that you can do almost anything you want and still call it "compatible."

In an effort to eliminate some confusion, several manufacturers have designed their equipment with the flexibility to deal with the plethora of "standards." Others have taken a different approach and provided a *real* standard interface, along with the peripherals to work with it. I am thinking particularly of Commodore, which has provided an IEEE-488 (Hewlett-Packard GPIB) interface since the introduction of its first computer back in the 1970s. This interface is rigidly defined right down to the type of wire to be used.

Unfortunately, it is a costly standard. The connectors and cables are expensive (up to $70 for a six-foot cable) and very few other computer or peripheral manufacturers have adopted the system. The IEEE-488 interface was designed primarily to connect test and lab equipment to dedicated controllers, and it is in this sphere that it has been most successful. Since there have been few personal-computer peripherals to adopt this system, several companies have sprung up to adapt the IEEE-488 to the more prevalent Centronics and RS-232 interfaces.

PIN 1	$\overline{\text{STROBE}}$	19	$\overline{\text{STROBE}}$ (RETURN)
2	DATA 1	20	DATA 1 (RETURN)
3	DATA 2	21	DATA 2 (RETURN)
4	DATA 3	22	DATA 3 (RETURN)
5	DATA 4	23	DATA 4 (RETURN)
6	DATA 5	24	DATA 5 (RETURN)
7	DATA 6	25	DATA 6 (RETURN)
8	DATA 7	26	DATA 7 (RETURN)
9	DATA 8	27	DATA 8 (RETURN)
10	$\overline{\text{ACK}}$	28	$\overline{\text{ACK}}$ (RETURN)
11	BUSY	29	BUSY (RETURN)
12	PE	30	$\overline{\text{INIT}}$ (RETURN)
13	SLCT	31	$\overline{\text{INIT}}$
14	±0V	32	FAULT
15	OSCXT*	33	NC
16	±0V	34	LINE COUNT PULSE*
17	CHASSIS GND	35	RETURN
18	+5V	36	NC

*GENERALLY NOT USED TODAY

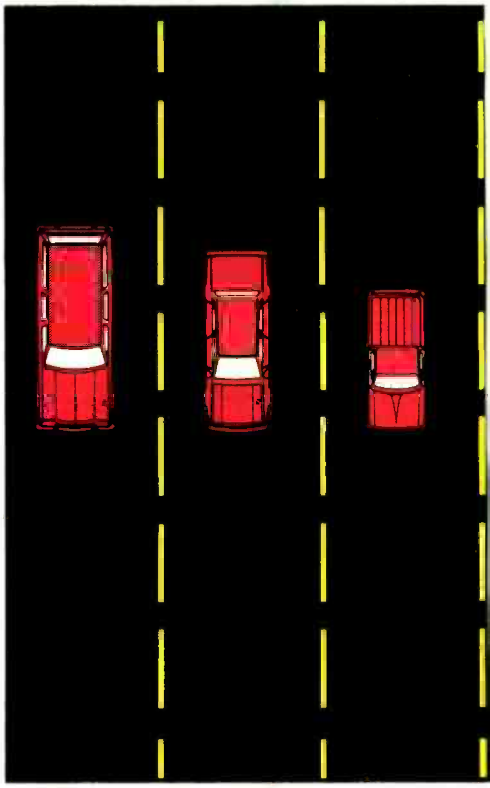


PRINTER CONNECTORS: AMPHENOL (DDK) 57-40360
CABLE CONNECTORS: AMPHENOL (DDK) 57-30360

Fig. 1. Pinout of a Centronics parallel connector.

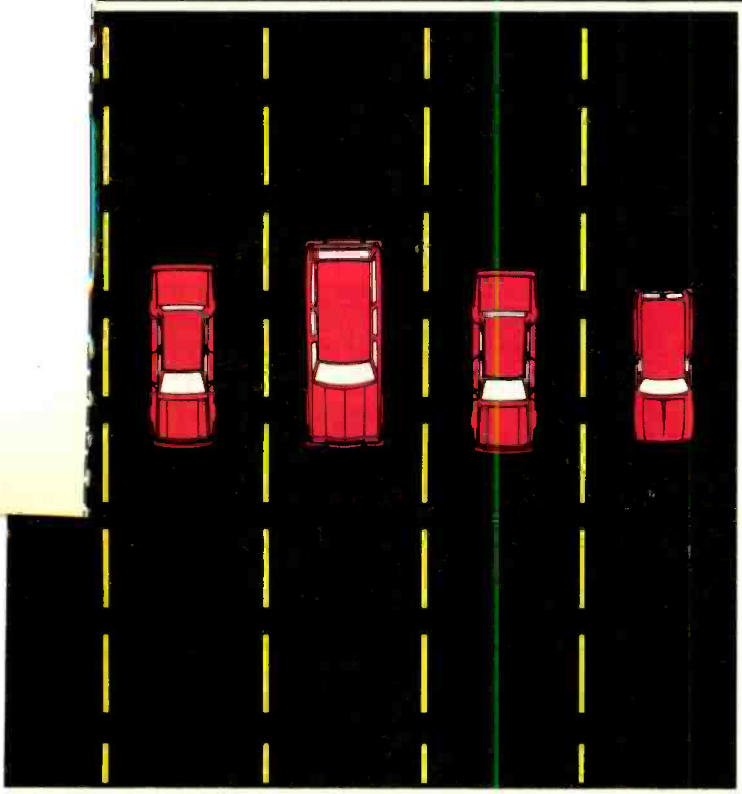
The Parallel Interface. The parallel printer interface is often called a Centronics interface, after the company that developed it for its line of printers. The specifications for this interface call for eight unidirectional data lines (or wires), three handshake lines, several control and miscellaneous signal lines, and signal-return and ground lines.

The "standard" Centronics connector is a 36-pin D connector such as the Amphenol (DDK) 57-30360. The mating female connector on the printer is an Amphenol (DDK) 57-40360 type. These connectors are produced by many manufacturers and are available for ribbon cable as well as for multi-conductor cable.



The parallel-communications concept can be described in terms of a short eight-lane highway, supporting only one-way travel. At the start is a roadblock to control access and at the far end is a toll booth. To avoid congestion on the highway, only eight vehicles are allowed to cross at a time. All the vehicles must travel abreast of one another, or in parallel. To control the traffic flow, there are several signals used. At both ends of the highway there are bells: the roadblock end can ring the toll booth's bell and vice versa. At the roadblock end, there is also a red-green traffic signal across all eight lanes. This light is controlled from the toll booth, or sending, end. At each end there is a man in charge of the bells and lights.

To start the whole thing going, the receiving end makes sure it's ready and then turns the traffic light green. Eight vehicles enter the highway and, when they reach the toll booths, the man at the roadblock end pulls his cord to ring the bell at the booths. This causes the toll keepers to look up from their newspapers and collect the tolls. At the same time, the controller at the toll booth turns the roadblock's traffic light red and also rings the bell at that end. This acknowledges the receipt of eight tolls. When the eight vehicles have left the booths, he turns the light green and eight more vehicles roar across to the other side and the cycle repeats. If one



▲ **The parallel concept can be thought of as a short strip of eight-lane highway with eight cars starting at the same time**

▶ **The serial interface is analogous to a single-lane road with each car following another at rigid time intervals**

of the toll clerks runs out of change and has to fetch more, the light is kept red to tell the sending side that the clerks are busy and traffic should be held up.

The idea of lights and bells is called *handshaking*. It is simply a method for one device to tell the other what it is doing. In the foregoing analogy, it showed when the toll booths were ready to receive more vehicles. In a printer, it would be used to tell the computer when it was ready to receive another character to print. The reason handshaking is necessary is that the printer, being a mechanical device, is much slower than the computer. You might reason that you could have the computer send out characters slowly enough for the printer to keep up. But, not only would this be inefficient, you couldn't take into account the fact that a printer takes longer to do a carriage return and line feed than it does to print a character. Also, you could not tell if the printer had run out of paper or if it were even turned on! Handshaking allows the computer to send characters as fast as the printer can accept them, as well as keep track of problems like running out of paper.

In the Centronics interface, the signal represented by the traffic light is called BUSY and is controlled by the printer. The printer uses it to tell the computer when it is busy, as when it is in the middle of printing a character or tied up doing a carriage return. The bell at the roadblock end is called Acknowledge or ACK. It is used to indicate when the printer has accepted the last character sent. The bell at the toll booth is called Strobe or STB. It is sent by the computer to tell the printer that there is a character ready to read on the cable. Without this signal, the printer cannot tell when a new character has been sent.

The true Centronics interface defines several more control signals, many of which are little used today. SELECT is used to tell the computer that the printer is on-line, or able to accept data through the interface (as opposed to accepting data from a panel switch or keyboard). Error conditions are also signaled by quite a few lines. These include Printer Error, or PE. It is used to indicate when the printer has malfunctioned in some way, as in the case of ribbon jam. FAULT or ERROR indicates some type of abnormal condition like a PE or the cover being open. The only reason I can see for all these error lines is to allow for intelligent interface software to tell the user, via the computer's display, the exact error condition. However, in most implementations today the BUSY signal is used to indicate all fault conditions. A fault condition is usually accompanied by the computer's "hanging," while waiting for the BUSY signal to disappear. A complete pin-out of a Centronics connector is shown in Fig. 1.

The voltage levels in the Centronics interface that define the high and low (or 1 and 0, yes and no, or on and off) control levels are the same as those used in the integrated circuits in microcomputers. In engineering jargon these are called *TTL levels*. A *high* is defined as being between 2.5 and 5.0 volts and a *low* is between 0 and 0.7 volts. As an aid to the user, timing charts are usually drawn to show the various signal levels and the timing relationships among them. Such a chart is shown in Fig. 2. The vertical axis shows time, and the horizontal axis voltage.

Note that the STROBE signal is true when it is low. This means that the

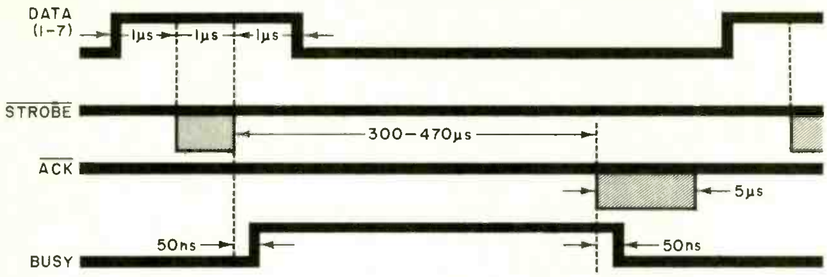


Fig. 2. Timing chart for a Centronics parallel interface.

printer reads data when the STROBE line changes from high to low. On the other hand, the BUSY signal indicates a busy condition when it goes from low to high. This is called *positive true.* The STROBE signal is an example of *negative true.* To indicate a negative true a bar is placed above the signal name, i.e. $\overline{\text{STROBE}}$ and $\overline{\text{ACK}}$.

The Data lines are represented by only one line in Fig. 2, as the timing of the data is more important than what data are sent. The time increments are in millionths of a second. The action is as follows. The computer puts data on the data lines and approximately 1 μs later causes the $\overline{\text{STROBE}}$ line to go low. The printer then makes the BUSY line true. When the printer has processed the character it takes the $\overline{\text{ACK}}$ line low, and a short time later releases the BUSY line. Shortly after that the $\overline{\text{ACK}}$ line is also released. Note how this compares to the toll booth and bell analogy.

Computer people are always looking for ways to simplify things, and it did not take them long to figure out that you do not have to use the $\overline{\text{ACK}}$ signal. Instead, if the computer just watches the BUSY line, it can determine when the printer is ready for another character. If the BUSY line is low, the printer can accept data. In fact, while printing, most computers just sit in a software loop doing nothing but watching the BUSY line. And since BUSY also indicates when the printer is off line, and error conditions, it eliminates hooking up the other signal lines! Most parallel interfaces today only use the $\overline{\text{STROBE}}$ and BUSY lines for handshaking. This is especially true in the Apple computers.

In the S-100 marketplace both methods are used. In fact, my system uses an old Processor Technology 3P+S board that has parallel outputs with generalized handshaking. To make it work requires setting it up to generate $\overline{\text{STROBE}}$ and accept BUSY. That requires not only the 3P+S but support software as well. A friend's S-100 system has a Godbout Interfacer 4 board, which has a Centronics type interface that supports full handshaking including a number of error and signal lines. Because the hardware supports all these functions, the software is simpler.

Do It Yourself. Armed with the information presented, it should be a simple matter for you to connect a parallel-interfaced printer and computer. Every day that task becomes simpler as more and more manufacturers strive for compatibility. However, problems can still arise. The minimum equipment you will need to get everything running is the documentation for both the printer's connections and the computer's connections and an ohmmeter or other sort of continuity testing device.

Most parallel-interfaced devices are limited to having about six feet of cable between them. The limitation is due to several factors, but it can be stretched. I have successfully run cables 15 feet or more. The best bet, though, is to keep the cable six feet or shorter. If you are trying to get a system running with long cables, make sure you get it working with a short cable first and then try the longer length. Many hours can be saved with this method. (Listen to the voice of experience!)

Using the data sheets, verify with the continuity tester that the wires go to the correct pins on both ends of the cable. Also check that none of the adjacent pins (side to side as well as front to back) are shorted together. This is a common problem with the newer clamp-on connectors for ribbon cable.

Unless one end of the interface specifically requires it, do not connect any pin with power on it to any other pin. Many printers have a +5-volt pin; I never connect anything to this pin. One bad connection or an accidental short can wreak havoc.

Printers generally have many pins labeled RETURN or 0 VOLT, and GROUND (GND), FRAME or PROTECTIVE GROUND. Always connect at least one RETURN or 0 VOLT and one GROUND, FRAME or PROTECTIVE GROUND. The RETURNS and 0 VOLTS are the return connections for the low-voltage data and signal wires. You can never connect too many of these together—in fact, the more the better. The GROUND, FRAME or PROTECTIVE GROUND is a connection to the metal chassis of the printer. It is used for safety purposes, both yours and the equipment's, to make sure that both the printer and computer are at the same electrical potential in case of some sort of error or accident at the 110-volt ac power connections. *Do not* use these connections for the low voltage signal returns. A missing ground connection or similar problem can severely damage

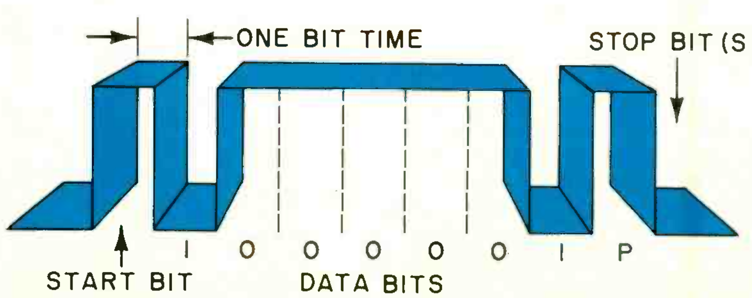


Fig. 3. Diagram of a typical serial data transmission.

your equipment, as well as present a shock hazard.

If all your connections seem proper but nothing works, it's time to check signal polarities. Though most printers today use positive true DATA, negative true $\overline{\text{STROBE}}$, positive true BUSY and negative true $\overline{\text{ACK}}$, don't take it for granted. Some printers and computers have switches or jumper wires to allow the polarities to be changed. Consult the manuals for as much detail as you can find and keep a record of your work. Make sure you cycle the printer off and on between trials since it could be "hung up" from an incorrect setup. Look for clues in the operation of the printer. For example, if the printer prints but starts dropping characters after a while, it is a sure sign that the handshaking is fouled up. Check the BUSY and $\overline{\text{ACK}}$ lines.

With a little patience and some sleuthing you should be able to get results. If all else fails, make sure the printer and computer interfaces are working. Other problems can include timing (does the $\overline{\text{STROBE}}$ signal last long enough?) as well as software bugs. Many computers send seven bits of data rather then eight. Simple printers may only have seven data lines while others may use the eighth bit for special functions like graphics. If the computer's software does not take into account the eighth bit, "interesting" effects can occur. Often just connecting the eighth bit on the printer side to a RETURN or 0 VOLT line may cure the problem.

Although all this sounds complicated, it really is not. I prefer the Centronics interface because it works the first time more than 90% of the time. And compared to the intricacies of the RS-232 serial interface, the parallel is almost child's play. However, if you need longer cable lengths than a parallel interface allows, or if you are working with a modem or similar piece of equipment, then RS-232 is inevitable.

The RS-232 Serial Interface. If I sound a little hostile towards RS-232 it's because it has been so corrupted over the years that a clear understanding of its subtleties is impossible. Although I have worked with it for years and it can be simple and efficient, I still prefer the Centronics interface because it is basically unchanged.

The RS-232 serial communications protocol was originally developed to connect a data terminal to a modem. Because computing was limited to mainframes and therefore expensive, users were generally connected via a terminal and modem to the often remote mainframe. The connection between the modem and the computer was frequently handled via dedicated lines, though telephone lines were a popular choice for all but the shortest distances. The RS-232 protocol was designed to connect Data Terminal Equipment, (DTE), which was a terminal, to Data Communications Equipment (DCE), which was a modem.

A modem converts digital signals into tones that can be sent along relatively inexpensive telephone lines. The price you pay for using the cheap lines is speed. Modems typically can send 30 characters per second (cps) as opposed to over 100,000 cps for a simple parallel interface. However, modems are not limited by distance, with communications possible over many thousands of miles.

Serial interfaces work by sending each bit of the transmitted character one after the other, or serially. The process is analogous to a single-lane road where each car must follow the other. The bits are sent at rigid time intervals. The transmission speed is called the baud rate and is equivalent to bits per second. Standard baud rates include 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600, and 19,200. Modems generally work at 300 baud but some also work at 1200 baud.

A high bit, or 1, is represented by a voltage between −5 and −25 V. A low bit, or 0, is represented by a voltage between +5 and +25 V. This negative true logic only applies to the data line; the handshaking lines which use the same voltage levels are positive true. The higher voltages and slower speeds of the serial interface permit longer cables—up to 50 feet for most appplications.

When no data is being sent, the

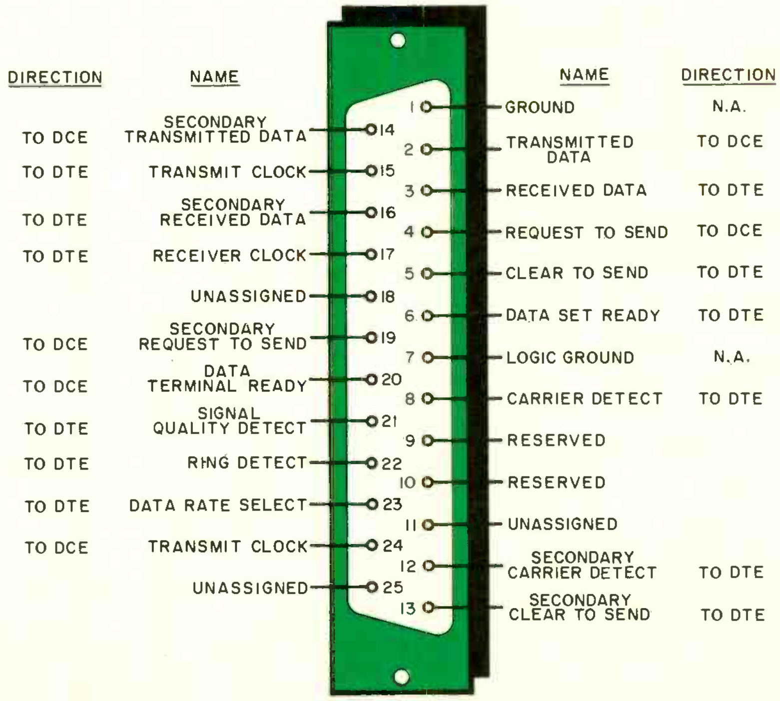


Fig. 4. Pinout of an RS-232 serial connector.

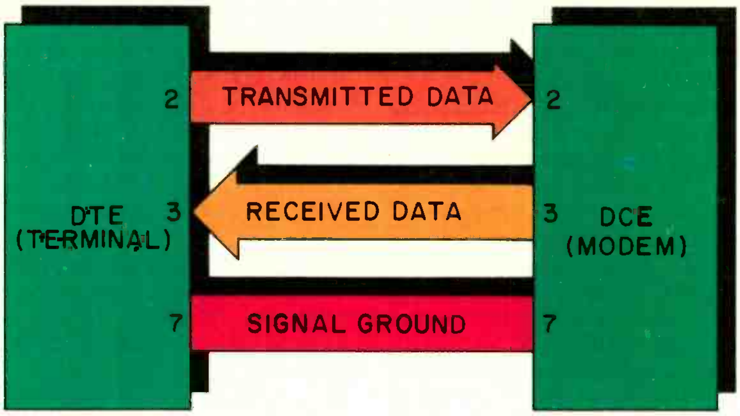


Fig. 5. The basic RS-232 connection uses only three lines.

"If you need longer cable lengths than a parallel

dataline sits at a 1 condition. To announce the start of a character transmission a *start bit* is sent. This brings the data line to 0 and tells the receiving end that there is information following. After all the data bits have been transmitted, a *parity bit* and one or more *stop bits* are sent to mark the end of the character.

Parity is a form of error checking. Noise can affect the transmission of a bit and result in an error at the receiving end. If the transmitter keeps track of the total number of 1s in a character, it can set the parity bit so the total number of 1s is always even (for *even parity)* or odd (for *odd parity)*.

The receiver can also keep track and determine whether the character was received correctly. Stop bits are rest times to allow the receiver to assemble and process the character. A diagram of the serial transmission process is shown in Fig. 3.

The number of characters per second may be found by dividing the baud rate by the number of bits per character. For example a character that consists of seven data bits, one start bit, one parity bit and one stop bit for a total of 10 bits, would be sent at 30 characters per second at 300 baud. However, there are many combinations available. The number of data bits can vary from five to eight. There can be 1, 1½ or 2 stop bits, and the parity bit may or may not be used. All these factors are important in setting up the interface. The transmitting and receiving ends must be set up the same way; otherwise errors will result.

A diagram of an RS-232 connector is shown in Fig. 4. The connector is a standard DB-25, which is available in many styles, including clamp-on for ribbon cable. The DTE and DCE are both equipped with female connectors. All signal designations are from the perspective of the DTE. Pin 2 is called TRANSMIT DATA and is the pin on which the DTE sends the data. The DTE receives data on pin 3. The DCE, however, receives data on pin 2 and transmits data on pin 3.

Two data or telephone lines are used for *full-duplex* communications. Full-duplex communication is like a telephone conversation in which both people can talk and listen at the same time. One use for full-duplex in data communications is *Echo-Plex*. When a character is typed at a terminal, the data travels to a distant computer which then echoes or returns the character to the terminal's screen. In this way, an operator can get an instantaneous confirmation of good data transmission. *Half-duplex* allows for two-way communication over just one data line. The terminal may not send data while the computer at the other end of the line is sending data and the computer must wait for the terminal to finish before it can send. An analogy is CB radio, where only one person can talk at a time.

You will note from Fig. 4 that there are a number of signal and handshaking lines. What all those lines do is beyond the scope of this article. However, the lines of interest to the average computer user are TRANSMITTED DATA, RECEIVED DATA, EARTH GROUND, LOGIC GROUND (RETURN), REQUEST TO SEND (RTS), CLEAR TO SEND (CTS), DATA SET READY (DSR), CARRIER DETECT (CD) and DATA TERMINAL READY (DTR). Although this may seem like a handful, only a few of these lines are used in actual practice.

The simplest RS-232 connection uses only three lines, as illustrated in Fig. 5. This is fine for low-speed applications, or where both devices can keep up with each other.

More sophisticated applications can use this system with software handshaking, perhaps using the XON/XOFF protocol. The two devices watch each other's transmissions for two special control characters: XON which is ASCII 16 (Control-Q) and XOFF which is ASCII 18 (Control-S). When the transmitter gets an XOFF from the receiver, it stops and waits until it receives the XON character to continue. This form of handshaking requires intelligence on both ends to process the XON/XOFF characters. If it is available it should be used because it simplifies the number of connections required and eliminates having to worry about which handshaking lines to use.

The RS-232 interface was never meant for use with printers or computers. Computer interfaces and printers can be configured as DTE or DCE at the discretion of the manufacturer. If your computer's interface is configured as DCE (a common occurence) and you try to hook it up to a modem (also DCE), they won't talk to each other. The solution to this problem is to make a null modem adaptor. This is a short cable with two connectors: one mates with the existing cable and the other plugs into the modem. The two connectors are cross wired so that the proper signals connect: that is, pin 2 to pin 3, pin 3 to pin 2, etc. A diagram of a null modem cable is shown in Fig. 6.

Printers present a special problem because the RS-232 handshaking lines are meant to deal with terminals and modems. The problem gets really serious at speeds higher than 300 baud. Most printers can handle 30 characters per second, which is roughly equivalent to 300 baud, without losing characters. This is especially true of printers with internal buffers that can store the additional characters that would back up when the printer does a carriage return. That might lead you to believe that handshaking wouldn't be necessary at slow baud rates; and it wouldn't if all you were doing were printing. But if you need to stop the printer to readjust the paper, change a ribbon or answer the phone, the computer will still send characters, blissfully unaware that the printer stopped five minutes ago.

With all the handshake lines available in the RS-232 protocol, you would think that there would be a solution to this problem. Unfortunately, there is not a single line set aside for the purpose because this problem does not exist between a terminal and modem. If we examine the signals carefully, we find two that look like they might do the job: pin 4, REQUEST TO SEND (RTS) and pin 5, CLEAR TO SEND (CTS). They certainly sound like they are a perfect handshaking pair. The problem is that they are really only half a handshake.

The DTE asserts (makes true) the REQUEST TO SEND line when it has data to send. The DCE acknowledges this, when it is ready, by asserting the CTS line. When the DTE sees the CTS it starts to send data. However, the DCE may not un-assert the CTS line any time it wishes; it must wait for the RTS line to go false first. Since only the DTE can control the data flow, we are still at square one.

Many printer manufacturers use pins 4 and 5 anyway. Since a printer is not defined in the specification of the protocol, what difference does it make if you don't follow the strict definitions? Other manufacturers try using different pins such as DTR or DSR, or a combination of several signals. There is no guarantee that a particular scheme will work with any interface that expects true RS-232 handshaking. The situation is getting better, however, because many manufacturers are letting their systems work outside the definitions of the protocol.

You can see why I prefer to use the Centronics parallel interface. There are times, of course, when the Centronics solution is not the best way to go, such as when there are distances over six feet involved, or when the equipment in question only is available with a serial interface. For those times here are some handy tips.

interface allows, the RS-232 is inevitable."

Doing It Yourself. Get all the information you can about the equipment. You will need to know how to modify baud rates, parity, and data word and stop bit lengths for both pieces of equipment. Also try to find out what kind of handshaking is required and whether the equipment is configured to be DCE or DTE. A DTE will send data on pin 2 and receive on pin 3, while a DCE sends on pin 3 and receives on pin 2. Be aware that in both cases pin 2 is called TRANSMIT DATA and pin 3 is RECEIVE DATA because all signal definitions are from the perspective of the DTE. Many manuals have arrows denoting data flow; for example, if the arrow points away from pin 2, then the system is DTE.

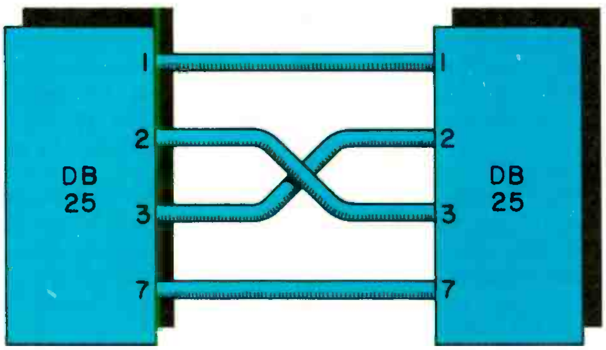


Fig. 6. A null modem cable reverses the leads to pins 2 and 3.

The first step is to connect pin 1 to pin 1 and pin 7 to pin 7 on both connectors. These are FRAME GROUND and SIGNAL GROUND (RETURN), respectively. For safety's sake make sure both are connected. The next set of pins is the data lines, pins 2 and 3. In many cases these connections will have to be crossed, pin 2 to pin 3 and pin 3 to pin 2. If your documentation spells out the connections, then so much the better. This is a good point to stop and try out what you have done so far.

Set both pieces of equipment to a slow baud rate—300 baud is fine. Most default setups call for seven data bits, no parity, one start bit and two stop bits. Connect the equipment and try sending data. If the transmitter seems to be sending but there is no response from the receiver, try reversing the connections to pins 2 and 3 at one end. If the transmitter locks up or if the receiver loses characters, then handshaking is at fault. Here you are going to have to rely on the manuals and experimentation. Some pairs of devices may have several handshaking lines at one end but only one at the other. In this case you can fool the multi-handshake line by having it handshake with itself by connecting complementary signals on the same connector. Two common examples of this are to connect the RTS (pin 4) back to the adjacent CTS (pin 5), and to connect DTR (pin 20) to DSR (pin 6) and sometimes, additionally, to CD (pin 8).

With perseverance and determination you should be successful. Once the interface is working, you can bring it up to full speed. Most printer interfaces will go to 1200 baud, and most terminals to 9600 or 19,200 baud.

Interfacing Aids. Several aids exist to help you get RS-232 interfaces working. The most common is a "breakout box," which is a small board or box with two DB-25 connectors and several switched or wire-jumper interconnect areas in between. The interconnect area allows fast changes to be made between the data lines and among the handshaking lines. Once the right combination has been found, a cable can be prepared with that configuration, or the breakout box can be left in place.

Conclusion. We have only really scratched the surface of the Centronics parallel and RS-232 serial interfaces. The information presented here should be enough to clear up most of the fog surrounding interfacing. Hopefully, you can now approach your next interconnecting task with confidence. ◇

RCA Convertible VCR

The complete VJP900 system consists of a tuner/timer/charger and a lightweight, fully portable removable VCR

WITH the most advanced features of a deluxe table model VCR, this new RCA VCR can also be used as a lightweight, fully portable video recorder. Just pull the VCR portions out of its base unit, snap a carrying strap on, or use the optional carrying case, connect a video camera, and you can go out and record. When you've done your recording—up to one hour on a fully charged battery—return the VCR portion to the tuner/timer/charger base and you have a full-feature, high-performance, video cassette recorder. Up to 133 TV channels (broadcast and cable) can be selected by either direct channel access or in the scanning mode, by feather-touch pushbuttons on the tuner or by the IR wireless remote control unit. Programs can be selected in a variety of ways up to three weeks in advance, daily or weekly, and up to eight different recording sessions can be programmed. Separate displays show time of day, TV, and a recording timer/counter.

The RCA VJP900 includes five recording heads, five separate microprocessors, and such an array of controls, indicators and connectors that our first impression was one of "everything

By Walter Buchsbaum

you've ever wanted in a VCR." Its 43-page operating instruction manual is dwarfed by a ¾"-thick service manual, but after a little study we found the technical details clearly presented and quite understandable. The operating instructions may be confusing for the first-time VCR owner, but anyone familiar with video recording will thrill to all the possibilities this deluxe equipment offers.

General Description. The complete VJP900 system consists of the tuner/timer/charger (VJP900T) and the VCR deck. The combined system weighs 18 lb and measures about 4½"H × 17"W × 11½"D. The VCR deck itself weighs about 8 lb including the battery, and is about 3¼"H × 10"W × 10¼"D. To mount the VCR on the tuner/timer/charger, set it into the two grooves in the base and slide toward the rear until the guide rods engage and the 24-pin and coax connectors mate properly. All dimensions and weights are considerably less than those for RCA's previous VGP170/TGP1500 system but the number of features and detailed performance characteristics have been greatly increased in the new system.

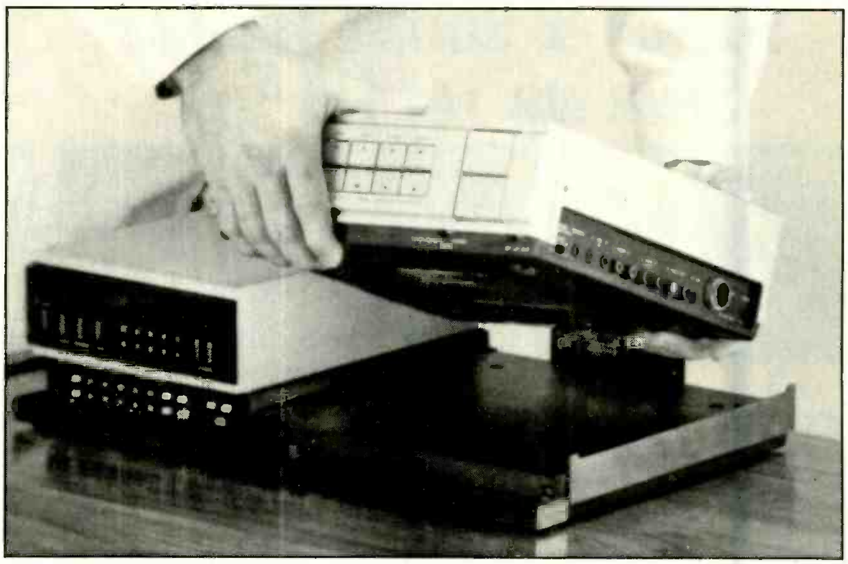
The TV tuner portion is controlled by three microprocessors that handle the programmed timing (3 weeks, 8 programs, daily and weekly), the tuning voltages for the vhf and uhf tuner itself and the decoding and processing of signals from the IR remote control unit. The block diagram shows the five microprocessors and their interconnection. TV channels can be selected by ten direct dialing numbers or up/down scanning. As long as either up or down button is pressed, each channel will appear just long enough to show what is on. It is also possible to program the scanning system so that only desired channels are tuned in. The NORMAL/CATV switch is used to select cable channels and to accommodate different systems of channel frequency positioning. A switch labelled STD/ICC/HRC is set to the system used by the local cable TV company. Of course, cable channels can also be programmed into the memory.

A hinged subpanel extending over the bottom of the base contains the clock/timer controls. There are 19 pushbuttons for setting the clock and

for selecting the different program times for each day of the week, as well as the week and the actual on/off time. Reset, clear, add, erase and brightness controls of the clock/timer display are included in the 19. The display itself is located near the top of the tuner portion and contains the clock/timer display, the channel display, and a set of small LEDs indicating the day of the week, which week, and which of eight programs is being recorded.

The IR remote control unit looks just like those supplied for RCA's latest color TV sets, but most of its functions deal with the VCR operation. All controls on the unit, which is powered by two AA batteries, are feathertouch pushbuttons and include the POWER switch and the up/down CHANNEL scanning controls.

The various VCR controls described here are duplicated on the VCR deck itself, but the remote control signals override them. In addition to the essential controls, such as PLAY, STOP, RECORD, REWIND and FAST FORWARD, the viewer can also control "special effects" from the remote control unit. SEARCH, up/down, permits scanning a recording at five or fifteen times the normal speed (SP and SLP mode). SLOW, pressed first, and followed by the up/down VARIABLE SLOW controls, varies speed from $1/5$ to $1/30$ of normal in the SLP mode and from $1/10$ to $1/30$ in the SP mode. The SLOW TRACKING controls are used together with the STILL/PAUSE and FRAME ADVANCE controls to move possible noise bands to the top or bottom of the picture. When the STILL/PAUSE pushbutton is pressed, the picture is stopped during playback or a momentary pause is inserted during recording. At the same time, the FRAME ADVANCE control can be pressed to display one frame at a time or held down to advance frames at 1/20 of normal speed.



In addition to the controls duplicated on the remote control unit, the VCR deck contains the EJECT, VIDEO DUB and AUDIO DUB switches on the front panel. The dubbing switches permit replacing previously recorded material but cause erasure of that material. Below the front panel are the adjustable tracking control, the audio input selector and the speed switch which selects SP, LP, or SLP. The VCR also has an LCD display which shows relative position of programs on the tape or recording time, depending on the setting of the three pushbuttons (RESET, MEMORY, COUNT) just below the display.

At the side of the VCR deck is the audio noise reduction switch which also selects recording on both or only one sound channel. Another switch selects TV channel 3 or 4 as the r-f output to the TV set. A total of eight RCA phono plugs are used for the various audio and video input and outputs. A 12-volt dc input for automobile or boat power source is accepted by a miniature jack. When the special camera input plug is connected, all other input signals are automatically disconnected.

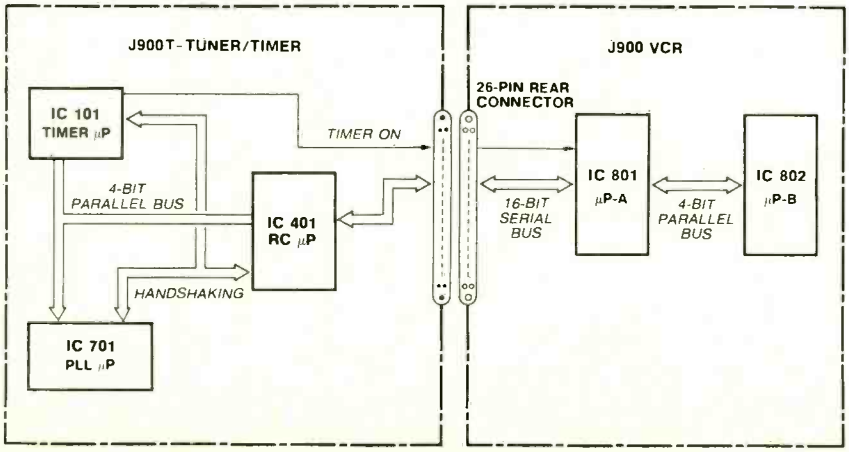
The back of the VCR deck plugs into the 26-pin connector of the tuner/timer/charger base and the coax r-f output connector. When the deck is used as a portable VCR, the coax output can be connected directly to any TV set.

The internal operation of the system is based, as mentioned before, on five microprocessors, three of which are located in the tuner/timer and two in the VCR. Microprocessor A *(IC801)* accepts control signals from the tuner timer, the VCR and the video camera. It processes them and passes them to microprocessor B *(IC802)*. The latter controls the two motors, operates the LCD display and other indicators, and monitors battery condition and potential trouble signals.

The tuner circuits are essentially identical to those used in RCA's latest TV receiver tuner and i-f sections. A SAW filter precedes the i-f amplifier. Two stages of video amplifiers, together with an elaborate filter (including a crystal 4.5-MHz rejection filter), provide an output with a 4.2-MHz bandwidth.

The fifth recording head that RCA has added in this otherwise conventional VHS recording system has the same azimuth as the SLP channel 2 head but is mounted one horizontal line away from the SLP channel 1 head. In the "still" or "slow" mode, this fifth head, together with the SLP channel 2 head, provide a wide FM output. Channels 1 and 2 operate on the same TV field to prevent any fluctuation. During "still" or "slow" mode, the tape mechanism stops so that the channel 2 SLP head and the fifth head play back the same video track. By using two heads, approximately 180° apart but at the same

Block diagram of the microprocessor communications bus.



azimuth, two identical fields per frame are played back.

The audio section of the VCR provides full stereo recording with separate stereo input and output jacks plus a stereo input phone jack. Two audio amplifier ICs and two analog switching ICs are used on a separate pc board which also contains the noise reduction and the audio dubbing circuits. Audio bandwidth is limited, as in all VCRs, to about 8 kHz for the fastest and 5 kHz for the slowest tape speed.

Laboratory Measurements. The tuner test results, as shown in the table, indicate that both the vhf and uhf portions performed extremely well. Their sensitivity and noise figure are essentially the same as those measured on the RCA VGM 2321 color TV receiver/monitor and the Sony component system tuner. The RCA tuner contains separate r-f amplifier stages for vhf, uhf, and the CATV channels and this results in excellent fringe area reception. Using a SAW-filter i-f system, followed by a good video bandpass amplifier, provides 4.2 MHz of video bandwidth. Almost all microprocessor-controlled tuners have the same excellent oscillator stability because they are based on a crystal controlled PLL (phase locked loop).

We checked the operation of the various timing features and the remote control unit and found everything working as indicated in the manufacturer's literature. While there are minor differences, the RCA 3-week, 8-program timing system is essentially the same as that found in most of today's deluxe VCRs.

The technical performance of the VCR itself was very good, but, except for the special effects assisted by the fifth head, not very different from that obtainable from any good VCR. As indicated in the table, the VCR video bandwidth was 2.8 MHz; the resolution, 220 lines; and the signal-to-noise ratio, 45 dB. When we recorded a grey scale and a color bar test signal, we observed no distortion and very good color reproduction. We recorded at all three speeds with no apparent degradation at the slower speeds.

Special effects, still pictures and one-frame-at-a-time especially, clearly show the advantage of the fifth playback head. When we recorded a color bar test signal or an off-the-air TV signal there were practically none of the usual noise bands during slow or still picture playback. When we recorded a signal from a ¾" tape, studio-type VCR we observed a small noise band on "still" pictures. We could move this interference to the top or bottom of the picture with the up/down slow tracking controls.

User Comment. As part of our tests we removed the VCR deck from its base and used it as a portable with a video camera. Again, everything worked very well. Of course, picture quality depends greatly on the camera and its correct use, but our results were excellent. Hanging on a shoulder strap the VCR was easy to operate, light to carry and convenient to connect with the camera. The one complaint was that the various indicator lights on the control pushbuttons and especially the LCD counter/timer display, were often difficult to see in sunlight. Greater familiarity with this VCR will reduce the need to check the status of these indicators, but for the first-time user it was definitely a problem.

After considering all the great features and wonderful performance of this RCA Tuner/Timer/Charger VCR, we thought of the new standards for ¼" video tape recording and couldn't help wondering just how compact and light the ¼" version of this VCR will be in a few years from now. For the present, however, we can see that the combination represented by the RCA VJP900 has a great many assets.

Other manufacturers offer portable VCRs, but, as far as we know, RCA is the first to come out with a system that combines a full-featured, deluxe VCR that can also be used as a portable. This arrangement appears ideal for the person who is seriously interested in a total video system, including a video camera, a portable VCR, a tuner and timer and a high-quality video monitor. If we consider any of the component TV systems, the cost of a tuner/timer plus a VCR is about the same as the RCA tuner/timer/charger and VCR combination. If we add the portability feature of RCA's VCR, $1300 may be a bargain.

The JVC model HR-C3U, reviewed in our January 1983 issue, was priced at $850 and did not include a tuner or timer. It weighed only 5.3 lb (compared to RCA's 8 lb and was a little smaller but it required a special cassette that could record for only 20 minutes. To play the JVC portable cassette back on a standard VCR, a special adapter was necessary.

For the person who is primarily interested in recording TV programs, the RCA tuner's 133-channel capacity seems attractive. High performance tuner/timers such as the Sony, NEC and others are also capable of receiving CATV and for these component TV systems a lower cost VCR, without tuner and timer, may be satisfactory. Again, the portability of the VCR deck is the key factor in such a situation.

Finally, when we fed the tuner video output signal to our studio-type monitor, our group of studio technicians agreed that the TV pictures were just as excellent as those previously admired in each of the top component TV systems. Obviously, this tuner is great.

Circle No. 94 on Free Information Card

RCA VJP900 VIDEO CASSETTE RECORDER LABORATORY MEASUREMENTS

Parameter	Measurement
Tuner/Timer	
Sensitivity, vhf (Ch. 3):	58 dBm
Sensitivity, uhf (Ch. 20):	56 dBm
Noise figure, vhf (Ch. 3)	5 dB
Noise figure, uhf (Ch. 20)	8 dB
Video bandwidth to video input (−6 dB):	4.20 MHz
Oscillator stability (Ch. 3):	0.05 MHz
(105 to 130 V ac, 2 hr) (Ch. 20):	0.05 MHz
Osc. Freq. Error (Ch. 3):	0.05 MHz
Agc dynamic range:	68 dB
A-f response	100 to 8000 Hz
Voltage regulation (105 to 130 V ac):	98%
Power:	55 W (incl. VCR & camera)
VCR	
Video bandwidth (−6 dB):	2.8 MHz
Resolution:	230 lines
Video input:	1 V, p-p
Video S/N:	45 dB
Grey scale:	Excellent
Color fidelity:	Excellent
Interference distortion:	None
Power (12 V):	7.3 W

ADS "Atelier" T2 AM/FM Tuner

MODULAR design of audio components has been advanced tremendously by the recent introduction by Analog & Digital Systems Inc. (ADS) of its "Atelier" line of units—actually made by its West German affiliate, Braun Electronics Laboratories.

These distinctively styled components have the same key dimensions and basic enclosure design so that they can be stacked one on top of the other in almost any order. An optional matching pedestal can then be obtained to make an attractive free-standing unit, or the components can be placed more conventionally on a shelf or table.

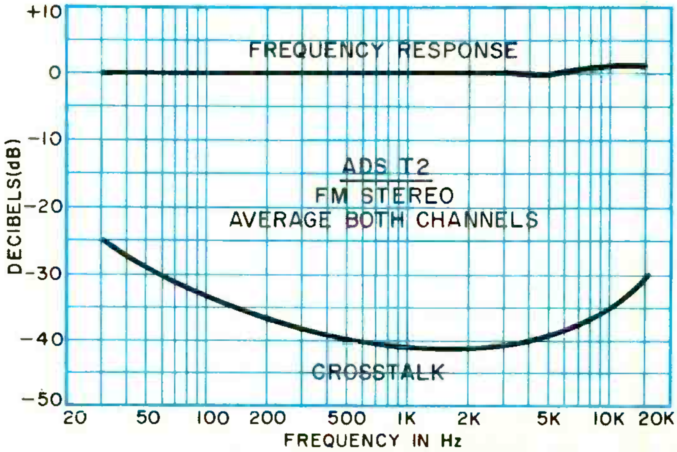
Currently, the ADS Atelier series consists of a receiver, cassette deck, turntable, integrated amplifier, and the new T2 AM/FM tuner, which was tested for this report. The ADS T2, like its companion pieces, is finished in black, with bevelled upper and lower front panel edges. It measures about 17½" W × 14⅞" D × 2¾" H, and weighs 13.2 lb. Most of the controls are out of sight behind a hinged door at the left of the panel.

The tuner's most visible features are a digital frequency display window (with large ½"-high yellow-green numerals) and the tuning knob to its right. Four small buttons below the window select AM or FM reception, and initiate an automatic search scan mode (FM only). Momentarily pressing one of the FM search buttons starts the tuner scanning rapidly in the selected direction. It stops and unmutes when it encounters a signal exceeding the muting threshold. Green LEDs to the left of the window light in sequence to indicate relative signal strength, and another shows the presence of a stereo pilot carrier on an FM signal. Below them is a single green LED that lights only when an FM station is tuned correctly. It is flanked by red arrows that light when the tuner is close to the station frequency to show the correct tuning direction.

The ADS T2 is digitally synthesized, tuning in 100-kHz steps for FM and 10-kHz steps for AM. The large tuning knob rotates freely, with a definite flywheel action, but with a large number of lightly detented positions, each corresponding to one tuning interval. At the extreme left of the panel is a green "system power" switch button. This controls not only the tuner, but 3 of the 4 ac outlets in the rear, allowing the T2 to serve as a system control center as well as a tuner.

On the left is a hinged door behind which are 4 round buttons, 9 small rectangular buttons, and a small knob. Eight of the small buttons are station memory selectors, and the ninth is used when storing a channel frequency in one of the memories. Although there are only 8 buttons, the T2 can store up to 16 preset frequencies, the buttons being switched between the 1-8 and 9-16 banks by one of the round buttons above them. Each can be used for either an FM or an AM channel (but not both). Operating one of the buttons automatically selects the correct band as well as the channel frequency. The memories are kept "alive" so long as the tuner is plugged into an energized outlet. A green LED in the frequency display window lights when the power switch is turned off as a reminder that the memory power is still on. Even with no power connection, the memories are retained for several days. (We verified that they lasted more than a week.)

The other round buttons behind the door switch the tuner to mono, blend the high frequencies for noise reduction on weak stereo signals, and switch the



Frequency response and noise for both channels.

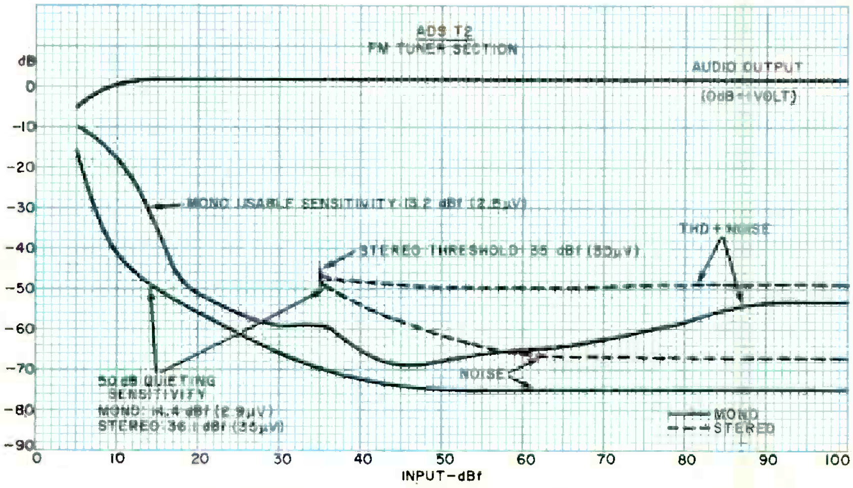
muting on or off. The small knob, marked "fine tuning," gives the T2 a capability unique among the synthesized tuners we have seen. Normally, such a tuner can be set only to discrete frequencies, determined by its internal quartz-crystal reference oscillator. If the reference is accurate, the received stations are on their exact assigned frequencies, and the tuner's i-f and detector circuits are aligned correctly, this system assures exactly correct tuning. If any one of those conditions is not satisfied, one may not be able to realize the low noise and distortion, and interference rejection, of which the tuner may be capable. Usually there is nothing the user can do to compensate for the incorrect condition.

However, the ADS T2 "fine tuning" knob gives it a continous vernier tuning range of at least ±25 kHz on the FM band (center-detented for normal operation). This can be useful when receiving FM signals through a cable distribution system, in which the center frequency accuracy is not necessarily as good as required by the FCC for the FM broadcasters themselves. It may also be advantageous in cases of adjacent-channel interference, where the tuner's i-f selectivity can be used to aid rejection of an unwanted signal without materially degrading the sound of the desired signal.

On the rear apron of the T2 are binding posts for an AM long-wire antenna (there is no built-in ferrite antenna) and a 300-ohm FM antenna feeder, plus a coaxial "F" type connector for a 75-ohm FM antenna system. The T2 contains a balun transformer to match either antenna impedance. The audio outputs are through phono jacks, at a fixed level. There are 4 ac outlets, 3 of them switched. A matching metal strip can be inserted to enclose the rear of the tuner after all cables have been connected, preserving an attractive appearance from any viewpoint. (The other Atelier units have a similar feature.)

The price of the ADS T2 is $399.

Laboratory Measurements. Almost every performance parameter of the ADS T2 that we were able to measure matched or surpassed its ratings, with due allowance for normal measurement uncertainties at FM frequencies. All FM measurements were made through the 300-ohm antenna input. The mono usable sensitivity was 13.2 dBf (2.5 μV), and the stereo sensitivity was set by its switching threshold of 35 dBf (30 μV). The more meaningful 50-dB quieting sensitivity in mono was 14.4 dBf



Audio output, sensitivity, and noise for tuner section.

(2.9 μV) and in stereo it was 36.1 dBf (35 μV).

The mono distortion at 65 dBf (1000 μV) input was only 0.06% (approximately the residual level in our Sound Technology 1000A signal generator). Only our stereo distortion measurement failed to match the tuner's ratings. (We measured 0.32%; the rating is 0.15%.) This measurement is critically dependent on the specific characteristics of the signal generator and alignment of the tuner circuits, so the apparent discrepancy is actually of little significance and would doubtless not exist with another generator (or using our generator with a different tuner).

The tuner noise level was a good −75 dB in mono and −67 dB in stereo. Other FM performance characteristics included a capture ratio of 2.36 dB at 65 dBf, AM rejection of 55 dB at 45 dBf (100 μV), and excellent image rejection of 91 dB. The selectivity of the T2 was also well above average—84 dB for alternate-channel (400-kHz) spacing and 11.4 dB for adjacent-channel (200-kHz) spacing. The muting threshold was 19.2 to 23.3 dBf (5 to 8 μV), and the stereo switching threshold was 31.2 to 34.7 dBf (20 to 30 μV). The range of values represents an intentional switching hysteresis so that signals around the threshold level do not constantly drop in and out or fluctuate between stereo and mono modes. The 19-kHz pilot carrier in the audio was suppressed to a low −70 dB, and the power line hum was also low at −72 dB.

The FM frequency response was flat within ±0.5 dB from 30 to 15,000 Hz. The channel separation was about 41 dB in the midrange (500 to 4000 Hz), reducing to 25 dB at 30 Hz and 30 dB at 15,000 Hz. The AM frequency response rolled off at low and high frequencies, to −6 dB at 130 and 2300 Hz, relative to the 1000-Hz level.

User Comment. The ADS T2 is one of the more intelligently designed hi-fi products we have seen. In normal operation, only the essential controls are visible, and there is actually no need to study the instruction manual (a very good one, by the way) in order to use the tuner effectively. On the other hand, the T2 has just about every useful operating and convenience feature one could ask for in a tuner. In all respects, its "human engineering" is outstanding.

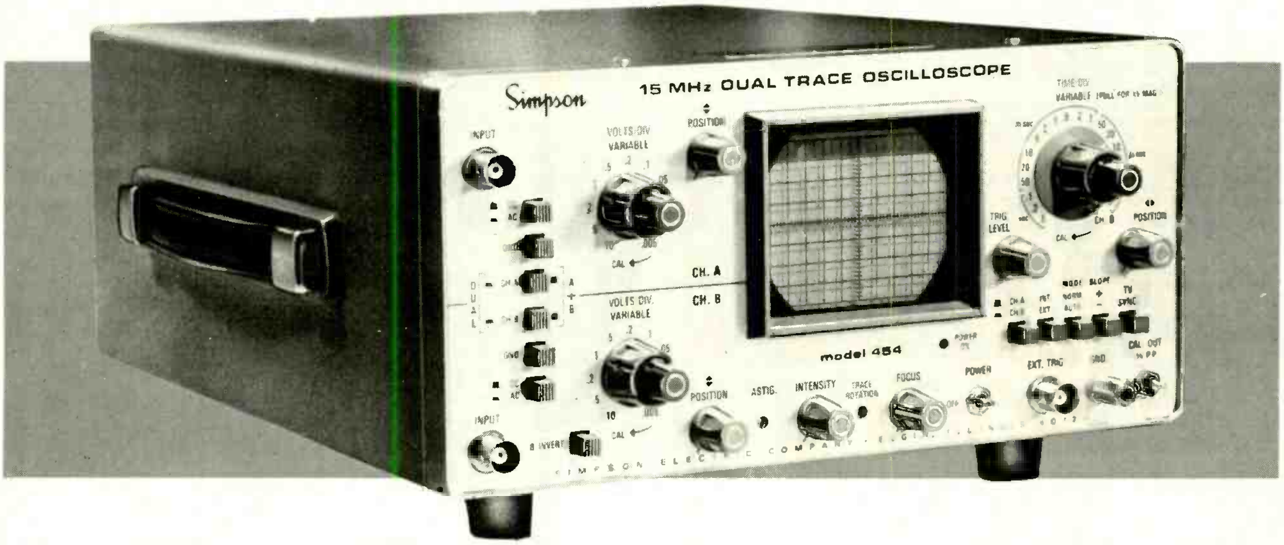
Tuning the T2 is pure pleasure. If (like us) you feel more comfortable turning a knob than pushing a button for tuning a receiver, here is a tuner that combines the "friendliness" of an analog tuner with the precision and foolproof tuning of a digitally synthesized tuner.

Furthermore, the T2 sounds as good as it looks, which is not very surprising in view of its excellent bench performance. Frankly, we did not find a single "bug" or irritating characteristic during our use of this tuner. The usual "bells and whistles" (but few of their useful functions) have been omitted from this handsome tuner and replaced by tasteful styling and ease of operation. Incidentally, the T2 feels heavier than it would appear, and this is partly due to its heavy steel top plate, designed to support the weight of one or more other Atelier components stacked in it. The tuner has a very solid look and "feel" that is much more than an illusion.

—Julian D. Hirsch

Circle No. 93 on Free Information Card

Simpson Model 454 Dual Trace Oscilloscope



The Simpson 454 Dual Trace Oscilloscope is designed for general-purpose observation of one or two waveforms. The 200-kHz chopping mode is intended for low-frequency signals, and the sweep is automatically switched to the alternate mode in the presence of high-frequency waveforms. The scope's basic features are: dual trace, dc-to-15-MHz vertical amplifier response, 5-mV/div. vertical and horizontal sensitivity, and a sweep rate of 100 ns/div. vertical and horizontal sensitivity, and a sweep rate of 100 ns/div. to 0.5 s/div. Thus it is ideal for lab measurements, industrial maintenance, and general electronic troubleshooting.

The instrument measures 4⅝″ H × 9⅞″ W × 13¼″ D and weighs about 13 lb. The suggested retail price is $730.

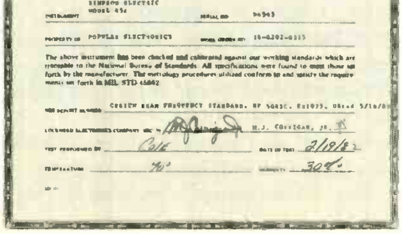
General Description. Simpson's design engineers have used IC technology and a 3″ CRT to create an instrument whose compact size makes it welcome even on a crowded workbench. Four rubber feet (along with a tilt stand) are provided on the bottom for bench use. An additional four rubber feet, located on the side opposite to the built-in carrying handle, enable the 454 to be placed on the ground without soiling the case.

All controls and connectors are logically grouped with the two signal inputs on the left side, the sweep controls and triggering on the right side, and the CRT controls under the CRT bezel. The front panel is brushed silver with color-coded contrasting control knobs. The rear apron carries the line cord supports and the fuse.

Each vertical input has four associated controls: the AC/DC push-button selector; an 11 position VOLTS/DIV selector switch arranged in a 1-2-5 sequence; a VARIABLE vernier; and a POSITION control. Signals arrive via a BNC connector.

Horizontal swept time can be selected by a 19-position TIME/DIV switch with selection between 0.5 seconds/div and 0.5 μs/div. The coaxial sweep VARIABLE control can be pulled out for ×5 magnification. Both TRIG LEVEL and horizontal POSITION controls are provided. Pushbuttons enable selection of trigger sources for CH A, AH B, INT/EXT, NORMAL/AUTO, SLOPE, and TV SYNC. An external trigger BNC connector and a CAL OUT 0.5-V peak-to-peak test signal are also provided.

The INTENSITY and FOCUS controls are positioned below the CRT bezel along with the POWER switch and indicator, and screwdriver-adjust ASTIG and TRACE ROTATION adjustments. The last switch, B INVERT, can be used to flip over the CH B signal.


CERTIFICATE OF CALIBRATION

LOCKHEED ELECTRONICS COMPANY, INC.

The rounded 3″ round, flat-faced CRT is surrounded with a 3″ × 2½″ bezel that carries the graticule plate. Complete specifications are shown in the accompanying Table.

User Comments. The Simpson 454 was tested by the Lockheed Electronics Instrumentation Measurement Laboratories (Plainfield, NJ) against standards traceable to the National Bureau of Standards, and the instrument was found to meet or exceed its claimed specifications.

As usual, we put the 454 to work on our test bench and awaited comments by the users. They all agreed that this was a good-quality scope having excellent readability, even at high CRT writing speeds, and exceptionally stable sync. Taking advantage of its relatively small size, light weight, and convenient carrying handle, the 454 was used on several outside service calls. Its performance was excellent away from the bench.

At first we were concerned that the small CRT display could cause eyestrain from squinting at tiny waveforms. However, the expected "uncomfortableness" never materialized, mostly due to the 454's clean, bright, traces. There is plenty of room around each control knob. Functions are easy to use, and fingers never obscure the CRT. After several weeks of use, no one made any unusual comments about the small CRT—other than to point out that it

MANUFACTURER'S SPECIFICATIONS

VERTICAL AMPLIFIER

(Channels A and B) Bandwidth, at −3 dB.
Deflection Sensitivity: 5 mV/div to 10 V/div in a 1-2-5 sequence, 11 steps. Accuracy is within ±5% of full-screen deflection. Uncalibrated continuous variable control between steps.
Response: Dc to 15 MHz in dc mode, 5 Hz to 15 MHz in ac.
Input Impedance: 1 megohm shunted by 25 pF.
Maximum Input Voltage: 500 V (dc + ac peak) with X10 probe. 250 V with X1 probe to 1 kHz.
Rise Time: 24 ns.
Overshoot: 5% or less.
Display Modes: Channel A only, channel B only, channel A and B automatically chopped at 1 ms/div and slower sweep speeds. Automatically alternated for all faster sweep times. Algebraic sum of channels A and B, channel B invert allows the algebraic difference between A and B to be displayed.
Chopping Frequency: 200 kHz.

HORIZONTAL AMPLIFIER

(Input through channel B) Bandwidth, at −3 dB.
Response: Dc to 1 MHz in dc mode, 5 Hz to 1 MHz in ac.
Input impedance: 1 megohm shunted by 25 pF.
Maximum Input Voltage: 500 V (dc + ac peak) with X10 probe. 250 V with X1 probe.
Deflection Sensitivity: 5 mV/div to 10 V/div calibrated in 1-2-5 sequency, 11 steps, accuracy within ±5% full screen deflection, uncalibrated continuous variable control between steps.
Calibration Voltage: 0.5 V peak-to-peak ±1%, 1 kHz square wave

HORIZONTAL SWEEP RANGES

Time/div: 0.5 μs/div to 0.5 s/div ±5%, calibrated in 1-2-5 sequence, 19 steps, uncalibrated continuous variable control between steps.
Magnifier: X5 (Expands fastest sweep to 0.1 μs/div.)

TRIGGERING

Source: External, channel A or channel B.
Mode: normal and automatic.
Coupling: Ac.
Slope: Positive or negative.
Trigger Sources and Sensitivity:
Normal and Auto:
Internal: 1 div from 5 Hz to 15 MHz.
0.5 div from 10 Hz to 10 MHz.
External: 0.5 V peak-to-peak from 5 Hz to 15 MHz.
Auto: 1 div peak-to-peak of deflection from 50 Hz to 15 MHz.
TV Sync: 0.5 div.
Max. External Input: 100 V peak-to-peak (ac + dc)
Ext. Trigger Input impedance: 100,000 ohms in parallel with 35 pF.

produces a very clean display.

As an aid to TV servicemen, the sweep trigger is equipped with a TV SYNC pushbutton that, when used, provides a rock-steady display of video information. As a result of the low differential phase shift between the horizontal and vertical stages, the 454 also makes an excellent vector slope.

The 454's owner's manual is very complete and covers the entire operation of the scope. It includes a lengthy section on applications and how to use the instrument to best advantage.

The Simpson 454 Dual Trace Oscilliscope is an excellent choice for the modern service bench and deserves careful consideration if you want a good bench scope that also offers portability where there's access to an outlet.

—*Les Solomon*

Circle No. 83 on Free Information Card

CREATIVE COMPUTING

WIN AN ATARI® SWEEPSTAKES

Save up to 33% on *Creative Computing*, too!

The Creative Computing Sweepstakes is open to all our readers. No purchase is necessary—and you'll receive a fantastic Atari home computer system worth over $1600 if you're the lucky winner!

How the Sweepstakes works

Just mail the attached card or the coupon below after filling in your name and address. Be sure to indicate whether you're also subscribing to *Creative Computing* at the special rates shown—you can save as much as 33%.

Then, if you win, you'll get a superb Atari personal computer system: the Atari 800 with 16K RAM and 10K ROM . . . an 810 Disk Drive . . . a 16K RAM Memory Module for extra memory . . . a pair of Joystick Controllers for game interaction. Use the Atari to handle small business and professional applications as well as sophisticated home processing functions—and, of course, for entertainment. Analyze your investments, learn languages, do business accounting, play video games. Programmable in Basic or Assembly, the 800 can use all Atari peripherals and can control up to four disk drives and a 60 lpm printer. In all, the 800 and its accessories form a package worth a full $1620 at retail!

You're sure to win with *Creative Computing!*

Whether you win our Sweepstakes or not, the hours you spend with a computer are certain to be winners when you subscribe to *Creative Computing*. It's the Number One magazine of computer applications and software—filled with in-depth evaluations of computers, peripherals and software, plus applications and software that you can run directly on your computer.

Why not enjoy a year or more of *Creative Computing* at our low introductory prices? You'll save up to 33% if you subscribe at the same time you enter our Sweepstakes!

Atari is a registered trademark of Atari, Inc.

OFFICIAL RULES

No Purchase Necessary

1. On an official entry form or a 3" x 5" piece of paper, hand-print your name, address and zip code. Enter as often as you wish, but mail each entry separately to Creative Computing Sweepstakes, P.O. Box 5215, Boulder, Colorado 80322. Entries must be received no later than December 31, 1983, and the drawing will be held by January 28, 1984. All entries become the property of Creative Computing, which reserves the right to reprint the name and address of the winner.
2. The winner will be selected in a random drawing from among all entries received, under the supervision of the publishers of Creative Computing, whose decision will be final. Only one prize will be awarded in this Sweepstakes. Winner will be notified by mail and may be required to execute affidavit of eligibility and release. Odds of winning will depend on the number of entries received. Creative Computing will arrange delivery of prize. Taxes are the responsibility of the winner. Any manufacturer's claims and warranties will apply, but Creative Computing makes no claims or warranties with regard to any prizes. Prize is not transferable. No substitutions for prizes.
3. Sweepstakes open to all residents of the U.S., its territories and possessions, except employees (and their families) of Creative Computing, its affiliates, and its advertising and promotion agencies. Void wherever prohibited or restriced by law.
4. For the winner's name, send a stamped, self-addressed envelope to Creative Computing Sweepstakes, Circulation Department, One Park Avenue, New York, N.Y. 10016.

OFFICIAL ENTRY FORM

Mail to: **Creative Computing Sweepstakes**
P.O. Box 5215, Boulder, Colorado 80322

☐ **YES!** Enter my name in the Creative Computing Sweepstakes and start my subscription to *Creative Computing* for the term checked:

☐ One year (12 issues) only $19.97—20% off!
☐ Two years only $36.97—26% off!
☐ Three years only $49.97—33% off!

Savings based on full one-year subscription price of $24.97.

CHECK ONE:
☐ Payment enclosed.
☐ Bill me later.

☐ **NO** I don't wish to subscribe now, but tell me if I've won the Creative Computing Sweepstakes.

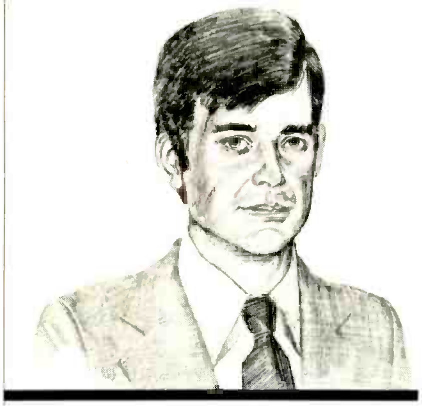
8H591

Mr./Mrs./Ms.______________________________
(please print full name)

Address________________________ Apt.________

City________________ State________ Zip________

Offer valid only in the U.S., its territories and possessions. Please allow 30 to 60 days for delivery of first issue if you subscribe.



Optical Data Communications
An Experimental Infrared Joystick Interface
A New Class of Semiconductors

By Forrest M. Mims, III

IF YOU own a fairly sophisticated personal computer system, i.e. computer, disk drives, printer, modem, joysticks, etc., you're well acquainted with the jumble of wires and cables that it creates. In this month's column, we'll examine one possible solution to this problem: optical data links employing near-infrared-emitting diodes.

While preparing the material on infrared data links, I decided to tackle a particular nuisance called the joystick cable. The result of my efforts is an experimental free-space, near-infrared, joystick-computer link designed specifically for use with Radio Shack's Color Computer.

This month we'll also experiment with a very simple model railroad crossing light. And we'll look at several new devices including some new power MOSFETs and a voltage sensing IC you should know about.

Optical Data Communications

When Atari introduced its wireless, remote-control joystick system, my first reaction was that someone had finally replaced the clumsy joystick cable with an infrared-emitting diode. Subsequently, though, I discovered that the Atari system uses miniature radio transmitters. A stubby antenna protrudes from each joystick assembly, and a longer, telescoping antenna extends from the receiver unit that connects to the computer.

Since I've spent many hours using joysticks and other graphic input devices for genuinely useful applications (no, I'm not a video game freak), I'm delighted that Atari has seen the wisdom of replacing those bothersome joystick cables with a wireless link. But I'm puzzled as to why they and many other companies haven't yet introduced free-space infrared data links for computers and their peripherals.

While many companies make fiber-optic data-transmission links, most electronic equipment manufacturers have been very slow to adopt near-infrared-emitting diodes for transmission of data through free space. This is all the more puzzling when one considers that there are some similarities in both the components and the operation of fiber-optic and free-space near-infrared data links.

Since both infrared-emitting and detecting diodes and a host of modulation and demodulation methods were pioneered in the United States, we certainly cannot plead ignorance of the subject. Perhaps our love affair with radio is the culprit.

In any event, though audio was first transmitted over light in the United States (beginning with Alexander Graham Bell in 1880), infrared-coupled high-fidelity earphones and speakers were first manufactured on a commercial scale in West Germany. Similarly, while we and the Japanese were building radio-controlled toy cars, a German company introduced an infrared-controlled toy vehicle with detection circuitry so sensitive it responds to signals bounced from ceilings, walls, people and plants. Unlike its radio-controlled counterparts, it completely ignores transmission from CB operators and passing taxis. And it is subject to no rules regarding frequency, radiated power, and antenna size.

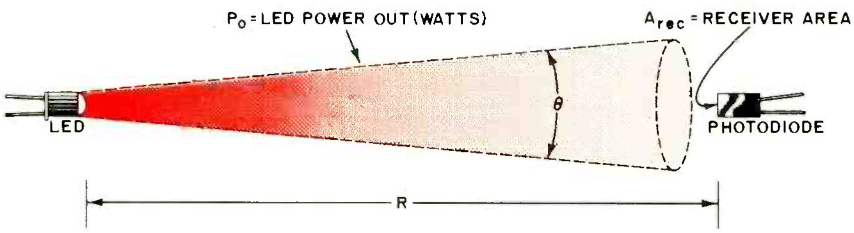
As for computers, several companies have finally begun to recognize the advantages of short-range, free-space, infrared data links between computers and peripherals. In 1979, for instance, Fritz R. Geller and Urs Bapst of IBM's Zurich Research Laboratory in Ruschlikon, Switzerland, published a paper describing in detail the transmission of in-house data by means of reflected beams of near-infrared ("Wireless In-House Data Communication via Diffuse Infrared Radiation," *Proceedings of the IEEE,* Nov., 1979).

This excellent paper discussed virtually all aspects of practical in-house infrared data transmission. Block diagrams of typical systems, design equations and detailed discussions concerning the near-infrared reflectance properties of various surfaces were included.

Never slow to adapt a useful technology, several Japanese computer firms have recently developed or introduced various kinds of near-infrared coupled, in-house, wireless, data-transmission systems. One of the most ambitious is an infrared modem developed by Fujitsu, a major Japanese manufacturer of computers.

Designed specifically for office automation, Fujitsu's system optically links several terminals equipped with infrared transceivers to one of several *satellite* transceivers connected by conventional cable to a central processor. The system is RS-232 compatible at full or half duplex with data rates of up to 19.2 kilobaud. The normal operating range of the system is about ten meters, but this is reduced to about three meters should any of the system's photodiodes be exposed to direct sunlight.

Incidentally, Fujitsu's system uses



$$R = \sqrt{\frac{4 P_0 A_{rec} \tau}{\pi P_{th} \theta^2}}$$

τ = TRANSMISSION OF RECEIVER OPTICS (IF USED)
P_{th} = RECEIVER SENSITIVITY (WATTS)

Fig. 1. Range equation for line-of-sight operation.

COMPUTER MAIL ORDER

TeleVideo

TERMINALS

910	$559.00
912	$689.00
920	$739.00
925	$719.00
950	$929.00
970	CALL

COMPUTERS

800A	$1099.00
802	$2699.00
803	$1949.00
802H	$4695.00
806/20	$4999.00
816/40	$9199.00
1602	$3399.00
1603	CALL

MODEMS

HAYES

Smart	$219.00
Smart 1200 (1200 Baud)	$519.00
Chronograph	$199.00
Micromodem 100	$309.00
Micromodem II	$279.00
Micromodem II (with term)	$299.00
Smart Com II	$99.00
Smart 1200B	$469.00

NOVATION

J-Cat	$119.00
Cat	$144.00
D-Cat	$159.00
103 Smart Cat	$189.00
Apple Cat II	$279.00
103/212 Smart Cat	$439.00
212 Apple Cat II	$609.00
Apple Cat II 212 Upgrade	$309.00

ANCHOR

Mark I (RS-232)	$79.00
Mark II (Atari)	$79.00
Mark III (T.I. 99)	$109.00
Mark IV (CBM-PET)	$125.00
Mark V (Osborne)	$95.00
Mark VI (IBM-PC)	$179.00
Mark VII (Auto Ans/Auto Dial)	$119.00
Mark VIII	$269.00
TRS-80 Color Computer	$99.00
9 Volt Power Supply	$9.00

ZENITH

ZT1 Terminal	$369.00

FRANKLIN

CALL

ACE 1000 Color Computer
ACE 1100 Drive & Cover for ACE 1000
ACE 1200 Computer with Disk Drive
ACE PRO PACK:
ACE 1000, Disk Drive, 80 Column Card, ACECalc & ACEWriter II

MICRO-SCI

Apple & Franklin

A2	$219.00
A40	$299.00
A70	$319.00
C2 Controller	$79.00
C47 Controller	$89.00

RANA

Elite I (Apple/Franklin)	$279.00
Elite II (Apple/Franklin)	$319.00
Elite III (Apple/Franklin)	$569.00

EAGLE

IIE-1	$1369.00
IIE-2	$1649.00
IIE-3	$2399.00
IIE-4	$3199.00
PC-E	$1579.00
PC-1	$2399.00
PC-2	$2799.00
PC-X	$3599.00
1620	$3599.00
1630	$5499.00
1640	$6499.00
Cyma Software	CALL

commodore

CBM 8032 $599

CBM64 ... $219

VIC 20 .... $99

CALL ON Executive 64 Portable

1520 Color Printer/Plotter	$169.00
1525 80 Column Printer	$219.00
1526	$319.00
1530 Datasette	$69.00
1541 Single Disk Drive	$249.00
1600 VIC Modem	$59.00
1650 AD/AA Modem	$89.00
1701 14" Color Monitor	$249.00
Pet 64	$569.00
Pet 4032	$599.00
CBM 8032	$599.00
Super Pet	$999.00
B128-80	$769.00
BX256-80	$969.00
2031	$299.00
4040	$699.00
8050	$949.00
8250	$1199.00
9060	$1999.00
9090	$2199.00
4023	$379.00
6400	$1399.00
64K Upgrade	$269.00
Spell Master	$149.00
Z-Ram	$549.00
Silicon Office	$749.00
The Manager	$209.00
Soft Rom	$129.00
Jinsam	CALL
Call Result 64	$139.00

PROFESSIONAL SOFTWARE

Word Pro 2 Plus	$159.00
Word Pro 3 Plus	$189.00
Word Pro 4 Plus	$279.00
Word Pro 5 Plus	$279.00
InfoPro	$179.00
Administrator	$399.00
Power	$79.00
Word Pro 64 Plus	$65.00

CAROCO for VIC 20/64

Light Pen	$32.00
Cassette Interface	$29.00
Parallel Printer Interface	$69.00
3 Slot Expans. Interface (20)	$32.00
6 Slot Expans. Interface (20)	$79.00

ATARI HOME COMPUTERS

ATARI

ATARI 600XL	$149
ATARI 800XL	$269
ATARI 1200XL	CALL
ATARI 400	CALL
ATARI 800	CALL

1010 Program Recorder	$74.00
1020 40 Col. Printer/Plotter	$249.00
1025 80 Col. Printer	$449.00
1027 Letter Quality Printer	$299.00
1050 Disk Drive	$379.00
1030 Direct Connect Modem	CALL
CX30 Paddles	$12.00
CX40 Joystick	$8.00
CX42 Remote Joystick	CALL
CX77 Touch Tablet	$69.00
CX80 Trak Ball	$49.00
CX85 Keypad	$105.00
CX418 Home Manager	$69.00
CX488 Communicator II	$229.00
KX7098 Atari Accountant	$209.00
KX7101 Entertainer	$69.00
KX7102 Arcade Champ	$75.00

PRINTERS

EPSON

MX80 FT, MX100, RX80, FX80, FX100	CALL

OKIDATA

82, 83, 84, 92, 93	CALL

STAR

Delta 10	$559.00
Gemini 10X	$299.00
Gemini P15	$449.00
Serial Board	$75.00

SMITH CORONA

TP-1	$469.00
TP-2	CALL
Tractor Feed	$119.00

C.ITOH

Gorilla	$209.00
Prowriter 8510P	$379.00
Prowriter 1550P	$589.00
Starwriter F10-40P	$1149.00
Printmaster F10-55P	$1369.00
Tractor Feed	$199.00

DAISYWRITER

2000 Letter Quality	$999.00
2500...NEW	CALL
Tractor Feed	$109.00

DIABLO

620	$949.00
630	$1769.00

IDS

Call for ALL Configurations on IDS PRISM PRINTERS.

NEC

8023	$399.00
8025	$729.00
3510	$1449.00
3530	$1499.00
3550	$1799.00
7710/7730	$1999.00

BMC

401 Letter Quality	$599.00
BX-80	$259.00

PERCOM

AT 88-S1	$329.00
AT 88-A2	$269.00
AT 88-S2	$569.00
AT 88-S1 PD	$469.00
AT 88-DDA	$145.00
RFD 40-S1	$449.00
RFD 40-A1	$279.00
RFD 40-S2	$729.00
RFD 44-S1	$539.00
RFD 44-S2	$869.00
TX 99-S1	$279.00

RANA

1000 Atari Disk Drive	$319.00

MONITORS

AMDEK

300G	$149.00
300A	$159.00
310A	$169.00
Color I	$279.00
Color I plus	$299.00
Color II	$399.00
Color III	$349.00
Color IV	$999.00

USI

PI 1, 9" G	$99.00
PI 2, 12" G	$119.00
PI 3, 12" A	$149.00
PI 4, 9" A	$139.00
1400 Color	$279.00

ZENITH

ZVM 122A	$109.00
ZVM 123G	$99.00

BMC

12" Green	$85.00
9191 AU 13" Color	$249.00

TAXAN

12 N Green	$129.00
12 A Amber	$139.00

PANASONIC

TR 120 Hi-res. Green	$149.00
CT 160 Dual Mode Color	$279.00

NEC

JB 1260	$119.00
JB 1201	$149.00
JB 1205	$169.00
JC 1215	$299.00
JC 1216	$429.00
JC 1203	$469.00

GORILLA

12" Green	$89.00

TIMEX SINCLAIR 1000 CALL

WEST

1-800-648-3311

In NV call (702)588-5654, Dept. 1107
P.O. Box 6689, Stateline, NV 89449
Order Status #: 588-5654

CANADA

1-800-268-4559

In Toronto call (416)828-0866, Dept. 1107
2505 Dunwin Ct., Unit 1B,
Mississauga, Ontario, Canada L5L1T1
Order Status #: 828-0866

EAST

1-800-233-8950

In PA call (717)327-9575, Dept. 1107
477 E. Third St. Williamsport, PA 17701
Order Status #: 327-9576

No risk, no deposit on C.O.D. orders. Pre-paid orders receive free shipping within the UPS Continental United States with no waiting period for certified checks or money orders. Add 3% (minimum $5.00) shipping and handling on all C.O.D. and credit card orders. Larger shipments may require additional charges. NV and PA residents add sales tax. All items subject to availability and price change. We stock manufacturer's and third party software for most all computers on the market. Call today for our new catalog.

CANADIAN ORDERS: All prices are subject to shipping, tax and currency exchange fluctuations. Call for exact pricing in Canada.

Circle No. 11 on Free Information Card

the new high-power AlGaAs "super" LEDs I've described several times in this magazine. Each terminal transceiver uses five diodes, each of which emits about 15 mW. The satellite stations use nine diodes.

Fujitsu's system shows what can be done on a large scale with infrared links. But I think you'll be more interested in a new handheld computer developed by Canon that can communicate with a printer by means of a midget infrared data link that plugs into the computer's RS-232 port. According to *Electronic Engineering Times,* Canon may formally introduce this new computer later this year.

Design Tips. Possibly one reason for the slow development of free-space optical data links for computers and nearby terminals and peripherals is the special design requirements imposed by such a system. First, a communications format must be selected. For instance, will one LED channel be sufficient or will others be required? What form of multiplexing, if any, will be used?

Next, a suitable LED and LED driver must be selected. If high data rates are not a requirement, high power AlGaAs near-infrared emitters are the best choice. A power MOSFET makes an excellent driver for these and other infrared-emitting diodes. For more power, several LEDs can be connected in series.

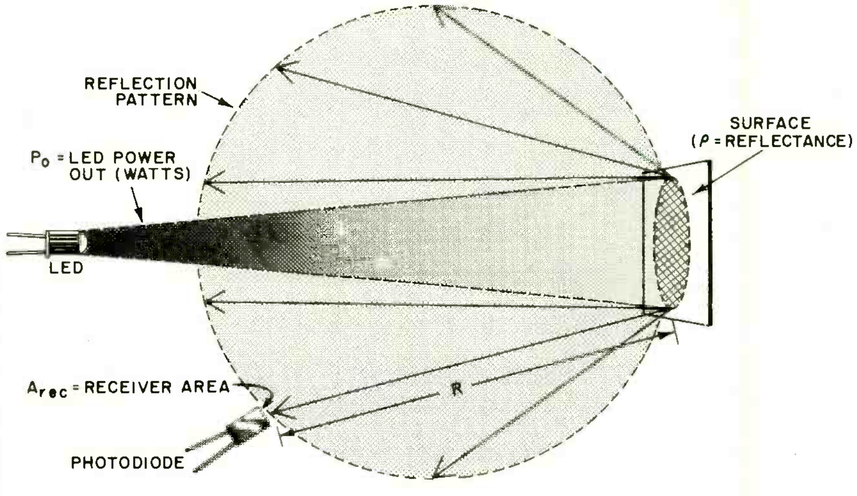
Many kinds of receivers are possible. A typical design might employ a photodiode or phototransistor detector followed by a low-noise, high-gain amplifier. Low noise is important for high sensitivity. Immunity to noise from incandescent and, especially, fluorescent lights is essential. Infrared filters can help. So can a filter that rejects 60-Hz and 120-Hz interference.

Over what range will the system operate? Two simple range equations can be used to give reasonable predictions. Both equations require a knowledge of such parameters as the optical output power from the transmitter (P_o), the receiver sensitivity (P_{th}), the area of the receiver's detector chip or lens (A_{rec}), the divergence or beam spread angle of the transmitter in radians (θ), and the transmissivity of the receiver's optics (τ).

The first equation, a simplified form of the optical communications range equation, is for line-of-sight operation where the infrared emitted by the transmitter's emitter has an unobstructed, direct path to the detector. In this case, the range is the square root of $(4P_oA_{rec}\tau)/(P_{th}\pi\theta^2)$. Figure 1 summarizes this equation.

The second equation, a simplified form of the optical radar range equation, is for systems in which the transmitted beam is reflected from diffusely reflecting walls, ceilings, and other surfaces before reaching the receiver's detector. In this case, the range is the square root of $(P_oA_{rec}\rho\tau)/(P_{th}\pi)$. This equation is summarized in Fig. 2.

The Greek letter ρ (rho) denotes the reflectance of the surface from which the transmitted beam is reflected. At 880 nm, plaster and unpainted pine



$$R = \sqrt{\frac{P_o A_{rec} \rho \tau}{P_{th} \pi}}$$

τ = TRANSMISSION OF RECEIVER OPTICS (IF USED)
P_{th} = RECEIVER SENSITIVITY (WATTS)

Fig. 2. Range equation for operation with a diffuse reflector.

Get the most from your Timex Sinclair or Sinclair computer.

Get THE BEST OF SYNC!

Here's the best from *Sync*, the exciting magazine devoted to Sinclairs!

The Best of Sync is a collection of more than 80 of the most valuable articles, programs, tutorials and reviews that appeared in Volume One of *Sync*, the magazine for Timex Sinclair and Sinclair owners.

This information-packed book is a vital resource for anyone who'd like to get more work (and more fun!) from a Timex Sinclair 1000, a Sinclair ZX81 or ZX80, or a MicroAce computer. Topics covered include:

- Games
- Mathematical applications
- Graphics techniques
- Software programming
- Translation
- Machine language hardware
- Resource listings
- Product reviews
- Complete glossary

In *The Best of Sync* you'll find game programs like "Forest Treasure" and "Motorcycle Race Game"...hardware plans for a "Key Click Generator" and a "Parallel Interface"...programming features on "Handling Character Strings in the ZX80," "Converting from Other BASICs" and "An Introduction to Machine Code." And that's just a small sample.

These ultrapractical features appeared in issues of *Sync* that are now out of print and nearly impossible to find. But you can still make use of the important information, techniques and programs they contain—by ordering *The Best of Sync* today!

8½" x 11", softcover.

Also available at your local bookstore or computer store.

For faster service, PHONE TOLL FREE: 800-631-8112
(In NJ only: 201-540-0445)

CREATIVE COMPUTING PRESS
Dept.NF9F, 39 East Hanover Avenue, Morris Plains, NJ 07950

Please send me ________ *The Best of Sync, Volume One*, at $9.95* plus $2.00 postage and handling each. Outside USA add $3.00 per order. #6M

☐ PAYMENT ENCLOSED $________ *Residents of CA, NJ and NY State add applicable sales tax.

☐ CHARGE MY: ☐ American Express ☐ MasterCard ☐ Visa

Card No.________________ Exp. Date________

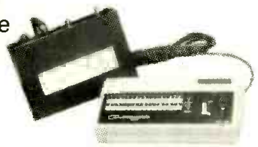
Signature________________________

Mr./Mrs./Ms.________________________
(please print full name)

Address________________________ Apt.______

City____________ State________ Zip________

☐ Send me a FREE *Creative Computing* Catalog.



have a typical reflectance of about 70% (0.7). Human skin and green vegetation have typical reflectances of 50 to 60% (0.5 to 0.6). (In the near infrared, differences in skin pigmentation are barely discernable.)

An Experimental Infrared Joystick Interface

Radio Shack's TRS-80 Color Computer can be equipped with two joysticks. Each includes two mechanically linked potentiometers and a "fire" switch. Figure 3 shows the internal circuitry of each joystick.

The *Color Computer Technical Reference Manual* (Radio Shack, 1981) gives complete details about the operation of the Color Computer's joysticks. Briefly, the two potentiometers in each joystick function as voltage dividers. As the wiper of a potentiometer is rotated, the voltage appearing across the wiper and ground varies from ground to +5 V. This voltage is applied via joystick input ports to a 6-bit digital-to-analog converter circuit in the Color Computer. A built-in software routine uses a successive approximation method to find, to the 6-bit accuracy of the D/A converter, the voltage equivalent of the position of the joystick. Since there are either two or four joystick potentiometers, a multiplexer is required to direct the selected potentiometer to the D/A converter.

One way to replace the cable between the joysticks and the Color Computer with an infrared link is to employ a pair of LEDs, each driven by a pulse generator with a repetition rate determined by the resistance of its respective joystick potentiometer. A pair of receivers would detect and amplify the signals from the LEDs and pass them to respective frequency-to-voltage converters. The resultant output voltages would then be applied to the joystick input ports of the Color Computer (Figure 4).

A Working Circuit. To test this idea, I assembled a working version of one of the channels shown in block diagram form in Fig. 4. The transmitter is shown in Fig. 5. The circuit is a straightforward pulse generator designed around a 555 timer whose pulse repetition rate is determined by joystick potentiometer *R1* and timing capacitor *C1*. Pulses from the 555 (pin 3) switch *Q1* on and off, thus applying current to infrared-emitting diode *LED1*. Resistor *R4* limits its current through the diode to less than 100 mA.

Figure 6 shows one of several simple receivers I tested that can detect the signal from the transmitter, amplify it and convert the variable pulse rate into its respective voltage.

For best results, especially in the presence of ambient light, a pin photodiode such as the Texas Instruments TIL413 (Radio Shack 276-144 or similar) should be used. This particular photodiode includes a built-in infrared filter that substantially improves performance in the presence of incandescent

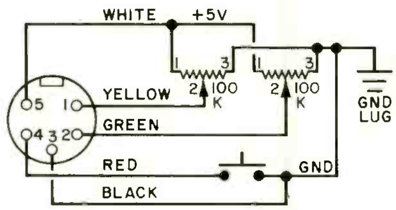


Fig. 3. Internal circuitry on the TRS-80 Color Computer joystick.

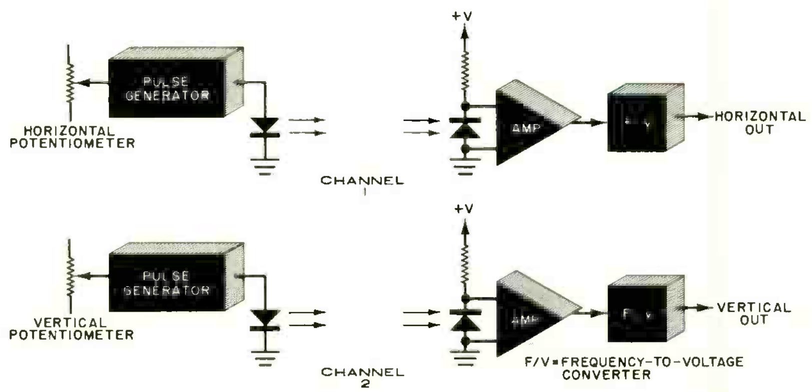


Fig. 4. Block diagram of infrared computer-joystick interface.

and fluorescent indoor lighting. A phototransistor can also be used, but noise immunity may be a problem.

If you use a phototransistor, connect its collector to the junction of *C1* and *R1* and its emitter to ground. You will also need to reduce *R1* to about 100K. Keep in mind that, while the phototransistor has built-in gain, the photodiode is less susceptible to the effect of ambient light.

I used a pair of 741 operational amplifiers to amplify the received signal, but many other amplifier arrangements can also be used. A 60-Hz or 120-Hz notch filter can also be included.

The frequency-to-voltage converter is designed around the familiar 555. Componenets *R9* and *C5* at the output of the 555 form an integrator that transforms the pulses from the 555 into a variable dc voltage.

While I've had good results with the 555 in this role, you can also use the 9400 or LM311 in their frequency-to-voltage converter roles for superior results. Both these chips were described in an installment of "Experimenter's Corner" in POPULAR ELECTRONICS (November 1979; reprinted in *The Forrest Mims Circuit Scrapbook*, McGraw-Hill, 1983).

Testing the Interface. I tested the experimental infrared joystick-computer link by disassembling a Color Computer joystick and unsoldering the yellow wire from the wiper terminal of one of the two potentiometers. I then connected this wire and the joystick's black wire (ground) to, respectively, the output of the receiver and its ground.

I then entered the following joystick test program into the Color Computer:

```
10  CLS
20  PRINT @0, JOYSTK (0);
```

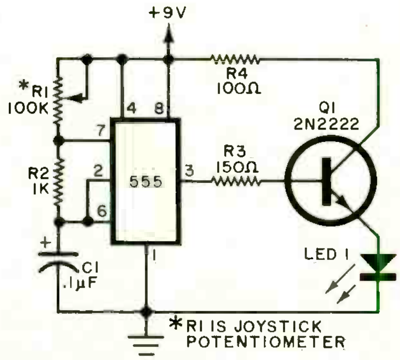


Fig. 5. Single-channel near-infrared joystick transmitter.

```
30 PRINT @5, JOYSTK (1);
40 GOTO 20
50 END
```

This simple program prints the coordinates (0 to 63) of the right joystick at the upper left corner of the monitor's screen. JOYSTK(0) is the horizontal potentiometer and JOYSTK(1) is the vertical potentiometer.

For initial tests, the transmitter's LED and the receiver's photodiode should be closely spaced and pointed directly at one another. When the system is operating properly, move the transmitter away from the receiver to determine the maximum range. The prototype circuit I built gave a maximum range of about four feet when a photodiode detector was used at the receiver. A phototransistor at the receiver gave a maximum range of about three feet. If the coordinates of JOYSTK (0) do not reach the full range, you may need to alter the value of *C1* in the transmitter.

You can monitor the output of the receiver with a high-impedance voltmeter. And you can gain a better understanding of the entire transmitter-receiver system by using an oscilloscope to observe pin 3 of the transmitter's 555 and the outputs of the various stages of the receiver. If you are able to perform these tests, be sure to experiment with the position of the transmitter's LED with respect to the receiver's photodiode.

Going Further. The simple infrared joystick-computer interface described above links only one of the potentiometers in the joystick with a Color Computer. One way to link both potentiometers is to assemble two identical transmitters and receivers as suggested in Fig. 4. Use an 880-nm LED for one transmitter and a 950-nm LED for the second transmitter. Replace the receiver photodiodes with identical LEDs. In other words, the 880-nm transmitter should be coupled with a receiver that uses an 880-nm LED as a photodiode. Since the LEDs can function as wavelength selective detectors, the system will provide a wavelength-multiplexed, two-channel link between the joystick and the computer.

The range of the system in which LEDs are used as photodiodes will not be as great as the system in which a silicon pin photodiode is used. Therefore, you may wish to explore various electronic multiplexing methods to send both channels of information from a joystick to a computer.

You can increase the transmission range of the infrared joystick-computer link by adding additional LEDs in series with *LED1* of the transmitter. Also, select *LED1*'s current limiting resistor, *R4*, to provide the highest possible current consistent with the power ratings of *LED1, Q1* and *R4*. For maximum power, *Q1* and *LED1* may require heatsinks. A power MOSFET can be directly substituted for *Q1*. The equivalent connections are base-gate, emitter-source and collector-drain.

If you want to further explore the topic of infrared free-space data links for computers and their peripherals, be sure to read the excellent IEEE paper mentioned earlier in this column. For more details about infrared data links in general and a derivation of the line-of-sight range equation (Fig. 1), see *A Practical Introduction to Lightwave Communications* (Forrest M. Mims, III, Sams, 1982).

Simplified Model Railroad Crossing Light

In a previous column for this magazine I described an optically triggered model railroad crossing light ("Project of the Month," May 1981). Recently, while writing a new book for Radio Shack called *Getting Started in Electronics,* I found that the original circuit can be considerably simplified, as shown in Fig. 7.

Two 4011 CMOS NAND gates form

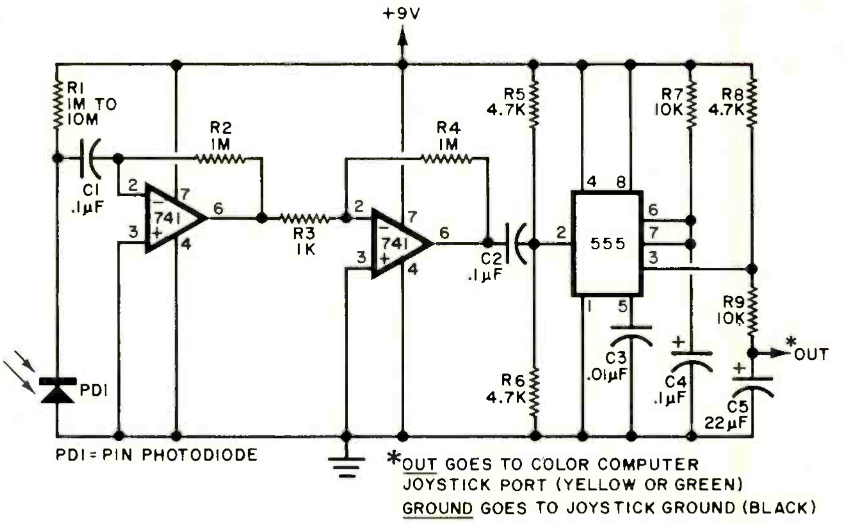


Fig. 6. Single-channel infrared-coupled joystick receiver.

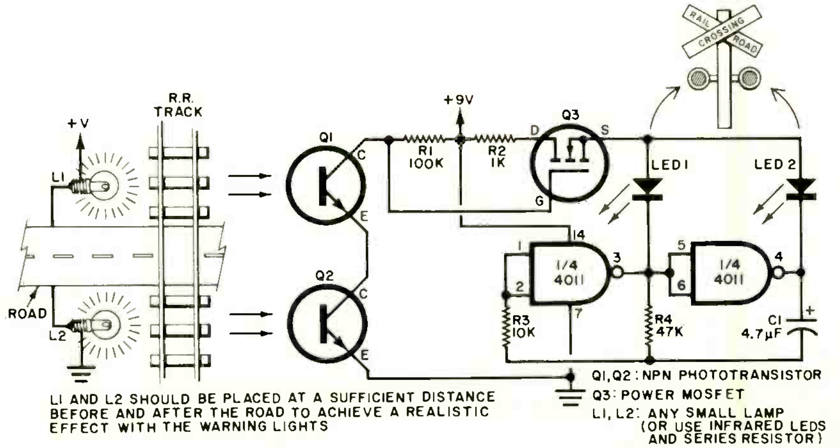


Fig. 7. Simple model railroad crossing light.

an astable oscillator that switches states continuously a few times each second so long as power is applied. Phototransistors *Q1* and *Q2* and power transistor *Q3* form a NAND gate that determines when the LEDs connected to the outputs of the 4011 oscillator are forward-biased.

When both *Q1* and *Q2* are illuminated by small lamps placed across the track on either side of the crossing, *Q3* is switched off and the flashing lights are extinguished. When light to either *Q1* or *Q2* or both *Q1* and *Q2* is blocked, *Q3*'s gate is positively biased via *R1*, thus turning on *Q3* and allowing the LEDs to flash.

The circuit is reasonably sensitive considering no amplification is employed beyond the built-in gain of the phototransistors. Either conventional npn phototransistors or photodarlington transistors can be used. For best results, place a short length of black heat-shrinkable tubing over each phototransistor to prevent ambient light from striking the phototransistor's active surface.

Small incandescent lamps can provide adequate illumination for the phototransistors. Infrared LEDs can also be used. Be sure to use a current-limiting resistor between the LED and its power source to restrict the current through the LED to a safe value. To find the value of the resistor, subtract the forward voltage of the LED (probably about 1.3 V) from the supply voltage and divide the result by the desired forward current in amperes.

Though I designed this circuit for model railroad enthusiasts, it has other uses as well. For instance, it can be used to signal a warning when an object or person is present in a certain location. Applications such as this require careful placement of the light-emitting and detecting components and, possibly, the use of external lenses. Additional amplification might also be necessary.

A New Class of Semiconductors

Scientists at Sandia National Laboratories in Albuquerque, NM, are developing an exciting new way to combine different semiconductors within the same structure or device. According to Dr. J. K. Galt, Sandia's Vice President for Research, "This appears to be a major advance in semiconductor device science."

The new fabrication method, which was explored at IBM by A. E. Blakeslee as early as 1970, allows semiconductor device designers far more flexibility. Present crystal growth methods limit designers to a handful of compatible semiconductor ingredients. The new fabrication method will greatly expand the potential recipe file of compatible semiconductors and allow designers to concoct a bevy of new devices.

Before finding out more about the new semiconductor fabrication method, let's review the limitations of current technology. Certain classes of highly specialized electronic, photonic and microwave components are now made by growing, one upon another, thin layers of elements from Groups III and V of the periodic table. A prime example is the new generation of semiconductor lasers and light-emitting diodes in which a sandwich-like "heterojunction" is formed by depositing a thin layer of semiconductor having a high refractive index on a layer having a slightly lower index. The structure is completed when a third layer having a low refractive index (similar or identical to the first layer) is grown over the second layer. This sandwichlike structure makes possible highly efficient diode lasers since light emitted in the junction region is kept there by the reflective interfaces between the inner and outer layers.

The problem with heterojunction semiconductors is that the physical dimensions of the crystal lattices of different semiconductors don't match. Therefore, when a layer of one semiconductor is grown atop another, crystal defects called *misfit dislocations* are formed. These defects cause strain within the crystal and act as unwanted recombination centers—that is, small regions that act like pn junctions.

For these reasons, conventional

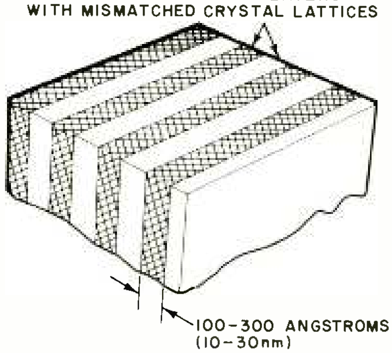
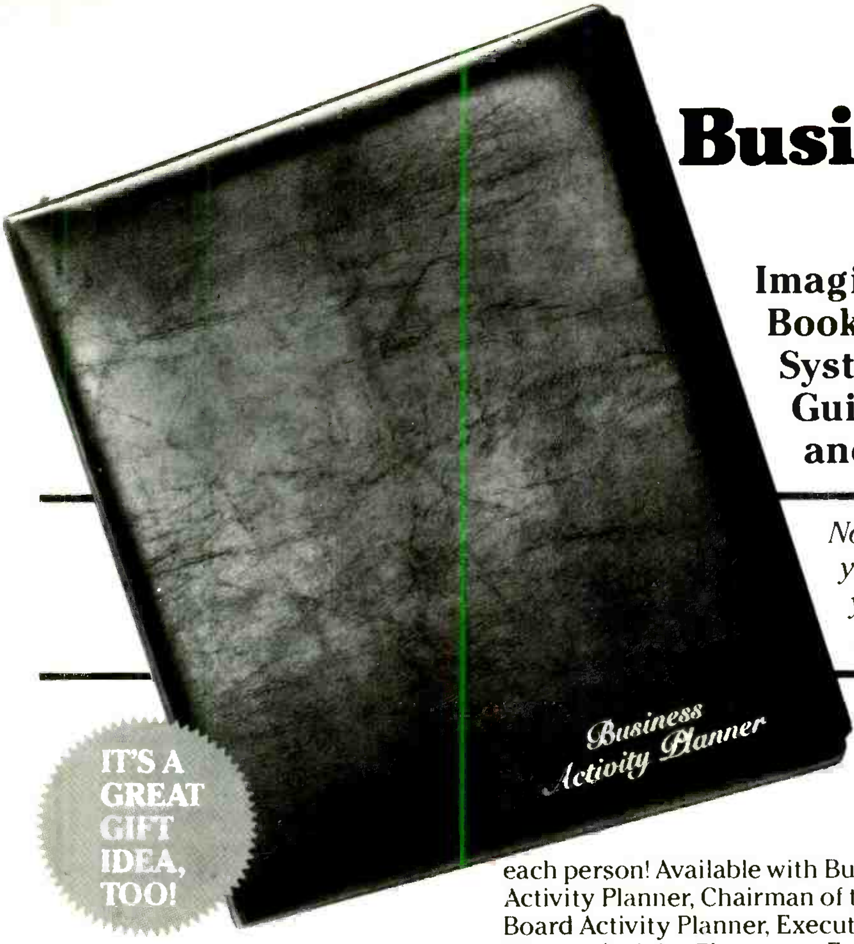


Fig. 8. Formation of a simple strained-layer superlattice device.

1984 Business Activity Planner

Imagine! A complete Appointment Book, Financial Record Keeping System, Travel Information Guide, Health and Fitness Aid and Directory...All in one book!

No matter how organized and successful you are today, our Planner will make you even better in the future...or your money back!



IT'S AN APPOINTMENT BOOK!

SEE-A-WEEK CALENDAR
■ A full week...at a glance! Time planning becomes easy when your appointments, meetings, luncheon and dinner engagements and special activities are in front of you.

HALF-HOUR TIME SCHEDULING
■ Convenient scheduling...seven days a week.

THINGS TO DO TODAY
■ Keep track of important follow-ups, telephone calls and correspondence.

SEVEN SNAP-LOCK RINGS
■ The seven ring format insures that your pages won't pull out...unless you want them to!

BEAUTIFUL, SOFT, LEATHER-LIKE BINDER
■ Padded front and back, your 9½ x 11½ Planner is comfortable to carry. You can take it with you wherever you go. The sturdy, permanent bookmark always keeps you in the right week and the two inside pockets enable you to keep all your important papers in your **1984 Activity Planner.**

YOUR CHOICE OF IMPRINTS
■ Order the 1984 Business Activity Planner for everyone in your office ...and select the cover imprint for each person! Available with Business Activity Planner, Chairman of the Board Activity Planner, Executive Woman Activity Planner, or Executive Activity Planner.

IT'S MUCH MORE!
■ Each Section is Index-Tabbed for Instant Retrieval of Information.

FINANCIAL RECORD KEEPER
■ 12 Income and Expense Reports
■ 1984 Business Tax Calendar
■ Executive Compensation Checklist
■ Personal Investment Portfolio

HEALTH AND FITNESS AID
■ Fat - Cholesterol - Calorie Charts
■ Value of Various Exercises
■ Substitution Chart for Better Health
■ First Aid Tips

TRAVEL INFORMATION
■ Average Temperatures for Most Major Cities
■ Rank and Population of the Top 100 U.S. Cities
■ Traveling Distances
■ Toll-Free Telephone Numbers for Major Airlines, Auto Rentals, Hotels, Motels and much more!

MISCELLANEOUS
This section is filled with valuable information including Principal Holidays, French and California Wine Vintage Charts and more.

DIRECTORY
Places all emergency and important telephone numbers at your fingertips.

ZIFF-DAVIS ACTIVITY PLANNER P.O. Box 16-2354, Miami, FL 33116
Please send me the following 1984 Activity Planners at $38.95* each plus $5 per copy postage and handling. Outside U.S.A. add $10 per copy postage and handling.

Specify quantity for each cover imprint ordered:

____ Business Activity Planner(s)
____ Chairman of the Board Activity Planner(s)
____ Executive Woman Activity Planner(s)
____ Executive Activity Planner(s)

QUANTITY DISCOUNTS
(on total number of Planners)

6–20	10% off	($4 P&H each)
21–50	15% off	($3 P&H each)
51–or more	20% off	($2 P&H each)

☐ Payment enclosed. ☐ American Express ☐ Visa ☐ MasterCard ☐ Purchase Order enclosed.

Card No. ________ Exp. Date ________

Signature ________

Name ________ (please print)

Company ________

Address ________

City/State/Zip ________

*Florida residents add 5% sales tax.
SATISFACTION GUARANTEED or return within 10 days for a prompt refund!
CE-11

FOR FASTER SERVICE CALL TOLL FREE
800-327-1969
(In Fla. and Canada call (305) 595-8744.)

4164 64K DYNAMIC 200 NS $5.95

TMM2016 2KX8 STATIC 200 NS $4.15

STATIC RAMS

2101	256 x 4	(450ns)	1.95
5101	256 x 4	(450ns) (cmos)	3.95
2102-1	1024 x 1	(450ns)	.89
2102L-4	1024 x 1	(450ns) (LP)	.99
2102L-2	1024 x 1	(250ns) (LP)	1.49
2111	256 x 4	(450ns)	2.49
2112	256 x 4	(450ns)	2.99
2114	1024 x 4	(450ns)	8/9.95
2114-25	1024 x 4	(250ns)	8/10.95
2114L-4	1024 x 4	(450ns) (LP)	8/12.95
2114L-3	1024 x 4	(300ns) (LP)	8/13.45
2114L-2	1024 x 4	(200ns) (LP)	8/13.95
2147	4096 x 1	(55ns)	4.95
TMS4044-4	4096 x 1	(450ns)	3.49
TMS4044-3	4096 x 1	(300ns)	3.99
TMS4044-2	4096 x 1	(200ns)	4.49
MK4118	1024 x 8	(250ns)	9.95
TMM2016-200	2048 x 8	(200ns)	4.15
TMM2016-150	2048 x 8	(150ns)	4.95
TMM2016-100	2048 x 8	(100ns)	6.15
HM6116-4	2048 x 8	(200ns) (cmos)	4.75
HM6116-3	2048 x 8	(150ns) (cmos)	4.95
HM6116-2	2048 x 8	(120ns) (cmos)	8.95
HM6116LP-4	2048 x 8	(200ns) (cmos)(LP)	5.95
HM6116LP-3	2048 x 8	(150ns) (cmos)(LP)	6.95
HM6116LP-2	2048 x 8	(120ns) (cmos)(LP)	10.95
Z-6132	4096 x 8	(300ns) (Qstat)	34.95

LP = Low Power Qstat = Quasi-Static

DYNAMIC RAMS

TMS4027	4096 x 1	(250ns)	1.99
UPD411	4096 x 1	(300ns)	3.00
MM5280	4096 x 1	(300ns)	3.00
MK4108	8192 x 1	(200ns)	1.95
MM5298	8192 x 1	(250ns)	1.85
4116-300	16384 x 1	(300ns)	8/11.75
4116-250	16384 x 1	(250ns)	8/11.95
4116-200	16384 x 1	(200ns)	8/12.95
4116-150	16384 x 1	(150ns)	8/14.95
4116-120	16384 x 1	(120ns)	8/29.95
2118	16384 x 1	(150ns) (5v)	4.95
4164-200	65536 x 1	(200ns) (5v)	5.95
4164-150	65536 x 1	(150ns) (5v)	6.95

5V = single 5 volt supply

EPROMS

1702	256 x 8	(1us)	4.50
2708	1024 x 8	(450ns)	3.95
2758	1024 x 8	(450ns) (5v)	5.95
2716	2048 x 8	(450ns) (5v)	3.95
2716-1	2048 x 8	(350ns) (5v)	5.95
TMS2516	2048 x 8	(450ns) (5v)	5.50
TMS2716	2048 x 8	(450ns)	7.95
TMS2532	4096 x 8	(450ns) (5v)	5.95
2732	4096 x 8	(450ns) (5v)	4.95
2732-250	4096 x 8	(250ns) (5v)	8.95
2732-200	4096 x 8	(200ns) (5v)	11.95
2764	8192 x 8	(450ns) (5v)	9.95
2764-250	8192 x 8	(250ns) (5v)	14.95
2764-200	8192 x 8	(200ns) (5v)	24.95
TMS2564	8192 x 8	(450ns) (5v)	17.95
MC68764	8192 x 8	(450ns) (5v)(24 pin)	39.95
27128	16384x8		Call

5v = Single 5 Volt Supply

EPROM ERASERS

	Timer	Capacity Chip	Intensity (uW/Cm²)	
PE-14		6	5,200	83.00
PE-14T	X	6	5,200	119.00
PE-24T	X	9	6,700	175.00
PL-265T	X	20	6,700	255.00
PR-125T	X	16	15,000	349.00
PR-320	X	32	15,000	595.00

Z-80

2.5 Mhz	
Z80-CPU	3.95
Z80-CTC	4.49
Z80-DART	10.95
Z80-DMA	14.95
Z80-PIO	4.49
Z80-SIO/0	16.95
Z80-SIO/1	16.95
Z80-SIO/2	16.95
Z80-SIO/9	16.95
4.0 Mhz	
Z80A-CPU	4.95
Z80A-CTC	4.95
Z80A-DART	11.95
Z80A-DMA	16.95
Z80A-PIO	4.95
Z80A-SIO/0	16.95
Z80A-SIO/1	16.95
Z80A-SIO/2	16.95
Z80A-SIO/9	16.95
6.0 Mhz	
Z80B-CPU	11.95
Z80B-CTC	13.95
Z80B-PIO	13.95
Z80B-DART	19.95
ZILOG	
Z6132	34.95
Z8671	39.95

CRYSTALS

32.768 khz	1.95
1.0 mhz	4.95
1.8432	4.95
2.0	3.95
2.097152	3.95
2.4576	3.95
3.2768	3.95
3.579535	3.95
4.0	3.95
5.0	3.95
5.0688	3.95
5.185	3.95
5.7143	3.95
6.0	3.95
6.144	3.95
6.5536	3.95
8.0	3.95
10.0	3.95
10.738635	3.95
14.31818	3.95
15.0	3.95
16.0	3.95
17.430	3.95
18.0	3.95
18.432	3.95
20.0	3.95
22.1184	3.95
32.0	3.95

CRT CONTROLLERS

6845	14.95
68B45	19.95
HD46505SP	15.95
6847	11.95
MC1372	6.95
68047	24.95
8275	29.95
7220	99.95
CRT5027	39.95
CRT5037	49.95
TMS9918A	39.95
DP8350	49.95

KEYBOARD CHIPS

AY5-2376	11.95
AY5-3600	11.95
AY5-3600 PRO	11.95

8000

8035	5.95
8039	6.95
INS-8060	17.95
INS-8073	24.95
8080	3.95
8085	5.95
8085A-2	11.95
8086	29.95
8087	CALL
8088	39.95
8089	89.95
8155	6.95
8155-2	7.95
8156	6.95
8185	29.95
8185-2	39.95
8741	39.95
8748	24.95
8755	24.95

8200

8202	24.95
8203	39.95
8205	3.50
8212	1.80
8214	3.85
8216	1.75
8224	2.25
8226	1.80
8228	3.49
8237	19.95
8237-5	21.95
8238	4.49
8243	4.45
8250	10.95
8251	4.49
8253	6.95
8253-5	7.95
8255	4.49
8255-5	5.25
8257	7.95
8257-5	8.95
8259	6.90
8259-5	7.50
8271	39.95
8272	39.95
8275	29.95
8279	8.95
8279-5	10.00
8282	6.50
8283	6.50
8284	5.50
8286	6.50
8287	6.50
8288	25.00
8289	49.95

DISC CONTROLLERS

1771	16.95
1791	24.95
1793	26.95
1795	49.95
1797	49.95
2791	54.95
2793	54.95
2795	59.95
2797	59.95
6843	34.95
8272	39.95
UPD765	39.95
MB8876	29.95
MB8877	34.95
1691	17.95
2143	18.95

CONNECTORS

RS232 MALE	2.50
RS232 FEMALE	3.25
RS232 HOOD	1.25
S-100 ST	3.95

6800

68000	59.95
6800	3.95
6802	7.95
6808	13.90
6809E	19.95
6809	11.95
6810	2.95
6820	4.35
6821	3.25
6828	14.95
6840	12.95
6843	34.95
6844	25.95
6845	14.95
6847	11.95
6850	3.25
6852	5.75
6860	9.95
6862	11.95
6875	6.95
6880	2.25
6883	22.95
68047	24.95
68488	19.95
6800 1MHZ	
68B00	10.95
68B02	22.25
68B09E	29.95
68B09	29.95
68B10	6.95
68B21	6.95
68B45	19.95
68B50	5.95

68B00 = 2 MHZ

6500

1 MHZ	
6502	4.95
6504	6.95
6505	8.95
6507	9.95
6520	4.35
6522	7.95
6532	9.95
6545	22.50
6551	11.85
2 MHZ	
6502A	6.95
6522A	9.95
6532A	11.95
6545A	27.95
6551A	11.95
3 MHZ	
6502B	14.95

UARTS

AY3-1014	6.95
AY5-1013	3.95
AY3-1015	6.95
PT1472	9.95
TR1602	3.95
2350	9.95
2651	8.95
TMS6011	5.95
IM6402	7.95
IM6403	8.95
INS8250	10.95

GENERATORS

BIT-RATE

MC14411	11.95
BR1941	11.95
4702	12.95
COM5016	16.95
COM8116	10.95
MM5307	10.95

FUNCTION

MC4024	3.95
LM566	1.49
XR2206	3.75
8038	3.95

74LS00

74LS00	.24	74LS173	.69
74LS01	.25	74LS174	.55
74LS02	.25	74LS175	.55
74LS03	.25	74LS181	2.15
74LS04	.24	74LS189	8.95
74LS05	.25	74LS190	.89
74LS08	.28	74LS191	.89
74LS09	.29	74LS192	.79
74LS10	.25	74LS193	.79
74LS11	.35	74LS194	.69
74LS12	.35	74LS195	.69
74LS13	.45	74LS196	.79
74LS14	.59	74LS197	.79
74LS15	.35	74LS221	.89
74LS20	.25	74LS240	.95
74LS21	.29	74LS241	.99
74LS22	.25	74LS242	.99
74LS26	.29	74LS243	.99
74LS27	.29	74LS244	1.29
74LS28	.35	74LS245	1.49
74LS30	.25	74LS247	.75
74LS32	.29	74LS248	.99
74LS33	.55	74LS249	.99
74LS37	.35	74LS251	.59
74LS38	.35	74LS253	.59
74LS40	.25	74LS257	.59
74LS42	.49	74LS258	.59
74LS47	.75	74LS259	2.75
74LS48	.75	74LS260	.59
74LS49	.75	74LS266	.55
74LS51	.25	74LS273	1.49
74LS54	.29	74LS275	3.35
74LS55	.29	74LS279	.49
74LS63	1.25	74LS280	1.98
74LS73	.39	74LS283	.69
74LS74	.35	74LS290	.89
74LS75	.39	74LS293	.89
74LS76	.39	74LS295	.99
74LS78	.49	74LS298	.89
74LS83	.60	74LS299	1.75
74LS85	.69	74LS323	3.50
74LS86	.39	74LS324	1.75
74LS90	.55	74LS352	1.29
74LS91	.89	74LS353	1.29
74LS92	.55	74LS363	1.35
74LS93	.55	74LS364	1.95
74LS95	.75	74LS365	.49
74LS96	.89	74LS366	.49
74LS107	.39	74LS367	.45
74LS109	.39	74LS368	.45
74LS112	.39	74LS373	1.39
74LS113	.39	74LS374	1.39
74LS114	.39	74LS377	1.39
74LS122	.45	74LS378	1.18
74LS123	.79	74LS379	1.35
74LS124	2.90	74LS385	1.90
74LS125	.49	74LS386	.45
74LS126	.49	74LS390	1.19
74LS132	.59	74LS393	1.19
74LS133	.59	74LS395	1.19
74LS136	.39	74LS399	1.49
74LS137	.99	74LS424	2.95
74LS138	.55	74LS447	.37
74LS139	.55	74LS490	1.95
74LS145	1.20	74LS624	3.99
74LS147	2.49	74LS640	2.20
74LS148	1.35	74LS645	2.20
74LS151	.55	74LS668	1.69
74LS153	.55	74LS669	1.89
74LS154	1.90	74LS670	1.49
74LS155	.69	74LS674	9.65
74LS156	.69	74LS682	3.20
74LS157	.65	74LS683	3.20
74LS158	.59	74LS684	3.20
74LS160	.69	74LS685	3.20
74LS161	.65	74LS688	2.40
74LS162	.69	74LS689	3.20
74LS163	.65	74LS783	24.95
74LS164	.69	81LS95	1.49
74LS165	.95	81LS96	1.49
74LS166	1.95	81LS97	1.49
74LS168	1.75	81LS98	1.49
74LS169	1.75	25LS2521	2.80
74LS170	1.49	25LS2569	4.25

JDR Microdevices

1224 S. Bascom Ave. • San Jose, CA 95128
(408) 995-5430 • Telex 171-110

VISIT OUR RETAIL STORE

HOURS: M-W-F, 9-5 T-Th., 9-9 Sat. 11-3

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: For shipping include $2 for UPS Ground or $3 for UPS Blue Label Air. Items over 5 pounds require additional shipping charges. Foreign orders, include sufficient amount for shipping. There is a $1 minimum order. Bay Area and Los Angeles Counties add 6½% Sales Tax. Other California residents add 6% Sales Tax. We reserve the right to substitute manufacturer. Not responsible for typographica errors. Prices are subject to change without notice. We will match o beat any competitor's price provided it is not below our cost.

Circle No. 22 on Free Information Card

7400

**Number of Pins of each I.C. for easy Socket purchase

Part No.	**Pins	Price	Part No.	**Pins	Price	Part No.	**Pins	Price
SN7400N	14	.25	SN7472N	14	.29	SN74156N	16	.59
SN7401N	14	.25	SN7473N	14	.35	SN74157N	16	.59
SN7402N	14	.25	SN7474N	14	.35	SN74160N	16	.69
SN7403N	14	.25	SN7475N	16	.45	SN74161N	16	.69
SN7404N	14	.25	SN7476N	16	.35	SN74162N	16	.69
SN7405N	14	.25	SN7479N	14	4.95	SN74163N	16	.69
SN7406N	14	.45	SN7480N	14	.89	SN74164N	14	.69
SN7407N	14	.29	SN7482N	14	1.49	SN74165N	16	.69
SN7408N	14	.25	SN7483N	16	.59	SN74166N	16	.89
SN7409N	14	.25	SN7485N	16	.59	SN74167N	16	2.95
SN7410N	14	.25	SN7486N	14	.35	SN74170N	16	1.29
SN7411N	14	.25	SN7489N	16	2.25	SN74172N	24	4.95
SN7412N	14	.29	SN7490N	14	.39	SN74173N	16	.69
SN7413N	14	.39	SN7491N	14	.79	SN74174N	16	.69
SN7414N	14	.49	SN7492N	14	.39	SN74175N	16	.69
SN7416N	14	.25	SN7493N	14	.39	SN74176N	14	.69
SN7417N	14	.25	SN7494N	14	.89	SN74177N	14	.69
SN7420N	14	.19	SN7495N	14	.49	SN74179N	16	1.49
SN7421N	14	.49	SN7496N	16	.49	SN74180N	14	.69
SN7422N	14	.49	SN7497N	16	3.25	SN74181N	24	1.95
SN7423N	16	.59	SN74100N	24	1.95	SN74182N	16	1.19
SN7425N	14	.29	SN74104N	14	1.19	SN74184N	16	2.49
SN7426N	14	.29	SN74105N	14	1.19	SN74185N	16	2.49
SN7427N	14	.25	SN74107N	14	.29	SN74190N	16	.69
SN7428N	14	.59	SN74109N	16	.39	SN74191N	16	.69
SN7430N	14	.25	SN74116N	24	1.49	SN74192N	16	.69
SN7432N	14	.29	SN74121N	14	.39	SN74193N	16	.69
SN7437N	14	.25	SN74122N	14	.69	SN74194N	16	.69
SN7438N	14	.29	SN74123N	16	.49	SN74195N	16	.69
SN7439N	14	.59	SN74125N	14	.45	SN74196N	14	.89
SN7440N	14	.19	SN74126N	14	.45	SN74197N	14	.89
SN7441N	16	.89	SN74132N	14	.49	SN74198N	24	1.19
SN7442N	16	.45	SN74136N	14	.69	SN74199N	24	1.19
SN7443N	16	1.25	SN74141N	16	.89	SN74221N	16	1.19
SN7444N	16	1.25	SN74142N	16	3.95	SN74251N	16	.79
SN7445N	16	.69	SN74143N	24	3.95	SN74276N	20	2.49
SN7446N	16	.69	SN74144N	24	3.95	SN74279N	16	.79
SN7447N	16	.69	SN74145N	16	.59	SN74283N	16	1.49
SN7448N	16	.69	SN74147N	16	1.49	SN74284N	16	2.95
SN7450N	14	.19	SN74148N	16	1.19	SN74285N	16	2.95
SN7451N	14	.19	SN74150N	24	1.19	SN74365N	16	.55
SN7453N	14	.19	SN74151N	16	.59	SN74366N	16	.55
SN7454N	14	.19	SN74152N	14	.59	SN74367N	16	.55
SN7459N	14	.25	SN74153N	16	.59	SN74368N	16	.55
SN7460N	14	.39	SN74154N	24	1.25	SN74390N	16	1.49
SN7470N	14	.29	SN74155N	16	.59	SN74393N	14	1.49

74LS

74LS00	14	.25	74LS92	14	.55	74LS192	16	.79
74LS01	14	.25	74LS93	14	.55	74LS193	16	.79
74LS02	14	.25	74LS95	14	.79	74LS194	16	.69
74LS03	14	.25	74LS96	16	.89	74LS195	16	.69
74LS04	14	.29	74LS107	14	.39	74LS197	14	.79
74LS05	14	.29	74LS109	16	.39	74LS221	16	.89
74LS08	14	.29	74LS112	16	.39	74LS240	20	1.09
74LS09	14	.29	74LS113	14	.39	74LS241	20	1.09
74LS10	14	.29	74LS114	14	.39	74LS242	14	1.09
74LS11	14	.35	74LS122	14	.49	74LS243	14	1.09
74LS12	14	.35	74LS123	16	.79	74LS244	20	1.09
74LS13	14	.39	74LS125	14	.49	74LS245	20	1.49
74LS14	14	.59	74LS126	14	.49	74LS247	16	1.09
74LS15	14	.35	74LS132	14	.59	74LS248	16	1.09
74LS20	14	.25	74LS133	16	.59	74LS249	16	1.09
74LS21	14	.29	74LS136	14	.39	74LS251	16	.59
74LS22	14	.29	74LS138	16	.59	74LS253	16	.59
74LS26	14	.29	74LS139	16	.59	74LS257	16	.59
74LS27	14	.29	74LS151	16	.59	74LS258	16	.59
74LS28	14	.35	74LS153	16	.59	74LS260	14	.59
74LS30	14	.25	74LS154	24	.99	74LS266	14	.69
74LS32	14	.35	74LS155	16	.69	74LS273	20	1.49
74LS33	14	.55	74LS156	16	.69	74LS279	16	.49
74LS37	14	.35	74LS157	16	.69	74LS283	16	.69
74LS38	14	.35	74LS158	16	.69	74LS290	14	.89
74LS40	14	.25	74LS160	16	.69	74LS293	14	.89
74LS42	16	.49	74LS161	16	.69	74LS298	16	.89
74LS47	16	.75	74LS162	16	.69	74LS352	16	1.29
74LS48	16	.75	74LS163	16	.69	74LS353	16	1.29
74LS49	16	.75	74LS164	14	.69	74LS365	16	.49
74LS51	14	.25	74LS165	16	1.19	74LS366	16	.49
74LS54	14	.25	74LS166	16	1.19	74LS367	16	.49
74LS55	14	.29	74LS168	16	1.19	74LS368	16	.49
74LS73	14	.39	74LS169	16	1.19	74LS373	20	1.29
74LS74	14	.39	74LS170	16	1.49	74LS374	20	1.29
74LS75	16	.39	74LS173	16	.69	74LS375	16	.69
74LS76	16	.39	74LS174	16	.69	74LS386	14	.45
74LS78	14	.39	74LS175	16	.69	74LS393	14	1.19
74LS83	16	.65	74LS181	24	2.95	74LS399	16	1.49
74LS85	16	.79	74LS190	16	.89	74LS670	16	1.49
74LS86	14	.39	74LS191	16	.89	81LS95	20	1.49
74LS90	14	.55				81LS97	20	1.49

74S/PROMS*

74S00	14	.35	74S114	14	.55	74S243	14	2.49
74S02	14	.35	74S133	16	.45	74S244	20	2.49
74S03	14	.35	74S134	16	.50	74S251	16	1.19
74S04	14	.35	74S135	16	.69	74S253	16	1.19
74S05	14	.45	74S136	14	1.39	74S257	16	1.19
74S08	14	.35	74S138	16	.89	74S258	16	1.19
74S09	14	.39	74S139	16	.89	74S260	14	1.19
74S10	14	.35	74S140	14	.55	74S280	14	1.95
74S11	14	.35	74S151	16	.99	74S287*	16	1.95
74S15	14	.35	74S153	16	.99	74S288*	16	1.95
74S20	14	.35	74S157	16	.99	74S373	20	2.49
74S22	14	.35	74S158	16	.99	74S374	20	2.49
74S30	14	.35	74S160	16	2.49	74S387*	16	1.95
74S32	14	.45	74S174	16	1.19	74S471*	20	5.95
74S38	14	.89	74S175	16	1.19	74S472*	20	4.95
74S40	14	.39	74S188*	16	1.49	74S473*	20	4.95
74S51	14	.35	74S194	16	1.49	74S474*	24	4.95
74S64	14	.39	74S195	16	1.49	74S475*	24	4.95
74S65	14	.39	74S196	14	1.49	74S570*	16	2.95
74S74	14	.55	74S240	20	2.25	74S571*	16	2.95
74S85	16	2.49	74S241	20	2.25	74S572*	18	4.95
74S86	14	.55	74S242	14	2.25	74S573*	18	4.95
74S112	16	.55				74S940	20	2.49
74S113	14	.55				74S941	20	2.49

CA—LINEAR

CA3010H		1.35	CA3081N	16	.99	CA3130E	8	.89
CA3039H		1.35	CA3082N	16	1.19	CA3140E	8	.79
CA3046N	14	1.35	CA3083N	16	1.49	CA3160H		1.95
CA3059N	14	2.95	CA3086N	14	.69	CA3162E	16	6.95
CA3060N	16	2.95	CA3089N	16	1.69	CA3189E	16	1.59
CA3065E	14	1.49	CA3096N	16	1.49	CA3401N	14	.59
CA3080E	8	.89				CA3600N	14	3.95

CD—CMOS

CD4000	14	.29	CD4040	16	1.19	CD4098	16	1.95
CD4001	14	.29	CD4041	14	1.19	CD4506	16	1.19
CD4002	14	.29	CD4042	16	.89	CD4507	14	1.19
CD4006	14	1.19	CD4043	16	.79	CD4508	24	3.95
CD4007	14	.29	CD4044	16	.79	CD4510	16	1.29
CD4009	16	.59	CD4046	16	1.19	CD4511	16	1.19
CD4010	16	.59	CD4047	14	1.29	CD4512	16	1.19
CD4011	14	.29	CD4048	16	.59	CD4514	24	2.49
CD4012	14	.29	CD4049	16	.39	CD4515	24	2.49
CD4013	14	.39	CD4050	16	.39	CD4516	16	1.59
CD4014	16	1.19	CD4051	16	.99	CD4518	16	1.19
CD4015	16	.39	CD4052	16	.99	CD4519	16	.59
CD4016	14	.49	CD4053	16	.99	CD4520	16	1.19
CD4017	16	1.19	CD4056	16	2.95	CD4522	16	1.49
CD4018	16	.99	CD4059	24	7.95	CD4526	16	1.19
CD4019	16	.99	CD4060	16	1.49	CD4528	16	1.49
CD4020	16	1.19	CD4066	14	.59	CD4529	16	1.69
CD4021	16	1.19	CD4068	14	.39	CD4543	16	1.95
CD4022	16	1.19	CD4069	14	.29	CD4562	14	6.95
CD4023	14	.29	CD4070	14	.39	CD4566	16	1.39
CD4024	14	.69	CD4071	14	.29	CD4583	16	2.49
CD4025	14	.23	CD4072	14	.29	CD4584	14	.69
CD4026	16	2.49	CD4073	14	.29	CD4723	16	1.19
CD4027	16	.45	CD4075	14	.29	CD4724	16	1.19
CD4028	16	.69	CD4076	16	1.19	MC14409	16	13.95
CD4029	16	1.29	CD4078	14	.49	MC14410	16	13.95
CD4030	14	.39	CD4081	14	.29	MC14411	24	11.95
CD4034	24	2.49	CD4082	14	.29	MC14412	16	13.95
CD4035	16	1.49	CD4093	14	.49	MC14419	16	7.95
						MC14433	24	13.95
						MC14538	16	1.19
						MC14541	14	1.19

(More in Catalog)

MICROPROCESSOR COMPONENTS

MICROPROCESSOR CHIPS

Part No.	**Pins	Function	Price
CDP1802	40	CPU	$2.95
MC6502	40	MPU w/Clock	5.95
MC6502B	40	MPU w/Clock at 3MHz	9.95
MC6802CP	40	MPU w/Clock and RAM	7.95
INS8035N-6	40	MPU—8-bit (6MHz)	5.95
INS8039N	40	CPU-Sgl. chip 8-bit (128 bts. Ram)	5.95
INS8040N-6	40	CPU (256 bytes RAM)	9.95
INS8070N	40	CPU (64 bytes RAM)	29.95
INS8073N	40	CPU w/Basic Micro Interpreter	29.95
P8085A	40	CPU	4.95
8086	40	CPU 16-bit 5MHz	24.95
8088	40	CPU 8/16-bit	29.95
8155	40	HMOS RAM I/O Port-Timer	6.95
8748	40	HMOS EPROM MPU	24.95

Z80, Z80A, Z80B, Z8000 SERIES

Z80	40	CPU (MK3880N)(780C) 2MHz	$3.95
Z80-CTC	28	Counter Timer Circuit	3.95
Z80-DART	40	Dual Asynchronous Rec./Trans.	10.95
Z80-DMA	40	Direct Memory Access Circuit	9.95
Z80-P10	40	Parallel I/O Interface Controller	3.95
Z80-S10/0	40	Serial I/O (TxCB and RxCB Bonded)	12.95
Z80-S10/1	40	Serial I/O (Lacks DTRB)	12.95
Z80-S10/2	40	Serial I/O (Lacks SYNCB)	12.95
Z80-S10/9	40	Serial I/O	12.95
Z80A	40	CPU (MK3880N-4)(780C-1) 4MHz	4.49
Z80A-CTC	28	Counter Timer Circuit	4.95
Z80A-DART	40	Dual Asynchronous Rec./Trans.	9.95
Z80A-DMA	40	Direct Memory Access Circuit	12.95
Z80A-P10	40	Parallel I/O Interface Controller	3.95
Z80A-S10/0	40	Serial I/O (TxCB and RxCB bonded)	12.95
Z80A-S10/1	40	Serial I/O (Lacks DTRB)	12.95
Z80A-S10/2	40	Serial I/O (Lacks SYNCB)	12.95
Z80A-S10/9	40	Serial I/O	12.95
Z80B	40	CPU (MK3880N-6) 6MHz	9.95
Z80B-CTC	28	Counter Timer Circuit	12.95
Z80B-P10	40	Parallel I/O Interface Controller	12.95
Z8001	48	CPU Segmented	44.95
Z8002	40	CPU Non-Segmented	34.95
Z8030	40	Serial Comm. Controller	44.95
Z8036	40	Counter/Timer & Parallel I/O Unit	29.95

6800/68000 SERIES

MC6800	40	MPU	2.95
MC6802CP	40	MPU with clock and RAM	7.95
MC6809E	40	CPU (1MHz) External (Locking)	14.95
MC6821	40	Peripheral Inter. Adapt (MC6820)	2.95
MC6828	24	Priority Interrupt Controller	15.95
MC6830L8	24	1024x8-bit ROM (MC68A30-8)	9.95
MC6850	24	Asynchronous Comm. Adapter	3.95
MC6852	24	Synchronous Serial Data Adapter	5.75
MC6860	24	0-600bps Digital MODEM	7.95
MC6862	24	2400bps Modulator	12.95
MC6880A	16	Quad 3-state bus. trans. (MC8T26)	2.25
MC68000L8	64	MPU 16-Bit (8MHz)	49.95
MC68488P	40	General Purpose Int. Adapter	9.95
MC68652P2	40	Multi. Protocol Comm. Controller	24.95
MC68661PB	28	Enhanced Prog. Comm. Int.	9.95
MCM68764	24	64K EPROM (450ns)	24.95
SY6522	40	Peripheral Inter. Adapter	7.95

8080A SERIES

INS8080A	40	CPU	2.95
TMS5501	40	Synchronous Data Interface (SIRC)	14.95
INS8154	40	128 Byte RAM 16-Bit I/O	13.95
INS82C06	20	Octal D Flip Flop Tri-State (74C374)	2.49
DP8212	24	8-bit Input/Output (74S412)	2.25
DP8214	24	Priority Interrupt Control	2.95
DP8216	16	Bi-Directional Bus Driver	1.95
DP8224	16	Clock Generator/Driver	2.25
DP8226	16	Bus Driver	2.25
DP8228	28	System Cont./Bus Driver (74S428)	3.49
DP8238	28	System Controller (74S438)	4.49
INS8243	24	I/O Expander for 48 Series	3.95
INS8245	18	16-Key Keyboard Encoder (74C922)	4.49
INS8246	20	20-Key Keyboard Encoder (74C923)	4.95
INS8247	28	Display Controller (74C911)	8.95
INS8248	28	Display Controller (74C912)	8.95
INS8250N	40	Asyn. Comm. Element	10.95
DP8251	28	Prog. Comm. I/O (USART)	4.49
DP8253	24	Prog. Interval Timer	6.95
DP8255	40	Prog. Peripheral I/O (PPI)	4.49
DP8257	40	Prog. DMA Control	5.95
DP8259	28	Prog. Interrupt Control	6.95
DP8275	40	Prog. CRT Controller	29.95
DP8279	40	Prog. Keyboard/Display Interface	8.95
DP8303	20	8-Bit Tri-State Bi-Directional Trans.	3.95
DP8304	20	8-bit Bi-Directional Receiver	2.95
DP8307	20	8-bit Bi-Directional Receiver	2.95
DP8308	20	8-bit Bi-Directional Receiver	2.95
DP8310	20	Octal Latched Peripheral Driver	4.95
DP8311	20	Octal Latched Peripheral Driver	4.95

DISK CONTROLLERS

INS1771-1	40	Single Density	16.95
FD1791	40	Single/Dual Density (inv.)	29.95
FD1793	40	Single/Double Density (True)	29.95
FD1795	40	Dual Density/Side Select (Inv.)	29.95
FD1797	40	Dual Density/Side Select True	29.95

SPECIAL FUNCTION

DS0025CN	8	Dual MOS Clock Driver (5MZ)	2.49
DS0026CN	8	Dual MOS Clock Driver (5MZ)	1.95
INS2651	28	Communication Chip	8.95
MM58167AN	24	Microprocessor Real Time Clock	8.95
MM58174AN	16	Micro. Compatible Time Clock	7.95
COP402N	40	Microcontroller w/64-digit RAM and Direct LED Drive	5.95
COP402MN	40	Microprocessor w/64-digit RAM & Direct LED Drive w/N Buss Int.	5.95
COP470N	20	32-seg VAC Fluor. Drvr. (20-pin pkg.)	3.25
IDM2909AJC	28	Microprocessor Sequencer	7.95
MM5369EST	8	Prog. Oscillator/Divider (100Hz)	1.95

DYNAMIC RAMS

Part No.	**Pins		Price
1103	18	1024x1 (300ns)	.99
4027	16	4096x1 (250ns)	2.49
4116N-2	16	16,384x1 (150ns)	1.89 - 8/14.95
4116N-3	16	16,384x1 (200ns)	1.69 - 8/12.95
4116N-4	16	16,384x1 (250ns)	1.49 - 8/10.95
4164N-150	16	65,536x1 (150ns)	6.95 - 8/49.95
4164N-200	16	65,536x1 (200ns)	5.95 - 8/44.95
MM5261	18	1024x1 (300ns)	.49 - 8/1.95
MM5262	22	2048x1 (365ns)	.49 - 8/1.95
MM5270	18	4096x1 (250ns) MK4096	4.95
MM5280	22	4096x1 (200ns) 2107	3.95
MM5290-2	16	16,384x1 (150ns)	1.89 - 8/14.95
MM5290-3	16	16,384x1 (200ns)	1.69 - 8/12.95
MM5290-4	16	16,384x1 (250ns)	1.49 - 8/10.95
MM5298-3	16	8192x1 (200ns)	1.69

STATIC RAMS

1101	16	256x1 (650ns)	1.49
2101	22	256x4 (450ns) 8101	2.49
2102	16	1024x1 (350ns)	.89
21L02	16	1024x1 (450ns) L.P.	1.49
2111	18	256x4 (450ns) 8111	2.95
2112	16	256x4 (450ns) MOS	1.95
2114	18	1024x4 (450ns)	1.49 - 8/9.95
2114L	18	1024x4 (450ns) L.P.	1.95 - 8/13.95
2114-2	18	1024x4 (200ns)	1.75 - 8/11.95
2114L-2	18	1024x4 (200ns) L.P.	2.25 - 8/14.95
2147	18	4096x1 (70ns)	4.95
2148	18	1024x4 (70ns)	4.95
TMS4045	18	1024x4 (450ns)	3.95
5101	22	256x4 (450ns) CMOS	2.95
MM5257	18	4096x1 (450ns) 4044	4.95
HM6116P-3	24	2048x8 (150ns) CMOS	5.95
HM6116-4	24	2048x8 (200ns) CMOS	4.95
HM6116LP-4	24	2048x8 (200ns) L.P. CMOS	5.49
HM6264P-15	28	8192x8 (150ns) CMOS	39.95
7489	16	16x4 (50ns) 3101	2.25
74C920	22	256x4 (250ns)	3.95
74C921	18	256x4 (250ns) CMOS	3.95
74C929	16	1024x1 (250ns) CMOS (6501)	3.95
74C930	18	1024x1 (250ns) CMOS (6518)	3.95
74S189	16	16x4 (35ns) 93405	1.95
74S200	16	256x1 (80ns) 93410	3.95
74S206	16	256x1 (60ns) 93411	3.95
74S289	16	16x4 (35ns) 3101	2.25
82S10	16	1024x1 (50ns) O.C. (93415)	3.95
82S25	16	16x4 (50ns) O.C. (74S289)	2.25

PROMS/EPROMS

1702A	24	256x8 (1us)	4.95
2708	24	1024x8 (450ns)	3.95
2708-5	24	1024x8 (550ns) SM00246	2.95
TMS2516	24	2048x8 (450ns) 2716	5.95
TMS2532	24	4096x8 (450ns) NMC2532	6.95
TMS2564	28	8192x8 (450ns)	14.95
TMS2716	24	2048x8 (450ns) 3 voltage	9.95
2716	24	2048x8 (450ns)	4.95
2716-1	24	2048x8 (350ns)	5.95
27160-5	24	2048x8 (550ns)	4.49
2732	24	4096x8 (450ns)	6.95
2732A-3	24	4096x8 (300ns) 21V	7.95
2732A-4	24	4096x8 (450ns) 21V	6.95
2732D-4	24	4096x8 (550ns) 25V	5.95
27580-A	24	1024x8 (450ns)	2.95
2764-4	28	8192x8 (450ns)	9.95
2764-3	28	8192x8 (300ns)	14.95
MCM68764	24	8192x8 (450ns)	24.95
27128	28	16,384x8 (450ns) 128K EPROM	59.95
74S188	16	32x8 PROM O.C. (6330-1)	1.49
74S287	16	256x4 PROM T.S. (6301-1)	1.95
74S288	16	32x8 PROM T.S. (6331-1)	1.95
74S471	20	256x8 PROM T.S. (6309-1)	5.95
74S472	20	512x8 PROM T.S. (6349-1)	4.95
74S473	20	512x8 PROM O.C. (6348)	4.95
74S474	24	512x8 PROM T.S. (DM87S296N)	4.95
74S570	16	512x4 PROM O.C. (6305)	2.95
74S571	16	512x4 PROM T.S. (6306)	2.95
74S572	18	1024x4 PROM O.C. (6352)	4.95
74S573	18	1024x4 PROM T.S. (82S137)	4.95
82S23	16	32x8 PROM O.C. (27S18)	2.95
82S115	24	512x8 PROM T.S. (27S15)	9.95
82S123	16	32x8 PROM T.S. (27S19)	2.95
82S126	16	256x4 PROM O.C. (27S20)	2.95
82S129	16	256x4 PROM T.S. (27S21)	2.95
82S130	16	512x4 PROM O.C. (27S12)	3.95
82S185	18	2048x4 PROM T.S. (TBP24S81)	9.95
DM87S180N	24	1024x8 PROM O.C. (82S180)	9.95
DM87S181N	24	1024x8 PROM T.S. (82S181)	9.95
DM87S184N	18	2048x4 PROM O.C. (82S184)	9.95
DM87S185N	18	2048x4 PROM T.S. (82S185)	9.95
DM87S190N	24	2048x8 PROM O.C. (82S190)	14.95
DM87S191N	24	2048x8 PROM T.S. (82S191)	14.95

DATA ACQUISITION

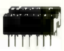
DC10		Mostek DC/DC Convert. +5V to -9V	2.95
MC3470P	18	Floppy Disk Read AMP System	4.95
MC1408L7	16	7-bit D/A Converter (DAC0807LCN)	1.49
MC1408L8	16	8-bit D/A Converter (DAC0808LCN)	1.95
ADC0803LCN	20	8-bit A/D Converter (±1/2LSB)	3.49
ADC0804	20	8-bit A/D Converter (1LSB)	3.49
DAC0806	16	6-bit D/A Converter (0.78% Lin.)	1.95
DAC0809	28	8-bit A/D Converter (8-Ch. Multi.)	4.49
ADC0817	40	8-bit A/D Converter (16-Ch. Multi.)	9.95
DAC1000	24	10-bit D/A Conv. Micro. Comp. (0.05%)	7.95
DAC1008	20	10-bit D/A Conv. Micro. Comp. (0.20%)	6.95
DAC1020	16	10-bit D/A Conv. (0.05% Lin.)	7.95
DAC1022	16	10-bit D/A Conv. (0.20% Lin.)	5.95
DAC1222	18	12-bit D/A Conv. (0.20% Lin.)	6.95
LM334Z		Constant Current Source	1.19
LM335Z		Temperature Transducer	1.40
LM399H		Temp. Comp. Prec. Ref. (.5ppm/C°)	5.00
AY-5-1013A	40	30K Baud Uart (TR1602)	3.95

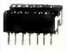
QUALITY COMPONENTS AT AFFORDABLE PRICES!

LOW PROFILE (TIN) SOCKETS

	1-9	10-99	100-up
8 pin LP	.16	.14	.13
14 pin LP	.17	.15	.14
16 pin LP	.19	.17	.16
18 pin LP	.26	.24	.23
20 pin LP	.30	.27	.25
22 pin LP	.31	.28	.26
24 pin LP	.33	.30	.28
28 pin LP	.40	.37	.35
36 pin LP	.45	.42	.39
40 pin LP	.49	.46	.43


LP


SG


ST


WW

SOLDERTAIL (GOLD) STANDARD

	1-9	10-99	100-up
8 pin SG	.30	.27	.25
14 pin SG	.43	.39	.37
16 pin SG	.47	.43	.41
18 pin SG	.53	.49	.47
24 pin SG	.69	.65	.61
28 pin SG	.81	.76	.72
36 pin SG	1.09	1.03	.97
40 pin SG	1.21	1.14	1.08

SOLDERTAIL STANDARD (TIN)

	1-9	10-99	100-up
14 pin ST	.29	.27	.25
16 pin ST	.34	.32	.30
18 pin ST	.38	.36	.34
20 pin ST	.45	.43	.41
24 pin ST	.49	.46	.43
28 pin ST	.69	.67	.63
40 pin ST	.99	.95	.89

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-9	10-99	100-up
8 pin WW	.49	.45	.42
10 pin WW	.65	.62	.59
14 pin WW	.65	.62	.59
16 pin WW	.69	.65	.61
18 pin WW	.89	.85	.79
20 pin WW	1.09	1.05	.99
22 pin WW	1.25	1.19	1.15
24 pin WW	1.29	1.23	1.18
28 pin WW	1.59	1.50	1.45
36 pin WW	1.85	1.75	1.69
40 pin WW	1.99	1.89	1.79

$10.00 Minimum Order — U.S. Funds Only
California Residents Add 6½% Sales Tax
Shipping — Add 5% plus $1.50 Insurance
Send S.A.S.E. for Monthly Sales Flyer!

Spec Sheets — 30¢ each
Send $1.00 Postage for your
FREE 1984 JAMECO CATALOG
Prices Subject to Change

MasterCard — Mail Order Electronics • Worldwide — **Jameco ELECTRONICS** — VISA

1355 SHOREWAY ROAD, BELMONT, CA 94002

11/83 *PHONE ORDERS WELCOME — (415) 592-8097 Telex: 176043*

Digitalker™

DT1050 — Applications: Teaching aids, appliances, clocks, automotive, telecommunications, language translations, etc.

The DT1050 is a standard DIGITALKER kit encoded with 137 separate and useful words, 2 tones, and 5 different silence durations. The words and tones have been assigned discrete addresses, making it possible to output single words or words concatenated into phrases or even sentences. The "voice" output of the DT1050 is a highly intelligible male voice. Female and children's voices can be synthesized. The vocabulary is chosen so that it is applicable to many products and markets.

The DT1050 consists of a Speech Professor Chip, MM54104 (40-pin) and two (2) Speech ROMs MMS2164SSR1 and MM52164SSR2 (24-pin) along with a Master Word list and a recommended schematic diagram on the application sheet.

DT1050 Digitalker™ .... $34.95 ea.

DT1057 — Expands the DT1050 vocabulary from 137 to over 260 words. Incl. 2 ROMs and specs.

DT1057 .... $24.95 ea.

INTERSIL

* Evaluation Kits

Part No.	**Pins	Function	Price
7045IPI	28	CMOS Precision Timer	14.95
7045EV/Kit*	28	Stopwatch Chip, XTL	19.95
7106CPL	40	3½ Digit A/D (LCD Drive)	9.95
FE0203D		3½ Digit LCD Display for 7106 & 7116	19.95
7106EV/Kit*	40	IC, Circuit Board, Display	34.95
7107CPL	40	3½ Digit A/D (LED Drive)	11.95
7107EV/Kit*	40	IC, Circuit Board, Display	29.95
7116CPL	40	3½ Digit A/D LCD Dis. HLD.	16.95
7201IUS		Low Battery Volt Indicator	2.25
7205IPG	24	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	24	Stopwatch Chip, XTL	14.95
7206CJPE	16	Tone Generator	4.95
7206CEV/Kit*	16	Tone Generator Chip, XTL	7.95
7207AIPD	14	Oscillator Controller	5.95
7207AEV/Kit*	14	Freq. Counter Chip, XTL	7.95
7215IPG	24	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	24	4 Func. Stopwatch Chip, XTL	14.95
7216AIJI	28	8 Digit Univ. Counter C.A.	29.95
7216CIJI	28	8 Digit Freq. Counter C.A.	24.95
7216DIPI	28	8 Digit Freq. Counter C.C.	19.95
7217IJI	28	4 Digit LED Up/Down Counter C.A.	10.95
7217AIPI	28	4 Digit LED Up/Down Counter C.C.	11.95
7224IPL	40	LCD 4½ Digit Up Counter DRI	10.95
7226AIJL	40	8 Digit Univ. Counter	29.95
7226AEV/Kit*	40	5 Function Counter Chip, XTL	74.95

30009 1983 INTERSIL Data Book (1356 p.) **$9.95**

NEW PRODUCT! 74HC High Speed CMOS

74HC00	14	.59	74HC139	16	.99	74HC251	16	.89
74HC02	14	.59	74HC147	16	1.19	74HC253	16	.99
74HC03	14	.75	74HC151	16	.89	74HC257	16	.89
74HC04	14	.59	74HC153	16	.99	74HC259	16	1.49
74HCU04	14	.65	74HC154	24	2.49	74HC266	14	1.19
74HC08	14	.59	74HC157	16	.89	74HC273	20	2.89
74HC10	14	.59	74HC158	16	.89	74HC280	14	3.95
74HC11	14	.59	74HC160	16	1.29	74HC373	20	2.39
74HC14	14	.85	74HC161	16	1.29	74HC374	20	2.39
74HC20	14	.59	74HC162	16	1.29	74HC390	16	1.49
74HC27	14	.59	74HC163	16	1.29	74HC393	14	1.49
74HC32	14	.75	74HC164	14	1.29	74HC533	20	2.39
74HC42	16	.99	74HC165	16	2.79	74HC534	20	2.39
74HC51	14	.75	74HC173	16	1.69	74HC595	16	3.95
74HC58	14	.75	74HC174	16	.99	74HC688	20	3.19
74HC73	14	.79	74HC175	16	.99	74HC4002	14	.59
74HC74	14	.79	74HC192	16	1.39	74HC4017	16	2.19
74HC75	16	.89	74HC193	16	1.39	74HC4020	16	1.39
74HC76	16	.79	74HC194	16	1.09	74HC4024	14	1.59
74HC85	16	1.59	74HC195	16	1.09	74HC4040	16	1.39
74HC86	14	.69	74HC237	16	2.95	74HC4060	16	1.39
74HC107	14	.79	74HC240	20	1.95	74HC4075	14	.59
74HC109	16	.79	74HC241	20	1.95	74HC4078	14	.69
74HC112	16	.79	74HC242	14	1.95	74HC4511	16	2.69
74HC113	14	.79	74HC243	14	1.95	74HC4514	24	3.79
74HC132	14	.99	74HC244	20	1.95	74HC4538	16	2.39
74HC137	16	1.95	74HC245	20	2.49	74HC4543	16	3.49
74HC138	16	1.09						

74HCU04 is unbuffered. All others are buffered.

NEW Programmable Array Logic (PALS)

Part No.	**Pins	Function	Price
PAL10H8	20	Octal 10-Input AND-OR Gate Array (High Output)	$3.95
PAL12H6	20	Hex 12-Input AND-OR Gate Array (High Output)	3.95
PAL14H4	20	Quad 14-Input AND-OR Gate Array (High Output)	3.95
PAL10L8	20	Octal 10-Input AND-OR-Invert Gate Array (Low Output)	3.95
PAL12L6	20	Hex 12-Input AND-OR-Invert Gate Array (Low Output)	3.95
PAL14L4	20	Quad 14-Input AND-OR-Invert Gate Array (Low Output)	3.95
PAL16L8	20	Octal 16-Input AND-OR-Invert Gate Array	9.95
PAL16R8	20	Octal 16-Input Register AND-OR Gate Array	7.95
PAL16R6	20	Hex 16-Input Register AND-OR Gate Array	7.95
PAL16R4	20	Quad 16-Input Register AND-OR Gate Array	7.95

30012 1982 NATIONAL PAL Data Book (176p.) .. **$5.95**

74C—C/MOS

74C00	14	.35	74C95	14	1.39	74C221	16	1.95
74C02	14	.35	74C107	14	.89	74C240	20	1.95
74C04	14	.29	74C151	16	2.49	74C244	20	1.95
74C08	14	.35	74C154	24	3.49	74C373	20	2.49
74C10	14	.35	74C157	16	2.25	74C374	20	2.49
74C14	14	.69	74C160	16	1.19	74C901	14	.59
74C20	14	.35	74C161	16	1.19	74C903	14	.59
74C30	14	.35	74C162	16	1.19	74C906	14	.59
74C32	14	.39	74C163	16	1.19	74C911	28	8.95
74C42	16	1.39	74C164	14	1.49	74C912	28	8.95
74C48	16	1.95	74C173	16	1.19	74C915	18	1.19
74C73	14	.79	74C174	16	1.19	74C917	28	8.95
74C74	14	.69	74C175	16	1.19	74C922	18	4.49
74C85	16	1.95	74C192	16	1.49	74C923	20	4.95
74C86	14	.39	74C193	16	1.69	74C925	16	5.95
74C89	16	5.95	74C195	16	1.39	74C926	18	5.95
74C90	14	1.19				80C95	16	.69
74C93	14	1.19				80C97	16	.69

LINEAR

TL071CP	8	.79	LM340T-5		.79	LM723N	14	.55
TL072CP	8	1.39	LM340T-12		.79	LM733N	14	1.00
TL074CN	14	1.95	LM340T-15		.79	LM739N	14	1.95
TL081CP	8	.59	LF347N	14	1.49	LM741CN	8	.35
TL082CP	8	1.19	LM348N	14	.99	LM747N	14	.69
TL084CN	14	1.95	LM350K		4.95	LM748N	8	.59
LM301CN	8	.35	LF355N	8	1.10	LM1310N	14	1.49
LM302H		1.95	LF356N	8	1.10	LM1458CN	8	.59
LM304H		1.95	LM370N	14	4.49	LM1488N	14	.89
LM305H		.99	LM373N	14	3.95	LM1489N	14	.89
LM307CN	8	.45	LM377N	14	1.95	LM1496N	14	1.95
LM308CN	8	.69	LM380N	14	.89	LM1800N	16	2.49
LM309K		1.25	LM381N	14	1.79	LM1871N	18	2.95
LM310CN	8	1.75	LM382N	14	1.39	LM1872N	18	3.25
LM311CN	8	.69	LM384N	14	1.79	LM1877N-9	14	2.49
LM312H		2.49	LM386N-3	8	.89	LM1889N	18	2.25
LM317T		1.19	TL494CN	16	3.95	LM1896N	14	2.95
LM317K		3.95	TL496CP	8	1.19	LM2002T		1.95
LM318CN	8	1.95	NE531V	8	2.95	LM3189N	16	1.59
LM319N	14	1.95	NE544N	14	2.95	LM3900N	14	.59
LM320K-5		1.35	NE550A	14	1.95	LM3905CN	8	1.19
LM320K-12		1.35	NE555V	8	.35	LM3909N	8	.99
LM320K-15		1.35	LM556N	14	.69	LM3914N	18	2.95
LM320T-5		.89	NE564N	16	2.95	LM3915N	18	2.95
LM320T-12		.89	LM565N	14	1.19	LM3916N	18	2.95
LM320T-15		.89	LM566CN	8	1.49	RC4136N	14	1.25
LM323K		5.95	LM567V	8	.99	RC4151NB	8	1.95
LM324N	14	.59	NE570N	16	3.95	RC4194TK		4.49
LM337T		1.95	LM703CN	8	1.19	NE5532	8	2.49
LM338K		6.95	LM709N	14	.49	NE5534	8	1.69
LM339N	14	.69	LM710N	14	.69	ICL8038B	14	3.95
LM340K-5		1.35	LM711N	14	.79	LM13080N	8	1.19
LM340K-12		1.35				LM13600N	16	1.19
LM340K-15		1.35						

MORE AVAILABLE

30003 1982 Nat. Linear Data Book (1952 pgs.) . **$11.95**

Circle No. 21 on Free Information Card

NEW! Let Colonel Byte take your child on a trip through Cybernia

They'll learn all about computers along the way!

Growing up in the computer world will be easier if your child understands computers. And there's no better place to start than with the computer that's in your home—and with the help of this delightful book.

Computer Parade traces the adventures of Katie and her brother after they fall into the family computer. It reads like a story book. Yet it actually teaches the basics of computer operation.

Any youngster age 4-10 will delight in *Computer Parade*. It's easy to read and richly illustrated in full color.

Help your child grow up computer literate by ordering your copies now.

MAIL TODAY TO: **CREATIVE COMPUTING PRESS**
Dept. NB8Q 39 East Hanover Avenue, Morris Plains, NJ 07950
Please send me______ copies of *Computer Parade* for $9.95 each, plus $2.00 shipping & handling per book. Total Amount $______
☐ Payment Enclosed. (CA, NJ and NY State residents please add applicable sales tax.)
☐ Charge my: ☐ American Express ☐ MasterCard ☐ Visa

Card #______ Exp.______

Signature______

NAME______
(please print)

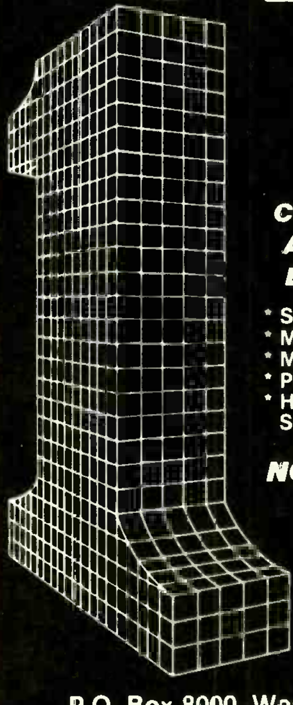
ADDRESS______

CITY______ STATE______ ZIP______

*Outside U.S., add $3 for shipping and handling.
☐ Check here to receive a FREE catalog of computing books, magazines and guides.
Also available in your local bookstore or computer store.

For Faster Service,
PHONE TOLL FREE: 800-631-8112
(In NJ only: 201-540-0445)

Active Electronics



NUMBER ONE IN QUALITY SERVICE AVAILABILITY

THE WORLD'S MOST COMPLETE PROFESSIONAL AND HOME ELECTRONICS ENTHUSIAST INVENTORY

- Semiconductors + Memories
- Microprocessors + Support Circuits
- Microcomputer Systems + Peripherals
- Passive Electronic Components
- Hand Tools, Wire Wrapping, Soldering Equipment + Hardware

NOW AVAILABLE — FREE
1983 80-page catalog
A complete listing of products and specifications

Call, write or circle the inquiry card for your free copy today.

P.O. Box 8000, Westboro, Mass. 01581
CALL TOLL FREE: 1-800-343-0874
Mass customers call (617) 366-0500

Circle No. 50 on Free Information Card

QUALITY COMPONENTS – *NOT MAIL ORDER "SECONDS"*

Send SASE for FREE Flyer or send $1.00 postage and handling for FREE COMPLETE CATALOG which includes coupon for $1.00 OFF purchase.

ARIES ZERO INSERTION FORCE SOCKETS –

cam actuated, true zero insertion – tin plated solder tail pins – capable of being plugged into dip sockets, including wire wrap.

Stock No.	No. of Pins	1-9	10-49	50
11055	24	4.98	$4.35	$3.90
11056	28	5.15	4.50	4.05
11057	40	6.81	5.95	5.35
11058	64	12.02	10.50	9.45

IC-KOOLERS™ from UNITRACK®

dissipate over 2 watts of heat from IC's, producing longer life and better performance. Just push IC-Kooler on – heat is collected from top and bottom of IC and dissipated. Won't shake loose!

Stock No.	No. Pins in IC	Price
22225	14	$.29
22226	16	.29
22228	18-20	.29

MIC 6000Z DIGITAL MULTIMETER

Single rotary switch operation. Large, easy to read .5" 3½ digit display. 800 hours operating life with single 9v battery. Seven functions—(DC Volts, DC Amps, Ohms, AC Volts, AC Amps, Diode and Resistor Junction, Audible Continuity Check)

Stock No. 62503 **$75.00**
Full 1 year warranty

Stock No. 62504 Carrying case with belt loop **$10.00**

WILD ROVER

Touch switch capsule. Operating motion is .005" without the use of a levered arm. Extremely fast on and off with low noise. Normally open – rated 115 VAC 1.6 amp-30 milliohm resistance – .615 radius by .160 thick

Stock No.	1-9	10 & Up
12098	$1.42	$1.28

60/40 ROSIN CORE SOLDER

Stock No	Dia	Length (feet)	Weight (oz.)	Price
50075	.062	9	1.5	$1.16
50076	.062	25	4	2.39
50077	.062	50	8	4.25
50078	.032	33	1.5	1.31
50079	.032	88.5	4	2.47
50080	.032	175	8	4.57

TI WIRE WRAP SOCKETS

Tin plated phosphor bronze contact – 3 wrap

Stock No.	No Pins	1-99	100-499	500
11301	8	$.40	$.36	$.30
11302	14	.59	.54	.45
11303	16	.64	.58	.48
11304	18	.73	.66	.55
11305	20	.99	.90	.75
11306	22	1.12	1.02	.85
11307	24	1.25	1.14	.95
11308	28	1.52	1.38	1.15
11309	40	2.05	1.86	1.55

TI LOW PROFILE SOCKETS

Tin plated copper alloy 688 contact pins with gas tight seal

Stock No.	No Pins	1-24	25-99	100-999
11201	8	$.10	$.09	$.08
11202	14	.14	.13	.12
11203	16	.16	.15	.14
11204	18	.18	.17	.15
11205	20	.20	.18	.16
11206	22	.22	.20	.18
11207	24	.24	.22	.20
11208	28	.28	.26	.25
11209	40	.40	.37	.33

EKI KITS come with all parts necessary to assemble!

- Stock No. 88844 TV Jammer Kit "wipes out" your TV screen .... **$ 7.71**
- Stock No. 88850 Whooper Alarm Kit makes a great alarm or siren..... **$11.33**

MANY, MANY MORE KITS AVAILABLE IN FULL LINE CATALOG

ELPAC POWER SUPPLIES – DC/DC CONVERTERS

SINTEC Stock No. 300 MW Type	ELPAC No.	Input Voltage (VDC)	Output Voltage (VDC)	Output Current (MA)	Dimensions (HxWxD) in Inches	Price
13825	CB3801	3.0-7.0	12±0.6	0-25	.48x.51x3.05	$ 7.95
13826	CB3811	3.0-7.0	-12±0.6	0-25	.48x.51x3.05	7.95
13827	CB3802	3.0-7.0	15±0.7	0-20	.48x.51x3.05	7.95
13828	CB3812	3.0-7.0	-15±0.7	0-20	.48x.51x3.05	7.95
13829	CB3804	3.0-7.0	28±0.7	0-10	.48x.51x3.05	7.95
13830	CB3814	3.0-7.0	-28±0.7	0-10	.48x.51x3.05	7.95
1.5 W TYPE:						
13831	CL3801	4.0-7.0	12±0.6	125	.651x1.2x1.77	$24.95
13832	CL3811	4.0-7.0	-12±0.6	125	.651x1.2x1.77	24.95
13833	CL3802	4.0-7.0	15±0.7	100	.651x1.2x1.77	24.95
13834	CL3812	4.0-7.0	-15±0.7	100	.651x1.2x1.77	24.95
13835	CL3804	4.0-7.0	28±1.4	50	.651x1.2x1.77	24.95
13836	CL3814	4.0-7.0	-28±1.4	50	.651x1.2x1.77	24.95
13825-1	DATA SHEET FOR DC/DC CONVERTERS					.25

Special of the Month!

CONTACT ELECTRONICS D-SUBMINIATURE CONNECTORS (RS232)

Stock No.	Description	Price
11354	25 Male solder cup	$1.65
11355	25 Female solder cup	2.45

OPCOA

Single Digit Displays – Common Cathode

Stock No.	Color	1	100
12082	Red	$1.12	$ .99
12085	Green	1.84	1.63
12087	Yellow	1.92	1.70
12089	Orange	2.08	1.84

LEFT DECIMAL POINT — RIGHT DECIMAL POINT

Right Angle Socket for Above Displays

Stock No.	1	100
11010	$1.24	$ .99

The Battery Just Wrap™ Tool

New battery powered tool wraps insulated wire around .025 square posts without need for pre-cutting and pre-stripping. Complete with bit and 100 ft. 30 AWG wire

Stock No	Description	Price
13340	Battery just wrap tool with bit and 100 ft. 30 AWG wire	$49.95
13341	Replacement bit	9.95
13342	100 ft. blue replacement wire	6.95
13343	100 ft. white replacement wire	6.95
13344	100 ft. yellow replacement wire	6.95
13345	100 ft. red replacement wire	6.95

MINI-DRILL

This portable hand drill is appropriate for circuit board drilling. Runs at 2,500 RPM on 4 "AA" batteries (not included). Supplied with one .039 dia. drill bit. Drill stand is designed like a drill press for precise hole drilling.

Stock No	Description	Price
13346	Hand drill with .039 dia. bit (no batteries)	$24.95
13347	Replacement bits, 2 each of .040 and .060 dia.	5.95
13348	Drill stand	13.95

PIN FORMING TOOL

puts IC's on their true row to row spacing. One side is for .300 centers. Flip tool over for devices on .600 centers. Put device in tool and squeeze.

ONE TOOL DOES 8 thru 40 PINS!

NEW! ANTI-STATIC MODEL Stock No. 10200 $14.95

Stock No. 11059 $12.95

OPTEL LCD's with pins

.1.8:8.8 Stock No. 47005

8.8:8.8 Stock No. 47006

88:88 Stock No. 47007

Stock No.	Description	1	10
47005	3½ dig, .5"	$ 5.95	$ 5.50
47006	4 dig, .5"	5.95	5.50
47007	4 dig, .7"	11.90	11.00

OK MACHINE AND TOOL

IC INSERTION/ EXTRACTION KIT

Includes DIP IC extractors and inserters to accommodate all ICs from 14 to 40 pins. Tools that engage conductive surfaces are CMOS safe and include grounding lugs. Stock No 13309 **$37.74**

SOCKET WRAP ID

DIP socket sized plastic panels with numbered holes in pin locations. Slip onto socket before wire wrapping to identify pins. Also write on them for location, IC part number, function, etc. Simplifies initial wire wrapping, troubleshooting and repair.

13295	14 pin
13296	16 pin
13297	18 pin
13298	20 pin
13299	22 pin
13300	24 pin
13301	28 pin
13302	40 pin
13303	36 pin

$1.82 per pack

IC EXTRACTOR

One-piece, spring steel construction. Will extract all LSI, MSI and SSI devices with 8 to 24 pins. Stock No. 13313 **$2.10**

SINTEC CO. 28 8th Ave., Box 410 Frenchtown, NJ 08825

VISA MasterCard

TOLL FREE 800-526-5960 in NJ (201) 996-4093

We accept VISA, MC, C.O.D., CHECK, or M.O.
*INCLUDE SHIPPING CHARGES - 0 to $100. - $3.00, $100. to $250. - $4.00, over $250. - $5.00

Circle No. 36 on Free Information Card

Circle No. 14 on Free Information Card

DoKay

COMPUTER PRODUCTS, Inc.

ORDER TOLL FREE

(800) 538-8800

(CALIFORNIA RESIDENTS)

(800) 848-8008

VISA MasterCard

TERMS: For shipping include $2.00 for UPS Ground or $3.00 for UPS Blue Air. $10.00 minimum order. Bay Area and Los Angeles Counties add 6½% Sales Tax, other California residents add 6% Sales Tax. We reserve the right to limit quantities and substitute manufacturer. Prices subject to change without notice.

VISIT OUR RETAIL STORE

2100 De La Cruz Blvd.
Santa Clara, CA 95050
(408) 988-0697

DoKay

STATIC RAMS

2101	256 x 4 (450ns)	1.90
5101	256 x 4 (450ns) (cmos)	3.90
2102-1	1024 x 1 (450ns)	.88
2102L-4	1024 x 1 (450ns) (LP)	.98
2102L-2	1024 x 1 (250ns) (LP)	1.45
2111	256 x 4 (450ns)	2.45
2112	256 x 4 (450ns)	2.95
2114	1024 x 4 (450ns)	8/9.90
2114-25	1024 x 4 (250ns)	8/9.95
2114L-4	1024 x 4 (450ns) (LP)	8/11.95
2114L-3	1024 x 4 (300ns) (LP)	8/12.45
2114L-2	1024 x 4 (200ns) (LP)	8/12.95
2147	4096 x 1 (55ns)	4.90
TMS4044-4	4096 x 1 (450ns)	3.45
TMS4044-3	4096 x 1 (300ns)	3.95
TMS4044-2	4096 x 1 (200ns)	4.45
MK4118	1024 x 8 (250ns)	9.90
TMM2016-200	2048 x 8 (200ns)	4.10
TMM2016-150	2048 x 8 (150ns)	4.90
TMM2016-100	2048 x 8 (100ns)	6.10
HM6116-4	2048 x 8 (200ns) (cmos)	4.70
HM6116-3	2048 x 8 (150ns) (cmos)	4.90
HM6116-2	2048 x 8 (120ns) (cmos)	8.90
HM6116LP-4	2048 x 8 (200ns) (cmos)(LP)	5.90
HM6116LP-3	2048 x 8 (150ns) (cmos)(LP)	6.90
HM6116LP-2	2048 x 8 (120ns) (cmos)(LP)	9.95
Z-6132	4096 x 8 (300ns) (Qstat)	33.95

LP = Low Power   Qstat = Quasi-Static

DYNAMIC RAMS

TMS4027	4096 x 1 (250ns)	1.95
UPD411	4096 x 1 (300ns)	2.95
MM5280	4096 x 1 (300ns)	2.95
MK4108	8192 x 1 (200ns)	1.90
MM5298	8192 x 1 (250ns)	1.80
4116-300	16384 x 1(300ns)	8/10.75
4116-250	16384 x 1(250ns)	8/10.95
4116-200	16384 x 1(200ns)	8/11.95
4116-150	16384 x 1(150ns)	8/13.95
4116-120	16384 x 1(120ns)	8/28.95
2118	16384 x 1(150ns) (5v)	4.90
4164-200	65536 x 1(200ns) (5v)	5.90
4164-150	65536 x 1(150ns) (5v)	6.90

5V = single 5 volt supply

EPROMS

1702	256 x 8 (1us)	4.45
2708	1024 x 8 (450ns)	3.90
2758	1024 x 8 (450ns) (5v)	5.90
2716	2048 x 8 (450ns) (5v)	3.90
2716-1	2048 x 8 (350ns) (5v)	5.90
TMS2516	2048 x 8 (450ns) (5v)	5.45
TMS2716	2048 x 8 (450ns)	7.90
TMS2532	4096 x 8 (450ns) (5v)	5.90
2732	4096 x 8 (450ns) (5v)	4.90
2732-250	4096 x 8 (250ns) (5v)	8.90
2732-200	4096 x 8 (200ns) (5v)	10.95
2764	8192 x 8 (450ns) (5v)	9.90
2764-250	8192 x 8 (250ns) (5v)	13.95
2764-200	8192 x 8 (200ns) (5v)	23.95
TMS2564	8192 x 8 (450ns) (5v)	16.95
MC68764	8192 x 8 (450ns) (5v)(24 pin)	38.95
27128	16384 x 8Call	Call

5v = Single 5 Volt Supply

74LS00

74LS00	.23	74LS173	.68
74LS01	.24	74LS174	.54
74LS02	.24	74LS175	.54
74LS03	.24	74LS181	2.10
74LS04	.23	74LS189	8.90
74LS05	.24	74LS190	.88
74LS08	.27	74LS191	.88
74LS09	.28	74LS192	.78
74LS10	.24	74LS193	.78
74LS11	.34	74LS194	.68
74LS12	.34	74LS195	.68
74LS13	.44	74LS196	.78
74LS14	.58	74LS197	.78
74LS15	.34	74LS221	.88
74LS20	.24	74LS240	.94
74LS21	.28	74LS241	.98
74LS22	.24	74LS242	.98
74LS26	.28	74LS243	.98
74LS27	.28	74LS244	1.25
74LS28	.34	74LS245	1.45
74LS30	.24	74LS247	.74
74LS32	.28	74LS248	.98
74LS33	.54	74LS249	.98
74LS37	.34	74LS251	.58
74LS38	.34	74LS253	.58
74LS40	.24	74LS257	.58
74LS42	.48	74LS258	.58
74LS47	.74	74LS259	2.70
74LS48	.74	74LS260	.58
74LS49	.74	74LS266	.54
74LS51	.24	74LS273	1.45
74LS54	.28	74LS275	3.30
74LS55	.28	74LS279	.48
74LS63	1.20	74LS280	1.95
74LS73	.38	74LS283	.68
74LS74	.34	74LS290	.88
74LS75	.38	74LS293	.88
74LS76	.38	74LS295	.98
74LS78	.48	74LS298	.88
74LS83	.59	74LS299	1.70
74LS85	.68	74LS323	3.45
74LS86	.38	74LS324	1.70
74LS90	.54	74LS352	1.25
74LS91	.88	74LS353	1.25

74LS92	.54	74LS363	1.30
74LS93	.54	74LS364	1.90
74LS95	.74	74LS365	.48
74LS96	.88	74LS366	.48
74LS107	.38	74LS367	.44
74LS109	.38	74LS368	.44
74LS112	.38	74LS373	1.35
74LS113	.38	74LS374	1.35
74LS114	.38	74LS377	1.35
74LS122	.44	74LS378	1.13
74LS123	.78	74LS379	1.30
74LS124	2.85	74LS385	1.85
74LS125	.48	74LS386	.44
74LS126	.48	74LS390	1.15
74LS132	.58	74LS393	1.15
74LS133	.58	74LS395	1.15
74LS136	.38	74LS399	1.45
74LS137	.98	74LS424	2.90
74LS138	.54	74LS447	.36
74LS139	.54	74LS490	1.90
74LS145	1.15	74LS624	3.95
74LS147	2.45	74LS640	2.15
74LS148	1.30	74LS645	2.15
74LS151	.54	74LS668	1.65
74LS153	.54	74LS669	1.85
74LS154	1.85	74LS670	1.45
74LS155	.68	74LS674	9.60
74LS156	.68	74LS682	3.15
74LS157	.64	74LS683	3.15
74LS158	.58	74LS684	3.15
74LS160	.68	74LS685	3.15
74LS161	.64	74LS688	2.35
74LS162	.68	74LS689	3.15
74LS163	.64	74LS783	23.95
74LS164	.68	81LS95	1.45
74LS165	.94	81LS96	1.45
74LS166	1.90	81LS97	1.45
74LS168	1.70	81LS98	1.45
74LS169	1.70	25LS2521	2.75
74LS170	1.45	25LS2569	4.20

6500

1MHZ

6502	4.90
6504	6.90
6505	8.90
6507	9.90
6520	4.30
6522	7.90
6532	9.90
6545	21.50
6551	10.85

2 MHZ

6502A	6.90
6522A	9.90
6532A	10.95
6545A	26.95
6551A	10.95

3 MHZ

6502B	13.95

6800

68000	58.95
6800	3.90
6802	7.90
6808	12.90
6809E	18.95
6809	10.95
6810	2.90
6820	4.30
6821	3.20
6828	13.95
6840	11.95
6843	33.95
6844	24.95
6845	13.95
6847	10.95
6850	3.20
6852	15.70
6860	9.90
6862	10.95
6875	6.90
6880	2.20
6883	21.95
68047	23.95
68488	18.95

6800 1MHZ

68B00	9.95
68B02	21.25
68B09E	28.95
68B09	28.95
68B10	6.90
68B21	6.90
68B45	18.95
68B50	5.90

8000

8035	5.90
8039	6.90
INS-8060	16.95
INS-8073	23.95
8080	3.90
8085	5.90
8085A-2	10.95
8086	28.95
8087	CALL
8088	38.95
8089	88.95
8155	6.90
8155-2	7.90
8156	6.90
8185	28.95
8185-2	38.95
8741	38.95
8748	23.95
8755	23.95

8200

8202	23.95
8203	38.95
8205	3.45
8212	1.75
8214	3.80
8216	1.70
8224	2.20
8226	1.75
8228	3.45
8237	18.95
8237-5	20.95
8238	4.45
8243	4.40
8250	9.95
8251	4.45
8253	6.90
8253-5	7.90
8255	4.45
8255-5	5.20
8257	7.90
8257-5	8.90
8259	6.85
8259-5	7.45
8271	38.95
8272	38.95
8275	28.95
8279	8.90
8279-5	9.00
8272	6.45
8283	6.45
8284	5.45
8286	6.45
8287	6.45
8288	24.00
8289	48.95

Z-80

2.5 Mhz

Z80-CPU	3.90
Z80-CTC	4.45
Z80-DART	9.95
Z80-DMA	13.95
Z80-PIO	4.45
Z80-SIO/0	15.95
Z80-SIO/1	15.95
Z80-SIO/2	15.95
Z80-SIO/9	15.95

4.0 Mhz

Z80A-CPU	4.90
Z80A-CTC	4.90
Z80A-DART	10.95
Z80A-DMA	15.95
Z80A-PIO	4.90
Z80A-SIO/0	15.95
Z80A-SIO/1	15.95
Z80A-SIO/2	15.95
Z80A-SIO/9	15.95

6.0 Mhz

Z80B-CPU	12.95
Z80B-CTC	12.95
Z80B-PIO	12.95
Z80B-DART	18.95

ZILOG

Z6132	33.95
Z8671	38.95

DISC CONTROLLERS

1771	15.95
1791	23.95
1793	25.95
1795	48.95
1797	48.95
2791	53.95
2793	53.95
2795	58.95
2797	58.95
6843	33.95
8272	38.95
UPD765	38.95
MB8876	28.95
MB8877	33.95
1691	16.95
2143	17.95

UARTS

AY3-1014	6.90
AY5-1013	3.90
AY3-1015	6.90
PT-1472	9.90
TR1602	3.90
2350	9.90
2651	8.90
TMS6011	5.90
IM6402	7.90
IM6403	8.90
INS8250	9.95

INTERFACE

8T26	1.54
8T28	1.84
8T95	.88
8T96	.88
8T97	.88
8T98	.88
DM8131	2.90
DP8304	2.24
DS8835	1.94
DS8836	.98

VOLTAGE REGULATORS

7805T	.74	7905T	.84
78MO5C	.34	7908T	.84
7808T	.74	7912T	.84
7812T	.74	7915T	.84
7815T	.74	7924T	.84
7824T	.74	7905K	1.44
7805K	1.34	7912K	1.44
7812K	1.34	7915K	1.44
7815K	1.34	7924K	1.44
7824K	1.34	79L05	.78
78L05	.68	79L12	.78
78L12	.68	79L15	.78
78L15	.68	LM323K	4.90
78H05K	9.90	UA78S40	1.90
78H12K	9.90		

C,T = TO-220 K = TO-3 L = TO-92

DIP SWITCHES

4 POSITION	.84
5 POSITION	.89
6 POSITION	.89
7 POSITION	.94
8 POSITION	.94

IC SOCKETS

	1-99	100
8 pin ST	.12	.10
14 pin ST	.14	.11
16 pin ST	.16	.12
18 pin ST	.19	.17
20 pin ST	.28	.26
22 pin ST	.29	.26
24 pin ST	.29	.26
28 pin ST	.39	.31
40 pin ST	.48	.38
64 pin ST	4.20	call

ST = SOLDERTAIL

	1-99	100
8 pin WW	.58	.48
14 pin WW	.68	.51
16 pin WW	.68	.57
18 pin WW	.98	.89
20 pin WW	1.04	.97
22 pin WW	1.34	1.23
24 pin WW	1.44	1.30
28 pin WW	1.64	1.44
40 pin WW	1.94	1.75

WW = WIREWRAP

	1-99	100
16 pin ZIF	6.70	call
24 pin ZIF	9.90	call
28 pin ZIF	9.95	call

ZIF = TEXTOOL (Zero Insertion Force)

CRYSTALS

32.768khz	1.90
1.0 mhz	4.90
1.8432	4.90
2.0	3.90
2.097152	3.90
2.4576	3.90
3.2768	3.90
3.579535	3.90
4.0	3.90
5.0	3.90
5.0688	3.90
5.185	3.90
5.7143	3.90
6.0	3.90
6.144	3.90
6.5536	3.90
8.0	3.90
10.0	3.90
10.738635	3.90
14.31818	3.90
15.0	3.90
16.0	3.90
17.430	3.90
18.0	3.90
18.432	3.90
20.0	3.90
22.1184	3.90
32.0	3.90

RESISTORS

¼ WATT 5• CARBON FILM ALL STANDARD VALUES FROM 1 OHM TO 10 MEG OHM

50 PCS.	1.25
100 PCS.	2.00
1000 PCS.	15.00

APPLE ACCESSORIES

80 Column Card	129.95
16 K Card	42.50
Fan	38.95
Power Supply	84.95
RF Mod	24.95
Joy Stick (Apple II)	29.95
Paddles Apple	9.95
Z80 Card	129.95
SCRG Switch-A-Slot	19.95
Paddle Adapple	24.95
Extend-A Slot	19.95
Disk Drive	224.95
Controller Card	69.95

5¼" DISKETTES

ATHANA OR NASHUA

SSSD	18.95
SSDD	22.95
DSDD	27.95

PERISOFT

ACCESSORIES FOR APPLE II & IIe

ALL WITH 1 YEAR WARRANTY BY

PRINTERLINK

CENTRONICS PARALLEL INTERFACE

- Simple to use — No configuring required
- Use with any centronics printer — EPSON, OKIDATA, etc.
- Includes Cable & Manual

$58.00

MESSENGER

SERIAL INTERFACE

- Connects to any RS-232 serial device
- 8 switch selectable drivers for printers, terminals and modems
- Includes Cable & Manual

$98.00

TIMELINK

REAL TIME CLOCK

- Applications in file management, word processing, communications, etc.
- Exclusive Alarm Clock feature
- Battery recharges automatically

$83.00

NEW BUFFERLINK

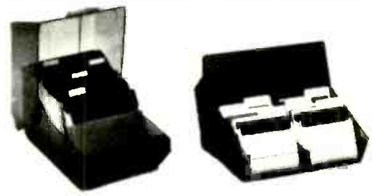
ADD-ON PRINTER BUFFER

- No more waiting for printed output
- Connects easily to any parallel interface
- Expandable from 16K to 64K

$138.00 (16K)

The Flip Sort™

The new Flip Sort™ has all the fine qualities of the original Flip Sort™, with some added benefits. Along with a new design, capacity has increased 50%, to hold 75 diskettes and the price is more reasonable than ever. **$19.95 ea.**



The Flip Sort Plus™

The Flip Sort Plus™ adds new dimensions to storage. Designed with similar elegant lines as the original Flip Sort™, in a transparent smoked acrylic. The Flip Sort Plus™ has a storage capacity of over 100 diskettes and has all the outstanding features you have come to expect from the flip sort Family. **24.95 each**

DoKay

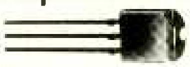
2100 De La Cruz Blvd.
Santa Clara, CA 95050

Circle No. 44 on Free Information Card

RADIO SHACK IS AMERICA'S PARTS PLACE™

High Quality! Wide Selection! Low Prices!

Replacement Transistors



Type		Cat. No.	Each
2N1305	PNP	276-2007	1.19
MPS222A	NPN	276-2009	.79
PN2484	PNP	276-2010	.89
MPS3904	NPN	276-2016	.69
TIP31	NPN	276-2017	.99
TIP3055	NPN	276-2020	1.59
MPS2907	PNP	276-2023	.79
MJE34	PNP	244-2027	1.49
2N3053	NPN	276-2030	.89
MPS3638	PNP	276-2032	.79
TIP120	NPN	276-2068	1.29
2N3055	NPN	276-2041	1.99
MJ2955	PNP	276-2043	2.19
2N4124	NPN	276-2057	.59
2N4401	NPN	276-2058	.59
MPSA06	NPN	276-2059	.59
MPSA13	NPN	276-2060	.59
MPSA42	NPN	276-2061	.69
MU4891	UJT	276-2029	.99
2SD313	NPN	276-2048	1.79
2SC945	NPN	276-2051	.79
2SC1308	NPN	276-2055	7.95
2N3819	N-FET	276-2035	.99
MPF102	N-FET	276-2062	.99

4000-Series CMOS ICs

With Pin-Out And Specs

Type	Cat. No.	Each
4001	276-2401	.79
4011	276-2411	.79
4013	276-2413	.99
4017	276-2417	1.49
4023	276-2423	.99
4049	276-2449	.99
4066	276-2466	.99

TTL Digital ICs

With Pin-Out and Specs

Type	Cat. No.	Each
7400	276-1801	.59
7404	276-1802	.79
7408	276-1822	.79
7447	276-1805	1.19
7490	276-1808	.39

Operational Amplifiers

Type		Cat. No.	Each
741	(Single)	276-007	.79
MC1458	(Dual)	276-038	.99
LM324	(Quad)	276-1711	1.29
TL082	(Dual)	276-1715	1.89
TL084C	(Quad)	276-1714	2.99
LM3900	(Quad)	276-1713	1.39
LM339	(Quad)	276-1712	1.49

Voltage Regulator ICs

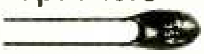
Type	Adjustable	Cat. No.	Each
LM723	0 to 40 VDC	276-1740	.89
LM317T	1.2 to 37 VDC	276-1778	2.79

Type	Fixed Output	Cat. No.	Each
7805	+5 VDC	276-1770	1.59
7812	+12 VDC	276-1771	1.59
7815	+15 VDC	276-1772	1.59
7905	−5 VDC	276-1773	1.59
7912	−12 VDC	276-1774	1.59

Computer Connectors

Type	Positions	Cat. No.	Each
ID Card Edge	34	276-1564	4.95
ID Card Edge	50	276-1566	4.95
Card-Edge Socket	44	276-1551	2.99
ID D-Sub Male	25	276-1559	4.99
ID D-Sub Female	25	276-1565	4.99
Solder D-Sub Male	25	276-1547	2.99
Solder D-Sub Female	25	276-1548	3.99
Hood	—	276-1549	1.99
D-Sub Solder Male	9	276-1537	1.99
D-Sub Solder Female	9	276-1538	2.49
Hood	—	276-1539	1.99

Tantalum Capacitors



- **20% Tolerance**
- **Standard IC Pin Spacing**

µF	WVDC	Cat. No.	Each
0.1	35	272-1432	.49
0.47	35	272-1433	.49
1.0	35	272-1434	.49
2.2	35	272-1435	.59
10	16	272-1436	.69
22	16	272-1437	.79

Power Transformers

120VAC Primaries

Type	Volts	Current	Cat. No.	Each
Mini	6.3	300 mA	273-1384	2.59
Mini	12.0	300 mA	273-1385	2.79
Mini	24.0	300 mA	273-1386	2.99
Mini	12.0 CT	450 mA	273-1365	3.59
Mini	24.0 CT	450 mA	273-1366	3.99
Std.	6.3	1.2A	273-050	3.79
Std.	12.6 CT	1.2A	273-1505	3.99
Std.	25.2	1.2A	273-1480	4.39
H-D	12.6 CT	3.0A	273-1511	5.99
H-D	25.2 CT	2.0A	273-1512	6.29
H-D	18.0 CT	2.0A	273-1515	6.99

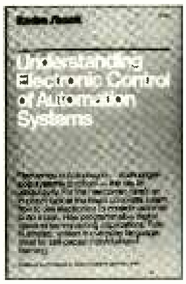
¼-Watt, 5% Resistors

39¢ Pkg. of 5

Ohms	Cat. No.	Ohms	Cat. No.
10	271-1301	10k	271-1335
100	271-1311	15k	271-1337
150	271-1312	22k	271-1339
220	271-1313	27k	271-1340
270	271-1314	33k	271-1341
330	271-1315	47k	271-1342
470	271-1317	68k	271-1345
1k	271-1321	100k	271-1347
1.8k	271-1324	220k	271-1350
2.2k	271-1325	470k	271-1354
3.3k	271-1328	1 meg	271-1356
4.7k	271-1330	10 meg	271-1365
6.8k	271-1333	—	—

Learn All About Robotics!

NEW! 2.95



Fully illustrated and written in everyday language, this 256-page book covers everything from single-loop systems to complex robots used in industry. Learn how electronics can control machines and increase productivity.
62-1387 . . . . 2.95

Ceramic Disc Capacitors

For RF, Bypass and Coupling Applications

Low As 39¢ Pkg. of 2

Moisture-proof coating. Hi-Q design for low loss in RF circuits. 50 WVDC minimum

pF	Cat. No.	Pkg. of 2	µF	Cat. No.	Pkg. of 2
4.7	272-120	.39	.001	272-126	.39
47	272-121	.39	.005	272-130	.39
100	272-123	.39	.01	272-131	.39
220	272-124	.39	.05	272-134	.49
470	272-125	.39	.1	272-135	.49

Miniature PC-Mount Potentiometers

⅛-Watt, Horizontal-Mount

Ohms	Cat. No.	Each
1k	271-333	.49
10k	271-335	.49
25k	271-336	.49
100k	271-338	.49
500k	271-339	.49

¼-Watt, Vertical-Mount

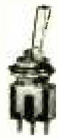
Ohms	Cat. No.	Each
500	271-226	.59
1k	271-227	.59
5k	271-217	.59
10k	271-218	.59
50k	271-219	.59
100k	271-220	.59
500k	271-221	.59
1 meg	271-229	.59

Micro-Mini Toggle Switches

Top quality! Rated 3 amps at 125 VAC. Body: $1/4 \times 5/16 \times 3/16$". Mounting hole: $3/8$". Solder lugs.

Type	Cat. No.	Each
SPST	275-624	1.49
SPDT	275-625	1.59
DPDT	275-626	1.89

Flatted-Lever Switches

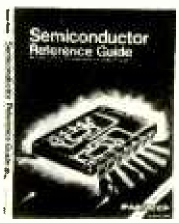


Rated 6 amps at 125VAC. Body: $3/8 \times 7/16 \times 1/4$". Require $1/4$" mounting holes.

Type	Cat. No.	Each
SPDT	275-635	2.39
DPDT	275-636	2.69

DPDT Momentary. Same size and rating as above, with spring return to center-off position.
275-637 . . . . **2.89**

Semiconductor Reference Guide 3.49



1984 Edition. Exclusive cross-reference and substitution section lists over 80,000 types and their low-cost Radio Shack equivalents. Also provides detailed data on Radio Shack ICs, SCRs, LEDs, diodes and opto devices. Helpful replacement tips, too. Illustrated. Over 200 pages.
276-4007 . . . . 3.49

OVER 8800 LOCATIONS WORLDWIDE **Radio Shack®** A DIVISION OF TANDY CORPORATION

Prices apply at participating Radio Shack stores and dealers

Computers&Electronics

ADVERTISERS INDEX

Classified Adv. cont'd. from pg. 114

CALIFORNIA

P.C. COMPUTERS, 10166 San Pablo Ave., El Cerrito 94530. (415) 527-6044. Commodore 64, VIC-20, Pet Specialists. In-House Maintenance.

CONNECTICUT

C&E DISTRIBUTING—Edgewood drive, Jewett City 06351, (203) 427-0657. Retail outlet and wholesaling for dealers.

NEW HAMPSHIRE

COMPUTER MART of NEW HAMPSHIRE, 170 Main Street, Nashua 03060. 603-883-2386. THE APPLE SPECIALISTS. Full line Hardware/Software. Training/Service.

OHIO

COLUMBUS—HEATHKIT ELECTRONIC CENTER, 2500 Morse Rd., (614) 475-7200. Heath/Zenith Computers, Software, Peripherals, Robotics, Training.

WASHINGTON

LYNNWOOD-MEDIA MAN—18500 33rd W., Suite B-2 (98036) (In the Alderwood Plaza), 206/775-8544. Software and supplies for Apple, Atari, IBM, Commodore.

WISCONSIN

MILWAUKEE—HEATHKIT ELECTRONIC CENTER, 5215 W. Fond du Lac, (414) 873-8250. Heath/Zenith Computers, Software, peripherals, robotics.

Circle No. 3 on Free Information Card

Computers & Electronics Marketplace

CLASSIFIED RATES: Per Word, 15 Word Minimum. **COMMERCIAL:** $5.00. **PERSONAL:** $3.00, **EXPAND-AD®:** $7.50. Ads set in all bold type @ 20% premium. Ads set with background screen @ 25% premium. **DISPLAY:** 1" × 2¼", $605.00. 2" × 2¼", $1,165.00 3" × 2¼", $1,675.00. **GENERAL INFORMATION:** Frequency rates and prepayment discounts available. Payment must accompany order except credit card—Am. Ex., Diners, MC, VISA (include exp. date)—or accredited ad agency insertions. Copy subject to publisher's approval; must be typewritten or printed. First word set in caps. Advertisers using P.O. Boxes MUST supply permanent address and telephone number. Orders not acknowledged. They will appear in next available issue after receipt. Closing date: 1st of the 2nd month preceding cover date (e.g., Mar. issue closes Jan. 1). Send order & remittance to: Classified Advertising, **COMPUTERS & ELECTRONICS** Magazine, 1 Park Avenue, New York, NY 10016. To Charge your ad to a major credit card, call Lois Price at (212) 725-7226. For Customer Service, call (212) 725-4312.

FOR SALE

GOVERNMENT and industrial surplus receivers, transmitters, snooperscopes, electronic parts, Picture Catalog 25 cents. Meshna, Nahant, Mass. 01908.

ELECTRONIC PARTS, semiconductors, kits. FREE FLYER. Large catalog $1.00 deposit. BIGELOW ELECTRONICS, Bluffton, Ohio 45817.

BUILD AND SAVE. TV EARTH STATION. DETECTIVE ELECTRONICS. Video Recorders, Color Cameras, advanced Telephone Projects. BROADCAST Electronics. 50 page color catalog of unusual electronic projects AIR MAILED $3.00; with 3 hour audio cassette dramatization of our catalog $5.00. Don Britton Enterprises, PO Drawer G, Waikiki, Hawaii 96815.

RECONDITIONED TEST EQUIPMENT $1.00 for catalog. WALTER'S TEST EQUIPMENT, 2697 Nickel, San Pablo, CA 94806, (415) 724-0587.

ELECTRONIC PARTS. Stamp for flyer, $1.00 deposit for catalog. DAYTAPRO ELECTRONICS, 3029 N. Wilshire, Arlington Hts., IL 60004.

ELECTRONIC CATALOG. Over 4,500 items. Parts, & components. Everything needed by the hobbyist or technician. $2.00 postage & handling (United States Only), refundable with first $15.00 order. T & M Electronics, 472 East Main St., Patchogue, NY 11772. (516) 289-2520.

PRINTED CIRCUIT BOARDS, your artwork. Quick delivery. Reasonable. Atlas Circuits, Box 892, Lincolnton, NC 28092. (704) 735-3943.

SATELLITE TELEVISION...HOWARD/COLEMAN boards to build your own receiver. For more information write...ROBERT COLEMAN, Rt. 3, Box 58-APE, Travelers Rest, S.C. 29690.

SOUND SYNTHESIZER KITS—Surf $19.95, Wind $19.95, Wind Chimes $24.95, Musical Accessories, many more. Catalog free. PAIA Electronics, Box J14359, Oklahoma City, OK 73114.

RF MODULATORS for SATELLITE TELEVISION, MICROCOMPUTERS CCTV. Also monitors, cameras, kits. FREE VIDEO CATALOG. Phone (402) 987-3771. Dealers Welcomed. ATV RESEARCH, 13-P Broadway, Dakota City, NE 68731.

CABLE TV CONVERTERS & EQUIPMENT. Plans and parts. Build or buy. For more information send $2.00: C & D ELECTRONICS INC., P.O. Box 21, Jenison, MI 49428.

CABLE TV
Buy Direct & Save
SUPER SPECIALS

40 CHANNEL CONVERTER $29.95
Advanced Solid State design and circuitry allows you to receive mid & super band channels. Restores programming to Video Recorders

36 CHANNEL REMOTE CONTROL CABLE CONVERTER $69.95

JERROLD 400 THE ULTIMATE CABLE TV CONVERTER
60 CHANNEL INFRARED REMOTE CONTROL $129.95

Send $5 for Complete Catalog

DIRECT **VIDEO** SALES
P.O. BOX 1329
JEFFERSONVILLE, INDIANA 47130
CALL
1-812-282-4766

RESISTORS, ¼W½W5%C.F., 3¢ ea., 1% Metalfilms. NO MINIMUMS. Quantity Discounts. Write: JR INDUSTRIES, 5834-A Swancreek, Toledo, OH 43614.

FREE FLYER! IC's, resistors, capacitors, jacks, etc., plus SSM music synthesizer/audio IC's, power amp modules, analog delay IC's, computer books, and more. Also plans for analog delay/chorus unit! PGS Electronics, Route 25, BOX 304 Terre Haute, IN 47802.

POLICE CODE UNSCRAMBLERS, lets you hear the coded messages of Police, Fire and Medical channels; plus other scanner accessories, satisfaction guaranteed. DNE Inc., Rt. 7, Box 257-A, Hot Springs, AR 71901. (501) 623-6027.

IF YOU ARE READY TO BUY OR SELL GAMES OR SOFTWARE, YOU NEED...
COMPUTER SHOPPER
Over 100 pages each month. Deal with individuals nationwide. Low ad rate, only 12¢ a word. Subscription: $10/year MC & VISA. Money back guarantee. 407 S. Washington, P.O. Box F599, Titusville, FL 32780. (305) 269-3211

CABLE TV
CONVERTERS & EQUIPMENT

We have the largest selection of JERROLD and OAK cable converters and equipment. Such as: Jerrold SB-3, Oak N12 and Jerrold 61 channel remote control converter with FULL features DRX3-DIC-105. Plus others.

CABLE TV KITS

Cable TV Kit (Jerrold gated pulse) 39.95.

We also have a large selection of cable TV and kits including all parts, silk screen, PC board and complete instructions.

Send for informative catalogue $2.00

J & W ELECTRONICS, INC.
P.O. BOX 61-K
CUMBERLAND, RI. 02864

CABLE TV SECRETS, the informative publication the cable companies are trying to ban. HBO, Movie Channel, Showtime converters, etc. Send $8.95 to: CABLE FACTS, Box 711-PE, Pataskala, Ohio 43062.

WHOLESALE: MATV/CATV/VCR equipment, Antennas, Audio, Cables, Adapters, Original and Replacement Cartridges, Styli, Telephone Accessories, Radios, Cassette Recorders, Speakers, etc. Send letterhead for catalog, 212-897-0509, D&WP, 66-19 Booth, Rego Park, NY 11374.

FREE CATALOG. Large selection of electronic kits and parts. Chaney Electronics, Box 27038, Denver, Colorado 80227. (303) 781-5750.

FREE Catalog of special function IC's and quality components. Goldsmith Scientific, Box 318M, Commack, New York 11725.

SATELLITE TELEVISION INFORMATION $4. Build or buy your Earth Station. Satellite Television, RD 3, Oxford, NY 13830.

ELECTRONIC KITS—Low cost Power Supplies, Amplifiers, Alarm Systems, etc. Catalog $0.25. CBBI, Box 222, North Granby, CT 06060.

LOW, LOW COMPONENT PRICES! Ask for free flyer. Write: EEP, 11 Revere Place, Tappan, NY 10983.

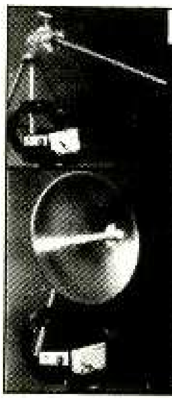
SATELLITE TV BREAKTHROUGH! Build your own Low Noise Amplifier now! Send for complete Instruction Manual today! Only $10.00! XANDI, Box 25647, Dept. 22S, Tempe, AZ 85282.

Worlds Most Remarkable Radar Jammer!

Causes speed radar guns and devices to read out your choice of either a percentage of your true speed when in automatic mode (example: Your speed: 76 mph, auto mode set for 75%, speed displayed — 57 mph), or the speed that you dial in when in manual mode. Transmits only in the presence of speed radar, or by manual override. Operates on both X and K bands. WARNING: The device described in this literature is not legal for use against police radar and is not FCC approved.

For complete literature and plan package, send $14.95 to:
Philips Instrument Design Co. Inc.
8135 S.W. Nimbus, Building #11, Suite #114 C
Beaverton, Oregon 97005

CABLE T.V. EQUIPMENT. Channel 36r4 notch filter $20.00. Information $1.00. Goldcoast, P.O. Box 63/6025A, Margate, FL 30363.

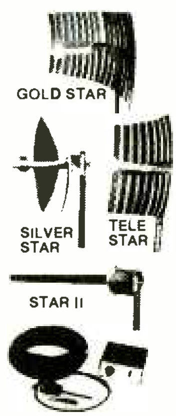


MICROWAVE ANTENNA SYSTEMS
Freq. 2.1 to 2.6 GHz • 34 db Gain+
COMPLETE SYSTEMS (as pictured)
Commercial 40" Rod Style $89.95
Parabolic 20" Dish Style $79.95
TWO YEAR WARRANTY PARTS AND LABOR
CALL OR WRITE FOR KITS • PARTS • INDIVIDUAL COMPONENTS
We Repair All Types Down Converters & Power Supplies
Phillips-Tech Electronics
P.O. Box 34772
Phoenix, AZ 85067
(602) 265-8255
COD'S
Special Quantity Pricing • Dealers Wanted

DISK FILE—$9.95 holds 150 disks: includes dividers, labels, backstops for 5¼" and 8". Call: 800/225-0044. Weber's, Box 104CA, Adelphia, NJ 07710.

PERSONALIZE your computer 1×3 golden stickback nameplate. Specify 15 letters maximum. 4.95 ML Productions, Box 47, Willmantic, CT 06226.

NEW! MULTI-CHANNEL MICROWAVE
Complete Antenna Systems from $69.95
Full 800 Mhz Range
Tune 1.9–2.7 Ghz
Includes all ITFS Channels
DEALERS WANTED
COD's and Credit Card Orders call TOLL FREE
1-800-247-1151



GALAXY ELECTRONICS
6009 N. 61 Avenue
Glendale, AZ 85301
1-602-247-1151

PAROBLIC DISHES AND Brackets 20" $6.70 ea. 28" $15.00 ea. Lots of 100. VIKING PRECISION INC. 4631 South 35th Place Phoenix, Ariz. 85040. (602) 276-6218.

LCD PEN WATCH, ideal for Christmas. Special, 2 for $7.00. Calculator alarm wristwatch. $14.00. Telephones. Guaranteed. Fantastic, unusual gift items available. Send $1.00 for catalog. Visa/Master Card. Starburst Industries, 6354 Van Nuys Blvd, Suite 161, Van Nuys, CA 91401 (213) 994-5671.

SATELLITE TELEVISION: Receivers $300, Dishes $100, LNA's, Microwave equipment. Catalog $5.00. Satellite Systems, Box 184, Milpitas, CA 95035.

SATELLITE TELEVISION COMPLETE SYSTEMS. Free catalog. Call: (612) 780-4088. Write: Sunspar Sales, P.O. Box 32245 A-7, Fridley, MN 55432.

U-FIX-M Oak CA TV converters -M-26 Buy one get one free 19.95 Cable Sales 3868 Trade Ctr. Dr. Ann Arbor Mich. 48104 C.O.D. or Certified Funds Other Converters Available.

30 CHANNEL WIRED remote CA TV converter kits. Complete with everything 39.95 Cable Sales 3868 Trade Ctr. Dr. Ann Arbor Mi. 48104 C.O.D. or Certified Funds Other Cvtrs. Available (313) 971-7501.

ROBOTICS AUTOMATION digital servo amplifier 400W. Servo-Amplifier Inc, Box 568, Station A, Toronto, Canada M5W1E4.

PRINTED CIRCUIT BOARDS, Design and artwork. Professional reasonable, fast! Printed Concepts. OEM inquiries invited. (414) 442-4548.

USA **CABLE TV UNITS** CANADA

AMAZING PRICE BREAKTHROUGH! ONLY $79.95*

Our model TX-200 is fully compatible with the Jerrold Starbase-3 (SB-3). The TX-200 is engineered with Automatic Gain Control (A.G.C.) and uses only the highest quality components. All our units come to you fully assembled and thoroughly tested. They are finished in simulated walnut, or matte black to match any decor. The TX-200 is fully guaranteed for a period of one year, including all parts and labour. We also have units which are compatible with the Oak, Hamlin and many other systems. Our deluxe catalogue is available for $3.00.

TELTECH TD 120 Wall St. Suite 1044 Dept. CE-11
New York, NY 10005

*Please add $3.00 postage and handling. Dealer inquiries invited.

ELECTRONIC BUYER'S GUIDE: Listing companies specializing in Surplus Parts, Audio Test Equipment, Computer Components, (I.C.'s to Printers), and many hard to find parts for the experimenter. $5.00 Electronic Data Research, P.O. Box 160811, Miami, FL 33116.

GEARMOTORS $35.00. 12VDC (6-36) 60 RPM. 1/6 HP. Instructions. Also speed controls. Drives robots, antenna, doors, gates, carts. Sepac, 625 NW 41 Street, Seattle, WA 98107.

CORDLESS TELEPHONE OWNERS: prevent unauthorized calls with Call-Garde.™ Write: Broadcast Company, Ltd., Box 59, Westmont, IL 60559.

WHOLESALE prices on Commodore. Send SASE to OMNI Micronics, 404 Auburn Rd, Waynesville, NC 28786.

COMPUTER EQUIPMENT/PARTS

SAVE 90% Build Your Own Minicomputer. Free Details. Digatek, 2723 West Butler Dr., Suite 20C, Phoenix, AZ 85021.

WANT A PLEASANT SURPRISE? Call or write for quotes: Atari, Commodore, Timex, T.I., Corona (IBM work-alike), Amdek, Anadex, Apple & IBM accessories, Hayes, More. GET SURPRISED! HARDWARE SOFTWARE ANYWARE CO., 10 Coles Street, Brooklyn, NY 11231, (212) 596-3592.

APPLE BUILDERS—Send stamp for our flyer of Apple parts. IC sets, ROM sets, component packages, Shugart—Apple modification kits, Apple 9-track tape drives etc. Electrovalue, P.O. Box 376-P, Morris Plains, NJ 07950.

HARD DISK DRIVE LIQUIDATION. Major OEM is liquidating inventory of unused Shugart 8" SA 1002 5.33 megabyte hard disk drives. $380 each. Western Digital's controller, $350. Call: LIQUIDATORS, 803-877-9828, or send check/money order to: 105 S. Main St., Greer, SC 29651.

FREE DISCOUNT CATALOG OF SYSTEMS, PERIPHERALS AND SOFTWARE. Most major brands. Descriptions complete with options and accessories. Please indicate your specific interest and application. MICRO TREND INC., 2001 Kirby Drive, Suite #906, Houston, TX 77019. (713) 520-0107.

RS-232 Line Check Board. Tri-color LED's clearly display activity, polarity, and validity of seven of the most commonly used RS-232 signals. Board and instructions, $7.50 board and parts kit $25.00, shipping $2.00 Romac Computer Equipment (815)-498-2111.

FREE! Computer supplies catalog—Low prices—Satisfaction guaranteed—DATA SYSTEMS, Box 99, Fern Park, Florida 32730. (305) 788-2145.

MONEY BACK GUARANTEE. Easy to install circuit adds Intercom/Hold capability to phones for under $10. Plans $5.00. Information SASE dB Enterprises, Box 8, Oradell, NJ 07649.

COMPUTER SOFTWARE

TI-99/4A MOON TRIP animated graphic program on cassette. Guide module through astroid belt. Then land on moon. Speech synthesizer and joyst capability. $12.00 postpaid. JAG Software, P.O. Box 2225, Dept 1CE, Ocean, New Jersey 07712.

DISCOUNT SOFTWARE—Available for Apple, TRS-80, IBM/PC and TI 99/4 personal computers. Professional applications for the doctor, dentist, attorney, school administrator, teacher, contractor and general office personnel. Catalog $1.00. Write for MONTHLY SPECIAL OFFERS! Creative Discount Software, 256 S. Robertson Blvd., Suite 2156, Beverly Hills, CA 90211.

COMPUTER PAPER—SAVE$$$; Top quality. Low single carton prices. Free samples. Shipping via UPS. Call A-1, (800) 628-8736 or (213) 804-1270.

ATARI, APPLE, IBM-PC: Extensive line educational, entertainment, business. FREE BROCHURE. New Dimension Software, 39010 Baroque, Mt. Clemens, Michigan 48044.

TI-99/4A PROGRAMMERS: Affordable Software! Catalog, only $1. PROGRAMS SOFTWARE, 1435 Burnley Square North, Columbus, Ohio 43229.

FREE money saving bulletin on popular brand name programs and books for your small computer. Superior, Dept CE, 8030 Westchester Road, Westchester, OH 45069.

VIC-20 and C64 SOFTWARE: Special Eighty VIC-20 Programs on two cassettes, $15.95. Postage $1.50. Public Domain. SASE to: FANFARE SOFTWARE, 120 E. Main, El Cajon, CA 92020.

TI-99/4A OWNERS. Send for free list of new and exciting, low cost software. D.E., Box 124, Hicksville, NY 11801.

FREE Timex/VIC-20/TI99-4A/Commodore-64 programs! SASEs bring catalogs. Inexpensive! EZRAEZRA, Box 5222-C, San Diego, California 92105.

TI PROGRAMS on cassette. Large selection and variety, over 700. 4 sample programs and catalog $3.00. KS SOFTWARE, Box 27130, Cincinnati, OH 45227.

FREE VIC-20 and COMMODORE 64 USERS GROUP MEMBERSHIP with software purchase. Why pay to belong to a users group when you don't have to? Benefits: Newsletter, extensive club library, discounts, contests, questions hot-line and more! Free details—(803) 797-1533. Lords of Basic, P.O. Box 459, Dept. 102 Ladson, SC 29456.

COMMODORE OWNERS VIC-20 and Commodore 64 unique hardware and software free catalog from: Microware Distributing, Inc., 1342B Route 23, Butler, NJ 07450. 201/838-9027.

TI-99/4A SOFTWARE: Programs for Astronomy, Mathematics, Finance, Education. Write: Eastbench Software, 1290 Cliffside Drive, Logan, UT 84321.

TRS-80, ATARI SOFTWARE: Science, Mathematics, Astronomy, Music, Curve Fitting, Fourier Analysis, Statistics, Graphics, Finance. BROCHURE. Benchmark Computing Services, P.O.B. 385-B, Providence, Utah 84332.

TRS-80 software, timer, thermometer, other kits, everything guaranteed, for catalog: DAC Industries, 6005 Musket Road, Fort Washington, PA., 19034.

COMMODORE 64: Entertainment, educational, financial, game 12 programs on disk $15.95 check, M.O. HUNG, 3175 South Hoover St. #167, Los Angeles, CA 90007.

LET YOUR TS/1000 Be more than a toy. Free catalog of over 100 programs. UAS, Box 612, Haddonfield, NJ 08033.

DISKETTE FORMAT CONVERSIONS/DOWNLOADING, from $500. Port-A-Soft, 423 #800 N, Orem, UT 84057, 801/226-6704.

SOFTWARE JUNKIE? Rent today's most popular computer software for pennies a day! Free brochure. The Soft Source-R Inc., P.O. Box 2931, Joliet, IL 60434.

FREE CATALOG OF DISCOUNT SOFTWARE. Specify computer. The Floppy Disk, Box 5392E, North Hollywood, CA 91616.

TIMEX 1000 SOFTWARE. David Leithauser's "MINE FIELD" $9.95. Many More. $1.50 shipping per order. For a FREE catalog send a 20¢ U.S. Stamp to: Software Development Associates, Dept. C3, 3328 W. Las Palmaritas, Phoenix, AZ 85021. Arizona residents add 6% tax.

SUPERIOR VIC-20 SOFTWARE! Educational programs and Adventure games. FREE program summaries with price list. Creative Workshop, P.O. Box 2725, Dept. 22 Spring Valley, CA 92077.

COMMODORE-64 OWNERS! Disc or cassette containing music synthesizer, sprite builder, space games, utilities, etc. $19.95 postpaid. KONI SOFTWARE, 3455 Kearny Villa 1a, San Diego, CA 92123.

COMMODORE 64, VIC-20, 99-4/A, SINCLAIR and ATARI software. Free catalog. Excaliber Enterprises, Box 20093, Riverside, CA 92516. (714) 359-8567.

VIC-20 APPLE II(+)*ATARI 400/800*PET*CBM*RCA* Programs for above, send 50¢ postage handling for Catalog to: DATRON, 1191 E. 3150 N. Ogden, UT 84404.

VIC-20, 40 COLUMN BASIC DISPLAY, $8.95, on tape, N.U.P.E. 102 Hickory Court, Portland, Indiana 47371.

VIC 20/s64—WHOLESALE PRICES ON ALL PRODUCTS! Send SASE: Omni Micronics, 404 Auburn Road, Waynesville, NC 28786.

TIMEX SINCLAIR COMPUTERS USERS' GROUP. Programs, newsletters! Information: Diana Wright, 2170 Oakbrook Circle, Palatine, IL 60074.

COMMODORE-64 OWNERS Craps, Address Filer, 21, Sprites, Reflex tester, Family Budget, Decision Maker, Adding Machine, Numbers Game, and Hangman. All 10 great programs for only $14.95. Please specify whether disk or tape is desired. Mail check or Money Order to C.M. Andre & Co., P.O. Box 5062, Glendale, AZ 85312.

COMPUTER SOFTWARE (Business, Educational and Games). Atari VIC-20 TRS-80, etc. Lowest prices. Free price list. Suburban Quality. Enterprise, P.O. Box 2637, Crystal River, FL 32629 (904) 795-0853.

COMPUTER HARDWARE

COMPUTERS, PRINTERS, ACCESSORIES! Epson FX-80 printer, $519.00. Gemini 10X printer, $295.00. Okidata, prowriters, etc. Lowest prices! Free catalog! Team Computers. (203) 777-2284. 109 Church St., Suite 303, New Haven, CT 06510.

LETTER QUALITY PRINTER, GE Terminet with/keyboard. 30 day warranty. $225.00. Access, P.O. Box 1053, Norristown, PA 19404 (215/272-4807)

Eagle PC-2 $2738; Compu Pro 816A $3998; Daisy Rider 2000 $1197; Epson, Call; Okidata 92 $509; Hayes 1200 $505; etc, WCB (707) 544-5304, 1800C Hobbie Lane, Santa Rosa, CA 95407.

COMPUTER PUBLICATIONS

TIMEX SINCLAIR OWNERS—get monthly news, tips, programs, projects to expand 1000/1500/ZX81, $29 per year. Back issues available. SYNTAX, RD 2 Box 457, Harvard, MA 01451, (617) 456-3661.

SAVE $ ON COMPUTER BOOKS & SOFTWARE! For FREE DISCOUNT CATALOG write: Downtown Book Bazaar, Dept. C, P.O. Box 2490, Brooklyn, NY 11202.

DEVELOPING APPLICATIONS FOR MICROCOMPUTER DATABASES; Concepts, Tools & Techniques Steve Patchen, with an example using dBaseII. Dataware Systems, 255 Chippena, Pontiac, MI 48053. (313) 338-4358.

USER'S BOOK for HP-41C/41CV. Hundreds of techniques and RPN subroutines. Send $15 per copy U.S.A./Canada, (elsewhere $20) to: Corvallis Software, P.O. Box 1421, Corvallis, Oregon. 97339. (503) 754-9245.

AMATEUR RADIO

VIDEOSCAN 1000 Slow Scan TV — HIGH RESOLUTION (amateur, phone line, monitoring, teleconferencing). CODE★STAR — DECODE Morse, RTTY, ASCII. LARGE LEDs or connect computer/printer. MORSE-A-KEYER — CW Keyboard. TRI-VOLTAGE POWER SUPPLY. Kits/Assembled. FREE brochures. MICROCRAFT CORPORATION, Box 513-PE, Thiensville, WI 53092. (414) 241-8144.

TIMEX/SINCLAIR

KROK,, STAR SEARCH, NOAH'S ARK, finest programs available. Machine Language action, graphics. SASE Brown Cottage, 5486 Bright Hawk, Columbia, MD 21045.

MAX *-Z-* TECH TIMEX HI-TECH educational programs. Hardware coming soon. For samples mail $2.00 to: CASH Progs., P.O.B. 318C, NFLD., NJ 07431.

ZX DATA-FINDER, ZX PRO/FILE & much more professional/game/hobby machine language software. Catalog 50¢ (refundable). ROBOTEC, INC., Box 55, Rossford, OH 43460. (419) 666-2410. VISA/MC.

5 TS/1000 PROGRAMS FOR $5. Send SASE for details: Programs, 3763 W. Crocus, Phoenix, AZ 85023.

TIMEX SINCLAIR owners—get monthly news, tips, programs, projects to expand 1000/1500/ZX81, $29 per year. Back issues available. SYNTAX, RD2 Box 457, Harvard, MA 01451.

C.B. EQUIPMENT

CB MODIFICATIONS, conversions, books, plans, kits, repairs. Catalog $2. CBCI, Box 31500PE, Phoenix, AZ 85046. (602) 996-8700.

CABLE TV

CHANNEL 3—60db notch filter. 63.5MHz. $32. Crosley, Dept. 607, Box 840, Champlain, NY 12919.

PLANS AND KITS

HIGH PERFORMANCE AUDIO KITS. Phono, Equalizers, Delay and more. Send for FREE catalog. PHOENIX SYSTEMS, 91 Elm Street, Manchester, Connecticut 06040, (203) 643-4484.

FREE KIT CATALOG contains test equipment. Phone (209) 772-2076. DAGE SCIENTIFIC, Box 144, Valley Springs, CA 95252.

PROJECTION TV . . . Convert your TV to project 7 foot picture . . . Results comparable to $2,500 projectors . . . Total Cost less than $30.00 . . . PLANS & LENS $19.95 . . . Illustrated information FREE. Macrocoma-cc, Washington Crossing, Pennsylvania 18977. Creditcard orders 24 Hours, (215) 736-3979.

ROBOTICS—BOOKS—build your own robot. Write now for FREE catalog! Kohn Co./CE11, Box 16265, Alexandria, VA 22302.

MAILING LISTS

COMPUTER SHOW ATTENDEES N.Y., N.J.: 15,000 NAMES. $30/M. P/S labels. For info, (201) 297-2526.

ALARMS

BURGLAR-FIRE ALARMS for home, business, auto. Install yourself and save. Installation manual/catalog shows how. Shows latest equipment, accessories. Lowest prices. Send $1.00 (refundable). BURDEX SECURITY, Box 82802-CEK, Lincoln, NE 68501.

PROTECT MICROCOMPUTERS AND ELECTRONICS! Free catalog of systems for SCHOOLS, OFFICES, HOMES. SGM Corporation, 6 West Main, Bound Brook, NJ 08805. (201) 469-8585.

WANTED

GOLD, electronic, circuit board scrap, silver, platinum, tantalum, mercury. Ores, metals assayed. Samples evaluated. Wholesale Terminal, toll free 1-800-932-1010, (617) 326-3442 in Mass.

GOVERNMENT SURPLUS

IS IT TRUE YOU CAN BUY JEEPS FOR $44 THROUGH THE U.S. GOVERNMENT? Get the facts today! Call (312) 742-1142 Ext. 4649.

ELECTRONIC COMPONENTS/EQUIPMENT thru Government Surplus. Updated Guidebook. How and where to buy. $2.00, Hammer Industries, P.O. Box 227, Glen Falls, NY 12801.

TUBES

TUBES: "Oldies", Latest. Supplies, components, schematics. Catalog Free (stamp appreciated). Steinmetz, 7519-PE Maplewood, Hammond, Ind. 46324.

HUGE INVENTORY! Thousands of types. Wholesale prices. FREE CATALOG! ETCO Electronics, DEPT. 290, Plattsburgh, NY 12901.

COLOR PICTURE TUBES: $55-$75 exchange. Also selling CRT rebuilding equipment. ATOLL TUBES, 6425 Irving Park, Chicago, IL 60634, (312) 545-6667.

PERSONALS

MAKE FRIENDS WORLDWIDE through international correspondence, illustrated brochure free. Hermes-Verlag, Box 110660/Z, D-1000 Berlin 11, W. Germany.

CORRESPONDENCE FOR FRIENDSHIP IN PHILIPPINES, MALAYSIA. Free information. AAWS-(PE), Box 2777, Orcutt, California 93455-0777.

SUNBELT SINGLES looking for a person of quality. Check our group. Details Box 83395, Oklahoma City, OK 73148.

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.Ds. Free revealing details. Counseling, Box 317-EP11, Tustin, California 92680.

USA/CANADA/EUROPE—Sophisticated singles seek correspondence, meaningful relationships. Details: (Send Stamp) Scannaclub-(CE), Box 4, Pittsford, NY 14534.

BEAUTIFUL PHILIPPINE LADIES seek nice friendship, correspondence!! Photos, information, free!! Transcor-(B), Box 2321 Manila, Philippines 2801.

FREE: WORLD'S LARGEST PARTNER PHOTO CATALOG for friendship and marriage. Personalized introductions. INTERCONTACT, Box 12, Toronto, Canada M4A 2M8.

INSTRUCTION

LEARN WHILE ASLEEP! HYPNOTIZE! Astonishing details, strange catalog free! Autosuggestion, Box 24-ZD, Olympia, Washington 98507.

MEDICAL ELECTRONICS TECHNOLOGY, home study. Troubleshoot medical instruments. WTI, P.O. Box 3124, Fresno, CA 93650-3124.

UNIVERSITY DEGREES BY SPECIAL EVALUATION of existing credits and Job Experience. Fast, inexpensive. Call (614) 863-1791. Or write: EVALUATION, Box 13151-A11, Columbus, Ohio 43213.

REPAIR ELECTRONIC ORGANS—Revised home study course covers all current makes and models. Free booklet. Niles Bryant School, P.O. Box 20153, Sacramento, CA 95820.

F.C.C. COMMERCIAL RADIOTELEPHONE LICENSE. Home Study. Fast, Inexpensive! Free details. COMMAND, D-100 Box 2223, San Francisco 94126.

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.D.s . . . Free revealing details. Counseling, Box 317-PE11, Tustin, California 92680.

UNIVERSITY Degrees! Economical home study for Bachelor's, Master's, Doctorate. Prestigious faculty counsels for independent study and life experience credits. Free proof—Richard Crews, M.D. (Harvard), President, Columbia Pacific University, 1415 Third Street, Suite D511, San Rafael, CA 94901; Toll Free: 800/227-1617, Ext. 480; California: 800/772-3545, Ext. 480.

EXPERIMENTAL ANALYSES of solar activity and Pacific area meteorology and seismology. Info: Sase. IWS 11625 W. McKinney Ave. Fresno CA 93711.

ELECTRONIC TECHNICIAN EMPLOYMENT EXAMS from Silicon Valley. Prepare for a high paying job. 400 questions with answers. Send $9.95 to: Advanced Learning Publications, 1348 Yosemite Drive, Milpitas, CA 95035.

FOR INVENTORS

INVENTORS! IDEAS HAVE VALUE!

Ever think of an idea, forget it and see it later on the market? Many people don't forget, act quickly and are rewarded by American Industry. Write down your idea! We offer free disclosure registration and initial consultation regarding your idea's potential value. Call or write without delay for your free information package.

AMERICAN INVENTORS CORPORATION
82 Broad St., Dept. CE
Westfield, MA 01086
413-568-3753

A fee Based Marketing Company
Offices Coast to Coast

INVENTIONS, IDEAS, NEW PRODUCTS WANTED! Industry presentation/national exposition. Call free 1-800-528-6050—Arizona, 1-800-352-0458. X831.

PATENT AND DEVELOP your invention. FREE PATENT INFORMATION. Richard L. Miller, P.E., 3612-E, Woolworth Building, New York, NY 10007, (212) 267-5252.

BUSINESS OPPORTUNITIES

FREE CATALOGS. Repair air conditioning, refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, Texas 75201.

MECHANICALLY INCLINED individuals desiring ownership of Small Electronics Manufacturing Business—without investment. Write: BUSINESSES, 92-K11 Brighton 11th, Brooklyn, New York 11235.

ERASE DEBTS with little-known law—create wealth!! Details FREE—Wealth Kit, No. EE11, Billings, NY 12510.

MAILORDER OPPORTUNITY! Start profitable home business without experience or capital. Information free. Mail Order Associates Inc., Dept 78, Montvale, NJ 07645.

ONE MAN CRT FACTORY. T.V.'s, Business machines, Monitors, Scopes, VDT's. $3.00 rebuilding nets $100-$500 each tube. Higher profits overseas. New/used. FACTORY, 1909 Louise, Crystal Lake, IL 60014. (815) 459-0666.

BORROW $300-$30,000 INTEREST FREE! Keep indefinitely! Free Details. Write: American, 1601 Main, Plainfield, Indiana 46168.

BORROW $30,000 without interest! All eligible. Repay anytime. Free details! Infohouse—508CE, 533 Sutter, San Francisco, CA 94102.

BUMPER STICKER PRINTING DEVICE. Cheap, Simple, Portable. Free details, Bumper, POB 22791 (PE), Tampa, FL 33622.

PROJECTION TV... MAKE $$$'s assembling Projectors... Easy... Results comparable to $2,500 projectors... Your total cost less than $20.00... PLANS, LENS & Dealers information $17.50... Illustrated information FREE... Macrocomacbx, Washington Crossing, Pennsylvania 18977. Credit-card orders 24 Hours. (215) 736-2880.

"PROFESSIONAL" GIANT SCREEN PROJECTION TV... "Don't be fooled by cheap imitations!"... "Build and sell the best with lenses and screens utilized by Sony, Zenith, Pioneer, and Magnavox!"... Simple Construction!... Unlimited profits!... Illustrated dealers information and complete parts catalog $2.00... Money back guarantee!... POLI-VISION, 187-C Cypress St., Throop, PA 18512.

U.S. GOVERNMENT DATA PROCESSING CONTRACTS for small business. Soft and hardware. Solicitation subscriptions $10.00 each. (800) 457-0522.

VIDEO GAME REPAIR BUSINESS. Start your own. Information/parts list $5.00. BEST ELECTRONICS, 4440 E. Sheena, Phoenix, AZ 85032.

ACQUIRE WEALTH! Borrow $30,000 interest free! Keep indefinitely. Erase debts with little-known law! Free details: Financial Technologies, Box 40434C, Fayetteville, N.C. 28309.

EMPLOYMENT OPPORTUNITIES

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUNITIES. Report on jobs now open. Details FREE. Aviation Employment Information Service, Box 240E, Northport, New York 11768.

JOBS OVERSEAS - Big money fast. $20,000 to $50,000 plus per year. Call 1-216-453-3000, ext. 4600.

GOVERNMENT JOBS—Thousands of vacancies must be filled immediately. $17,634 to $50,112. Call 716-842-6000, Ext 3907.

BOOKS & MAGAZINES

PUBLISHERS' OVERSTOCKS. BARGAIN BOOKS 2,000 titles, all subjects! Free catalog: Hamilton's, 98-85 Clapboard, Danbury, CT 06810.

SATELLITE, MICROWAVE, VIDEO, Audio Components and Equipment. Send $1 for 1983 catalog. DSCo, Department B, 3110 Evelyn Street, Roseville, MN 55113.

CRASH course in Microcomputers, bestseller, only $19.95. Order from Per Aspera Press, P.O. Box 265, St. Joseph, MI 49085.

SATELLITE TV VIEWERS
Get the most complete weekly listings
Send $1 for sample copy.
Satellite TV Week
P O Box 308, Fortuna, California 95540
800-358-9997 (U.S.) • 800-556-8787 (Calif.)
707-725-2476 (all others)

RUBBER STAMPS

RUBBER STAMPS, BUSINESS CARDS. Free catalog 1-800-851-4945, Jackson's, E-100, Brownsville Rd., Mt. Vernon, Ill. 62864.

RECORDS/TAPES

RECORDS—TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main St., PO Box 2000, Dept. 5-1183, New Rochelle, NY 10801.

RETAIL ROSTER

ALASKA

JUNEAU ELECTRONICS—1000 Harbor Way, 99801, (907) 586-2260. Apple, Osborne Hardware/Software/Peripherals. Full service and support.

Classified Adv. cont'd. on pg. 111

Computer Mart

RATE: Ads are " by 3". 1 insertion: $935.00. 6 insertions: $900.00 ea. 12 insertions, $865.00 ea. Closing date: 1st of the 2nd mo. preceding cover date. Send order and remittance to Computer Mart, Computers & Electronics, 1 Park Ave., N.Y., N.Y. 10016. Direct inquiries to (212) 725-4215.

MERRY XMAS

ATARI VCS ADAPTER
FOR THE VIC-20
WAS $89.95
THRU DEC. 25 $55.95

AND MUCH MORE!

- Discounts on Large Orders
- MasterCharge and VISA Accepted

FREE CATALOG

Name ____________
Address ____________
____________ Zip ____________

Cougar Computer Systems
1319 Bailey Ave
Buffalo, NY 14206
(716) 895-0672

Add 3% for Shipping

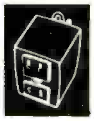
CIRCLE NO. 98 ON FREE INFORMATION CARD

PROTECT YOUR COMPUTER FROM DESTRUCTIVE POWER LINE *SURGES*

Surges — momentary variations of thousands of volts strike *daily* on your home AC power line. Unchecked surges can disrupt normal computer operation and damage hardware.
Now CUTS Company offers surge protectors engineered specifically for *personal* computers.

- Both models protect *your* system from losing memory, misregistering programs, and blowing out components
- Both models contain a unique *three-stage* filter that *clamps, limits,* and *dissipates* incoming surges *instantaneously* for reliable and effective surge protection
- Both models are compatible with *all* makes of computers and accessories

DON'T DELAY—PROTECT YOUR INVESTMENT NOW, ORDER TODAY:



SURGE BLOCK (shown) Portable protected dual outlet that plugs into any 3 wire outlet. Includes neon light that monitors protector and ground path. 125V 10A — $29.95

SURGE BUS Five outlet surge protected plug strip with 6' power cord. Includes line fuse. ON-OFF switch with pilot light in a sturdy steel case. 125V 10A — $49.95

★12-Month Warranty on all Products★

Specify model, send name, address and check or M.O. to include $2 postage (NY Res. add Sales Tax) to

P.O. Box 691B
SYOSSET, N.Y. 11791
(516) 921-2327

CUTS COMPANY

CIRCLE NO. 99 ON FREE INFORMATION CARD

Put 64K CP/M 2.2 in your TRS-80 Model III.

Our plug-in Shuffleboard III comes with 16K and gives you the full power of 64K CP/M 2.2, the industry standard operating system.

Tap into over 2,000 off-the-shelf business programs such as dBASE II, SuperCalc, WordStar, etc.

READ/WRITE and RUN software from Osborne, Xerox, Superbrain, Kaypro II, HP 125 and TeleVideo. You can even READ/WRITE IBM PC software for CP/M 86.

Simple to install, Shuffleboard III plugs into two existing sockets inside your Model III. No permanent modifications, no cut traces, no soldering. You'll be up and running in minutes. For only $299. Includes MBASIC Interpreter, a software manual and a first class user's manual. Coming soon: an 80 x 24 Video Board and a Floppy Disk Controller.

See the Shuffleboard at your local computer store or order directly from us. Credit card orders shipped directly from stock. Sorry, no COD's. Free 12 page brochure. Call (415) 483-1008

$299.

Memory Merchant 14666 Doolittle Drive San Leandro, CA 94577

CIRCLE NO. 100 ON FREE INFORMATION CARD

SAVE 90%

YES you can save up to 90% on a computer system for home or office.

68000 microsystem (8MHz) with 128KB & three RS-232C ports, $252.00

8086 microcomputer with 128KB & three RS-232C ports, $204.00

Floppy Interface as little as $60.00

Also Z80A-8080A systems, CRT's Monitor Roms & parts

FREE CATALOG

DIGATEK CORPORATION
SUite 7
2723 West Butler Drive
Phoenix, Az. 85021

ROLL-YOUR-OWN TECHNOLOGY AND SAVE A BUNDLE

CIRCLE NO. 101 ON FREE INFORMATION CARD

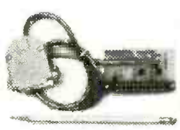
GET THE MOST FROM YOUR VIC-20/C64

CASSETTE INTERFACE

- USE ANY STANDARD CASSETTE RECORDER
- CONNECTS TO THE CASSETTE PORT
- CONTROLS THE CASSETTE MOTOR
- NEEDS NO BATTERIES
- COPY FROM RECORDER TO RECORDER
- THIS IS THE BEST ONE FOR LESS $$$
- ONLY $34.95 POSTPAID. ADD $2.50 FOR SHIPPING OUTSIDE US CANADA, MEXICO

THE MODEM INTERFACE

- CONNECTS TO THE USER I/O PORT
- NEEDS NO BATTERIES/SOLDERING
- CONNECTS ANY STANDARD MODEM
- USE MODEM AUTODIAL, ANSWER FEATURES
- COMES WITH A FREE TYPE IN BASIC TERMINAL PROGRAM
- ONLY $24.95 POSTPAID. ADD $2.50 FOR SHIPPING OUTSIDE US CANADA, MEXICO



CHARGE OR COD ORDERS CALL
1-800-227-3800
ASK FOR OPERATOR 225

BYTESIZE MICRO TECHNOLOGY
PO BOX 12309 DEPT CJ
SEATTLE, WA 98111
(206) 236-BYTE

CALL OR WRITE FOR DEALER INFORMATION

CIRCLE NO. 102 ON FREE INFORMATION CARD

GOT A TS-1000 ?
GET STARTED WITH
BOSS SOFTWARE

DISCOUNT

CASSETTE PROGRAMS FOR THE TIMEX 1000/1500 COMPUTERS

GAMES, BUSINESS, EDUCATION, TUTORIAL

ALSO

START YOUR OWN SOFTWARE COMPANY ON A SHOESTRING. DUPLICATE 1 TO 50 CASSETTES WITH THE **DIGITALIZER** *AMPLIFIED CLEAN COPY OUTPUT. INEXPENSIVE, PROFESSIONAL CASSETTE DUPLICATING EQUIPMENT AND WE SHOW YOU HOW!*

WRITE FOR FREE CATALOG

EULYN ENTERPRISES
4N 650 RIDGEWOOD
BENSENVILLE, IL., 60106
(312) 832-1599

MasterCard VISA

CIRCLE NO. 103 ON FREE INFORMATION CARD

Join the Click!

NOT JUST A KEYBOARD REPLACEMENT BUT AN ENHANCEMENT THAT GIVES KEYBOARD FEATURES FOUND ONLY ON MORE EXPENSIVE COMPUTERS

FOR FASTER & EASIER DATA ENTRY WITH YOUR E-Z KEYBOARD . . .
Here at last is a large 60 key TACTILE FEEL keyboard that plugs into the same connectors as the existing keyboard on your ZX81, TIMEX/SINCLAIR 1000 or 1500
HERE THE CLICK . . . FEEL THE SNAP! for every key pressed (tactile feedback)

IT'S THE ONLY KEYBOARD WITH ALL OF THESE FEATURES

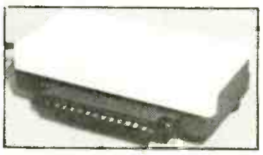
$84.95
90 day warranty

Try it, you'll like it — 10 day return privilege on all keyboard enclosures and keyboard in stock

E-Z KEY
Suite 75, Dept. CE
711 Southern Artery
Quincy, Massachusetts 02169
(617) 773-1187

CIRCLE NO. 104 ON FREE INFORMATION CARD

Home Control System for the VIC 20



- Control up to 256 lights & appliances
- ON, OFF, ALLON, ALLOFF Commands
- 9 levels of Brightness
- Manual & Time Control Software
- Uses BSR remote switches
- Plugs into User Port

only **$59.95**

MasterCard or VISA Accepted
Call 215-861-0850 to Order

GENESIS COMPUTER CORP.
1444 Linden Street
Bethlehem, PA 18018

VIController

CIRCLE NO. 105 ON FREE INFORMATION CARD

WE EXPAND THE USE OF YOUR TIMEX SINCLAIR COMPUTERS

INTERCONTROLLER Fully programmable controller for home, office, lab, and workshop — $99.95
SOFTBOX™ Expansion port, contains 4 software selectable cartridge connections (needs Ribbon Connector) — $59.95
FLEXIBLE RIBBON CONNECTOR No more system crashes caused by RAM/computer movements — $24.95
DATA COMMUNICATION PACKAGE 0-300 BAUD Modem RS232 Interface, cable — $197.95
PRINTER PACKAGE 9" Printer, Interface, cable — $299.95
QSAVE 16 times faster Loading/Saving — $37.95
MCODER BASIC to MACHINE code compiler — $18.95
ASSEMBLER/DEBUGGER with a comprehensive manual — $18.95
DISASSEMBLER Plug-In Cartridge (needs Ribbon Connector) — $34.95
STOPPER Break through any MACHINE code software — $18.95
Shipping and Handling for QSAVE — $4.95
For each Package — $9.95

To order or to receive a FREE brochure of our full line of software and MEMOTECH products please call or write to

INTERCOMPUTER INC.
P.O. Box 90, Prudential Center
Boston, MA 02199 Tel (617) 738-5310

CIRCLE NO. 106 ON FREE INFORMATION CARD

$1,250.00
FRANKLIN SYSTEM

SYSCOM II (Apple Compatible)	$ 550
APPLE IIe SYSTEM	$1,675
FRANKLIN 1200	$1,599
***APPLE TYPE DRIVE**	**$ 180.**
128 K Card	$ 250
GEMINI 10	$ 300

FREE BROCHURE

!!WE WILL BEAT ANY PRICE!!

SOFTSELL SYSTEMS
P. O. Box 18928
Philadelphia, Pa. 19119
Visa, MasterCard preferred or C.O.D.
Apple is a trademark of Apple Computer

CIRCLE NO. 133 ON FREE INFORMATION CARD

TRS-80+ MOD I, III, COCO, TI99/4a
TIMEX 1000, OSBORNE, others

GOLD PLUG - 80

Eliminate disk reboots and data loss due to oxidized contacts at the card edge connectors. **GOLD PLUG 80** solders to the board edge connector. Use your existing cables. (if gold plated)

GOLD PLUG 80 Mod I (6)	$54.95
Keyboard/EI (mod I)	18.95
Individual connectors	9.95
COCO Disk Module (2)	18.95
Ground tab extensions	1.00
Disk Drives (all R.S.)	9.95
Gold Disk Cable 2 Drive	29.95
Four Drive Cable	39.95
GOLD PLUG 80 Mod III (6)	54.95
Internal 2 Drive Cable	29.95
Mod III Expansion port	10.95
USA shipping $1.45	Can/Mex $4.
Foreign $7.	TEXAS 5% TAX

E.A.P. CO.
P.O. BOX 14
KELLER, TEXAS 76248
(817) 498-4242 MC/VISA
+ trademark Tandy Corp

CIRCLE NO. 134 ON FREE INFORMATION CARD

TECH-SYSTEMS

TECH-SYSTEMS TECH-SYSTEMS

PRINTERS

NEC 3510	$1540
NEC 3530	1650
NEC 7710	2190
NEC 7730	2290
OKIDATA 80	350
OKIDATA 82A	425
OKIDATA 83A	680
OKIDATA 84P	1025
OKIDATA 84S	1120
OKIDATA 92	510
OKIDATA 93	850

MONITORS

AMDEK COLOR I	$320
AMDEK COLOR II	720
AMDEK COLOR III	410

TECH-SYSTEMS
P.O. Box 565
Spring, Texas 77383
713-749-3524

We accept money orders, cashiers or certified checks and personal checks (14 days to clear). Texas residents add 5% sales tax. FREE U.P.S. GROUND SHIPPING ON ALL ORDERS. WRITE FOR FREE PRICE LIST

CIRCLE NO. 135 ON FREE INFORMATION CARD

Full Size Keyboard Conversion
10¾ x 7¼ x 2⅛

For Your ZX81/ TS1000

SUN KD-81
$59.95

Easy To Install
No Soldering — No Modifications

41 Keys with Full Size Space Bar • Allows Touch Typing Same Key Layouts as Sinclair • Two Color Keytops Keyboard Case Holds Both Keyboard and Computer Commands and Graphics Spelled Out on Keytops Rear Cutout for Any RAM or Expansion Modules

16K Piggyback RAM Module P N MX-16 $49.95

SUNTRONICS CO., INC.
In Calif Call 213-644-1149
Outside Calif Call 1-800-421-5775
Or send Check or M.O. to
P.O. Box 1957 Hawthorne CA 90250
California residents add 6½% sales tax.
Add $4.00 ship/handling. VISA/Mastercard include expiration date

---

COMPOSE YOURSELF

MUSIC for the TIMEX-SINCLAIR computer

Now that you've balanced your checkbook, calculated your biorythms, and chased the Klingons out of the galaxy — isn't it time to do something creative?

INTRODUCING **MOZART**

- A complete hardware/software package
- Built-in speaker
- Plugs into ZX81 or TS1000 without modification
- Complete instruction manual included
- 15 day unconditional money-back guarantee
- Allows addition of RAM pack and other modules

yours for a song... **$79.91**

WRITE TO: TRIGON

Calif. Residents add 6% Sale Tax
$3.00 Shipping and Handling

572 AVENIDA DE LA PLATA, DEPT. 101
NEWBURY PARK, CA 91320 (805) 498-1735

CIRCLE NO. 136 ON FREE INFORMATION CARD

Votrax® SC-01A SPEECH SYNTHESIZER

$42 Each ($32 in hundreds)

Order in Ones or Thousands

The SC-01A Speech Synthesizer is a completely self-contained solid state device. This single chip phonetically synthesizes continuous speech of unlimited vocabulary.

Computer interfaces and text-to-speech algorithms also available for product development.

Micromint is the largest U.S. distributor of the SC-01A. Call us for a price quote.

Call 1-800-645-3479, in N.Y. 1-516-374-6793

MICROMINT INC.
561 Willow Avenue
Cedarhurst, NY 11516

Add $2.00 for shipping & handling

MICRO MINT

Monument COMPUTER SERVICE

VILLAGE DATA CENTER
P.O. BOX 603
JOSHUA TREE, CA 92252

Choose from Our Menu

Monday-Friday
8:00 AM — 5:00 PM

Our sales staff is happy to take your order.

#1. Medical
#2. Dental
#3. CAI Programs
#4. Construction Accounting
#5. School Administration
#6. Word Processing
#7. General Accounting

The above items are now being served for connoisseurs of the Apple and IBM PC Computers.

To make reservations, or to inquire about our weekly SPECIALS,
Call
(619) 365-6668

CIRCLE NO. 138 ON FREE INFORMATION CARD.

IBM® DISKETTES

5¼" Diskette 1D	5¼" Diskette 2D
Single Side	Double Side
Double Density	Double Density
$29.90	$39.90
Soft* Box of 10	Soft* Box of 10

* Add $1.75 for Plastic Library Case
8" and other brands also available.

COD ACCEPTED
DEALER INQUIRIES INVITED

CALL TOLL FREE 800-848-1101
In N.Y.S. (716) 631-3925
BETSY BYTES Division
BB International, Inc.
P.O. Box 564
Buffalo, N.Y. 14221

TERMS: Prepaid orders receive free shipping within continental U.S.A. Add 3% ($2.00 minimum) shipping and handling charge on all COD and credit card orders. N.Y. res. add 7% tax.

CIRCLE NO. 139 ON FREE INFORMATION CARD

WE SELL TIME!

TIME FOR DECISIONS. TIME FOR LEISURE. YOUR TIME. **ISA's** software gives it back to you.

SUPER™ DATABASE - $199.00

- EASY! FAST!
- General purpose business program DBMS

ManageMint™ — $395.00 & up.

- PERT/CPM project control system

(Both menu driven for IBM PC, CPM & all TRS-80)

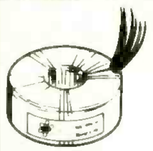
INSTITUTE FOR SCIENTIFIC ANALYSIS
P.O. BOX 7186, DEPT. C-1
WILMINGTON, DE. 19803

(215) 358-3735 / orders only (800) 441-7860
M.C. & VISA accepted.

CIRCLE NO. 140 ON FREE INFORMATION CARD

TOROIDAL POWER TRANSFORMERS

Small size • Low noise • Easy mounting



Ideal for audio amps, CRT monitors and computers where low hum is required.

Includes mounting washer with center hole for screw.

A wide selection of toroidal power transformers for 117V-60Hz available from stock. Included are transformers in sizes below with dual secondaries 2 × 8.5V or 2 × 15V or 2 × 18V, your choice. (Rated current = Power/2 × Volts)

Power	Size OD × H	Net wt. lbs.	Price 1	Price ea. 2-4
20VA	2.4" × 1.2"	.7	$24.30	$20.40
40VA	2.8" × 1.3"	1.1	$26.10	$22.00
70VA	3.2" × 1.4"	1.5	$27.90	$24.20
100VA	3.7" × 1.4"	2.2	$30.00	$25.70
150VA	3.7" × 1.8"	2.9	$34.60	$29.30

Call to place order, or write for complete listing of US made off-the-shelf toroidal power transformers in sizes 20VA-600VA.

We custom make toroids 20VA-3,600VA.

Terms: C.O.D., VISA, MASTERCARD or Money Order
Shipping: Add $1.00/lbs for UPS (+$1.50 for C.O.D.).

(301) 459 8898 **TOROID CORPORATION OF MARYLAND**
4720 Q Boston Way, Lanham, MD 20706

CIRCLE NO. 124 ON FREE INFORMATION CARD

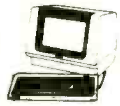
Tele Video® Users!

TEACH YOUR TELEVIDEO® WORDSTAR®!

TV2000 PRICES SLASHED!! NOW $179!!
(was $220)

FEATURES
- 92 WordStar® commands
- The Power of a dedicated word processor
- No loss of TeleVideo® attributes
- Soft switch activated
- Cuts WordStar® learning time to an hour

INCLUDES
- microprocessor
- 46 Keycaps with WordStar® legends
- 45 Page WordStar® manual



WordTechSystem
953 Mountain View Dr., Suite 114
Lafayette, California 94549
(415) 254-7747

TRADEMARKS WORDSTAR MICROPRO INTERNATIONAL
TELEVIDEO TELEVIDEO SYSTEMS, INC

CIRCLE NO. 125 ON FREE INFORMATION CARD

ATTENTION APPLE LOVERS

100% APPLE COMPATIBLE

DISK DRIVE	$199.
DUAL DISK CONTROLLER	$ 49.
Z-80 BOARD	$ 85.
80 COLUMN BOARD	$159.

MONITORS

ZENITH ZVM 121 12" Green Screen	$ 89.
AMDEK COLOR I+ 13" Color	$289.

FREE BROCHURE

!!CALL US FOR LOWEST PRICES ON OTHER ACCESSORIES!!

XICOM COMPUTER PRODUCTS
414 B. West Fifth Sreet
Naperville, Illinois 60566
(312) 961-1616 MC, Visa

CIRCLE NO. 126 ON FREE INFORMATION CARD

YORK 10™ CASSETTES

- **LOWER PRICES**
- **LONGER LENGTHS**

DATA TRAC C-06, C-12, C-24

From the leading supplier of Computer Grade Cassettes, new, longer length C-12's (6 minutes per side) provide the extra few feet needed for some 16K programs.

- Premium 5-screw shell with leader — BASF tape
- Error Free
- Money back Guarantee

ITEM	1 DOZ	2 DOZ
C-06	7.00	13.00
C-12	7.50	14.00
C-24	9.00	17.00
Hard Box	2.50	4.00

SHIPPING/HANDLING $3.50
NOTE: Outside 48 Contin. States shipping $3.50 PLUS $1 per caddy, per dozen cassettes, per dozen boxes, per 10 discs. In Cont. U.S. shipments are by UPS unless Parcel Post requested. California residents add Sales Tax

FOR IMMEDIATE SHIPMENT USE YOUR VISA OR MASTERCARD **Call: 213/700-0330**

YORK 10™ Computerware
9525 Vassar Ave. #P1 Chatsworth, CA 91311

CIRCLE NO. 127 ON FREE INFORMATION CARD

$ SAVE $$$$ SAVE $$$$ SAVE $

MAKE MONEY WITH YOUR MICRO NOW!!!!

There's probably a gold mine in your own kitchen drawer loaded with unused food coupons. That's right coupons!!! Complete system for maximizing the return on your Micro by utilizing a creative methodology that combines a manual and systems approach (in Basic) by maintaining and evaluating food coupon activities, utilizing tips and techniques that will pay for this package many times over. At this very low price of $35 you can hardly afford to be without it. Make that Micro begin paying for itself now!!! Includes complete programs listings and documentation.

Send $35 to
Sensible Systems
PO Box 2961
Richardson, TX 75083
(specify operating system and floppy type)

CIRCLE NO. 128 ON FREE INFORMATION CARD

Music Teacher in a Box?

To get ahead in music, you need to know music theory. PAIA's Chord Computer helps you understand both music and keyboards better by cramming the equivalent of pages and pages of music theory into a compact, calculator-style package.

The Chord Computer is easy to use. Simply select a chord letter, and the Chord Computer's LCD 31-key piano keyboard display will show which notes to play for the selected chord. Press another button to choose sharp, flat, major, minor, augmented, diminished, 6th, 7th or 9th chords — including inversions. The Chord Computer can also display complete scales for all keys, or even transpose them at the touch of a button.

Serious about music? The Chord Computer could be the best investment you'll ever make.

only $59.95 (+ $2.50 postage/handling) Order yours today

CHARGE TO VISA OR MC TOLL-FREE
1-800 654 8657 9AM to 5PM CST MON-FRI

Ask for your free PAIA catalog.
Direct mail orders and inquiries to: Dept.10-P

PAiA Electronics, Inc.
1020 W. Wilshire, Oklahoma City, OK 73116 (405)843 9626

CIRCLE NO. 129 ON FREE INFORMATION CARD

SAVE MORE THAN EVER ON 3M Scotch® DISKETTES!

$1.95 ea. Qty. 20 — 5¼" SSDD (744)

$2.70 ea. Qty. 20 — 5¼" DSDD (745)

5¼" SSQD—96TPI (746)	$2.89 ea.
5¼" DSQD—96TPI (747)	$3.95 ea.
(Specify soft, 10 or 16 sector.)	
8" SSSD (740)	$2.07 ea.
8" SSDD (741)	$2.54 ea.
8" DSDD (743)	$3.30 ea.
(Specify soft or 32 sector.)	

Save even more on quantity orders!

Minimum Order: 20 diskettes. Add $3.00 shipping per 200 diskettes. C.O.D. charge $1.65 additional.

Visa • Mastercard • Checks

For fast service, call
DISK WORLD!
Nationwide: 1-800-621-6827
In Illinois: 312-944-2788
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

Authorized Distributor
Information Processing Products **3M**

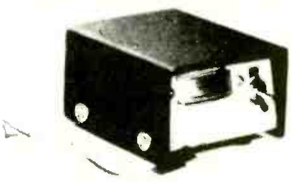
CIRCLE NO. 130 ON FREE INFORMATION CARD

THE ONE - THE ONLY "THE BOX"

New Innovation for TIMEX SINCLAIR users.

- Eliminates Save-Load Program troubles
- Saves time on Save-Load Programs
- Stops ground loops - Easy VU METER MONITOR
- Remote pause cassette switch
- Easy hook up between Computor and recorder (Pin plug cable included)

DOES NOT VOID TIMEX-SINCLAIR Warranty



Dimensions 3" x 2" x 4"

Send $26.95 Check or Money Order To: SCONZO & SONS
724 Montauk Hwy., Bayport, NY 11705
M/C - VISA Call: (516) 472-1700 or (212) 297-0976
COD - ADD $2.00 - Allow 4-6 week delivery
N.Y.S. Res. add sales tax
90 DAY GUARANTEE

CIRCLE NO. 131 ON FREE INFORMATION CARD

BUSINESS SOFTWARE PACKAGE

$59
Reg. $159

Features:
- Accounting Ledger
- Inventory Control
- Letter Writer
- Mail-Out

For TI-99 VIC-20 ATARI COM-64

Toll Free 1-800-221-7171
In Ga. 1-404-925-4686

BIZWARE, INC./5014 Hwy. 29/Lilburn, Ga. 30247

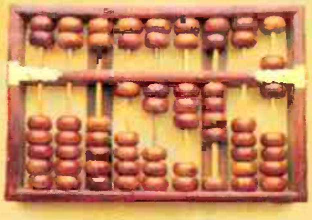
CIRCLE NO. 132 ON FREE INFORMATION CARD

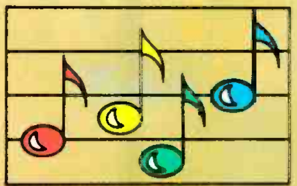
It writes, rates, creates, even telecommunicates. Costs less, does more- the Commodore 64.

When Commodore introduced the 64, the industry suddenly realized that there would be a computer in every home, school and business years before anyone ever dreamed.

That's because Commodore 64 halved the price of high technology: while you can compare the 64's capabilities with those of any sophisticated business PC, you can compare its price with that of an average television.

What can you do with it? Create with its high resolution Sprite Graphics. Add a printer and type with it. Add a disk drive to use spread sheets and other financial programs. Learn and play music through your home sound system on the 64's professional quality music synthesizer.





Add a modem, and hook up with the vast computer networks through your telephone. In short, the Commodore 64 is the ultimate personal computer, at a price you can afford.

COMMODORE 64

Circle No. 29 on Free Information Card